John E. Amos Power Plant

Notice of Intent to Comply With the Site-Specific Alternative to Initiation of Closure

CCR Unit – Bottom Ash Pond

As required by 40 CFR 257.103(f)(1)(ix)(A), this is a notification that on November 30, 2020 John E. Amos Power Plant (Amos Plant) submitted a site-specific alternative to initiation of closure due to development of alternative capacity infeasible to US EPA. The submission has been placed in Amos Plant's operating record and posted to the CCR Rule Compliance Data and Information website.

AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY

American Electric Power
1 Riverside Plaza
Columbus, OH 43215
aep.com

November 30, 2020

Submitted Electronically via Email

Mr. Andrew R. Wheeler, EPA Administrator
Environmental Protection Agency
1200 Pennsylvania Avenue, N.W.
Mail Code 5304-P
Washington, DC 20460

RE: Appalachian Power Company
John E. Amos Power Plant Alternative Closure Demonstration

Dear Administrator Wheeler,

Appalachian Power Company (APCO) John E. Amos Power Plant (Amos Plant) hereby submits this request to the U.S. Environmental Protection Agency (EPA) for approval of a site-specific alternative deadline to initiate closure pursuant to 40 C.F.R. § 257.103(f)(1) for the Bottom Ash Pond located at the Amos Plant near Winfield, West Virginia. Amos Plant is requesting an extension pursuant to 40 C.F.R. § 257.103(f)(1) to allow the Bottom Ash Pond to continue to receive CCR and non-CCR wastestreams after April 11, 2021, such that retrofits can be completed. Enclosed is a demonstration prepared by American Electric Power and Worley that addresses all of the criteria in 40 C.F.R. § 257.103(f)(1)(i)-(iii) and contains the documentation required by 40 C.F.R. § 257.103(f)(1)(iv). As allowed by the agency, in lieu of hard copies of these documents, electronic files were submitted to Kirsten Hillyer, Frank Behan, and Richard Huggins via email. A separate cover letter and confidential copy of Appendix C is being submitted in hard copy by overnight mail. If you have any questions regarding this submittal, please contact me at 614-716-2281 or damiller@aep.com.

Sincerely,

David A. Miller

David A. Miller, P.E.
Director, Land Environment & Remediation Services
Environmental Services Division

Attachments

cc: Kirsten Hillyer – USEPA
Frank Behan – USEPA
Richard Huggins – USEPA

Appalachian Power Company

John E. Amos Power Plant

Demonstration Request to Develop Alternative Disposal Capacity for the Bottom Ash Pond Complex

Prepared by:

American Electric Power Service Corporation
1 Riverside Plaza
Columbus, OH 43215

and

Worley
2675 Morgantown Road
Reading, PA 19607

Submitted

11/30/2020

Table of Contents

List of Figures

List of Tables

Appendices

Professional Engineer's Certification

I certify, as a Professional Engineer in the State of West Virginia, that the information in this document was assembled under my direct supervisory control and is accurate as of the date of my signature. This report is not intended or represented to be suitable for reuse without the specific verification or adaptation by the engineer.

DAVID ANTHONY MILLER

Printed Name of Registered Professional Engineer

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

David Anthony Miller

Signature

22663	WEST VIRGINIA	11.30.2020
Registration No.	Registration State	Date

INTRODUCTION

American Electric Power Service Corporation (AEP) as agent for its affiliate, Appalachian Power Company (APCO), the owner and operator of the Amos Plant, seeks EPA approval under 40 CFR 257.103(f) (1) - *"Development of Alternate Capacity Infeasible"* for the coal combustion residuals (CCR) surface impoundment located at John E. Amos Plant (Putnam County - 1530 Winfield Rd, Winfield, West Virginia). APCO seeks to establish a site-specific compliance deadline to continue to receive CCR wastestreams in the bottom ash pond (BAP) complex until October 31, 2022 while the generating units are converted to dry ash handling. Non-CCR wastestreams will continue to be routed to the unlined BAP complex until October 15, 2023. BAP 1B, Reclaim, Clearwater, and BAP 1A which make up the BAP complex will be sequentially closed by removal and converted to lined wastewater ponds for the non-CCR wastestreams and BAP 1A will be permanently closed. Tank-based systems will provide chemical treatment for the non-CCR wastestreams to assure continued compliance with the requirements of the facility's wastewater discharge permit. Closure of the BAP complex will be completed by February 9, 2024.This document will demonstrate that the CCR and/or non-CCR wastestreams must continue to be managed in the CCR surface impoundments because no alternative disposal capacity is available on or off-site and it is technically infeasible to complete the measures necessary to provide alternative disposal capacity either on-site or off-site by April 11, 2021.

OVERVIEW OF AMOS PLANT AND AFFECTED CCR UNITS

The Amos Plant, located in Putnam County, West Virginia, is bounded by WV Route 817 to the west and the Kanawha River to the east. The plant is approximately five miles southeast of Winfield, West Virginia. The Amos Plant began operations in 1971 as a coal-fired generating power plant with a single 800 megawatt (MW) coal-fired electric generating unit, Amos Unit 1. An additional 800 MW coal-fired unit with the same basic design was added as Unit 2 in 1972, and a 1300 MW coal-fired unit was brought online in 1973, resulting in a total plant net generating capacity of 2900 MW. Throughout the life of the generating plant, CCR material (bottom ash) has been generated. To manage the wet bottom ash and other wastewaters generated from the plant, the Amos Plant operates an active CCR surface impoundment called the Bottom Ash Pond (BAP). The BAP is located immediately northwest of the Plant, south and adjacent to Bill's Creek and less than one-quarter mile southwest of the Kanawha River. The Amos Plant includes two additional federally regulated CCR Units. These are the closed (inactive) Fly Ash Pond (FAP) and the open (active) Flue Gas Desulfurization (FGD) Landfill (LF). The general site layout can be found in **Figure 1**.

The BAP Complex has two basins that are utilized in alternating fashion, known as BAP 1A and 1B, with one generally receiving CCR and other wastestreams while the other is being cleaned out and solid materials are transported to the landfill. The treated wastewater from BAP 1A and 1B flows through to the Reclaim pond and then to the Clearwater pond. Much of the water in the Reclaim Pond is pumped back to the plant for use. Water that is not pumped back for re-use continues to the Clearwater Pond for eventual discharge to the Kanawha River through Outfall 003, subject to the limitations in the West Virginia National Pollutant Discharge Elimination System (NPDES) Permit No. WV0001074.

The combined surface area of the Amos BAP Complex is approximately 38.5 acres. It was originally constructed as a single pond. The individual basins within the BAP complex were later separated by splitter dikes. All of the basins are assumed to contain more than de minimis amounts of CCR material based on their historic operations, and they have been treated as one CCR unit. The BAP Complex is unlined and was constructed mainly by excavating into clayey silt soil. There is less than 5 feet of separation between the uppermost aquifer and the bottom of a portion of the BAP Complex, and it must be closed. All CCR material will be removed, and new lined impoundments will be created within the footprint of the 1B, Reclaim, and Clearwater ponds to allow for continued management of non-CCR wastestreams.

Groundwater at the BAP Complex is monitored in accordance with an assessment monitoring program, following the requirements of 40 CFR 257.95 in the CCR rule. There have been no statistically significant levels over groundwater protection standards detected for any constituent at any monitoring well in the unit's groundwater monitoring network. Following the requirements of 40 CFR 257.95, groundwater samples from each monitoring well are analyzed for all parameters in appendix IV of the CCR rule during the first monitoring event of the annual monitoring cycle. During the two subsequent events in the annual cycle, samples from each well are analyzed for all parameters in appendix III and those parameters in appendix IV that were detected during the first sampling event in the cycle. Analysis results for each constituent at each monitoring well are compared to corresponding groundwater protection standards according to statistical procedures and performance standards specified in 40 CFR 257.93(f) and 40 CFR 257.93(g).

SATISFACTION OF THE CRITERIA IN 40 CFR §257.101(f)(1) FOR THE BAP CCR UNIT

WORK PLAN

To demonstrate that the criteria in 40 C.F.R. § 257.103(f)(1)(i) and (ii) have been met, the following is a workplan, consisting of the elements required by § 257.103(f)(1)(iv)(A). Specifically, this workplan documents that there is no alternative capacity available on or off-site for each of the CCR and/or non-CCR wastestreams that must continue to be managed in the CCR surface impoundment, and discusses the options considered for obtaining alternative disposal capacity. As discussed in more detail below, AEP has elected to convert to dry ash handling at the Amos Plant. The workplan provides a detailed schedule for the conversion project, including a narrative description of the schedule and an update on the progress already made toward obtaining the alternative capacity. In addition, the narrative includes an analysis of the site-specific conditions that led to the decision to convert to dry handling and an analysis of the adverse impact to plant operations if the Amos Plant were no longer able to use the Bottom Ash Pond Complex.

Section One – Narrative Description of How Alternative Capacity will be Developed

From the regulatory text § 257.103(f)(1)(iv)(A)(1)

> *(1) A written narrative discussing the options considered both on and off-site to obtain alternative capacity for each CCR and/or non-CCR wastestreams, the technical infeasibility of obtaining alternative capacity prior to April 11, 2021, and the option selected and justification for the alternative capacity selected. The narrative must also include all of the following:*
>
> > *(i) An in-depth analysis of the site and any site-specific conditions that led to the decision to select the alternative capacity being developed;*
> > *(ii) An analysis of the adverse impact to plant operations if the CCR surface impoundment in question were to no longer be available for use; and*
> > *(iii) A detailed explanation and justification for the amount of time being requested and how it is the fastest technically feasible time to complete the development of the alternative capacity.*

Existing On and Off-site Disposal Capacity Evaluation

The Amos Plant does not currently have an existing alternate pond that meets the liner requirements of EPA's CCR regulation, and considerable modifications to plant equipment, facilities, and processes will be necessary before the Amos Plant can cease placing CCR and non-CCR wastestreams into the BAP Complex. Likewise, considerable modifications and new equipment would be necessary to transport CCR and non-CCR wastestreams to an off-site disposal facility, if one were available. Currently, no known off-site facilities are available that are capable of processing the wastestreams generated by the Amos Plant.

CCR Wastestreams:

The BAP receives approximately 1.92 million gallons a day (MGD) of sluiced water containing bottom ash.

In terms of on-site alternative disposal capacity; there are no other on-site CCR surface impoundments that are available to dispose of the CCR materials. In order to develop alternate capacity refer to **Table 3** and the timing required to do so; the current approach is the fastest feasible alternative which is to convert all three generating units to dry ash handling and utilize the existing landfill for ash disposal.

Relative to off-site disposal capacity, the effluent limitation guidelines prohibit the disposal of CCR sluice water into public treatment works. Moreover, the sheer volume which will need to be handled on a daily basis makes off-site disposal of wet ash impractical. 1.92MGD of bottom ash sluice flows equates to approximately 7,968 tons per day of sluiced water and would require 398 trucks per day to haul off and dispose. There are currently no facilities to collect and load this wastestream into tankers for transport, and construction of such facilities to manage these flows on a temporary basis would interfere with the activities needed to comply with the new requirements of both the CCR and ELG rules. The increase in traffic associated with such an operation on the plant site poses significant safety risks and is impossible to achieve. The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the CCR wastestream, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available.

AEP evaluated each CCR wastestream placed in the BAP at the Amos Plant. For the reasons discussed above, and in **Table 1** below, bottom ash must continue to be placed in the BAP due to lack of alternative capacity both on and off-site.

Table 1: Amos Plant CCR Wastestreams

CCR Wastestream	Average Flow (gpd)	Current Configuration	AEP Notes
Bottom Ash	1,920,000	Bottom ash is currently sluiced to the BAP CCR unit, where it is temporarily stored until removed, dewatered and beneficially reused or disposed of on-site in a CCR compliant landfill.	Bottom ash wastestream cannot be removed from the BAP until new Under Hopper Drag Chain (UHDC) dry bottom ash system is installed on each Unit allowing ash to be collected and transported to the onsite landfill. This wastestream will cease being placed in the BAP Complex in October 2022. The number of trucks per day to transport this wastestream off-site for disposal was calculated as follows: 1.92 million gallons per day * 8.3 pounds per gallon = 15,936,000 pounds / 2000 pounds per ton = 7,968 tons per day / 20 tons per truck = 398.4 → 398 trucks per day

Non-CCR Wastestreams:

Approximately 16 to 25 MGD of various non-CCR wastestreams are sent to the BAP Complex. These wastewater streams include cooling tower blowdown, coal pile runoff, fly ash silo sump water, pyrites transfer water, seal trough water, various low volume wastestreams (wash down of the plant areas) to plant drains and sumps, non-chemical metal cleaning wastewaters, landfill leachate, and storm water runoff.

There are no alternate ponds on the site, which includes stormwater ponds in the vicinity, that can accept these wastesteams nor is there infrastructure to deliver the wastestreams to a different location. Re-routing these flows to another on-site pond would decrease the settling time, increase loadings to the ponds, and require permitting equivalent to the permitting required for the selected alternative. The discharge limitations would not be met under these conditions and renders on-site alternatives for disposal as infeasible. Therefore, the existing non-CCR wastestreams need to be discharged to the existing ponds and receive treatment in the current treatment path through the BAP Complex to ensure and maintain compliance with current NPDES permit limits. In addition, once the BAP Complex is closed and converted to lined wastewater ponds the majority of these non-CCR wastesteams will be routed through the new mix tanks to allow for enhanced solids settling.

Relative to off-site disposal capacity and similar to bottom ash; the sheer volume which will need to be handled on a daily basis makes this impractical. During dry weather conditions 16.28 MGD equates to approximately 67,562 tons per day of non-CCR wastestreams and would require 3,378 trucks per day to haul off and dispose of. During storm events non-CCR wastestreams could be as much as 25 MGD. There are currently no facilities to collect and load these wastestreams into tankers for transport, and construction of such facilities to manage these flows on a temporary basis would interfere with the activities needed to comply with the new requirements of both the CCR and ELG rules. The increase in traffic associated with such an operation on the plant site poses significant safety risks and is impossible to achieve. The most likely facility type capable of managing industrial wastewaters are publicly-owned or private treatment works, underground injection wells, or publicly available waste management facilities capable of solidifying liquid wastes for disposal in a landfill. Given the volume and characteristics of the non-CCR wastestreams, increases in permitted capacity or other modifications to the permitted pretreatment programs of a public or private wastewater treatment facility would likely be required to manage this flow, if one were available.

AEP evaluated each non-CCR wastestream placed in the BAP Complex at Amos. For the reasons discussed above, and in **Table 2** below, each of the following non-CCR wastestreams must continue to be placed in the BAP Complex due to lack of alternative capacity both on and off-site.

Table 2: Amos Plant non-CCR Wastestreams

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	AEP Notes
Fly Ash Silo Sumps	1,080,000	Flows to the existing BAP	The BAP Complex provides treatment for these non-CCR wastestreams (primarily solids settling) to allow them to meet the NPDES discharge limits and no alternative capacity exists for treatment until the repurposed WWP is completed. The number of trucks per day to transport these wastestreams off-site for disposal was calculated as follows: 1,080,000 gallons per day * 8.3 pounds per gallon = 8,964,000 pounds / 2000 pounds per ton = 4,482 tons per day / 20 tons per truck = 224.1 → 224 trucks per day 6,720,000 gallons per day * 8.3 pounds per gallon = 55,776,000 pounds / 2000 pounds per ton = 27,888 tons per day / 20 tons per truck = 1394.4 → 1394 trucks per day 2,840,000 gallons per day * 8.3 pounds per gallon = 23,572,000 pounds / 2000 pounds per ton = 11,786 tons per day / 20 tons per truck = 589.3 → 589 trucks per day 5,220,000 gallons per day * 8.3 pounds per gallon = 43,326,000
Seal Trough Water (includes Turbine Room Sump)	6,720,000		
Wastewater Sumps	2,840,000		
Cooling Tower Blowdown	5,220,000		
Pyrite Transfer Water	380,000		
Quarrier Leachate	40,000		
Coal Pile Runoff Amos and PCT, and FGD and Haul Road Runoff	4,030,000 (maximum)		
Storm Water Runoff (contact and noncontact)	5,100,000 (maximum)		
Metal Cleaning Waste	Intermittent		

Non-CCR Wastestream	Average Flow (gpd)	Current Configuration	AEP Notes
			pounds / 2000 pounds per ton = 21,663 tons per day / 20 tons per truck = 1,083.15 → 1,083 trucks per day 380,000 gallons per day * 8.3 pounds per gallon = 3,154,000 pounds / 2000 pounds per ton = 1,577 tons per day / 20 tons per truck = 78.85 → 79 trucks per day 40,000 gallons per day * 8.3 pounds per gallon = 332,000 pounds / 2000 pounds per ton = 166 tons per day / 20 tons per truck = 8.3 → 8 trucks per day

i) Alternatives for Disposal Capacity

In order to comply with the CCR rule, AEP performed an evaluation (beginning in 2017 and completing in 2018) of alternative disposal capacity options at the Amos Plant for both CCR and non-CCR wastestreams that are managed in the BAP Complex. The evaluation determined the feasibility of options to achieve CCR compliance requirements. Feasible options were evaluated by balancing the technology, performance, schedule duration, other risk factors, and considered potential Effluent Limitation Guidelines (ELG) compliance alternatives.

The options considered for alternative disposal capacity of the wastestreams currently routed to the BAP Complex are summarized in **Table 3** below.

Table 3: Alternatives for Disposal Capacity

Alternative Capacity Technology	Estimated Implementation Time (Months)	Feasible at the Amos Plant?	Selected?	AEP Notes
Conversion to dry handling	26	Yes	Yes	Adequate space is available at the site to install equipment necessary for a dry bottom ash conversion. This alternate has a similar compliance schedule to the other alternatives consider and allows for compliance with ELG rules.

Alternative Capacity Technology	Estimated Implementation Time (Months)	Feasible at the Amos Plant?	Selected?	AEP Notes
New CCR surface impoundment	38 to 72	No	No	New CCR impoundment alone does not provide compliance with the ELG rules. Not feasible due to the time required for siting, permitting, engineering and design, and construction of the new impoundment. Past AEP projects experienced a range from 38-72 months before waste could be placed in the new impoundment and thus was not further pursued.
Retrofit a portion of CCR surface impoundment to a CCR compliant liner system	31.5	Yes	No	Retrofitting a portion of the pond alone will not bring the facility into compliance with the ELG rule without additional water recycle systems that have an uncertain impact on the plant water balance; the dry ash handling systems have a similar compliance schedule.
Repurpose a portion of CCR surface impoundment to a lined pond for non-CCR wastestreams	38	Yes	Yes	This alternative was selected for the Amos Plant since the existing BAP Complex currently handles the existing non-CCR wastestreams and provides the treatment capacity required to comply with the facilities NPDES permit. These ponds will be closed by removal and converted to lined wastewater ponds.
Multiple technology system	26-38	Yes	Yes	This alternative was selected for the Amos Plant since the existing BAP Complex has the capacity to receive the non-CCR wastestreams once it is closed and repurposed. Dry handling of the bottom and economizer ash streams (26 months) and repurposing the ponds to receive non-CCR wastestreams (38 months) will satisfy all compliance needs on the fastest feasible schedule for the site balancing both CCR and ELG rule requirements.
Off-site disposal	N/A	No	No	As EPA explained in the preamble of the 2015 rule, it is not possible for sites that sluice CCR material to an impoundment to eliminate the impoundment and dispose of the material offsite. See 80 Fed. Reg. 21,301, 21,423 (Apr. 17, 2015) It is infeasible to collect, transport, and provide offsite treatment of the large volume of CCR and non-CCR wastestreams currently routed to the BAP Complex without considerable modifications and new equipment necessary to transport CCR and non-CCR wastestreams to an off-site disposal facility, if one were available.

Alternative Capacity Technology	Estimated Implementation Time (Months)	Feasible at the Amos Plant?	Selected?	AEP Notes
Temporary treatment system	Not defined	No	No	These systems are not proven for reliable long-term management of high volume CCR materials in the industry and would not realistically provide the required non-CCR wastewater storage capacity to replace the BAP Complex. Temporary treatment systems to manage the CCR and non-CCR wastestreams for Amos Plant would require a chemical feed system, chemical mix tanks, clarifiers, and a filtration system. Based on the flow rates, the number and size of clarifiers required to handle these streams outside of the BAP Complex would range from 2 to 4, 140 foot diameter tanks based upon typical and max flow characteristics. The size of this temporary system is well beyond any type of rental units that are available in the market.

Based on the decision to convert to a dry ash handling system at the Amos Plant, AEP evaluated potential options for compliance with both the CCR and ELG rules as noted in **Table 4** below.

Table 4: Alternatives Considered for CCR Wastestreams

System	Technology	Practicability or Feasibility for the Amos Plant
Bottom Ash	Under Hopper Drag Chain Conveyor System	Feasible
Bottom Ash	Remote Drag Chain Conveyor System	Feasible. Challenging to add remote pumps and power supply for recirculation not required with other options. Risk associated with managing plant water balance.
Bottom Ash	Dry Belt/Tray Conveying System	Feasible
Bottom Ash	Pneumatic Conveying System	Feasible
Bottom Ash	Vibratory Conveying System	Not practicable; requires frequent labor intensive maintenance and no longer industry standard practice for bottom ash (replaced by remote conveyors for similar costs)
Bottom Ash	Remote Settling Basins	Not practicable; requires frequent labor intensive maintenance and both water balance and safety concerns. Challenging to add remote pumps and power supply for recirculation that is not required with other options.
Bottom Ash	Remote Dewatering Bins	Not practicable; requires frequent labor intensive maintenance and no longer industry standard practice for bottom ash

		(option replaced by remote conveyors for similar costs)
Bottom Ash	Closed Loop Recirculation System	Not practicable; risks associated with managing plant water balance.

Timeframe for delivering dry ash handling alternatives were determined to be equivalent and not a factor in the final selection.

Based on the evaluation of alternative disposal options, AEP selected the following options for compliance at the Amos Plant:

- Converting from wet bottom ash system to dry handling system, using an under hopper drag chain conveyor (UHDC)

- Closure of the BAP Complex (1A, 1B, Reclaim, and Clearwater Ponds) by CCR material removal.

- Constructing new Wastewater ponds (WWP) within the footprint of the closed BAP 1B, Reclaim, and Clearwater ponds to manage non-CCR wastewaters.

This alternative and strategy can be implemented in the least or equal amount of time of the alternatives and accommodates the unique site features such as quantity of wastestreams, and the lack of off-site disposal facilities. This alternative complies with both the CCR and ELG rules at the Amos Plant.

AEP contracted with Worley to provide engineering, design and procurement services for the selected alternative disposal option. The conceptual design stage of the projects has been completed and includes the following scope:

- Dry Ash Handling System
  - Installation of an UHDC and associated equipment to collect and dewater bottom ash from Unit 1, Unit 2, and Unit 3.
  - Installation of a dry pneumatic system and associated equipment on Unit 1 and Unit 2 to convey the economizer ash to the boiler throat just above the ash hopper to then be collected by UHDC system.
  - Installation of concrete ash bunker on Unit 3 and a common ash bunker for Units 1 and 2 to collect and temporarily store material from the UHDC.
  - Installation of a sump at ash bunker to collect stormwater and excess quench water and return to ash hopper pit sump.
  - Material from ash bunker to be hauled to the Amos landfill for disposal or be sold for beneficial reuse.

- Bottom Ash Pond Closure by Removal
  - All CCR material within the existing BAP Complex will be removed via dewatering and mechanical excavation. All CCR material will either be hauled to the Amos landfill for disposal or be sold for beneficial reuse.
  - A third-party engineer will certify the removal of CCR upon completion. Certification will be performed in phases across the entire BAP Complex.
  - After certification of removal of all CCR within a given area of the existing BAP Complex, construction within that area will proceed. A portion of the area within the footprint of the existing BAP Complex will be developed into new Non-CCR

Wastewater Ponds, while the remainder of area will be re-graded and vegetated.

- New Non-CCR Wastewater Ponds
  - o New (9-acre) lined WWP, constructed within the footprint of the existing BAP Complex, to process the non-CCR wastestreams.
  - o New (5-acre) lined Reclaim Pond constructed within the footprint of the existing BAP Complex, to receive effluent from the WWP.
  - o New (2-acre) lined Clearwater Pond, constructed within the footprint of the existing BAP Complex, to receive effluent from the Reclaim Pond. The Clearwater Pond will discharge to the Kanawha River through West Virginia NPDES Permit No. WV0001074 Outfall #003.
  - o Installation of tank-based chemical treatment system with appropriate retention time to provide proper mixing of chemicals to facilitate settling to meet plant discharge requirements.

Appendix A includes a site plan showing the existing and future configurations after rerouting of non-CCR wastewater and removal of CCR from the BAP Complex. The existing and future water balances are included in **Appendix B**.

ii) Impact to Plant Operations if Alternative Capacity Not Obtained

If the Amos Plant were required to immediately cease the placement of CCR and non-CCR wastestreams into the BAP Complex, which is necessary for handling more than 18 MGD of CCR and non-CCR wastestreams, and initiate closure, AEP would have to temporarily or permanently cease power production at the Amos Plant. Idling or closure of the Amos Plant would stop the production of CCR wastestreams and some non-CCR wastestreams, but would not eliminate the need for handling other non-CCR wastestreams, such as coal pile runoff and low volume wastewater from various water collection sumps from around the plant. The BAP is integral in receiving and treating these flows as required to meet the NPDES discharge limits. Therefore, the need for uninterrupted non-CCR wastestream capacity in the BAP Complex will be necessary for a significant amount of time until alternate capacity from the new wastewater ponds is available. Put simply, the BAP will be unable to immediately cease operation even if the Amos Plant immediately discontinued the combustion of coal and production of CCR wastestreams.

The immediate forced cessation of power production at the Amos Plant could cause serious local power delivery constraints and more regional reliability concerns in the affected states. If other coal-fired facilities in these or neighboring states are also forced to cease power production, the consequences could be serious. For example, according to the Energy Information Administration's Electric Power Annual for 2019, coal-fired units provided the following percentages of electricity generation in 2018 and 2019, in the midwestern states where AEP's units operate:

Utility Scale Generation from Coal – 2018•

State	Total Utility Scale Generation (Thousands MWh)	Utility Scale Generation from Coal (Thousands MWh)	Percentage of Utility Scale Generation from Coal
Indiana	113,460	77,455	68.3%
Kentucky	78,804	59,168	75.1%
Ohio	126,185	58,727	46.5%
West Virginia	67,249	62,039	92.3%

- Data from *Electric Power Annual 2019*, Tables 3.7 and 3.8, Energy Information Administration, eia.gov/electricity/annual/pdf/epa.gov (last referenced October 26, 2020).

Utility Scale Generation from Coal – 2019•

State	Total Utility Scale Generation (Thousands MWh)	Utility Scale Generation from Coal (Thousands MWh)	Percentage of Utility Scale Generation from Coal
Indiana	102,505	60,762	59.3%
Kentucky	71,804	51,714	72.0%
Ohio	120,001	46,765	39.0%
West Virginia	63,926	58,182	91.0%

- Data from *Electric Power Annual 2019*, Tables 3.7 and 3.8, Energy Information Administration, eia.gov/electricity/annual/pdf/epa.gov (last referenced October 26, 2020).

As shown in these tables, West Virginia in particular is heavily dependent on coal-fired units for the vast majority of electricity produced in the state. Simultaneous immediate closure of a significant portion of the coal-fired capacity in these states could destabilize the electricity grid and would not be in the public's best interest.

iii) Justification for Time Needed to Complete Development of Alternative Capacity Approach

The schedule for developing alternative disposal capacity is described in more detail in Section 3. As the schedule shows, AEP has already undertaken significant planning and implementation steps towards ceasing the receipt of CCR and non-CCR wastestreams within the BAP Complex. Finalization of the both the CCR and ELG rules impacts APCO's ability as a regulated utility to obtain regulatory approval for the required capital expenditures to comply with both rules. This schedule represents the fastest technically feasible timeframe for compliance at the Amos Plant, driven primarily by the need for a major outage on each Unit to allow for removal of the current sluicing equipment and installation of the new UHDC equipment. The Amos Plant serves the PJM interconnection which manages the grid to provide electricity to 13 states and the District of Columbia. Outages are planned in advance with the Regional Transmission Operator (RTO) to effectively manage the generation capacity footprint. The RTO does not typically allow the Amos Plant much flexibility to adjust these outages or perform them in the non-shoulder months (summer and winter) due to the limited generating capacity during these peak electricity usage times and resulting potential impacts to grid stability. The sequencing and final tie-ins associated with this work as described in the work plan in Section 3 further elaborates on the complexities associated with this option. The Units must be converted to dry ash handling in order to cease receipt of CCR wastestreams in the current configuration. The dry ash handling conversion will be worked in parallel with the pond closure, new pond construction, tank based chemical treatment and non-CCR stream reroute construction activities to achieve compliance as soon as possible. The total project duration of approximately 38 months from the date AEP initiated detailed design (August 2020) until the date that CCR sluicing is ceased and alternative capacity is provided for non-CCR wastestreams (October 15, 2023) is less than the average multiple technology system timeline of 39.1 months identified in the EPA Final Part A rule.

Section Two – Visual Timeline Depicting the Steps Necessary to Obtain Alternative Capacity

From the regulatory text § 257.103(f)(1)(iv)(A)(2)

(2) A detailed schedule of the fastest technically feasible time to complete the measures necessary for alternative capacity to be available including a visual timeline representation. The visual timeline must clearly show all of the following:

> *(i) How each phase and the steps within that phase interact with or are dependent on each other and the other phases;*
> *(ii) All of the steps and phases that can be completed concurrently;*
> *(iii) The total time needed to obtain the alternative capacity and how long each phase and step within each phase will take; and*
> *(iv) At a minimum, the following phases: engineering and design, contractor selection, equipment fabrication and delivery, construction, and start up and implementation.*

Appendix C contains a timeline that illustrates all relevant phases and details the steps necessary for implementation of obtaining Alternative Capacity.

Section Three – Narrative of the Schedule and Timeline to Obtain Alternative Capacity

From the regulatory text § 257.103(f)(1)(iv)(A)(3). *(3) A narrative discussion of the schedule and visual timeline representation, which must discuss all of the following:*

> *(i) Why the length of time for each phase and step is needed and a discussion of the tasks that occur during the specific step;*
> *(ii) Why each phase and step shown on the chart must happen in the order it is occurring;*
> *(iii) The tasks that occur during each of the steps within the phase; and*
> *(iv) Anticipated worker schedules;*

The schedule for this project is generally broken down into two major scopes of work: Dry Ash Handling (DAH) System installation and Pond Closure / New Pond Construction.

Dry Ash Handling System

<u>Engineering, Design and Procurement (August 2020 – January 2022)</u>
The conceptual design of the new DAH system has been completed. Equipment procurement for the DAH system to support this project is underway with a forecasted delivery date of the major equipment by January 2022. Detailed design of the DAH System has started and is scheduled to be completed by August 2021.

<u>Contractor Selection (May 2021 – June 2022)</u>
There are 6 Construction (Labor) bid packages that are planned to be developed in parallel with the detailed design efforts. The typical timeframe to competitively bid major labor contracts is six months in accordance with AEP's procurement processes. The Civil labor package will be issued for bid in May 2021. For capital improvements of this magnitude, Regulatory approvals from the West Virginia Public Service and Virginia State Corporation Commissions are required. Applications for approval are being prepared and will be submitted by the end of January 2021. Proceedings are estimated to be concluded by July 31, 2021. After receipt of regulatory approval, the Civil labor contract for Unit 3 will be

awarded to the selected construction contractors by September 2021 with construction planned to start immediately after. The Structural/Mechanical (S/M) and Electrical, Instrumentation, and Controls (EIC) construction bid packages are planned to be issued in June and July of 2021 and awarded by October and December of 2021. The Civil and S/M packages for Units 1 and 2 are planned to be issued in October and November 2021 with the EIC package planned for February 2022. These packages will be awarded in February, April and June 2022. Construction is planned to start immediately following award of each major labor package.

Construction on Unit 3 (October 2021- May 2022)
The civil work on Unit 3 will include underground utility relocations, excavation and subgrade prep for the ash bunker footings and foundation installation. Once the footings and foundation are poured, the new ash bunker walls will be formed and poured. Similar activities will be performed for the belt transfer conveyor and transfer tower foundations. Soon after the civil work has started the structural/mechanical (S/M) work will start which includes above ground utility relocations inside Unit 3, setting of the transfer tower structural steel, assembly and erection of the belt transfer conveyor that will receive the ash from the UHDC conveyors to discharge into the ash bunker. The ash bunker sump pumps will be set, and piping run back to the ash hopper pit sump. Balance of plant piping such as service water, instrument air, plant air, and other systems will be installed. Building penetrations will be made for the UHDC conveyors. The existing ash hopper pit concrete will be saw cut to make additional space required to route the conveyor out from underneath the ash hopper. During this time as much demolition of existing equipment and structural steel that can be performed ahead of the Unit tie-in outage will be completed which includes reinforcing of the existing ash hopper structural steel to accommodate the new UHDC equipment loads.

The electrical/instrumentation and controls contractor (EIC) will mobilize soon after the S/M contractor to begin above ground utility relocations, installation of conduit and cable tray for both power and control cabling to the new equipment mentioned above. New electrical equipment will be set which includes distributed control system cabinets. Once the conduit and cable tray runs are completed the power and control cabling will be pulled, tested and terminated to the greatest extent possible. A majority of the power feeds and control cables for the UHDC equipment will need to be rolled up and temporarily staged at the ash hopper pit to be completed once the UHDC equipment is erected in place during the tie-in outage.

Tie-in Outages and Concurrent Construction Activities (February 2022 – December 2022)
Although as much work as possible will be performed while the Units are operating, a significant portion of the work to complete the DAH system equipment installation requires a Unit outage. The outage for Unit 3 is planned in the Spring of 2022. Once the Unit comes out of service both the S/M and EIC contractors will work two shifts sixty hours per week to complete the outage related activities. The pulverizer door relocation will begin along with the demolition of boiler down comer piping and any remaining equipment in the ash hopper pit area to allow for installation of the collection and dewatering conveyors. The new ash gate will be installed and the instrumentation and remaining connections trimmed out both electrically and mechanically to complete the UHDC system installation.

Once Unit 3 is substantially complete, startup and commissioning activities will begin as described below. During this time, the civil contractor will have moved to Unit 1 and Unit 2 and started performing similar activities mentioned above with respect to underground utility relocations and installation of the ash bunker, transfer conveyor foundations, and transfer tower foundations. The S/M contractor will follow suit to begin structural steel reinforcing along the Unit 1 and Unit 2 boiler building columns, installing transfer conveyor support steel in various areas along each Unit, setting transfer tower structural steel, erection and assembly of the transfer conveyor from the common ash bunker back towards the Unit 1 boiler. Above ground utility relocations and demolition activities inside each Unit will be going on in parallel as well as installation of balance of plant piping systems. The economizer ash handling system for each Unit will be installed during this time leaving final tie-ins at the economizer ash hopper and the boiler for the tie-in outages. The EIC contractor will also move from Unit 3 to perform similar activities as mentioned above relative to above ground utility relocations, installation of conduit and cable tray, setting of electrical equipment, pulling power and control cabling, testing and terminating.

The 800 MW Units will be removed from service sequentially with a planned 4 week overlap in the Fall of 2022 to complete the UHDC and economizer ash handling system outage related activities and final tie-ins. Contractors will work two shifts sixty hours per week to complete the installation.

All CCR flows to the BAP Complex will completely cease no later than October 31, 2022.

Startup and Implementation
Once substantially complete and each system is turned over by Construction, the AEP startup and commissioning group will begin checkout and functional testing to ensure proper operation. After the commissioning and check out is complete the system will be turned over to plant operations to perform plant testing and checkout and return the Unit back to service.

Bottom Ash Pond Closure/ New Pond Construction

Engineering and Design (August 2020 – July 2021)
Detailed design of the ponds has started and is planned to be completed by July 2021. The design of the ponds includes performing topographic surveys, bathymetric surveys, and geotechnical investigations to understand subgrade materials at the locations of the new ponds. The investigations will also be used to verify CCR depths at certain locations.

Permitting (November 2020 – November 2021)
The regulatory filing process has commenced and is planned to continue through January 2021. Permitting efforts relative to the NPDES, WV Dam Safety, and Putnam County Floodplain permit necessary to construct the ponds have started and are planned to continue through November 2021.

Contractor Selection (April 2021 – December 2021)
There are 3 construction bid packages (labor contracts) that are planned to be developed in parallel with the detailed design efforts. The typical timeframe to competitively bid major labor contracts is six months in accordance with AEP's procurement processes. The first package will be issued for bid in April 2021 with an award date following receipt of regulatory approval from the West Virginia Public Service Commission and Virginia State Corporation Commission anticipated in July 2021. The other construction bid packages are planned to be issued in June and July 2021 and awarded by November and December 2021. Pond construction is planned to start immediately following award.

Construction (August 2021 – September 2024)
The closure of the BAP Complex and construction of the new WWP, Reclaim Pond, and Clearwater Pond requires specific sequencing in order to complete the work due to the fact

that the new ponds will be located within the existing BAP Complex footprint and the need to maintain overall pond operations while including provisions to meet the NPDES discharge permit requirements throughout construction. Final completion of the pond closure and construction activities is dependent upon installation of the DAH system equipment and ceasing CCR flows to the BAP Complex. However, steps have been included in the project plan to allow for parallel activities to complete the work as much as possible as shown on the schedule in **Appendix C** and further described in this section.

The BAP Complex as defined by the CCR Unit Boundary is approximately 38.5 acres. Of this, approximately 25 acres is actively used to impound ash (Existing BAP 1A and 1B), 5 acres is an existing Reclaim Pond, 2 acres is an existing Clearwater Pond, and the remaining area is generally higher ground within the overall CCR Unit Boundary, some of which is open and some of which contains miscellaneous plant equipment. The BAP Complex does receive some local stormwater run-off from adjacent areas, but measures will be taken to isolate the work area during each phase from stormwater to minimize impacts to the ongoing closure and construction work. The BAP Complex will be closed by removal of CCR primarily by means of dewatering and mechanical excavation.

The removal of ash will be verified visually. When the removal is complete, the Contractor will remove an additional one foot of material to confirm removal of CCR. Additionally, a third-party engineer will perform quality assurance/quality control (QAQC) services to independently verify that all CCR materials are removed.

The closure by removal will be verified with a minimum of two groundwater sampling events. If the groundwater monitoring concentrations taken during those events do not exceed any groundwater protection standards the BAP Complex will be considered closed.

The pond construction and closure work will be performed in phases across four construction seasons during calendar years 2021-2024. The phases are shown in the timeline in **Appendix C** and timeframes are based on the estimated volumes of material to be removed as well as the estimated earthwork, liner, and protective cover quantities required for pond construction. These durations are based on an average work schedule of five days per week / ten hours per day and do not take into account delays from periods with significant rain events greater than average or normal for the geographical location.

Phase 1 (Ash Pond B Closure and Pond Repurposing) - The mobilization of the final pond construction and closure contract is planned to start in July 2021. Once the contractor mobilizes to begin closing the BAP Complex, the contractor will work to complete early site preparation activities including mobilization, installing erosion control, preparing laydown and construction office areas, diverting wastewater inflows from the initial closure and construction work area, and dewatering the work area in preparation for the first phase of CCR removal.

The first phase CCR removal includes the existing footprint of BAP 1B (where the future WWP will be located) and will be completed in October 2021. Upon certification of closure by removal, construction of the new WWP will proceed. Clean fill will be placed to achieve subgrade elevation from November 2021 through March 2022. In parallel, subgrade prep will be underway for the tank based chemical treatment system and the new liner in the pond. New berms will be installed and will complete in April 2022. The new liner system and protective cover will be installed in April 2022 and complete in June 2022. The construction of the WWP is scheduled for completion in September 2022, which includes the tank-based chemical treatment equipment and rerouting of non-CCR wastewater piping. Startup and commissioning activities associated with the tank-based chemical treatment equipment will also be completed in parallel. During this time all non-CCR wastesteams that are currently routed through the BAP complex will be flowing through BAP 1A, Reclaim, and Clearwater ponds. After the tank based chemical treatment system is installed and commissioned a majority of these non-CCR wastewater streams will be routed through this system which is a key component in the construction execution strategy to allow the Reclaim and Clearwater pond closure and repurposing work to be completed while maintaining compliance with the facility's NPDES permit discharge limits.

Phases 2 and 3 (Reclaim and Clear Water Pond Closure and Repurpose / Ash Pond A Closure) - Closure by removal and new WWP construction in the Reclaim and Clearwater ponds will follow a similar sequence as outlined above for the WWP during the second and third construction seasons (2022 and 2023). It is important to note that during each phase that the non-CCR wastestreams are continuously flowing through BAP 1A and will need to bypass the Reclaim and Clearwater ponds via temporary pumps and piping to complete the closure and repurposing work. As mentioned above the tank based chemical treatment system is a key component to the construction sequencing as a majority of the non-CCR wastewater streams will be routed through this system prior to executing the Reclaim and Clearwater pond closure and repurposing construction work. Once the Reclaim and Clearwater ponds are closed and repurposed as lined wastewater ponds all non-CCR streams will then be flowing through 1B, Reclaim, and Clearwater ponds which in turn allows for BAP 1A closure to commence. Closure by removal of BAP1A will be completed in February 2024, with final filling, grading and stabilization of the permanently closed areas completed in September 2024. The closure by removal will be certified by a third-party engineer and the records will be posted in the operating record and on the AEP CCR website as appropriate.

All Non-CCR streams will be running through newly constructed lined WWPs by October 15, 2023.

At the completion of the CCR material removal and pond construction, the temporary construction facilities, laydown areas, and erosion controls will be removed, and these areas will be restored to their pre-construction conditions.

Section Four – Narrative of the Steps Already Taken to Initiate Closure and Develop Alternative Capacity

From the regulatory text § 257.103(f)(1)(iv)(A)(4).

> *(4) A narrative discussion of the progress the owner or operator has made to obtain alternative capacity for the CCR and/or non-CCR wastestreams. The narrative must discuss all the steps taken, starting from when the owner or operator initiated the design phase up to the steps occurring when the demonstration is being compiled. It must discuss where the facility currently is on the timeline and the efforts that are currently being undertaken to develop alternative capacity.*

AEP has made considerable progress at the time of this request towards creating alternative disposal capacity for the CCR and non-CCR wastestreams at the Amos Plant that are currently managed in the BAP Complex. The following major activities have been completed or are in process:

- Conceptual design for all aspects of the project required to achieve the alternate disposal capacity has been completed and detailed design has commenced.
- Dry bottom ash equipment has been specified and is being procured with equipment delivery scheduled.
- Contractors have been engaged to discuss different aspects of the work and identify expected construction timeframes.
- Permitting agencies have been engaged to discuss plans.
- Geotechnical investigations required to support the work have been started and are expected to be completed in 2020

NARRATIVE STRATEGY FOR COMPLIANCE WITH ALL REQUIREMENTS OF 40 CFR 257 SUBPART D

From the regulatory text 40 CFR § 257.103(f)(1)(iv)(B)

(B) To demonstrate that the criteria in paragraph (f)(1)(iii) of this section have been met, the owner or operator must submit all of the following:

> *(1) A certification signed by the owner or operator that the facility is in compliance with all of the requirements of this subpart;*
>
> I hereby certify that, based on my inquiry of those persons who are immediately responsible for compliance with environmental regulations for the Amos Plant, the facility is in compliance with all of the requirements contained in 40 CFR 257 Subpart D – *Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments*.
>
> X David A. Miller
> David A. Miller P.E.
> Director – Land Environmental and Remediation Services

The Amos Plant is maintaining compliance with all requirements of Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments. Reports documenting compliance with the rule's provisions, such as location restriction, design criteria, operating criteria, and groundwater monitoring are posted to the AEP public CCR Rule Compliance Data and Information Internet site at the following link: https://aep.com/environment/ccr.

40 CFR § 257.103(f)(1)(iv)(B)(2) Visual representation of hydrogeologic information at and around the CCR unit(s) that supports the design, construction and installation of the groundwater monitoring system. This includes all of the following:

> *(i) Map(s) of groundwater monitoring well locations in relation to the CCR unit(s);*
> *(ii) Well construction diagrams and drilling logs for all groundwater monitoring wells; and*
> *(iii) Maps that characterize the direction of groundwater flow accounting for seasonal variations;*

Groundwater monitoring at the Amos CCR units is accomplished using PE-certified groundwater monitoring networks. The BAP network is comprised of four up-gradient monitoring wells and six down-gradient monitoring wells. The FAP network is comprised of 5 up-gradient and 10 down-gradient monitoring wells. The LF network is composed of 5 up-gradient and 4 down-gradient monitoring wells. The complete Groundwater Monitoring Well Network Evaluation (GWMN) Reports are provided in **Appendix D** and include the following:

- A map showing the location of the PE certified monitoring wells relative to the CCR unit is included in the GWMN report as *Figure 7*
- Boring logs and well construction diagrams are included in the GWMN Report as *Appendix D*
- A typical groundwater flow direction map is included in the GWMN Report as *Figure 6*

Additionally, four groundwater flow direction maps from monitoring events throughout the different seasons to show seasonal changes are provided in the figures section of this submittal as **Figures 2 – 5** for the BAP, **Figures 6 – 9 for the FAP,** and **Figures 10 – 13** for the Landfill**.**

40 CFR § 257.103(f)(1)(iv)(B)(3) Constituent concentrations, summarized in table form, at each groundwater monitoring well monitored during each sampling event;

The most recent Groundwater Monitoring and Corrective Action Reports summarize Appendix III and IV constituent concentrations at each groundwater monitoring well monitored during each sampling event as Table 1 (see **Appendix E**).

40 CFR § 257.103(f)(1)(iv)(B)(4) A description of site hydrogeology including stratigraphic cross-sections;

The Site is immediately underlain by Quaternary-aged alluvial deposits consisting of clay, silt, sand, and gravel. While there is a general coarsening downward pattern, the shallower clay matrix is interbedded with silty or sandy layers and the deeper sand matrix is interbedded with silty or clayey layers. The uppermost groundwater zone occurs in the confined to semi-confined deeper sand zones that exhibit a potential head. Maximum alluvium thickness is approximately 50 ft and thins towards the edges of the valley. The Site is adjacent to the Kanawha River, and the ash pond system is located approximately 1,000 ft southwest of the Kanawha River. Bill's Creek, a tributary of the Kanawha River, is immediately adjacent and north of the Reclaim Pond. Groundwater flow direction is generally to the north, northeast, and east towards the Kanawha River and Bill's Creek. The Kanawha River stage level is dam controlled and is a gaining surface water feature. Groundwater elevations on site are higher than the normal stage elevation of the Kanawha River of 566 ft.

Groundwater flow direction within the alluvium is towards the Kanawha River or Bill's Creek. In the upland areas surrounding the Site, bedrock primarily consists of the Pennsylvanian age sandstones, shales, limestones, and coal of the Monongahela and Conemaugh Groups. At higher elevations, the hilltops are capped by the Permian age Dunkard Formation. The Conemaugh Group immediately underlies alluvial sediments at the Site, and gently dips to the north. Groundwater occurrence in the bedrock generally coincides with the stress relief fracture system and is not necessarily related to lithology. Bedrock groundwater flow generally mimics surface topography, flowing from ridges towards valleys.

The complete GWMN Reports for each CCR unit at Amos Plant are provided in **Appendix D** and include a description of site hydrogeology. Stratigraphic cross-sections are included in the GWMN Reports as *Figures 4 – 5C for the BAP, Figures 4 – 6 for the FAP, and Figures 4 – 5B for the LF.*

40 CFR § 257.103(f)(1)(iv)(B)(5) Any corrective measures assessment conducted as required at § 257.96;

The BAP Complex is expected to remain in assessment monitoring until closure by removal is complete. The FAP and LF are in detection monitoring. The CCR units will transition to an assessment of corrective measures and selection of a remedy following requirements in 40 CFR 257.96 and 40 CFR 257.97 and a corrective action program following requirements in 40 CFR 257.98, if necessary.

40 CFR § 257.103(f)(1)(iv)(B)(6) Any progress reports on corrective action remedy selection and design and the report of final remedy selection required at § 257.97(a);

The Amos CCR units have not entered Assessment of Corrective Measures, therefore no progress reports on remedy selection and design and a report of final remedy selection have been required or prepared.

40 CFR § 257.103(f)(1)(iv)(B)(7) The most recent structural stability assessment required at § 257.73(d); and

The most recent structural stability assessment required by § 257.73(d) for the BAP and FAP are included in **Appendix F** and **Appendix H**, respectively. These report will be updated every 5 years as required by the CCR rule.

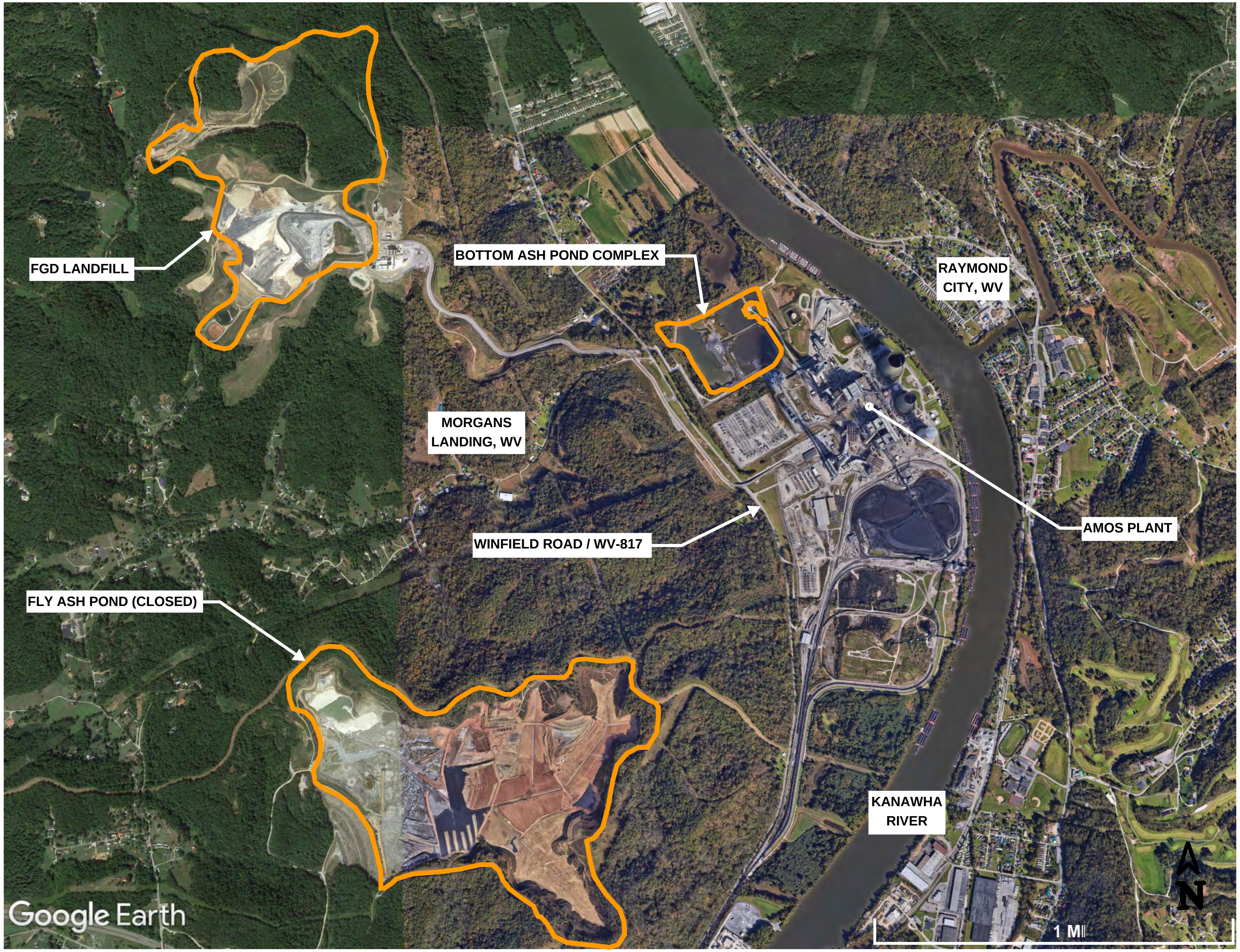
40 CFR § 257.103(f)(1)(iv)(B)(8) The most recent safety factor assessment required at § 257.73(e).

The most recent safety factor assessment required by § 257.73(e) for the BAP and FAP are included in **Appendix G** and **Appendix H**, respectively. These reports will be updated every 5 years as required by the CCR rule.

CONCLUSION

As set forth and allowed by 40 CFR 257.103 – *Alternative Closure Requirements* and specifically 40 CFR 257.103(f)(1) – *Development of Alternative Capacity is Technically Infeasible,* the Amos Plant qualifies for the site specific alternate time frame provisions for continuing to receive CCR and non-CCR wastestreams and initiate closure of the CCR surface impoundments. Based upon the information submitted, APCO seeks to establish a site-specific compliance deadline to continue to receive CCR wastestreams in the BAP complex until October 31, 2022 and Non-CCR wastestreams until October 15, 2023. All CCR material will be removed from the BAP complex and the BAP will be closed by February 9, 2024.

Figures



LEGEND:

CCR UNIT BOUNDARY

REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/ TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER
A	17 JUN 20	ISSUED FOR REVIEW	FMW						

Worley energy | chemicals | resources

OneWay

PRELIMINARY STATUS DATE - - INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.
LDE

APPROVED STATUS DATE - - REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.
LDE

ORIGINATING PERSONNEL	PROFESSIONAL ENGINEER'S SEAL
DRAWN BY	
CHECKED BY	
LEAD DESIGNER	
ENGINEER/TECH SPECIALIST	
PROJECT ENGINEERING MANAGER	

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

AEP CONFIDENTIAL

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

APPALACHIAN POWER COMPANY

AMOS PLANT

SCARY WEST VIRGINIA

CCR/ELG PROJECT

FIGURE 1

UNIT: DRAWING NUMBER: REV:

SCALE: MECHANICAL ENGINEERING
DR:
CH:
SUP:
ENG:
DATE:
APPROVED BY

DOCUMENT PREPARED BY WORLEY

AEP AMERICAN ELECTRIC POWER

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 2/4/2020
PLOT TIME: 6:12:04 AM
BY: craig.rauenzahn

CROSS REFS:

DRAWING NUMBER:

TENTHS 10 20 30 INCHES 1 2 3

...\EPFSPiping2DSeed_G_V8.dgn
2/4/2020 6:12:04 AM

Legend
- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on October 17, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

1,000 500 0 1,000
Feet

Groundwater Elevation Contour Map
October 2016

AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec
consultants

Columbus, Ohio | 2017/12/26

Figure
2

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_BAP_GW_October2016_rev.mxd. CGregory. 12/26/2017. CHA8423/04/08.

Legend
- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on February 7, 2017) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

1,000 500 0 1,000 Feet

Groundwater Elevation Contour Map
February 2017

AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/12/27

Figure
3

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_BAP_GW_2017-02_Feb.mxd. CGregory. 12/27/2017. CHA8423/04/08.

Legend

- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on April 27, 2018) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

Groundwater Elevation Contour Map
April 2018

AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/08/30

Figure 4

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2018\AEP-Amos_BAP_GW_2018-05_May.mxd. ARevezzo. 8/30/2018. CHA8423/04/08.

Legend
- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on July 22, 2019) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
July2019

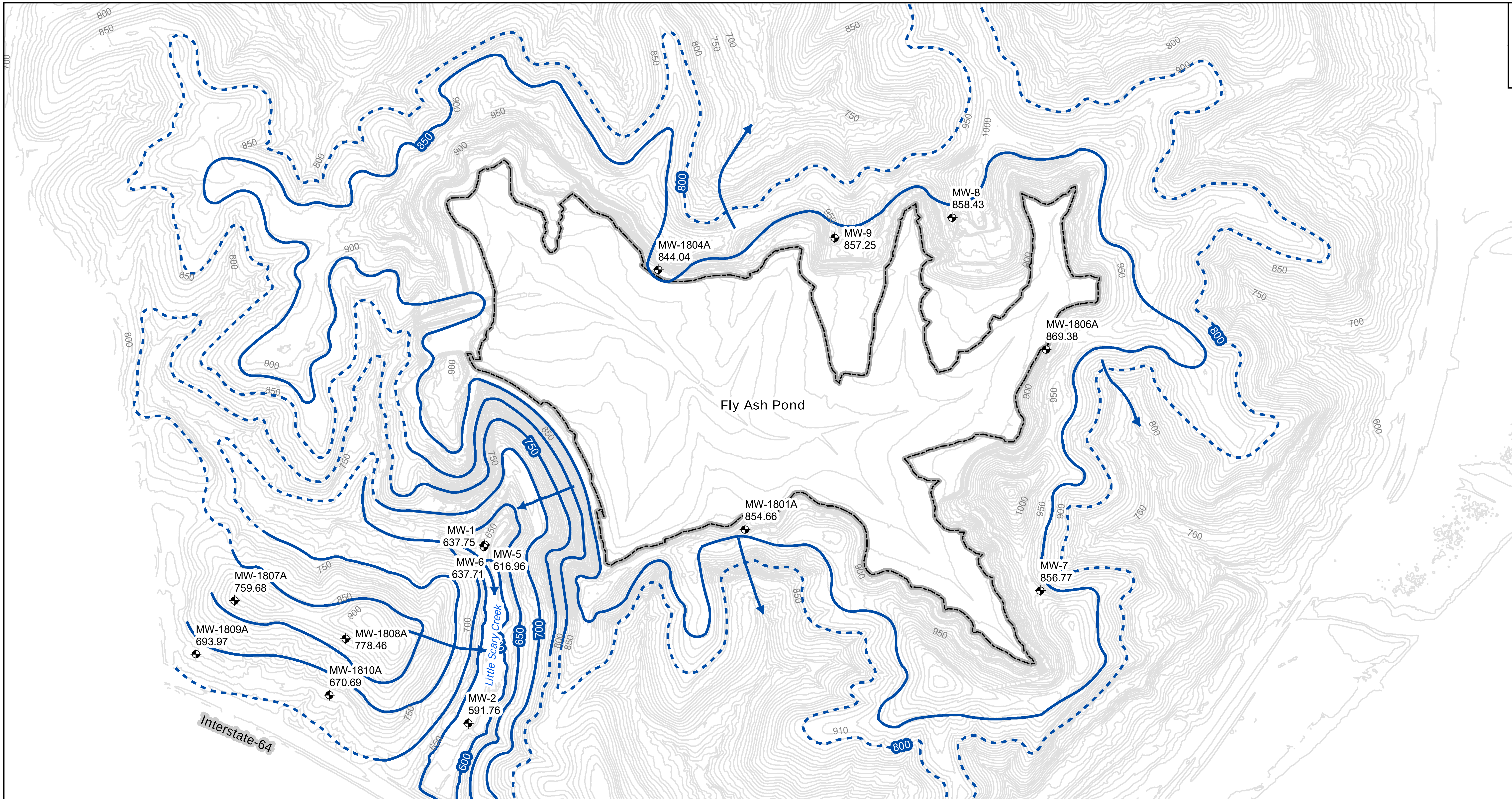
AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/01/14

Figure 5

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_BAP_GW_2019-07_July.mxd. ARevezzo. 1/14/2020. CHA8423/04/08.



Legend
- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes
- Monitoring well coordinates and water level data (collected on January 22, 2019) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

1,000 500 0 1,000 Feet

Potentioetric Surface Map - Uppermost Aquifer
January 2019

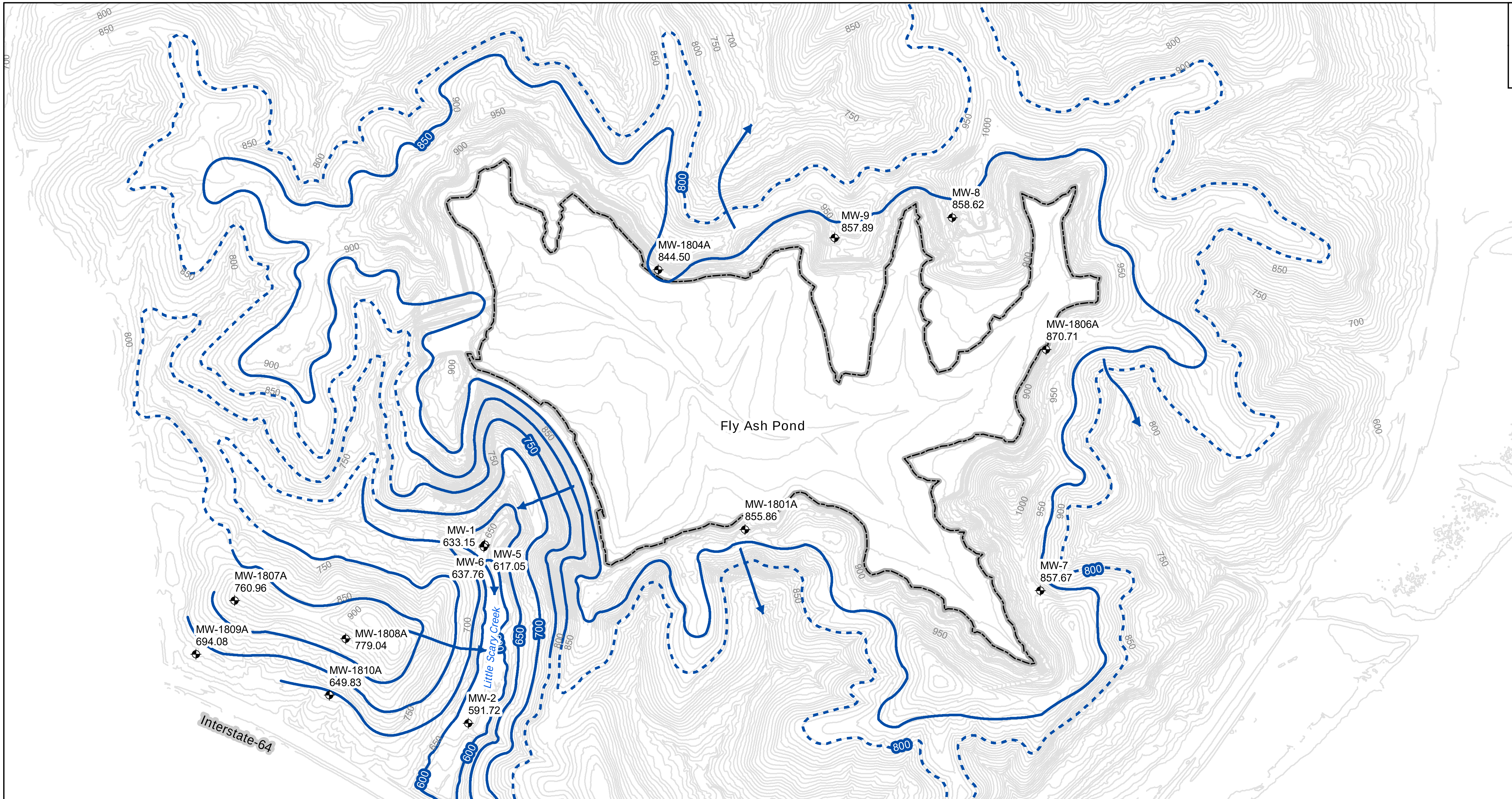
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Figure 6

Columbus, Ohio | 2019/07/29

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2019-01Jan.mxd. ARevezzo. 7/29/2019. CHA8423.



Legend
- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes
- Monitoring well coordinates and water level data (collected on March 14, 2019) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

1,000 500 0 1,000 Feet

Potentioetric Surface Map - Uppermost Aquifer
March 2019

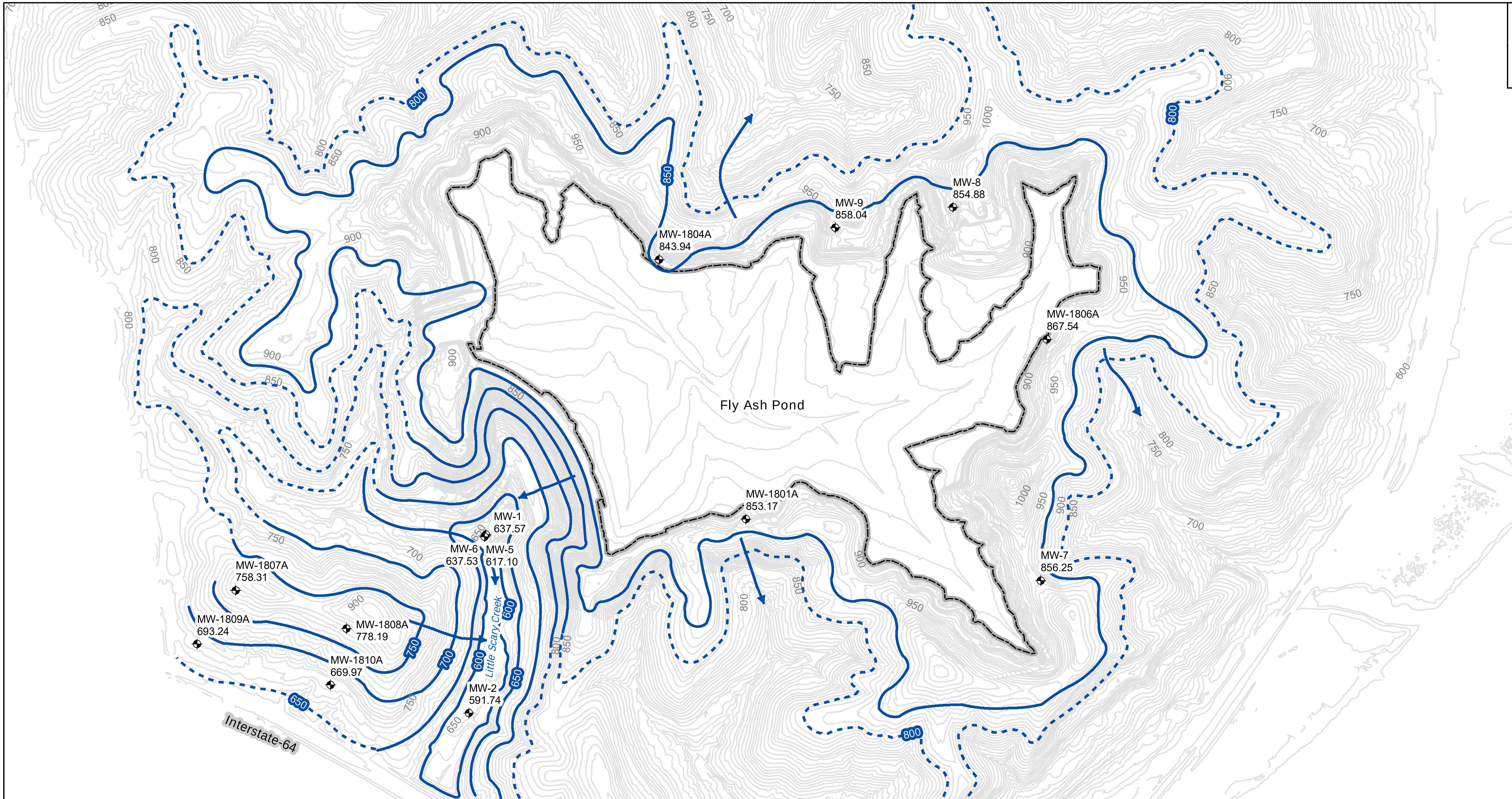
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Figure
7

Columbus, Ohio | 2019/07/29

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2019-03Mar.mxd. ARevezzo. 7/29/2019. CHA8423.



Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes

- Monitoring well coordinates and water level data (collected on July 23, 2018) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
July 2018

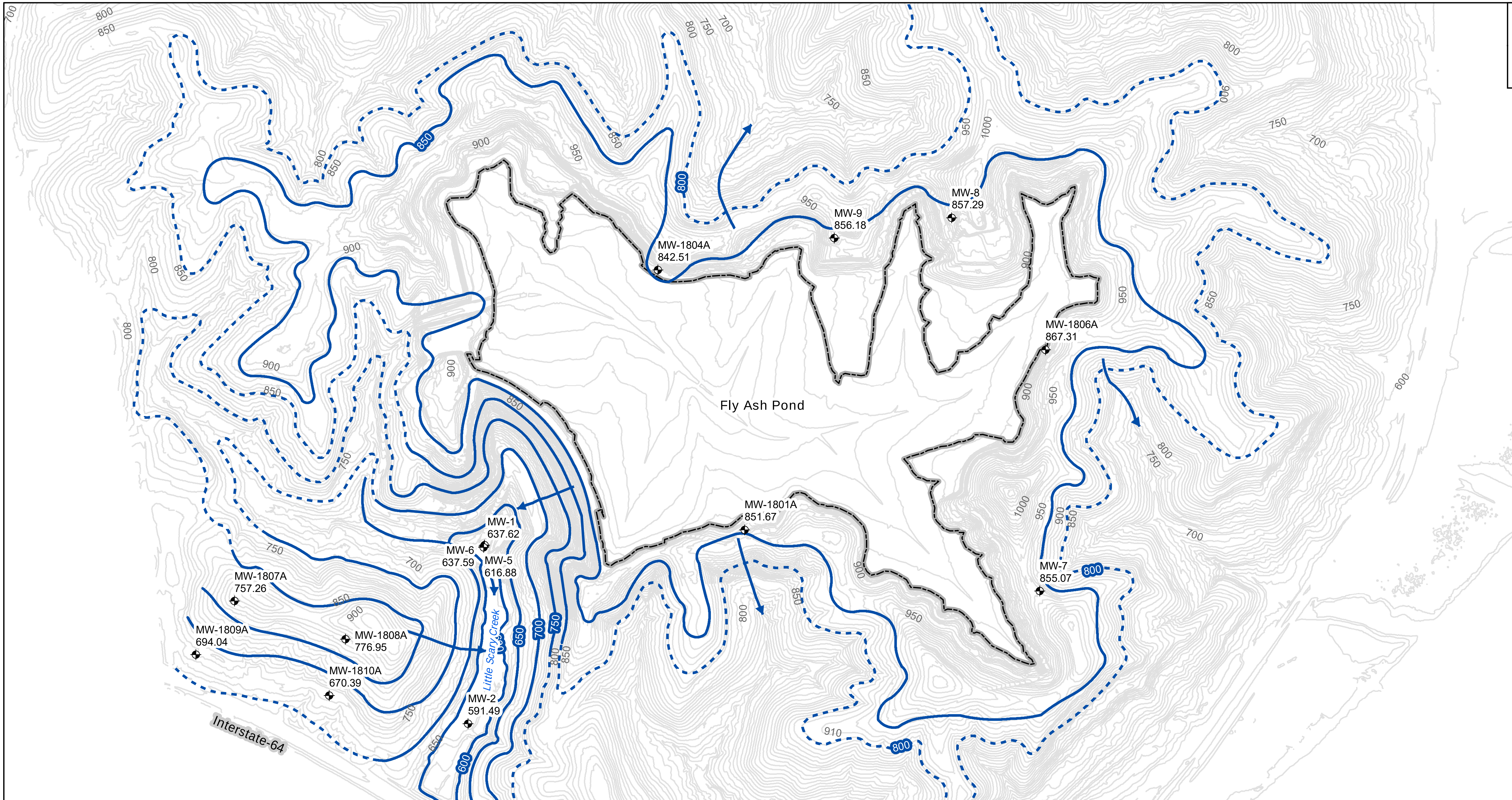
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/07/29

Figure 8

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2018-07July.mxd. ARevezzo. 7/29/2019. CHA8423.



Legend
- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes
- Monitoring well coordinates and water level data (collected on October 22, 2018) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

1,000 500 0 1,000 Feet

Potentioetric Surface Map - Uppermost Aquifer
October 22, 2018

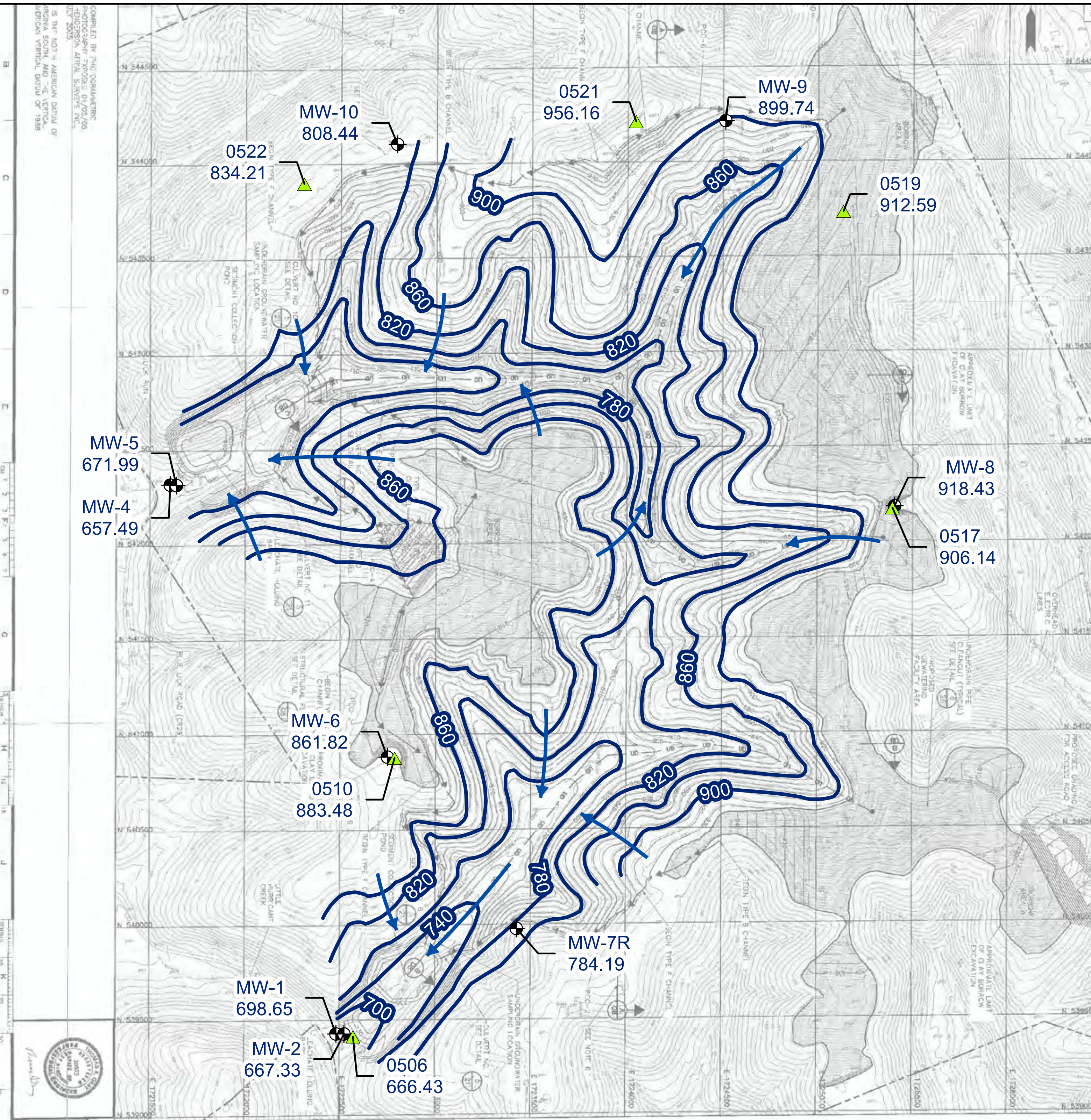
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Figure
9

Columbus, Ohio | 2019/07/29

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2018-10-22Oct.mxd. ARevezzo. 7/29/2019. CHA8423.



Legend
- Groundwater Monitoring Well
- Piezometer
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on December 12, 2016) provided by AEP.
- Potentiometric surface contour interval is 40 feet.
- Topography and drainage system basemap from AEP Drawing No. 13-30500-05-A (topographic contour interval: 10 feet).
- Groundwater elevation units are feet above mean sea level.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
December 2016

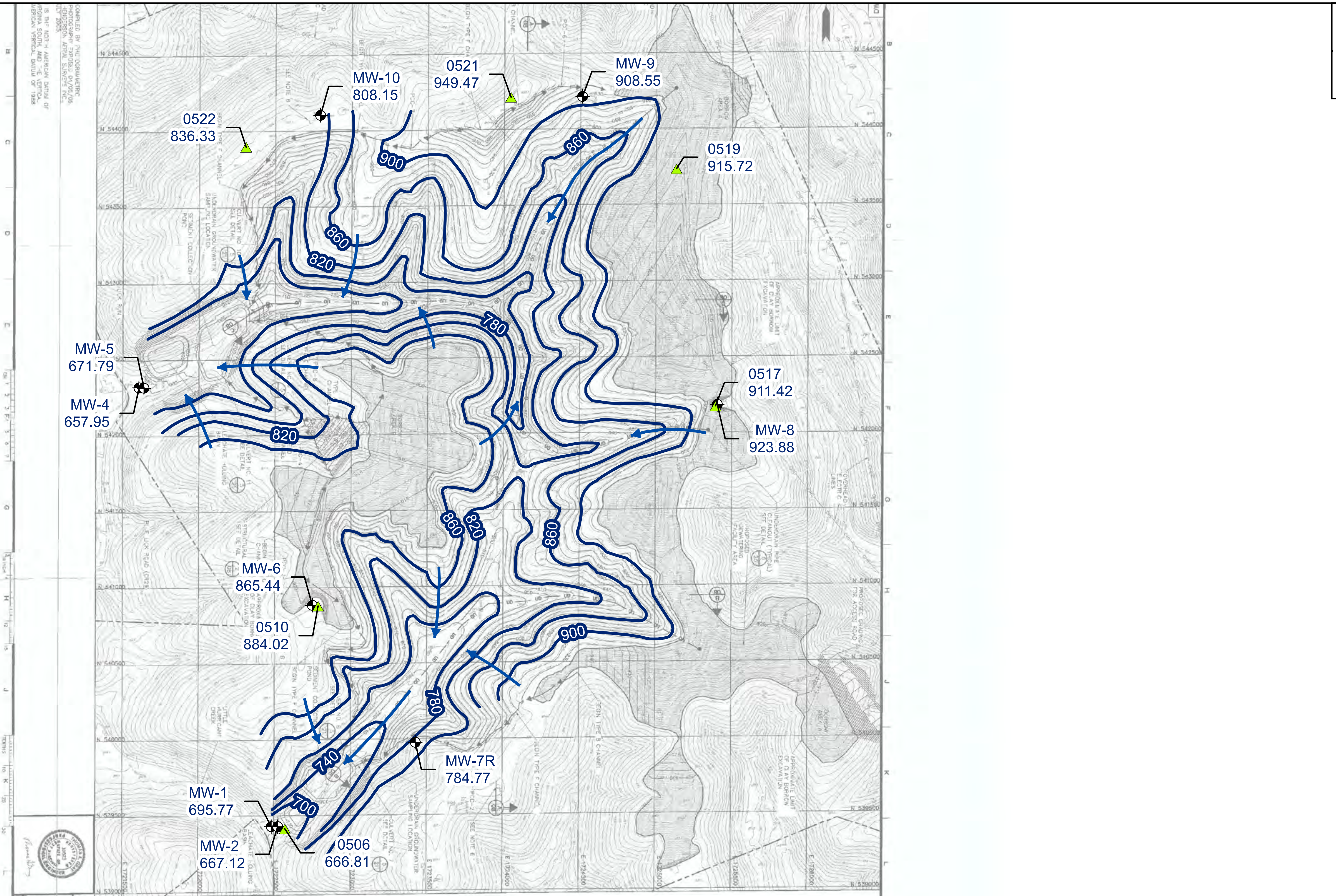
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/12/29

Figure 10

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_GW_2016-12.mxd. CGregory. 12/29/2017. CHA8423/04/08.



Legend

- Groundwater Monitoring Well
- Piezometer
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on March 13, 2017) provided by AEP.
- Potentiometric surface contour interval is 40 feet.
- Topography and drainage system basemap from AEP Drawing No. 13-30500-05-A (topographic contour interval: 10 feet).
- Groundwater elevation units are feet above mean sea level.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
March 2017

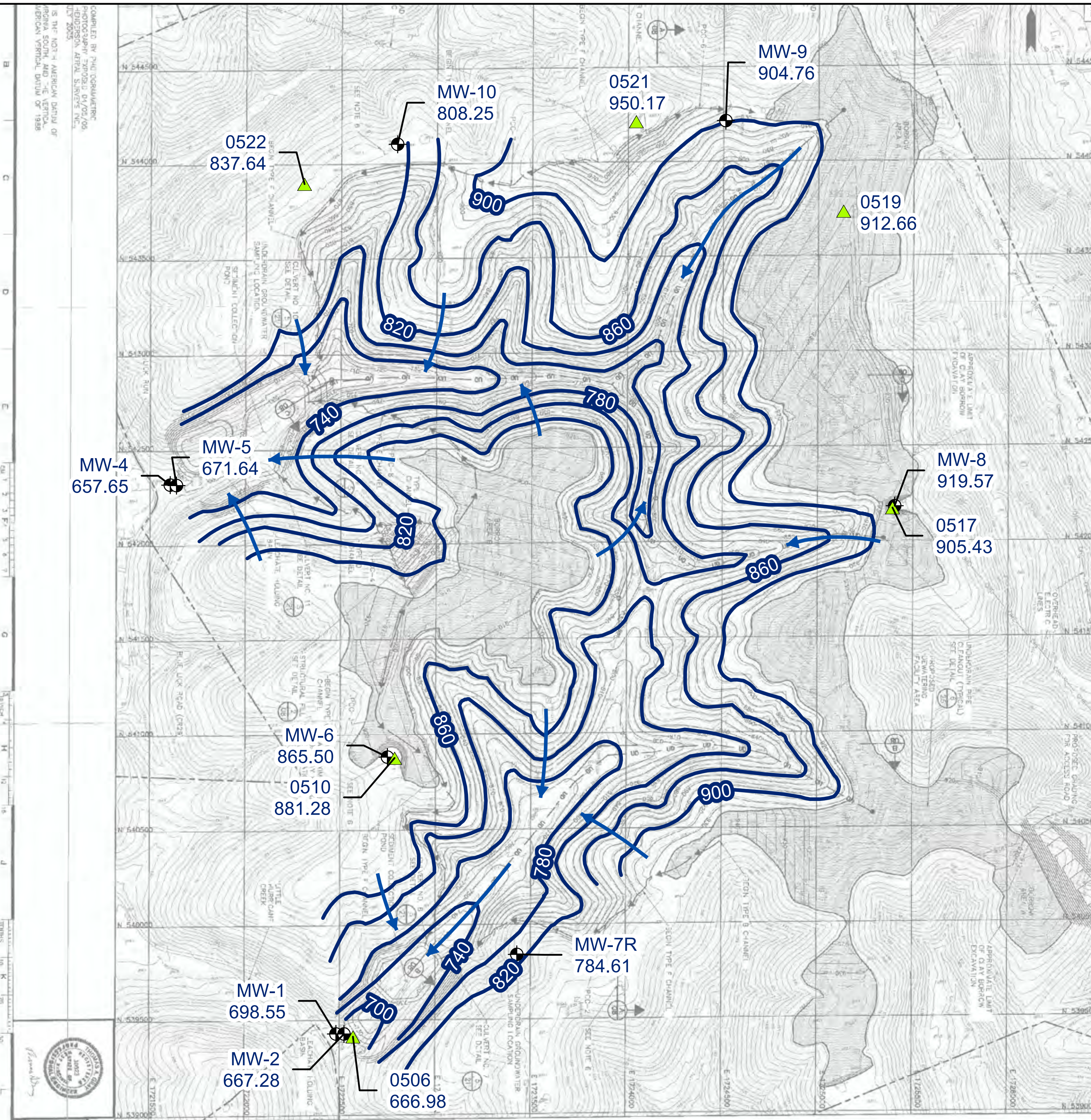
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2017/12/29

Figure 11

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_GW_2017-03.mxd. CGregory. 12/29/2017. CHA8423/04/08.



Legend
- Groundwater Monitoring Well
- Piezometer
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on June 10, 2019) provided by AEP.
- Potentiometric surface contour interval is 40 feet.
- Topography and drainage system basemap from AEP Drawing No. 13-30500-05-A (topographic contour interval: 10 feet).
- Groundwater elevation units are feet above mean sea level.

700 350 0 700 Feet

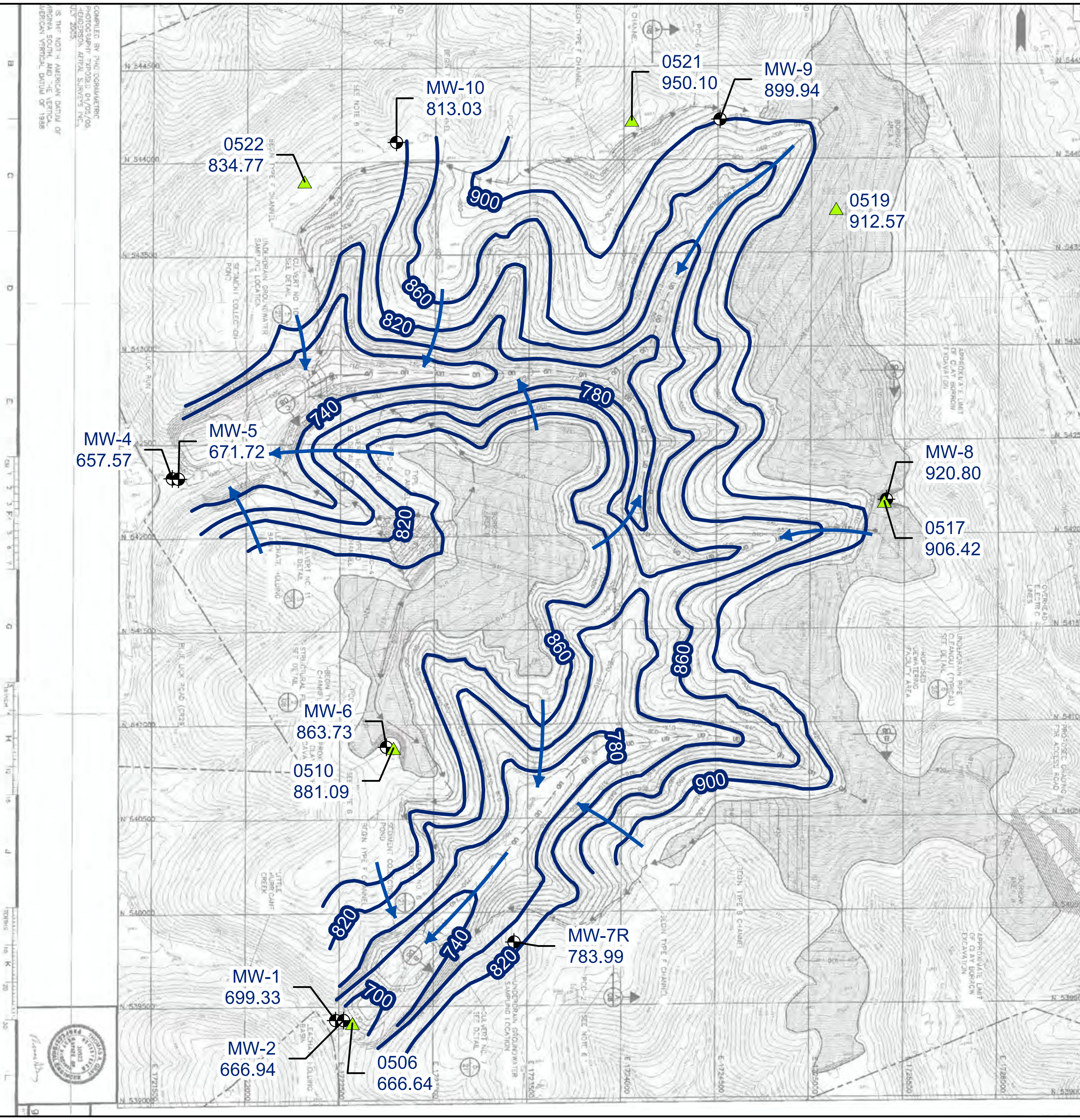
Potentiometric Surface Map - Uppermost Aquifer
June 2019

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/01/29

Figure
12



Legend

- Groundwater Monitoring Well
- Piezometer
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on November 4, 2019) provided by AEP.
- Potentiometric surface contour interval is 40 feet.
- Topography and drainage system basemap from AEP Drawing No. 13-30500-05-A (topographic contour interval: 10 feet).
- Groundwater elevation units are feet above mean sea level.

700 350 0 700
Feet

Potentiometric Surface Map - Uppermost Aquifer
November 2019

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec
consultants

Figure
13

Columbus, Ohio | 2020/01/29

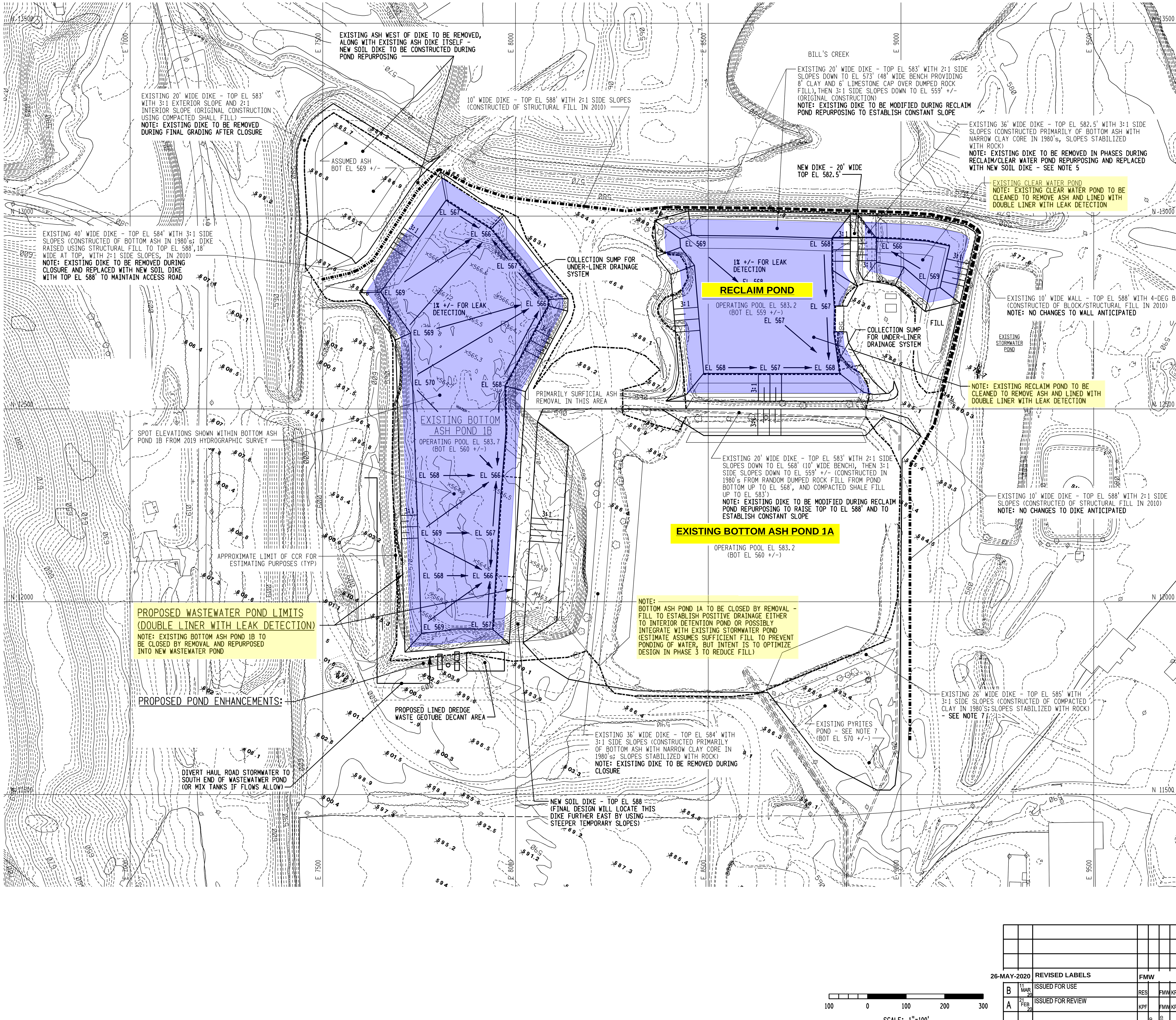
P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_Landfill_GW_2019-11.mxd. ARevezzo. 1/29/2020. CHA8423/04/08.

Appendix A

Existing and Future Pond Configurations

CROSS REFS:

AMP-PR-0-180-EC-SK002-001



NOTES:

1. COORDINATE GRID SHOWN IS PLANT COORDINATE SYSTEM.
2. EXISTING TOPOGRAPHIC SURVEY TAKEN FROM AERIAL SURVEY EXPOSED ON APRIL 5, 2005.
3. EXISTING CONTOURS ARE TIED TO NAVD88 VERTICAL DATUM.
4. LOW-PERMEABILITY SUBGRADE FILL WILL BE COMPACTED TO PROVIDE 5' THICK (MIN) SEPARATION BETWEEN THE TOP OF THE UPPERMOST AQUIFER AND THE BOTTOM OF THE LINER SYSTEM. THE POND LINER SYSTEM WILL BE LOCATED AS NEAR AS POSSIBLE TO THE TOP OF THIS 5' SEPARATION FILL LAYER, ABOVE ADDITIONAL GENERAL FILL USED TO ESTABLISH SLOPING OF THE LINER SYSTEM. ALL UNDER-LINER DRAINAGE SYSTEM WILL BE INSTALLED TO COLLECT ANY GROUNDWATER SEEPING TOWARDS THE LINER SYSTEM AND CONVEY IT TO A SUMP IN EACH LINED POND.
5. IT MAY BE POSSIBLE TO CLEAN/LINE RECLAIM AND CLEAR WATER PONDS AT THE SAME TIME DEPENDING IN PART ON THE TIMING OF DRY BOTTOM ASH CONVERSION.
6. CLOSURE AND REPURPOSING OF PONDS (e.g. NORTHWEST POND 1B AREA AND ALONG WEST SIDE OF POND 1B) WILL REQUIRE CLEARING AND GRUBBING AND ASSOCIATED PERMITTING.
7. PYRITES POND FALLS OUTSIDE CCR UNIT BOUNDARY AND DOES NOT REQUIRE CLOSURE BY REMOVAL. THIS POND WILL BE LEFT IN PLACE TO MANAGE PYRITES AND LOCAL STORMWATER RUNOFF. THE EXISTING GRAVITY PIPING FROM THE PYRITES POND TO ASH POND 1B WILL BE REPLACED WITH NEW GRAVITY PIPING FROM THE PYRITES POND TO THE MIX TANKS.

DATE	NO.	DESCRIPTION	APPD.

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

AEP CONFIDENTIAL

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

Worley energy | chemicals | resources — OneWay

PRELIMINARY STATUS	DATE	
LDE FM WOOD	21-FEB-20	INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.
APPROVED STATUS	DATE	REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.
LDE	- -	

ORIGINATING PERSONNEL	PROFESSIONAL ENGINEER'S SEAL
DRAWN BY: KPF	
CHECKED BY	
LEAD DESIGNER: KP FEEG	
ENGINEER/TECH SPECIALIST: FM WOOD	
PROJECT ENGINEERING MANAGER: FG NADEAU	

APPALACHIAN POWER COMPANY

AMOS PLANT

SCARY — WEST VIRGINIA

CCR/ELG PROJECT

SITE DEVELOPMENT SKETCH POND REPURPOSING AND CLOSURE

UNIT:	DRAWING NUMBER: AMP-PR-0-180-EC-SK002-001	REV: C
SCALE: 1"=100'	CIVIL ENGINEERING	

DR: CH: SUP: ENG: DATE: — APPROVED BY — DOCUMENT PREPARED BY WORLEY

	26-MAY-2020	REVISED LABELS	FMW					
B	11 MAR 20	ISSUED FOR USE	RES	FMW	KPF	FMW	FMW	FGN
A	21 FEB 20	ISSUED FOR REVIEW	KPF	FMW	KPF	FMW	FMW	FGN
REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER TECH SPEC.	PROJECT ENGINEERING MANAGER

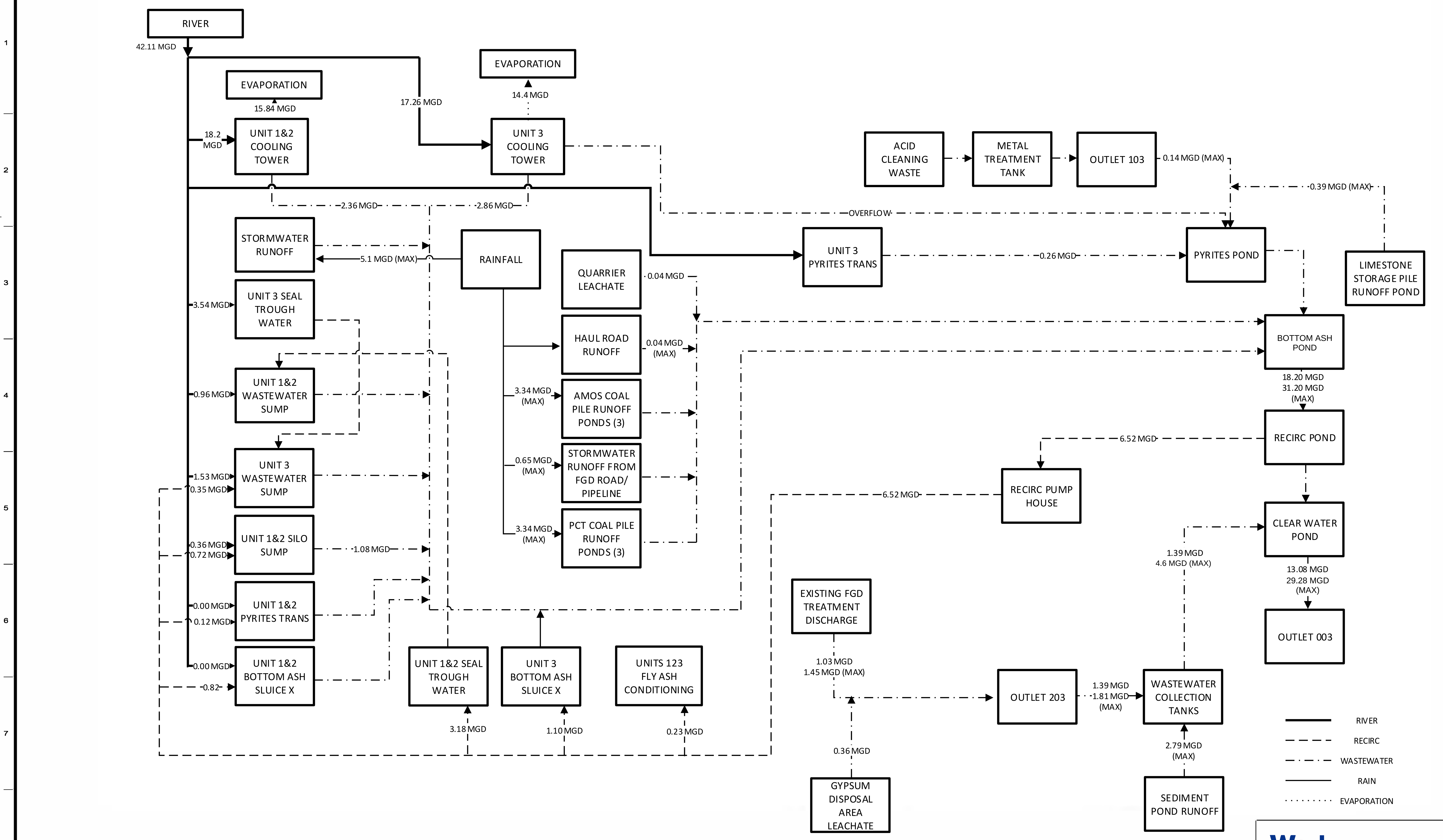
AMERICAN ELECTRIC POWER — AEP SERVICE CORP. 1 RIVERSIDE PLAZA COLUMBUS, OH 43215

$$DESIGN-FILE-NAME$$ $$DATE$$$ $$$$TIME$$$$

CROSS REFS:

Appendix B

Existing and Future Water Balances



PRELIMINARY STATUS — H. SUBER, LDE — DATE 12-OCT-20 — INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.

APPROVED STATUS — LDE — DATE - - — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.

ORIGINATING PERSONNEL

DRAWN BY J. FAN

CHECKED BY

LEAD DESIGNER

ENGINEER/TECH SPECIALIST H. SUBER

PROJECT ENGINEERING MANAGER

PROFESSIONAL ENGINEER'S SEAL

ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

REV	DATE	DESCRIPTION
A	12OCT20	ISSUED FOR USE

REVISIONS

THIS DRAWING IS CLASSIFIED AS:

AEP CONFIDENTIAL

REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

APPALACHIAN POWER COMPANY

AMOS PLANT

SCARY WEST VIRGINIA

CCR/ELG PROJECT

CURRENT WATER BALANCE BLOCK FLOW DIAGRAM WATER TREATMENT

UNIT: DRAWING NUMBER: REV:

SCALE: DR: CH: SUP: ENG: DATE: APPROVED BY

MECHANICAL ENGINEERING

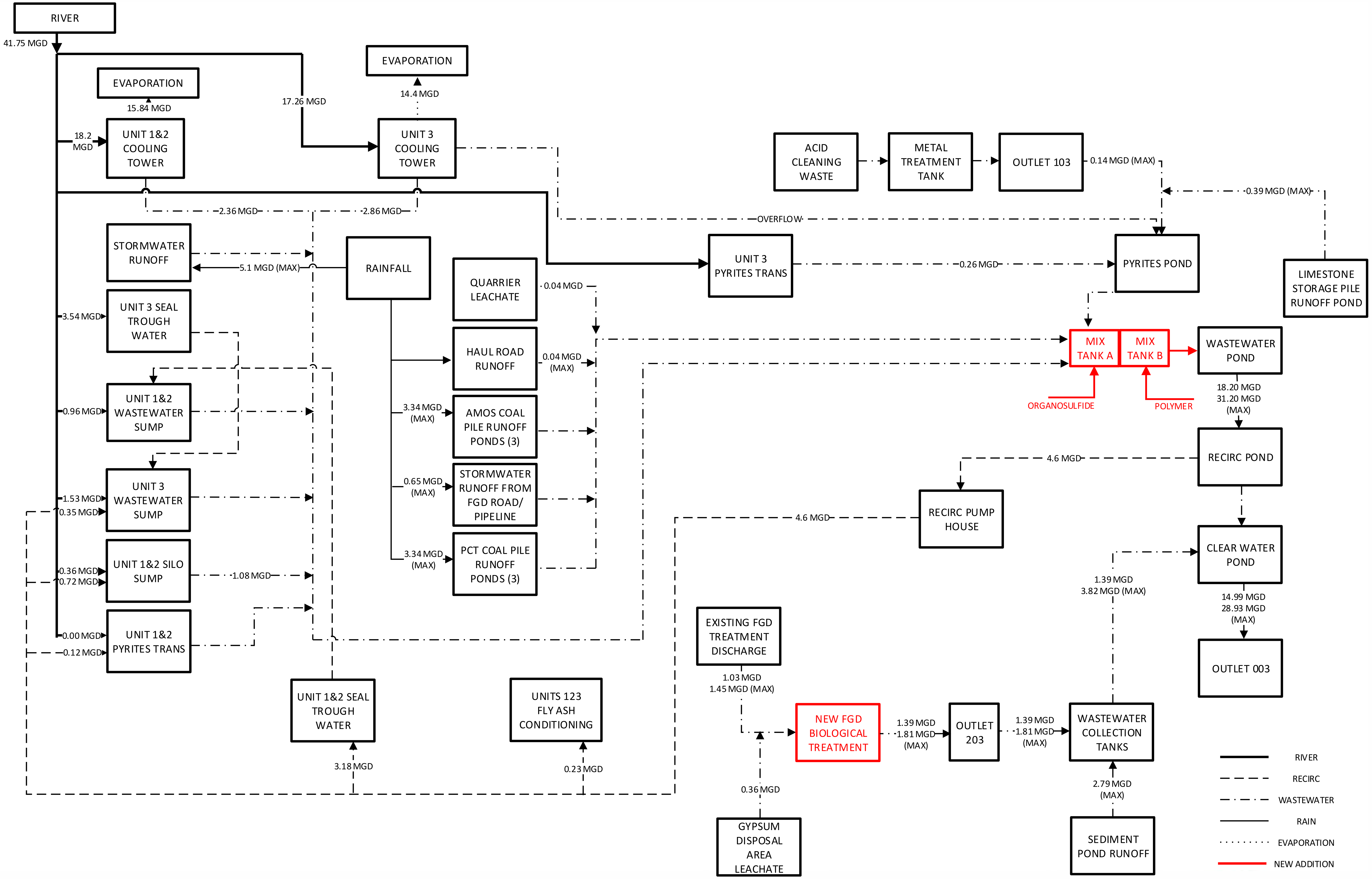
DOCUMENT PREPARED BY WORLEY

AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

...\EPFSPiping2DSeed_G_V8.dgn 2/4/2020 6:12:04 AM

PLOT DATE: 2/4/2020 PLOT TIME: 6:12:04 AM BY: craig.rauenzahn

CROSS REFS:



REV	DATE	DESCRIPTION	DRAWN	CHECKED	REVIEWED	LEAD DESIGNER	ENGINEER/ TECH. SPEC.	LEAD DISC ENGINEER	PROJ ENGR MANAGER
D	26/NOV20	ISSUED FOR USE	JF	HS					
C	27MAY20	ISSUED FOR USE	HS						
B	11MAR20	ISSUED FOR USE	EG		TH		MS	MS	TM
A	11FEB20	ISSUED FOR REVIEW	EG		TH		MS	MS	TM

Worley energy | chemicals | resources
OneWay empowered | enabled | ethical

PRELIMINARY STATUS — H. SUBER, LDE — DATE 26-NOV-20 — INFORMATION ONLY - NOT TO BE USED FOR CONSTRUCTION.

APPROVED STATUS — LDE — DATE - - — REPRESENTS REVIEWED AND APPROVED DESIGN. ANY PORTION MARKED "HOLD" RETAINS PRELIMINARY STATUS.

ORIGINATING PERSONNEL
DRAWN BY: J. FAN
CHECKED BY:
LEAD DESIGNER:
ENGINEER/TECH SPECIALIST: H. SUBER
PROJECT ENGINEERING MANAGER: T. MiLLER

PROFESSIONAL ENGINEER'S SEAL
ORIGINALLY PREPARED UNDER THE RESPONSIBLE SUPERVISION OF
PE: STATE:
LIC. NO.: DATE:

DATE | NO. | DESCRIPTION | APPD.
REVISIONS

THIS DRAWING IS CLASSIFIED AS:
AEP CONFIDENTIAL
REFERENCE AEP's CORPORATE INFORMATION SECURITY POLICY

APPALACHIAN POWER COMPANY
AMOS PLANT
SCARY — WEST VIRGINIA

CCR/ELG PROJECT
UPDATED WATER BALANCE BLOCK FLOW DIAGRAM WATER TREATMENT

UNIT: | DRAWING NUMBER: | REV:

SCALE: | MECHANICAL ENGINEERING
DR:
CH:
SUP:
ENG:
DATE:
APPROVED BY
DOCUMENT PREPARED BY WORLEY

AEP AMERICAN ELECTRIC POWER
AEP SERVICE CORP.
1 RIVERSIDE PLAZA
COLUMBUS, OH 43215

PLOT DATE: 2/4/2020
PLOT TIME: 6:12:04 AM
BY: craig.rauenzahn
CROSS REFS:

...\EPFSPiping2DSeed_G_V8.dgn
2/4/2020 6:12:04 AM

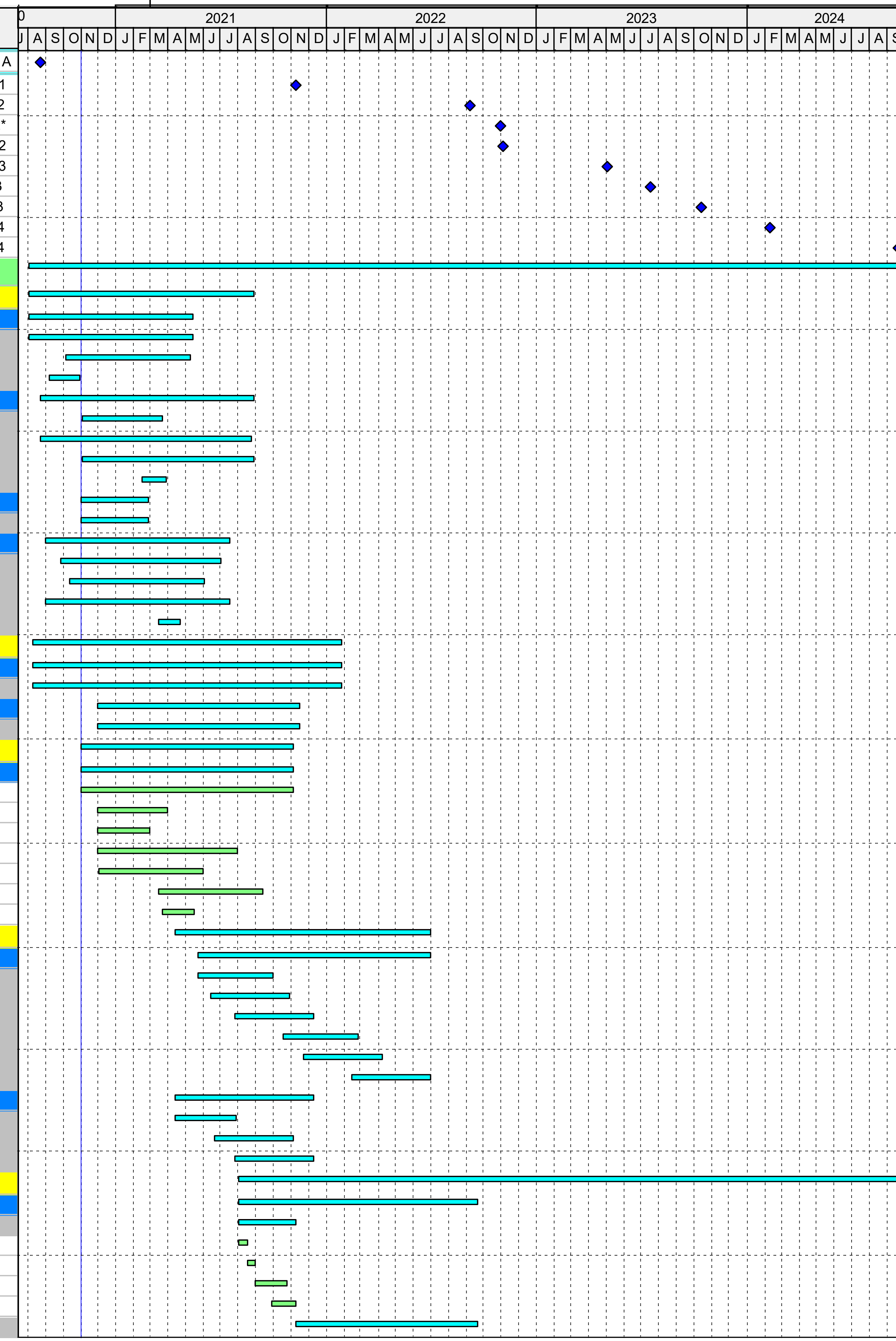
Appendix C

Site-Specific Schedule to Obtain Alternative Capacity

Amos - CCR/ELG EPA Updated Timelines...

AEP CCR-ELG AMP USEPA Public Version

Activity ID	Activity Name	Duration (Months)	Start	Finish
A-00-M-020-SR-G-RPS-A80	AEP Release Engineer and OEM to Complete Detailed Design for CCR Compliance	0.0		24-Aug-20 A
A-PR-M-020-SR-G-RPS-A60	3rd Party QAQC Certification of CCR Materials Removed for Ash Pond B Closure by Removal	0.0		08-Nov-21
A-PR-M-020-SR-G-RPS-A10	Initial Operation of Repurposed Wastewater Pond	0.0		08-Sep-22
A-PR-M-020-SR-G-RPS-A40	Cease sluicing CCR from Unit 3 and Unit 1 & 2	0.0		31-Oct-22*
A-PR-M-020-SR-G-RPS-A100	3rd Party QAQC Certification of CCR Materials Removed for Reclaim Pond Closure by Removal	0.0		03-Nov-22
A-PR-M-020-SR-G-RPS-A20	Initial Operation of Repurposed Reclaim Pond	0.0		04-May-23
A-PR-M-020-SR-G-RPS-A80	3rd Party QAQC Certification of CCR Materials Removed for Clearwater Pond Closure by Removal	0.0		18-Jul-23
A-PR-M-020-SR-G-RPS-A30	Initial Operation of Repurposed Clearwater Pond / All non-CCR Streams Routed through Lined WW Ponds (CCR Compliance)	0.0		15-Oct-23
A-PC-M-020-SR-G-RPS-A20	3rd Party QAQC Certification of CCR Materials Removed for Ash Pond A Closure by Removal	0.0		09-Feb-24
A-PC-M-020-SR-G-RPS-A10	Completion of All Ash Pond A Closure Activities	0.0		20-Sep-24
Amos Plant		43.2	Aug-20 A	Sep-24
Engineering & Design		11.2	Aug-20 A	Aug-21
Common		8.2	Aug-20 A	May-21
Byproduct Handling		8.2	Aug-20 A	May-21
Mechanical BOP Systems		6.2	Oct-20 A	May-21
Electrical BOP Systems		1.6	Sep-20 A	Oct-20 A
BA Conversion		10.6	Aug-20 A	Aug-21
Civil / Site Infrastructure		4.0	Nov-20	Mar-21
Byproduct Handling		10.4	Aug-20 A	Aug-21
Mechanical BOP Systems		8.6	Nov-20	Aug-21
Electrical BOP Systems		1.2	Feb-21	Mar-21
Pond Closure		3.4	Nov-20	Feb-21
Civil / Site Infrastructure		3.4	Nov-20	Feb-21
Pond Repurpose		9.2	Aug-20 A	Jul-21
Civil / Site Infrastructure		8.0	Sep-20 A	Jul-21
Byproduct Handling		6.8	Oct-20 A	Jun-21
Mechanical BOP Systems		9.2	Aug-20 A	Jul-21
Electrical BOP Systems		1.2	Mar-21	Apr-21
Procurement		15.4	Aug-20 A	Jan-22
BA Conversion		15.4	Aug-20 A	Jan-22
OEM Ash Handling Equipment Engineering / Design / Fabrication / Delivery		15.4	Aug-20 A	Jan-22
Pond Repurpose		10.0	Nov-20	Nov-21
Mechanical BOP Systems		10.0	Nov-20	Nov-21
Permitting		10.6	Nov-20	Nov-21
Environmental Permits		10.6	Nov-20	Nov-21
A-00-L-915-SP-MP-PMT-A90	Air Permit (Amos)	10.6	Nov-20	Nov-21
A-00-L-915-SP-MP-PMT-A10	Tree Clearing (Amos)	3.5	Nov-20	Mar-21
A-00-L-915-SP-MP-PMT-A50	Local Land Development Approval (Floodplain) (Amos)	2.6	Dec-20	Mar-21
A-00-L-915-SP-MP-PMT-A100	Prepare / Submit CPCN Application & Obtain Regulatory Approval from Public Service Commission	7.0	Dec-20	Jul-21
A-00-L-915-SP-MP-PMT-A70	NPDES (Amos)	5.2	Dec-20	Jun-21
A-00-L-915-SP-MP-PMT-A80	Dam/Dike Modifications (Amos)	5.2	Mar-21	Sep-21
A-00-L-915-SP-MP-PMT-A40	SWPPP (Amos)	1.6	Mar-21	May-21
Labor Contracts		12.7	Apr-21	Jun-22
Bottom Ash Conversion Labor Contracts		11.6	May-21	Jun-22
Civil U3		3.8	May-21	Sep-21
Mechanical / Structural U3		4.0	Jun-21	Oct-21
Electrical / I&C U3		4.0	Jul-21	Dec-21
Civil U1/2		3.8	Oct-21	Feb-22
Mechanical / Structural U1/2		4.0	Nov-21	Apr-22
Electrical / I&C U1/2		4.0	Feb-22	Jun-22
Pond Repurpose & Closure Labor Contracts		6.9	Apr-21	Dec-21
Civil		3.1	Apr-21	Jul-21
Mechanical / Structural		4.0	Jun-21	Nov-21
Electrical / I&C		4.0	Jul-21	Dec-21
Construction		32.8	Aug-21	Sep-24
Ash Pond B Closure & Wastewater Pond Repurpose		11.9	Aug-21	Sep-22
Ash Pond B Pond Closure		2.8	Aug-21	Nov-21
A-PC-C-100-C-CON-S1-10	Install temporary pumps and piping to divert pond flows	0.4	Aug-21	Aug-21
A-PC-C-100-C-CON-S1-30	Dewater Pond	0.4	Aug-21	Aug-21
A-PC-C-100-C-CON-S1-40	CCR Material Removal	1.6	Aug-21	Oct-21
A-PC-C-100-C-CON-S1-50	QA/QC of CCR Removal	1.2	Sep-21	Nov-21
Wastewater Pond Repurpose		9.0	Nov-21	Sep-22



Current Bar Labels — Summary

◆ Milestone

Date: 19-Nov-20

Activity ID	Activity Name	Duration (Months)	Start	Finish
A-PR-C-100-C-CON-S1-05	Fill Ash Pond B to Achieve Subgrade Elevation	3.6	Nov-21	Mar-22
A-PR-C-100-C-CON-S1-10	Subgrade prep for pond enhancement equipment area	0.2	Mar-22	Mar-22
A-PR-C-100-C-CON-S1-20	Subgrade prep for liner	1.0	Mar-22	Apr-22
A-PR-C-100-C-CON-S1-30	Install new berms	1.0	Mar-22	Apr-22
A-PR-C-100-C-CON-S1-80	Tank Based Chemical Treatment System Installation	5.2	Mar-22	Sep-22
A-PR-C-100-C-CON-S1-50	Liner and protective cover installation (Drainage layer, Double liner, revetment)	1.6	Apr-22	Jun-22
Reclaim Pond Construction		6.4	Sep-22	Apr-23
Reclaim Pond Closure		1.6	Sep-22	Nov-22
A-PC-C-100-C-CON-S2-10	Install temporary pumps and piping to divert pond flows	0.4	Sep-22	Sep-22
A-PC-C-100-C-CON-S2-15	Install sheet piling or berms to establish isolation	0.4	Sep-22	Sep-22
A-PC-C-100-C-CON-S2-20	Dewater Pond	0.4	Sep-22	Sep-22
A-PC-C-100-C-CON-S2-25	CCR Material Removal	0.8	Sep-22	Oct-22
A-PC-C-100-C-CON-S2-30	QA/QC of CCR Removal	0.8	Oct-22	Nov-22
Reclaim Pond Repurpose		4.8	Nov-22	Apr-23
A-PR-C-100-C-CON-S2-05	Fill Reclaim Pond to Achieve Subgrade Elevation	2.8	Nov-22	Feb-23
A-PR-C-100-C-CON-S2-10	Subgrade prep for liner	0.8	Feb-23	Mar-23
A-PR-C-100-C-CON-S2-15	Install new berms	0.6	Feb-23	Mar-23
A-PR-C-100-C-CON-S2-20	Liner installation (Drainage layer, Double liner)	0.8	Mar-23	Apr-23
A-PR-C-100-C-CON-S2-25	QA/QC Consultant Prepare Reclaim Pond Certification for Operation	0.2	Apr-23	Apr-23
Clearwater Pond Construction		4.6	May-23	Oct-23
Clearwater Pond Closure		2.1	May-23	Jul-23
A-PC-C-100-C-CON-S2-40	Install temporary pumps and piping to divert pond flows	0.4	May-23	May-23
A-PC-C-100-C-CON-S2-45	Dewater Pond	0.4	May-23	May-23
A-PC-C-100-C-CON-S2-50	CCR Material Removal	1.3	May-23	Jul-23
A-PC-C-100-C-CON-S2-55	QA/QC of CCR Removal	0.8	Jun-23	Jul-23
Clearwater Pond Repurpose		2.5	Jul-23	Oct-23
A-PR-C-100-C-CON-S2-70	Fill Clearwater Pond to Achieve Subgrade Elevation	0.6	Jul-23	Aug-23
A-PR-C-100-C-CON-S2-40	Subgrade prep for liner	0.2	Aug-23	Aug-23
A-PR-C-100-C-CON-S2-45	Install new berms	0.6	Aug-23	Sep-23
A-PR-C-100-C-CON-S2-50	Liner installation (Drainage layer, Double liner)	0.8	Sep-23	Oct-23
A-PR-C-100-C-CON-S2-55	QA/QC Consultant Prepare Clearwater Pond Certification for Operation	0.2	Oct-23	Oct-23
Ash Pond A Closure		9.8	Oct-23	Sep-24
Ash Pond A Closure/Backfill		9.8	Oct-23	Sep-24
A-PC-C-100-C-CON-AP-10	Install temporary pumps and piping to divert pond flows	0.4	Oct-23	Oct-23
A-PC-C-100-C-CON-AP-15	Dewater Pond	0.4	Oct-23	Nov-23
A-PC-C-100-C-CON-AP-20	CCR Material Removal	2.4	Nov-23	Feb-24
A-PC-C-100-C-CON-AP-25	QA/QC of CCR Removal	0.2	Feb-24	Feb-24
A-PC-C-100-C-CON-AP-35	Backfil Ash Pond A	2.0	Mar-24	May-24
A-PC-C-100-C-CON-AP-40	Grading and Drainage	2.0	May-24	Jul-24
A-PC-C-100-C-CON-AP-45	Final Stabilization (establish full stand of grass)	1.8	Jul-24	Sep-24
Bottom Ash Conversion Construction		12.5	Oct-21	Dec-22
Construction U3		6.5	Oct-21	May-22
A-BA-C-492-C-CON-72	Civil (UG Piping Relocations and Installation / Foundations / Ash Bunker)	2.2	Oct-21	Dec-21
A-BA-C-492-C-CON-82	Str / Mech (AG Utility Relos / Conv Steel / Eqpmnt Install / BoP Piping)	5.7	Oct-21	May-22
A-BA-C-492-C-CON-132	Elec / I&C (Conduit & Cable Tray Install / DCS Eqpmnt Install / Pull Power and Control Cabling and Terminate)	4.4	Dec-21	May-22
Construction U2		7.9	Feb-22	Nov-22
A-BA-C-492-C-CON-142	Civil (UG Piping Relocations and Installation / Foundations / Ash Bunker)	2.8	Feb-22	Jun-22
A-BA-C-492-C-CON-152	Str / Mech (AG Utility Relos / Conv Steel / Eqpmnt Install / BoP Piping)	6.7	Apr-22	Nov-22
A-BA-C-492-E-CON-162	Elec / I&C (Conduit & Cable Tray Install / DCS Eqpmnt Install / Pull Power and Control Cabling and Terminate)	3.9	Jul-22	Nov-22
Construction U1		8.3	Feb-22	Dec-22
A-BA-C-492-C-CON-172	Civil (UG Piping Relocations and Installation / Foundations / Ash Bunker)	2.8	Feb-22	Jun-22
A-BA-C-492-M-CON-182	Str / Mech (AG Utility Relos / Conv Steel / Eqpmnt Install / BoP Piping)	7.1	Apr-22	Dec-22
A-BA-C-492-E-CON-192	Elec / I&C (Conduit & Cable Tray Install / DCS Eqpmnt Install / Pull Power and Control Cabling and Terminate)	3.7	Aug-22	Dec-22
Tank Based Chemical Treatment & Bottom Ash Conversion Startup & Commissioning		7.1	Apr-22	Dec-22

Current Bar Labels
Summary
Milestone

Appendix D

Groundwater Monitoring Well Network Evaluation (GWMN) Report

ASH POND-CCR GROUNDWATER MONITORING WELL NETWORK EVALUATION - REVISION 1

Amos Plant
Winfield Road
Putnam County
Winfield, West Virginia

October 22, 2020

ASH POND-CCR GROUNDWATER MONITORING WELL NETWORK EVALUATION - REVISION 1

Amos Plant
Winfield Road
Putnam County
Winfield, West Virginia

Everett Fortner III, PG
Senior Geologist

Matthew J. Lamb
Project Manager

Todd Minehardt, PE
Principal Engineer

Prepared for:

American Electric Power Service Corporation

Prepared by:

Arcadis U.S., Inc.

100 E Campus View Boulevard

Suite 230

Columbus

Ohio 43235-1447

Tel 614 985 9100

Fax 614 985 9170

Our Ref.:

30060036

Date:

October 22, 2020

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
bgs	below ground surface
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
EPRI	Electric Power Research Institute
FGD	flue gas desulfurization
ft	feet
GA	Geo/Environmental Associates, Inc.

1 OBJECTIVE

This report was prepared by Arcadis U.S., Inc. (Arcadis) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the ash pond system (CCR Unit) at the AEP Amos Generating Plant (Plant) located on Winfield Road in Winfield, West Virginia (**Figure 1**). This report has been revised to modify the ash pond system boundary from the original report dated October 18, 2016. The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit in the uppermost aquifer and an evaluation of whether the CCR unit meets up to 5 location restrictions. The objective of this report is to present an evaluation of the adequacy of the groundwater monitoring well network in the uppermost aquifer at the onsite ash pond system (Site).

Three regulated CCR units associated with the Plant were identified for review, which include the onsite ash pond system, the offsite flue gas desulfurization (FGD) landfill, and the offsite fly ash pond (FAP) (**Figure 2**). The evaluation of the FGD landfill and FAP are not included in this report and were completed under separate cover.

Initial evaluation of the monitoring well network was completed in November 2015 and included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the ash pond system, as well as publicly-available geologic and hydrogeologic data. Gaps in the monitoring well network, as well as in the characterization of subsurface geology, were identified during this initial evaluation. An electrical resistivity geophysical survey was conducted in December 2015, and additional monitoring wells were installed from April through May 2016 to address these data gaps. Drilling activities were performed by AEP personnel with Arcadis personnel completing borehole logging and well installation oversight. The following report presents the current Conceptual Site Model (CSM), combining the historical Site information with collected geologic and hydrogeologic data. This report also includes a description of the uppermost aquifer and the current monitoring well network. The monitoring well network was determined to adequately cover the up and down gradient areas of the ash pond system in the uppermost aquifer; therefore, the report objective has been met.

2 BACKGROUND INFORMATION

The following section provides background information for the AEP Amos Generating Plant ash pond system.

2.1 Facility Location Description

The AEP Amos Generating Plant is located in Putnam County, bounded by U.S. Route 35 to the west and the Kanawha River to the east. The Plant is approximately 5 miles southeast of Winfield, West Virginia. The ash pond system CCR unit is immediately northwest of the Plant. The ash pond system is located south and adjacent to Bill's Creek and less than one quarter mile southwest of the Kanawha River (**Figures 1** and **2**).

2.2 Description of Ash Pond System CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the ash pond system.

2.2.1 Embankment Configuration

The ash pond system main dike extends 800 feet (ft) along the northwest side of the ash pond system. The maximum height of the dike is approximately 28 ft above ground surface with a minimum crest elevation of approximately 588 ft. Prior to 2010, the minimum crest elevation was 584 ft, however it was heightened to accommodate raising the operating pool level of the ash pond system. The main dike is approximately 10 to 26 ft wide and is primarily constructed of clay/shale fill above native clayey gravel and clay (GA, 2005).

Secondary splitter dikes were constructed that separate the ash pond system into individual ponds including: Bottom Ash Pond (BAP) 1A, BAP 1B, Reclaim Pond, and Clearwater Pond. The splitter dike separating BAP 1A and BAP 1B has a minimum elevation of 585 ft, but is typically greater than 587 ft. The splitter dike separating BAP 1A and the Reclaim Pond has a minimum elevation of approximately 584 ft while the splitter dike separating the Reclaim Pond and the Clearwater Pond has a minimum elevation of approximately 583.5 ft (GA, 2005).

2.2.2 Area/Volume

The ash pond system, consisting of BAP 1A, BAP 1B, Reclaim Pond, and Clearwater Pond occupies a total surface area of approximately 38.5 acres (**Figure 3**). The combined normal reservoir volume of BAP 1A and BAP 1B is 297 acre ft; the combined maximum reservoir volume of BAP 1A and BAP 1B is 312 acre ft (GA, 2008).

2.2.3 Construction and Operational History

The AEP Amos Generating Plant began operations in 1971 with Unit 1. Units 2 and 3 were brought online in 1972 and 1973, respectively. The first available design drawings of the ash pond system are dated June 28, 1970. Fly ash and wastewater generated from Units 1, 2 and 3 were assumed to be transferred to the ash pond system as early as 1971 when Unit 1 became active. The ash pond system was constructed by excavation below natural ground surface. From 1970 to 1976 the ash pond system configuration changes included construction of a road embankment on the northwest corner of BAP 1B and removal of an emergency spillway from the northwest corner of BAP 1B. While some modifications to the ash pond system have been made since 1977, the present-day configuration of the ash pond system with respect to splitter dikes and individual pond units has remained the same since 1976 (GA, 2005; **Figure 3**). All ash ponds are unlined (EPRI, 1999). In 2010, the main dike (northwest dike) was raised 5 ft using concrete block filled with compacted soil.

Currently, bottom ash and coal mill rejects from all three generating units are sluiced to the BAP 1A and BAP 1B for settling. The BAPs are filled in an alternating fashion, with one BAP generally receiving bottom ash while the other BAP is being cleaned out. Additionally, wastewaters from the generation building sumps are pumped to BAP 1A and BAP 1B. Finally, Unit 3 coal pulverizer wastewater is pumped to the Pyrites Pond (EPRI, 1999).

2.2.4 Surface Water Control

The perimeter of the ash pond system is graded such that surface runoff is directed away from the ponds. This grading is accomplished by either natural topographic relief or constructed embankments, for example the main dike along the northwest side of ash pond system (GA, 2008). Surface runoff is directed towards storm water ponds, which are unlined and were constructed by excavating into clayey silt soil (EPRI, 1999). The nearest storm water ponds to the ash pond system are located to the southwest and northeast of the system (**Figure 3**).

Surface water flow within the ash pond system is controlled by a series of embankments and splitter dikes. Pond elevations are maintained so that surface water flows via gravity through underground pipes to ponds in the following order: BAP 1A and BAP 1B, Reclaim Pond, and Clearwater Pond (EPRI, 1999). A majority of water in the Reclaim Pond is pumped to the Plant for re-use. Water that is not recycled into the Plant continues to the Clearwater Pond (GA, 2005). From the Clearwater Pond, water flows to the Kanawha River through a National Pollutant Discharge Elimination System permitted outfall via underground piping.

Two spillway pipes are present in the ash pond system (**Figure 3**). These spillway pipes are intended to discharge excess storm flow into Bill's Creek in the event of a large storm event. One spillway pipe is located at BAP 1B, and the other is located at the Reclaim Pond. Both pipes cross the main dike and discharge in the watershed of Bill's Creek.

2.3 Previous Investigations

From 1995 through 1998, AEP worked in coordination with Ish, Inc., META Environmental, Inc., HIS GeoTrans, Inc., and Electric Power Research Institute (EPRI) to evaluate groundwater quality associated with a number of AEP power generating facilities, including the Amos Plant. The primary objectives of these site investigations were to characterize hydrogeology and identify potential contaminant source areas, establish existing groundwater quality, and identify constituents that exceeded West Virginia Groundwater Standards (WVGS). These studies are described in detail in the report *Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia* (EPRI, 1999). Field work for these investigations included 41 direct push technology (DPT) groundwater sampling points, installation of 10 permanent monitoring wells (MW-1 through MW-10), surface water sampling from onsite ponds and Bill's Creek, and geotechnical soil characterization.

In 2005, Geo/Environmental Associates, Inc. (GA) performed site investigations at the direction of AEP associated with planned modifications to the main dike. Field methods involved drilling and logging 8 soil borings through the main dike (B-1 through B-8). Split-spoon samples were collected during installation of the borings for the purpose of slope stability analysis, and 3 of the borings were converted to standpipe piezometers (P1, P3, P6). Additionally, boring B-7 was converted to a 2-inch monitoring well, P7 (GA, 2005). This site investigation included numerical hydraulic and slope stability analysis.

The findings of the above-mentioned GA site investigation were submitted to West Virginia Department of Environmental Protection (WVDEP) and were subsequently returned to AEP with comments. This prompted a revision of the hydraulic analyses and construction design specification associated with the plans to raise the elevation of the main dike. No additional field work was performed as part of this scope (GA, 2008).

2.4 Hydrogeologic Setting

The Site is immediately underlain by Quaternary-aged alluvial deposits consisting of clay, silt, sand, and gravel. While there is a general coarsening downward pattern, the shallower clay matrix is interbedded with silty or sandy layers and the deeper sand matrix is interbedded with silty or clayey layers. The uppermost groundwater zone occurs in the confined to semi-confined deeper sand zones that exhibit a potential head. Maximum alluvium thickness is approximately 50 ft and thins towards the edges of the valley. Groundwater flow direction within the alluvium is towards the Kanawha River or Bill's Creek.

In the upland areas surrounding the Site, bedrock primarily consists of the Pennsylvanian age sandstones, shales, limestones, and coal of the Monongahela and Conemaugh Groups. At higher elevations, the hilltops are capped by the Permian age Dunkard Formation. The Conemaugh Group immediately underlies alluvial sediments at the Site, and gently dips to the north. Groundwater occurrence in the bedrock generally coincides with the stress relief fracture system and is not necessarily related to lithology. Bedrock groundwater flow generally mimics surface topography, flowing from ridges towards valleys.

These features are further illustrated on three lines of cross section that were prepared through the ash pond system. The cross section location map is included as **Figure 4** and the lines of cross section are included as **Figure 5A** (A to A'), **Figure 5B** (B to B'), and **Figure 5C** (C to C'). Boring logs and well construction diagrams are included in **Appendix A**.

2.4.1 Climate and Water Budget

The climate of Winfield, West Virginia is characterized as humid continental with an average rainfall of approximately 40 inches annually. The average maximum temperature is 66 ºF and the average minimum temperature is 44 ºF based on information from Southeast Regional Climate Center (SERCC, 2015).

2.4.2 Regional and Local Geologic Setting

The Site is located in the Appalachian Plateau physiographic province and is also situated in the Kanawha River valley along the southern bank of the Kanawha River. Alluvial sediments consist of clay, silt, sand and gravel deposits that generally coarsen downward. Unconsolidated alluvial sediments are present in thicknesses to approximately 50 ft with thinning towards the valley walls.

Bedrock is present underlying the alluvial deposits, as well as in ridges located to the west of the Site. The primary bedrock units encountered are sedimentary rocks of the Permian age Dunkard Formation and the Pennsylvanian age Monongahela and Conemaugh Formations. The depositional environment for these formations is characterized by a gradually subsiding shallow sea with alternating marine and freshwater strata; the sedimentary units associated with the Monongahela and Conemaugh Formations consists of alternating shale and sandstone units, with occasional thin limestone beds. Several coal horizons are present in the region and often serve as marker beds for unit identification (EPRI, 1999).

Unconsolidated sediments in the upland areas are generally limited to nominal thicknesses of residuum overlying the bedrock. In incised valleys, there is generally a layer of colluvium or alluvium derived from eroded up-valley bedrock on top of the colluvium.

2.4.3 Surface Water and Surface Water/Groundwater Interactions

The Site is adjacent to the Kanawha River, and the ash pond system is located approximately 1,000 ft southwest of the Kanawha River. Bill's Creek, a tributary of the Kanawha River, is immediately adjacent and north of the Reclaim Pond. Groundwater flow direction is generally to the north, northeast, and east towards the Kanawha River and Bill's Creek. The Kanawha River stage level is dam controlled and is a gaining surface water feature. Groundwater elevations on site are higher than the normal stage elevation of the Kanawha River of 566 ft.

The stage levels of the ash pond system are generally maintained no greater than the normal operating levels ranging from 583 to 583.5 ft above mean sea level (amsl) (GA, 2008). Groundwater is generally present at lower elevations at around 570 ft amsl based on 2016 data. The ponds are unlined and likely providing recharge to the uppermost aquifer resulting in groundwater mounding in the vicinity of the ash pond system.

2.4.4 Water Users

The Amos Plant uses Putnam County Public Service Department water supply. There are no active groundwater production wells at the Site. During the development of a water well inventory for the Site by Arcadis in 2014, no information was available regarding the location of nearby public or private water supply wells.

3 GROUNDWATER MONITORING WELL NETWORK EVALUATION

An initial evaluation of the monitoring well network present at the Site was performed in November 2015 to determine if any of the wells were viable for continued use as part of the groundwater monitoring well network or also be retained as part of a larger groundwater hydraulic monitoring well network. As part of this review, hydrogeologic conditions were evaluated to determine if the uppermost aquifer unit had an adequate monitoring well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer up gradient and down gradient of the Site. As a result of this evaluation, a geophysical investigation was completed in December 2015 along with installation of additional borings and monitoring wells in April through May 2016. Monitoring wells included in the monitoring network are designated as up or down gradient. Up gradient wells represent background groundwater quality and the down gradient monitoring wells monitor water quality groundwater down gradient of the CCR unit.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

The uppermost unconsolidated aquifer consists of the saturated alluvial sediments beneath and surrounding the Site. The upper limit of the uppermost aquifer is defined by the elevation of the top of the saturated sand zone, which is variable across the Site. The uppermost aquifer is generally confined to semi-confined by clay and sandy clay deposits. However, alluvial sands may be semi-confined to unconfined in some areas of the Site (e.g. SB-1604, MW-1602A). The base elevation of the ash pond system varies, but ranges from approximately 559 ft amsl (SB-1604) to 584 ft amsl (SB-1603). Soil borings installed in 2016 indicate that the base of the ash pond system is in contact with the underlying uppermost aquifer. This is illustrated in cross sections A-A’, B-B’, and C-C’ (**Figures 5A, 5B,** and **5C**).

The vertical extent of the aquifer extends to the base of the unconsolidated deposits in the valley at the bedrock interface. The uppermost unconsolidated aquifer is approximately 50 feet thick and appears laterally extensive to the north, south and east around the ash pond system. The uppermost aquifer pinches out towards the bedrock valley wall to the west.

3.1.2 Overall Flow Conditions

Groundwater recharge occurs from regional precipitation infiltration and from ash pond use. Bedrock, to a lesser extent, contributes recharge to the uppermost unconsolidated aquifer from the west of the Site were the alluvial valley is in contact with the valley wall.

Available groundwater elevations for 1995 through 1996, as well as groundwater elevations collected in July 2016 from installed wells, are summarized on **Table 1**. The average vertical hydraulic gradient from 1995 to 1996 between wells MW-2 and MW-3 was 0.008 in an upward direction from MW-2, which is screened in the shallow sandy clay, to MW-3, which is screened deeper in the basal gravel zone. In July 2016, a similar upward vertical hydraulic gradient of 0.009 was observed. Near the ash pond system, the average vertical gradient between wells MW-4 and MW-5 from 1995 to 1996 was -0.036 in a downward direction. In July 2016, a similar downward vertical gradient of -0.046 was observed. Both of these wells are screened in the uppermost aquifer (i.e. alluvial sands), indicating likely localized recharge from the ash pond system.

The most recent groundwater data set, collected on July 25, 2016, is depicted with potentiometric surface contours on **Figure 6**. Groundwater flow is generally to the north and east towards the Kanawha River. There is also a northern component of groundwater flow towards Bill's Creek. As presented in **Table 2**, wells included in the monitoring network have been designated as up or down gradient.

3.1.3 Soil Property Testing

During unconsolidated monitoring well installation, selected split-spoon soil samples were retained for particle-size analysis by sieving and hydrometer in accordance with American Society for Testing and Materials (ASTM) D421, D422, and D4718 and moisture content in accordance with ASTM D2216. Split spoon samples selected for particle-size analysis corresponded to the final well screen interval at each boring. For each installed monitoring well location, one composite soil sample was compiled from the selected split spoon samples, which was then transported to the AEP Dolan Civil Engineering Laboratory in Groveport, Ohio for particle-size analysis. The particle-size analysis indicates silty sands and poorly graded sands that make up the alluvial deposits within the screened intervals of the installed monitoring wells in 2016. Note that MW-1603A is installed in a weathered bedrock sequence adjacent to Bill's Creek. The results of this analysis are summarized in **Table 3**, and complete laboratory reports are provided in **Appendix B**.

3.1.4 Hydraulic Conductivity

Pneumatic and bail down slug tests were performed on a total of 2 up gradient wells (MW-1602A, MW-1603A) and 3 down gradient wells (MW-1604, MW-1605, MW-1606) on June 16 and 17, 2016 to provide a broader understanding of the hydraulic conductivity distribution within the alluvial sands (i.e. uppermost aquifer). Well construction details for these wells, as well as all other wells in the monitoring well network, are presented in **Table 2**. Data-logging pressure transducers were used during these tests to monitor and record water level displacement.

Three pneumatic slug tests were performed at each well except MW-1604. Two tests were performed using an identical initial pressure and one test was performed using approximately double the pressure applied in the other two tests. This protocol was implemented to verify the initial head displacement and to evaluate the reproducibility of the results. Equilibration was achieved prior to and after each pneumatic slug test in order to minimize any potential interference between tests. Equilibration was achieved when water level readings stabilized. The pressure applied to each monitor well induced head displacements ranging from approximately 0.5 to 1.5 feet.

At MW-1604, three bail-down slug tests were completed. The pneumatic tests could not be completed due to insufficient initial displacement upon pressurization. Two tests were performed by submerging and removing half the bailer (24-inches) and one test was performed by submerging and removing the entire bailer (48-inches). This protocol was implemented to verify the initial head displacement and to evaluate the reproducibility of the results. The bailer removal induced head displacements ranging from approximately 1.1 to 2.1 feet.

For each well, one representative test was selected for analysis and analyzed using AQTESOLV® for Windows® Version 4.50 (Duffield, 2007). The hydraulic conductivity values were determined using applicable analytical solutions for a single (partially-penetrating) well under confined or unconfined conditions, as appropriate. Analytical solutions were selected based on the observed response. Results of the slug test analyses are summarized in **Table 4** and solution reports with individual curve matches are provided in **Appendix C.**

The hydraulic conductivity estimates from the five monitoring wells tested ranged from 0.7 ft per day (MW-1605) to 12.5 ft per day (MW-1602A). The overall mean hydraulic conductivity estimate was 6.8 ft per day, while the overall geometric mean was 4.6 ft per day. Estimated hydraulic conductivity values at MW-1602A, MW-1603A, and MW-1606 were consistent with silty sand. The estimated hydraulic conductivity values at MW-1604 and MW-1605 were lower, which is likely due to increased fines associated within the alluvial sand zone.

3.1.5 Geophysical Survey

In order to provide an initial characterization of the ash pond system and the hydrostratigraphic units at the Site, Arcadis completed an electrical resistivity survey from December 8 through December 11, 2015. This geophysical investigation aided in boring/monitoring well placement and provided insight on subsurface conditions between borings. Five total electrical resistivity transects (Line ER-1 through Line ER-5) were performed. Lengths of the resistivity transects ranged from 291 meters (approximately 950 ft.) to 333 meters (1,100 feet). For each survey line, up to 112 non-corrosive stainless-steel electrode stakes were used, which were separated by a distance of 3 meters (approximately 6.6 feet) and inserted into surface soils with an approximate constant spacing along a relatively straight transect. Once the electrical resistivity data set was collected, the data was downloaded for processing. Additional detail of the procedures and results of the electrical resistivity surveys are included in **Appendix D**. The locations of the transect lines are illustrated on **Figure D-1**.

There are three distinct zones of contrasting electrical resistivity apparent on all four resistivity cross-sections. As shown in **Figures D-2** through **D-5**, the uppermost resistivity zone is characterized by lower resistivity values (generally 10 to 100 Ohm-meters, shown in blue to green colors) and is interpreted as finer-grained unconsolidated native clay soils, clay fill materials, or fine-grained ash fill deposits. The second resistivity layer is characterized by higher resistivity values (generally 100 to 800 Ohm-meters, shown in green to red colors) and are interpreted as unconsolidated coarser-grained native sand or sand/gravel soils, or sandy fill materials. This coarser-grain layer is consistent with the sand saturated zone and is delineated by black dashed lines in **Figures D-2** through **D-5**. The third resistivity zone is characterized by significantly low resistivity values of less than 10 Ohm-meters (shown as dark blue to white colors). These zones of anomalous low resistivity are not likely due to naturally occurring soils/geologic conditions but are rather interpreted to indicate saturated soils impacted by high concentrations of total dissolved solids in groundwater.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

Per 40 CFR 257.60(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (5 ft) above the upper limit of the uppermost aquifer, or must demonstrate there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high conditions).

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified Site hydrostratigraphic unit is the unconsolidated alluvial aquifer consisting of confined sands. This aquifer is not known to be used locally for groundwater supply or industrial water use.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

Arcadis and AEP personnel visited the Site on August 11, 2015 to review existing well network conditions and locations. The well network that existed at the time of that site visit was deficient, lacking the distribution to accurately represent background water quality and the quality of groundwater passing the waste boundary of the CCR Unit, per 40 CFR 257.91. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 2**. The wells that were not located or abandoned are gray shaded on **Tables 1** and **2** and **Figure 3**.

The groundwater quality monitoring well network monitors the alluvial aquifer consisting of confined to semi-confined sands. It includes 4 wells installed between 1995 and 2005 and 6 wells installed from April to May 2016. An additional 3 wells, which were pre-existing, are utilized only for the purpose of hydraulic monitoring (**Table 2**). Two well pairs, MW-2/MW-3 and MW-4/MW-5 measure vertical flow.

Spatially, the groundwater quality monitoring well network extends as far up gradient to the south as MW-1602A and up gradient along Bill's Creek to the west (MW-1603A). Down gradient, the network extends from immediately down gradient of the ash pond system (MW-4, MW-1604) to the Kanawha River (MW-1605). The current monitoring well network distribution is presented on **Figure 7**.

3.3.2 Gaps in Monitoring Network

As discussed in Section 3.3.1 of this report, gaps in the monitoring network were identified upon initial Arcadis review in 2015. Following a geophysical survey and boring/monitoring well installation described in **Appendix D** of this report, there are no gaps in the monitoring network. The recommended monitoring well network is further described in Section 4.

4 RECOMMENDED MONITORING WELL NETWORK

The groundwater monitoring well network is intended to meet specifications stated in 40 CFR 257.91. The network is discussed with respect to location to the ash pond system (up gradient or down gradient), well depth, and well construction. The recommended existing monitor well network described below will provide an adequate understanding of seasonal and temporal fluctuations in groundwater quality, hydraulics, and groundwater flow in the uppermost aquifer.

4.1 Monitoring Well Network Distribution

A total of 6 monitoring wells were installed to augment the existing network. Specifics on field methodology and other documentation on installation of the additional wells in 2015 and 2016 is provided in **Appendix D**. Monitoring well construction was targeted to monitor the saturated alluvial sands down gradient, which is identified as the uppermost aquifer. Up gradient wells were installed in the upper most alluvial aquifer and weathered bedrock (MW-1603A). The total groundwater quality monitoring network includes 4 up gradient wells and 6 down gradient wells (**Table 2** and **Figure 7**). The monitoring well distribution adequately covers down gradient and up gradient areas as detailed in the following sections. In addition to the 10 groundwater quality wells, 3 wells are used to refine the understanding of groundwater flow and hydraulic gradients in the vicinity of the ash pond system and down gradient at the Plant (**Table 2** and **Figure 7**).

4.1.1 Down Gradient Locations

Down gradient monitoring wells are located to the north and east of the ash pond system. These wells include existing wells MW-1, MW-4, and MW-5, as well as 2016 installed wells MW-1604, MW-1605, and MW-1606 (**Table 2**). These wells monitor groundwater as it flows north and east past the CCR unit boundary.

4.1.2 Up Gradient Locations

Up gradient monitoring wells are located south and west of the ash pond system. These wells include existing well MW-6, as well as 2016 installed wells MW-1601, MW-1602A, and MW-1603A (**Table 2**). These wells establish background groundwater quality up gradient of the CCR unit boundary.

4.2 Well Construction

Monitoring wells in the network are constructed of 2-inch Schedule 40 PVC risers with 5 to 10 ft of 0.01 inch slotted PVC screens, with the exception of MW-1606 which has 15 ft of screen. Installation details and field methods are provided in **Appendix D**. Well construction data for the monitoring well network is summarized on **Table 2**. Boring logs and the monitoring well completion diagrams are provided in **Appendix A**.

5 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Todd A. Minehardt, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91.

Todd A. Minehardt

Printed Name of Registered Professional Engineer

Signature

023518	West Virginia	10/22/2020
Registration No.	Registration State	Date

TODD A. MINEHARDT REGISTERED 23518 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

10-22-2020

6 REFERENCES

Duffield, G.M. 2007. AQTESOLV® for Windows® 95/98/Mw/NT/2000/XP/Vista, Version 4.50 – Professional. HydroSOLVE, Inc.

Electric Power Research Institute (EPRI). 1999. Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia, Prepared for American Electric Power Service Corp.

Fetter, Charles Willard, and C. W. Fetter. 2001. Applied Hydrogeology. Vol. 3. No. 3. Upper Saddle River: Prentice Hall.

Geo/Environmental Associates, Inc. (GA) 2005. Responses to February 15, 2005 DEP Review Letter, John Amos Plant – Bottom Ash Complex, Putnam County, West Virginia, Prepared for AEP Service Corporation.

Geo/Environmental Associates, Inc. (GA) 2008. Responses to May 12, 2008 DEP Review Letter, John Amos Plant – Bottom Ash Complex, Putnam County, West Virginia, Prepared for AEP Service Corporation.

Southeast Regional Climate Center. 2015. Historical Climate Summaries, Winfield Locks, West Virginia, http://www.sercc.com, Query conducted by Mr. Josh Roberts of Arcadis on October 6, 2015.

United States Geological Survey (USGS), Aquifers and Groundwater. 2015. Available online at www.usgs.gov.

Wilmoth, B.M. 1966. Ground Water in Mason and Putnam Counties, West Virginia, West Virginia Geological and Economic Survey Bulletin 32.

TABLES

Table 1
Water Level Data
AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Well ID	Sep-95	Mar-96	Jul-96	Jul-16
	GW Elev [a] ft amsl	GW Elev [a] ft amsl	GW Elev [a] ft amsl	GW Elev ft amsl
Sandy Clay Zone Wells				
MW-2	572.27	572.97	572.90	574.80
MW-6	571.21	572.71	572.47	571.55
MW-8	575.24	576.23	576.05	577.13
MW-9	572.26	572.77	572.58	--
Sand Zone Wells				
MW-1	565.86	566.28	565.95	567.04
MW-4	569.84	570.35	570.31	570.99
MW-5	569.10	569.62	569.60	570.08
MW-7	573.84	574.84	574.88	--
MW-1601	--	--	--	574.87
MW-1602A	--	--	--	576.11
MW-1603A	--	--	--	579.14
MW-1604	--	--	--	568.10
MW-1605	--	--	--	568.79
MW-1606	--	--	--	572.73
Basal Gravel Zone Wells				
MW-3	572.45	573.28	573.21	575.10
MW-10	572.21	572.76	572.51	--

Notes:
Shaded - well abandoned or not verified
a. Source: EPRI. April 1999. Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia, Table 2-5.
-- - not measured
amsl - above mean sea level
Elev - elevation
ft - feet
GW - groundwater

Table 2
Well Construction Details
AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Well ID	Hydraulic Monitoring Only	Location Description to CCR Unit	Northing [a]	Easting [a]	Ground Surface Elevation [a]	Top of Casing Elevation [a]	Borehole Depth ft bls	Date Installed	Screen Material	Well Diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
											Depth ft bls	Elevation ft amsl	Depth ft bls	Elevation ft amsl	Depth ft bls	Elevation ft amsl	Depth ft bls	Elevation ft amsl
Sandy Clay Zone Wells																		
Upgradient																		
MW-6 [b]		West	539170.0	1729695.5	586.5	589.42	43.0	8/30/1995	Slotted PVC	2	27.0	559.54	42.7	543.84	31.0	555.54	41.0	545.54
MW-8 [b]	x	South	536151.9	1732199.2	584.8	587.57	24.0	9/13/1995	Slotted PVC	2	6.0	578.82	21.9	562.92	10.0	574.82	20.0	564.82
MW-9 [b]		Southeast	536983.3	1734099.7	586.8	588.54	32.0	8/29/1995	Slotted PVC	2	17.0	569.80	32.0	554.80	21.0	565.80	31.0	555.80
Downgradient																		
MW-2 [b]	x	East	539188.3	1732745.0	586.3	589.10	57.9	8/24/1995	Slotted PVC	2	9.0	577.34	24.7	561.64	13.0	573.34	23.0	563.34
Sand Zone Wells																		
Upgradient																		
MW-7 [b]		Southeast	537838.4	1731735.7	587.1	588.72	39.0	8/31/1995	Slotted PVC	2	24.0	563.10	39.0	548.10	28.0	559.10	38.0	549.10
MW-1601		Southeast	538186.6	1731490.3	586.5	589.48	42.0	5/10/2016	Slotted PVC	2	24.0	562.49	42.0	544.49	28.4	588.09	38.0	548.49
MW-1602A		South	537031.1	1730894.1	598.0	600.66	59.5	5/25/2016	Slotted PVC	2	43.4	554.56	59.5	538.46	47.9	550.06	58.0	539.96
MW-1603A		West	538963.7	1729314.5	584.1	586.81	45.0	5/24/2016	Slotted PVC	2	34.0	550.06	45.0	539.06	38.0	546.06	43.0	541.06
Downgradient																		
MW-1 [b]		Northeast	540566.9	1731165.6	582.1	584.33	56.0	9/6/1995	Slotted PVC	2	19.9	562.21	35.0	547.11	24.0	558.11	34.0	548.11
MW-4 [b]		Northeast	539605.5	1731129.0	585.7	587.96	35.0	9/8/1995	Slotted PVC	2	19.9	565.80	35.0	550.70	24.0	561.70	34.0	551.70
MW-5 [b]		Northeast	539614.2	1731120.8	585.0	587.10	55.0	9/7/1995	Slotted PVC	2	39.3	545.73	55.0	530.03	44.0	541.03	54.0	531.03
MW-1604		Northwest	539459.6	1729931.7	586.0	589.05	45.0	5/6/2016	Slotted PVC	2	29.0	557.01	45.0	541.01	33.9	552.11	44.0	542.01
MW-1605		Northeast	540038.8	1731401.7	583.4	586.40	42.5	5/4/2016	Slotted PVC	2	22.6	560.75	42.5	540.85	26.3	557.05	41.5	541.85
MW-1606		East	539197.0	1731559.3	580.8	583.88	40.5	5/3/2016	Slotted PVC	2	21.2	559.59	40.5	540.29	24.3	556.47	39.0	541.79
Basal Gravel Zone Wells																		
Upgradient																		
MW-10 [b]		Southeast	536989.9	1734094.7	586.4	588.47	59.0	8/28/1995	Slotted PVC	2	43.0	543.40	58.9	527.50	47.5	538.90	57.5	528.90
Downgradient																		
MW-3 [b]	x	East	539200.1	1732739.6	586.3	588.97	58.0	8/23/1995	Slotted PVC	2	42.7	543.64	57.9	528.44	46.9	539.44	56.9	529.44

Notes:
Shaded - well abandoned or not verified
Elevation in feet above mean sea level
a. Monitoring well coordinates and elevations were surveyed by AEP in June 2016 (1983 West Virginia State Planar Coordinates, NAVD 88).
b. Well Construction Source: EPRI. April 1999. Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia, Appendix B.
amsl - above mean sea level
bls - below land surface
ft - feet

Table 3
Grain Size Analysis Summary
AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

ARCADIS Design & Consultancy for natural and built assets

		Grain Size Analysis					
Sample ID	**Depth feet**	**% Gravel**	**% Sand**	**% Silt**	**% Clay**	**USCS Classification**	**Moisture Content %**
MW-1601	27-39	0.6	87.8	5.3	6.3	(SP-SM) POORLY-GRADED SAND with SILT	23.0
MW-1602A	48-58	2.6	80.8	5.5	11.1	(SM) SILTY SAND	21.9
MW-1603A	38-43	10.0	60.3	16.7	13.0	(SM) SILTY SAND	20.3
MW-1604	33-43.5	0.8	80.0	7.9	11.4	(SM) SILTY SAND	23.8
MW-1605	25.5-42	0.2	83.6	4.7	11.4	(SM) SILTY SAND	25.5
MW-1606	29-39	0.4	90.4	4.3	4.8	(SP-SM) POORLY-GRADED SAND with SILT	23.4

Note:
USCS - Unified Soil Classification System

Table 4
Hydraulic Testing Results Summary
AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Well ID	Screen Interval ft bgs	Aquifer Thickness [a] ft	Screened Interval USCS Classification	Slug Test Type	Hydraulic Conductivity ft/day	Hydraulic Conductivity cm/sec	Slug Test Solution
MW-1602A	47.9-58.0	19	(SM) SILTY SAND	Pneumatic - Rising head	12.5	4.4E-03	Hyder et al., 1994
MW-1603A	38.0-43.0	5	(SM) SILTY SAND	Pneumatic - Rising head	8.8	3.1E-03	Hyder et al., 1994
MW-1604	33.9-44.0	27	(SM) SILTY SAND	Bail Down - Rising head	2.7	9.6E-04	Hyder et al., 1994
MW-1605	26.3-41.5	31	(SM) SILTY SAND	Pneumatic - Rising head	0.7	2.6E-04	Hyder et al., 1994
MW-1606	24.3-39.0	40	(SP-SM) POORLY-GRADED SAND with SILT	Pneumatic - Rising head	9.4	3.3E-03	Hyder et al., 1994
				Slug Test Overall Mean	**6.8**	**2.4E-03**	
				Slug Test Overall Geometric Mean	**4.6**	**1.6E-03**	
				Slug Test Minimum	**0.7**	**2.6E-04**	
				Slug Test Maximum	**12.5**	**4.4E-03**	

Notes:

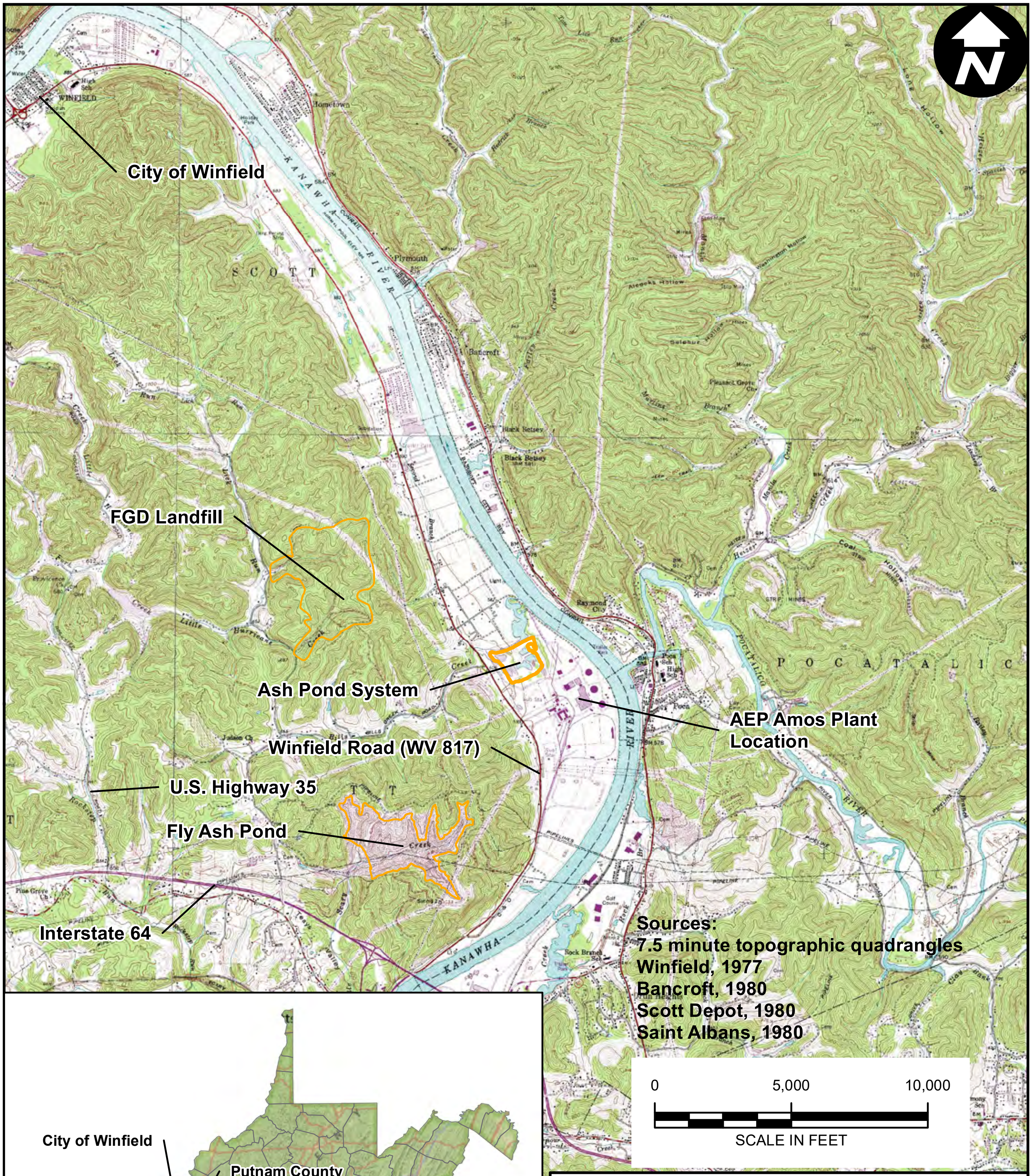
a. Estimate made from boring logs
bgs - below ground surface
cm/sec - centimeters per second
ft - feet
USCS - Unified Soil Classification System

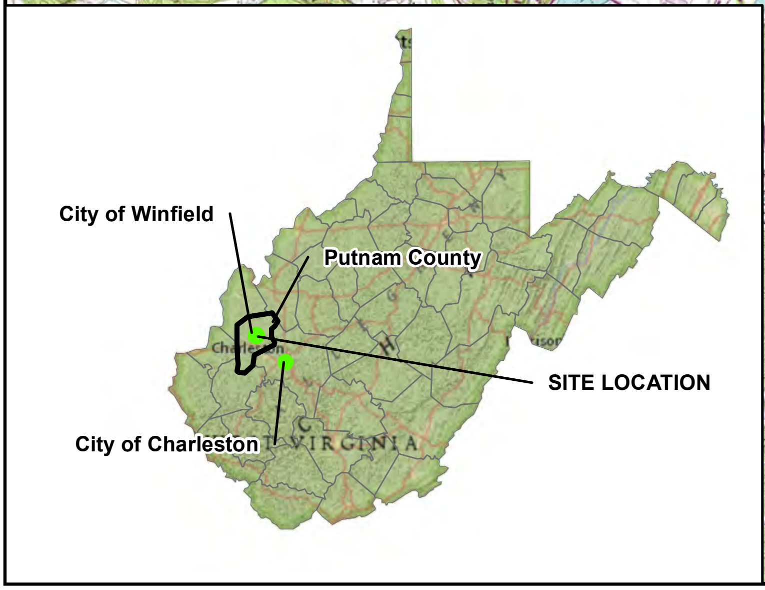
References:

Butler Jr, J.J., 1998. *The design, performance, and analysis of slug tests*. CRC Press.

Hyder, Z, J.J. Butler, Jr., C.D. McElwee and W. Liu, 1994. Slug tests in partially penetrating wells, Water Resources Research, vol. 30, no. 11, pp. 2945-2957.

FIGURES





AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISProjects_ENV\AEP\Amos\mxd\Ash Pond Report\October2018\F1_ site map.mxd

Legend

Coal Combustion Residual (CCR) Unit

Rivers and Streams

NOTES:
1. 2014 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. WEST VIRGINIA 1983 STATE PLANAR COORDINATES

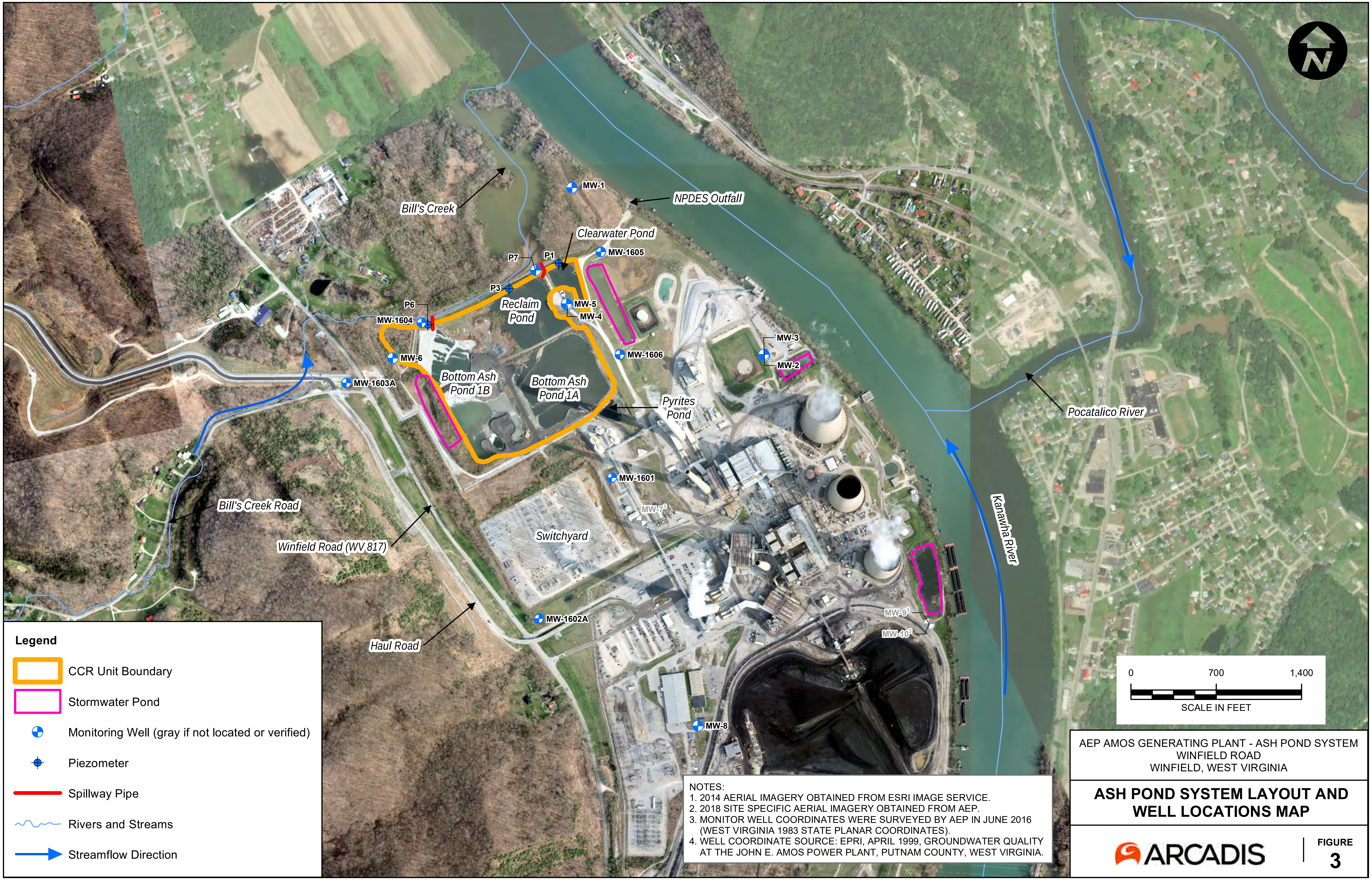
AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Ash Pond Report\October2018\F2_AmosRegionalMap.mxd 10/10/2018 9:58:13 AM



Legend

- CCR Unit Boundary
- Stormwater Pond
- Monitoring Well (gray if not located or verified)
- Piezometer
- Spillway Pipe
- Rivers and Streams
- Streamflow Direction

NOTES:
1. 2014 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. MONITOR WELL COORDINATES WERE SURVEYED BY AEP IN JUNE 2016 (WEST VIRGINIA 1983 STATE PLANAR COORDINATES).
4. WELL COORDINATE SOURCE: EPRI, APRIL 1999, GROUNDWATER QUALITY AT THE JOHN E. AMOS POWER PLANT, PUTNAM COUNTY, WEST VIRGINIA.

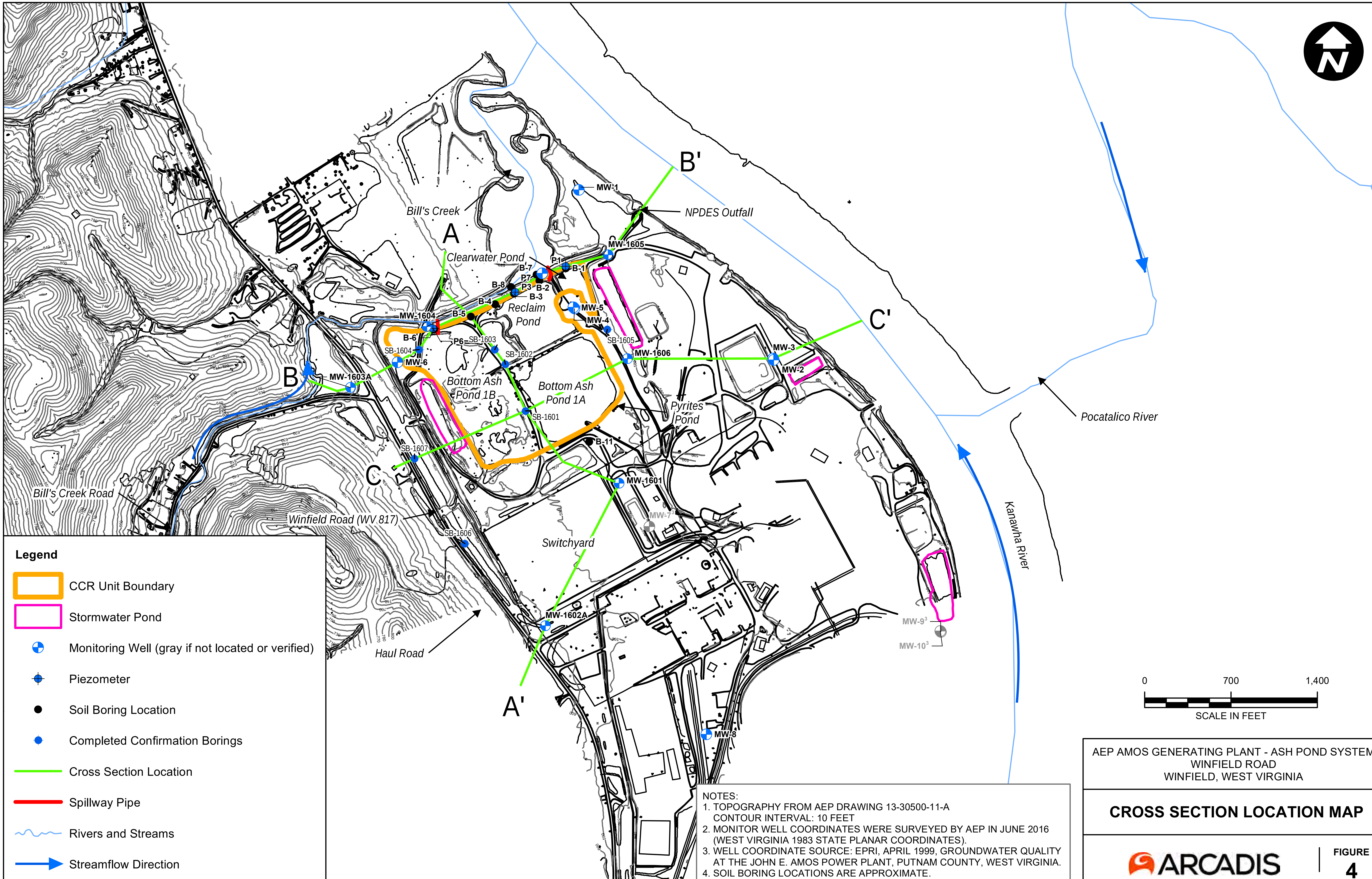
AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

ASH POND SYSTEM LAYOUT AND WELL LOCATIONS MAP

ARCADIS

FIGURE
3

City: CITRIX Div/Group: IMDV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Ash Pond Report\October2018\F3_ Amos Ash Pond Well Network-Ash Pond Layout and Well Location Map_v3.mxd 10/10/2018 9:58:32 AM



Legend

- CCR Unit Boundary
- Stormwater Pond
- Monitoring Well (gray if not located or verified)
- Piezometer
- Soil Boring Location
- Completed Confirmation Borings
- Cross Section Location
- Spillway Pipe
- Rivers and Streams
- Streamflow Direction

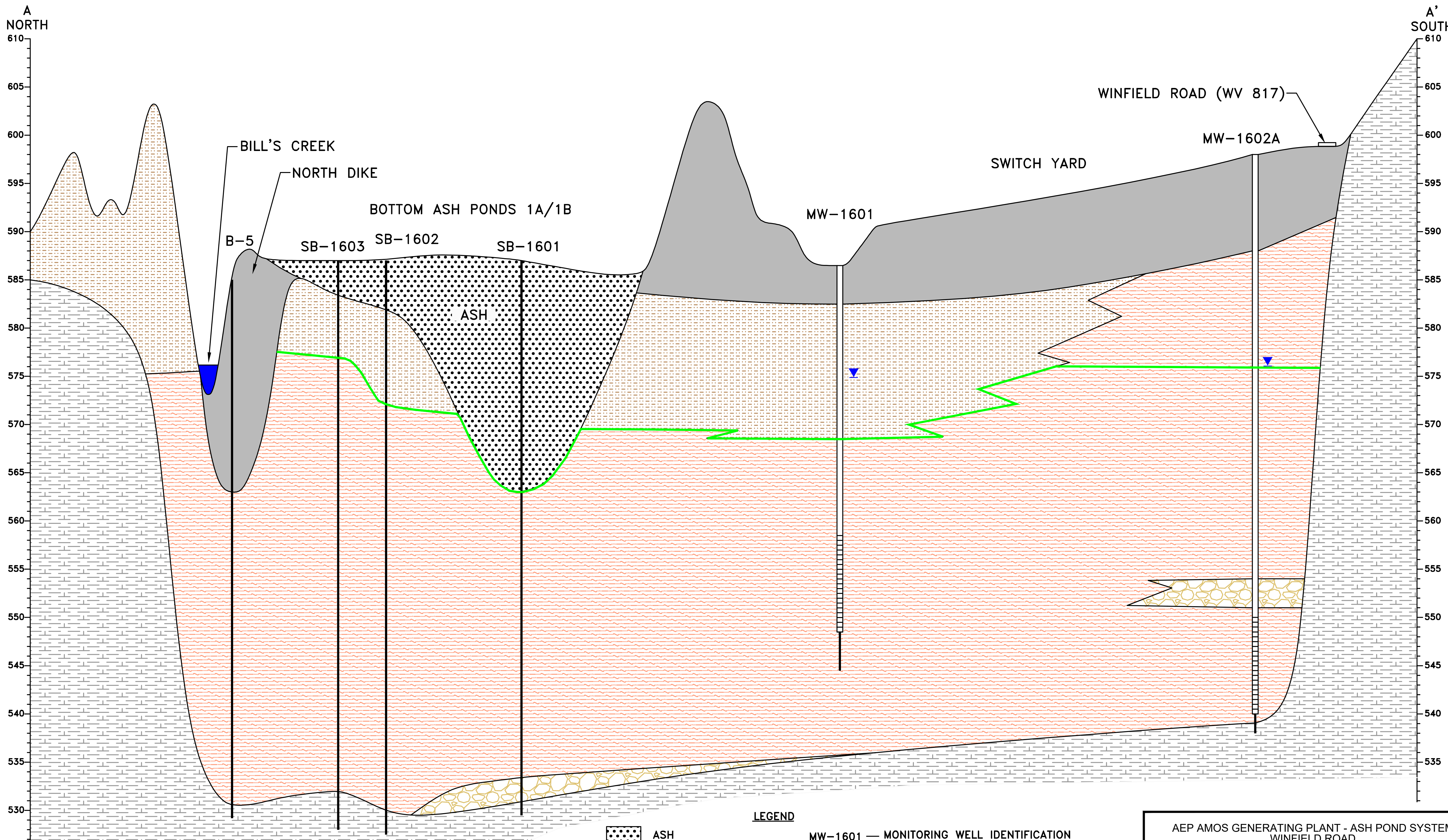
NOTES:
1. TOPOGRAPHY FROM AEP DRAWING 13-30500-11-A
   CONTOUR INTERVAL: 10 FEET
2. MONITOR WELL COORDINATES WERE SURVEYED BY AEP IN JUNE 2016 (WEST VIRGINIA 1983 STATE PLANAR COORDINATES).
3. WELL COORDINATE SOURCE: EPRI, APRIL 1999, GROUNDWATER QUALITY AT THE JOHN E. AMOS POWER PLANT, PUTNAM COUNTY, WEST VIRGINIA.
4. SOIL BORING LOCATIONS ARE APPROXIMATE.

AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION LOCATION MAP

ARCADIS

FIGURE 4



VERTICAL SCALE: 1-INCH = 10-FEET

HORIZONTAL SCALE: 1-INCH = 300-FEET

NOTES:

1. CLAY ZONES CHARACTERIZED BY SEQUENCES CLAY AND SANDY CLAY.
2. SAND ZONES CHARACTERIZED BY INTERBEDDED FINE SAND TO COARSE SAND FLUVIAL DEPOSTION. GENERALLY LESS SILT AND COARSENING DOWNWARDS.
3. WEATHERED SANDSTONE AND SHALE MAY INCLUDE RESIDUUM ON PORTIONS OF THE VALLEY WALL.

LEGEND

ASH

CLAY

SAND

SAND AND GRAVEL

WEATHERED SANDSTONE AND SHALE

FILL

MW-1601 — MONITORING WELL IDENTIFICATION

— WELL

— WELL SCREEN

SB-1601 — SOIL BORING IDENTIFICATION

— SOIL BORING

WATER LEVEL (JULY 2016)

LIMIT OF UPPERMOST AQUIFER

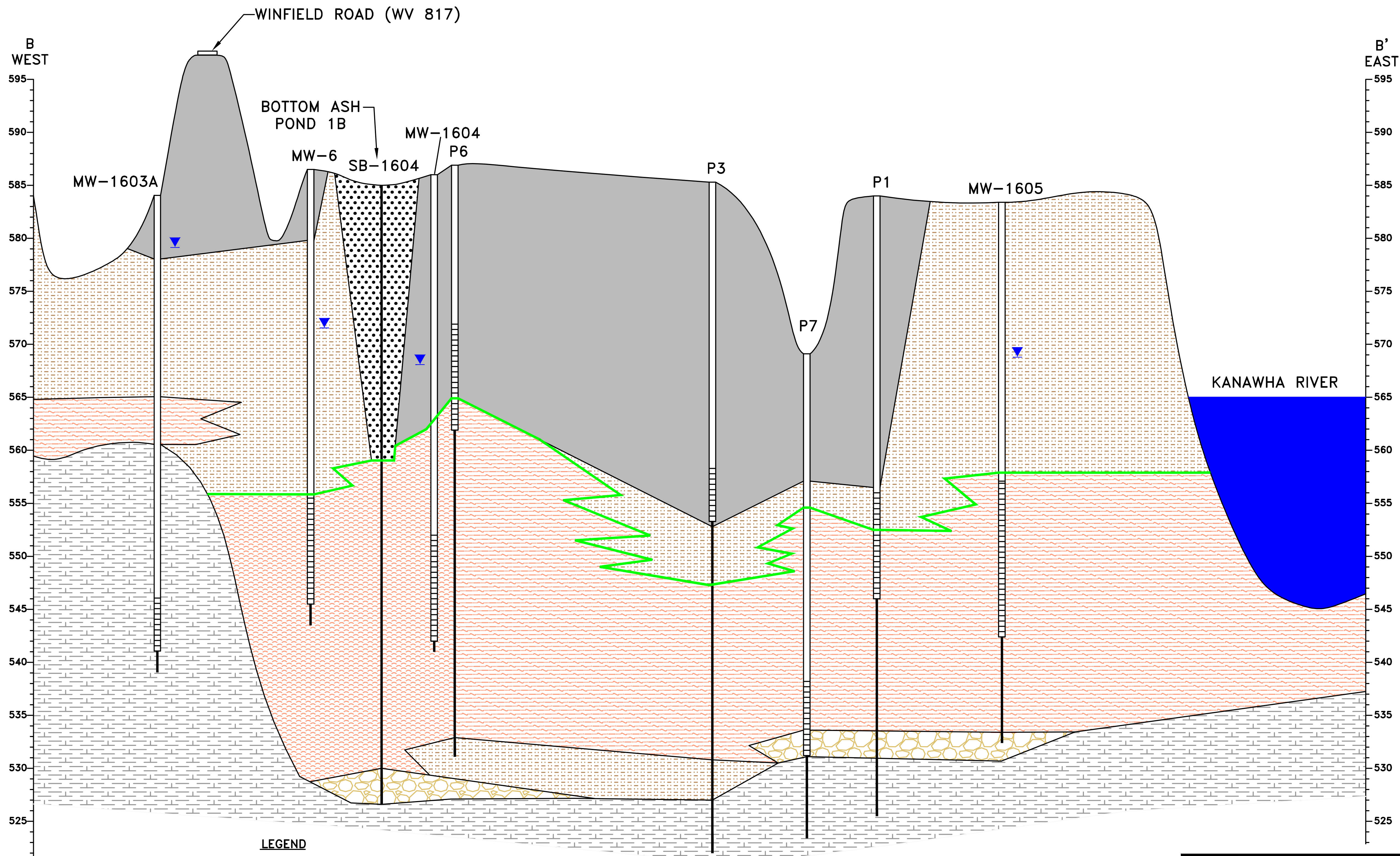
AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION A-A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5A

CITY:(COLUMBUS, OHIO) DIV/GROUP:(IM/DV) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(J. ROBERTS) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\Users\bsmith\OneDrive - ARCADIS\BIM 360 Docs\AMERICAN ELECTRIC POWER\AEP AMOS PONDS\2018\ASH PONDS\01-DWG\OH015976-AMOS-ASHPOND-2016CSr.dwg LAYOUT: CS-AA SAVED: 10/12/2018 1:53 PM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB
PLOTTED: 10/12/2018 1:57 PM BY: SMITH, BOB
XREFS:



LEGEND

- ASH
- CLAY
- SAND
- SAND AND GRAVEL
- WEATHERED SANDSTONE AND SHALE
- FILL

MW-1605 — MONITORING WELL IDENTIFICATION
— WELL
— WELL SCREEN

B-0601 — SOIL BORING IDENTIFICATION
— SOIL BORING

WATER LEVEL (JULY 2016)

LIMIT OF UPPERMOST AQUIFER

VERTICAL SCALE: 1-INCH = 10-FEET
HORIZONTAL SCALE: 1-INCH = 300-FEET

NOTES:
1. CLAY ZONES CHARACTERIZED BY SEQUENCES CLAY AND SANDY CLAY.
2. SAND ZONES CHARACTERIZED BY INTERBEDDED FINE SAND TO COARSE SAND FLUVIAL DEPOSTION. GENERALLY LESS SILT AND COARSENING DOWNWARDS.
3. WEATHERED SANDSTONE AND SHALE MAY INCLUDE RESIDUUM ON PORTIONS OF THE VALLEY WALL.

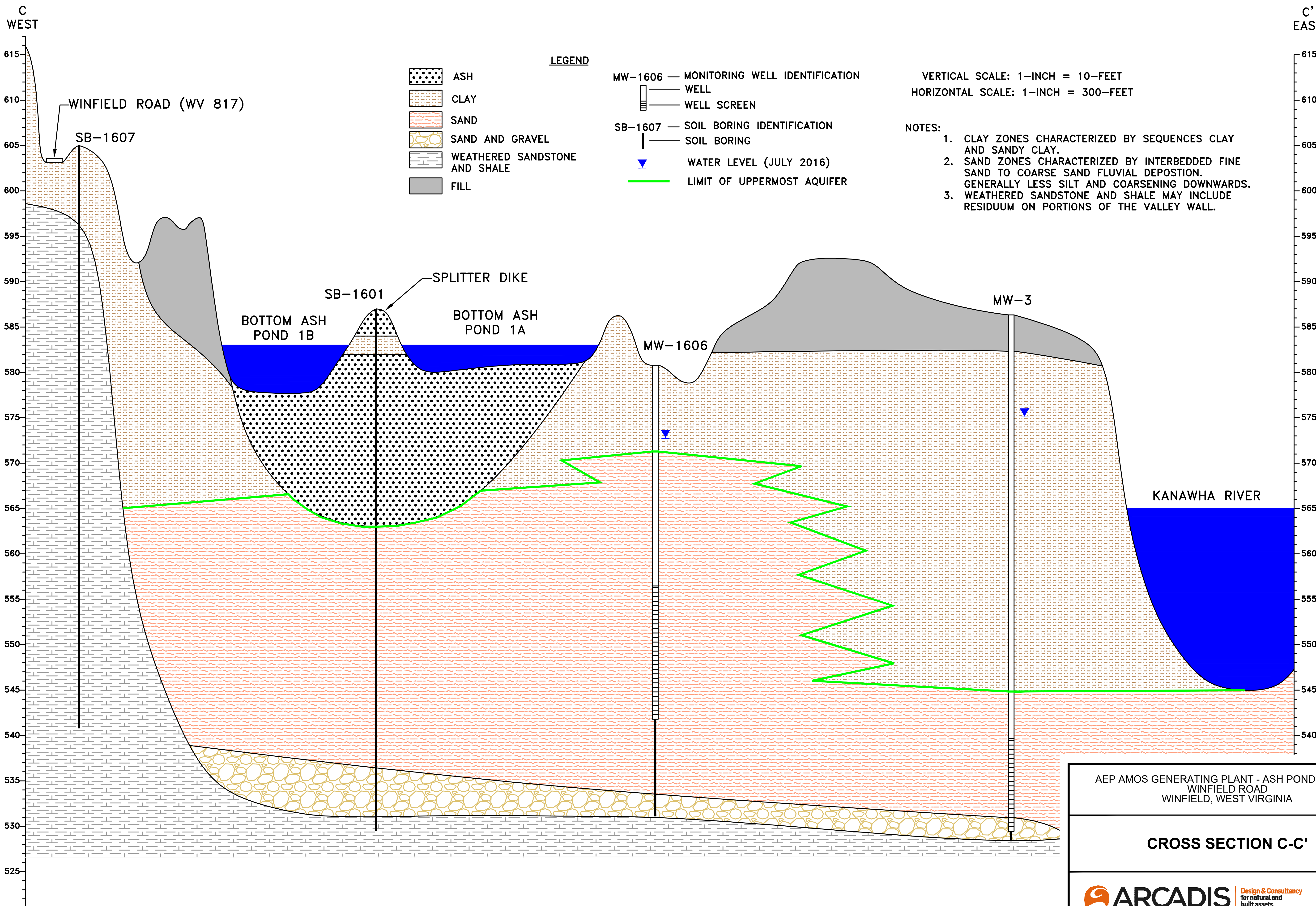
AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION B-B'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5B

CITY:(COLUMBUS, OHIO) DIV/GROUP:(IM/DV) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(J. ROBERTS) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\Users\bsmith\OneDrive - ARCADIS\BIM 360 Docs\AMERICAN ELECTRIC POWER\AEP AMOS PONDS\2018\ASH PONDS\01-DWG\OH015976-AMOS-ASHPOIND-2016CSr.dwg LAYOUT: CS-BB SAVED: 10/12/2018 1:53 PM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB
PLOTTED: 10/12/2018 1:57 PM BY: SMITH, BOB
XREFS:

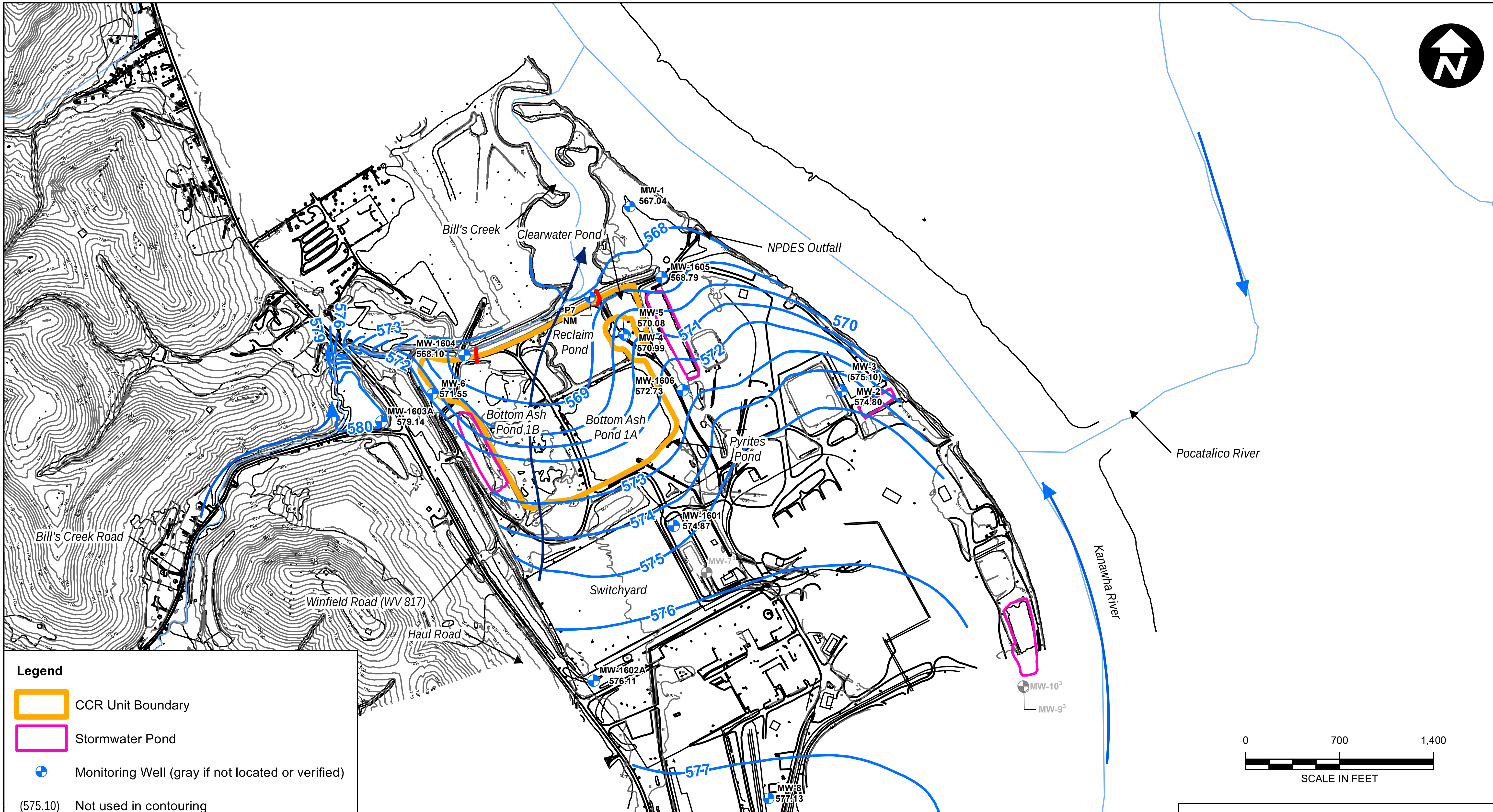


AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION C-C'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5C



Legend

- CCR Unit Boundary
- Stormwater Pond
- Monitoring Well (gray if not located or verified)
- (575.10) Not used in contouring
- Potentiometric Surface Contour Lines
- Estimated Groundwater Flow Path
- Spillway Pipe
- Streamlow Direction

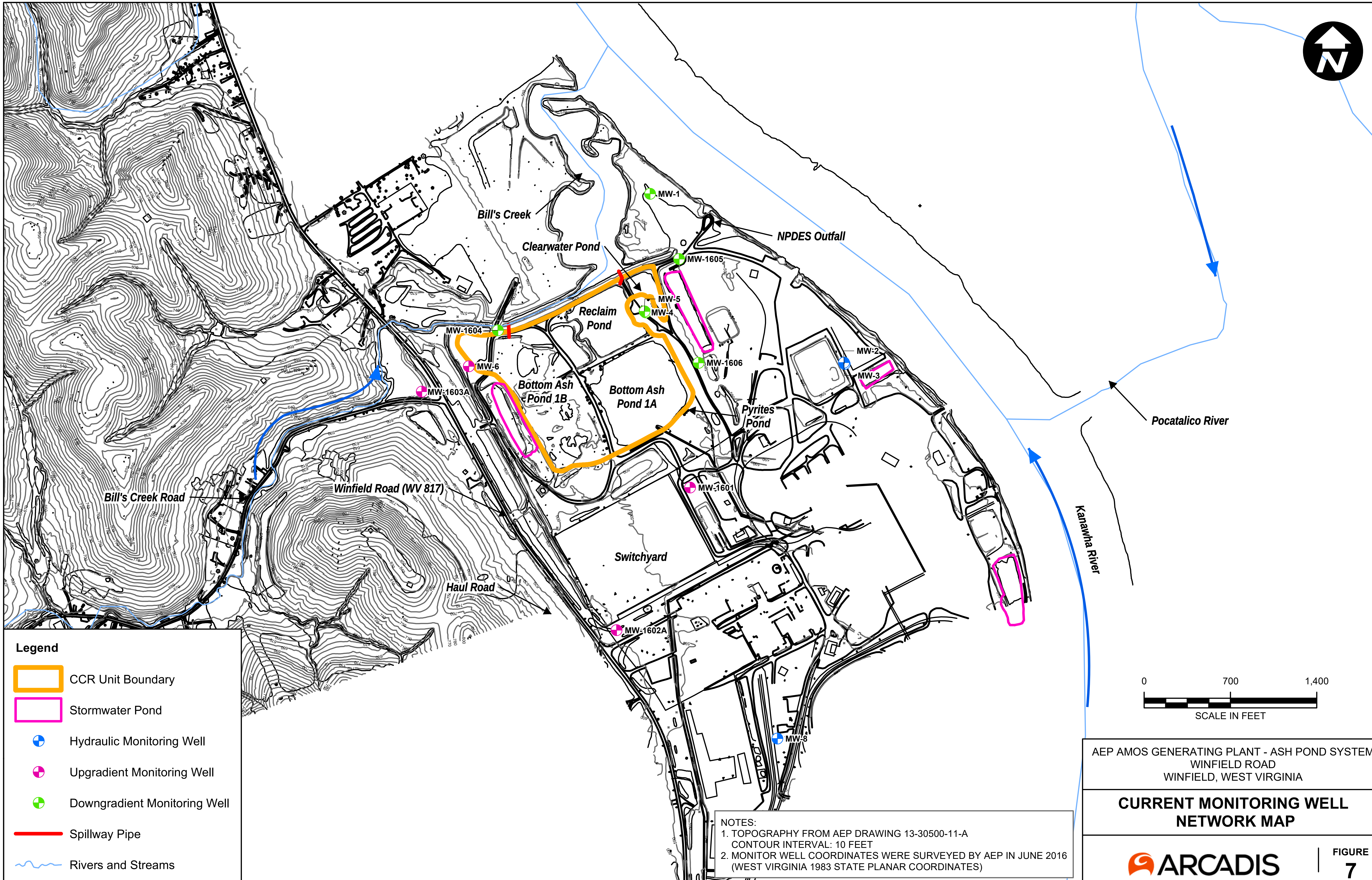
NOTES:
1. TOPOGRAPHY FROM AEP DRAWING 13-30500-11-A
   CONTOUR INTERVAL: 10 FEET
2. MONITOR WELL COORDINATES WERE SURVEYED BY AEP IN JUNE 2016 (WEST VIRGINIA 1983 STATE PLANAR COORDINATES).
3. WELL COORDINATE SOURCE: EPRI, APRIL 1999, GROUNDWATER QUALITY AT THE JOHN E. AMOS POWER PLANT, PUTNAM COUNTY, WEST VIRGINIA.
4. NM = NOT MEASURED

AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

POTENTIOMETRIC SURFACE MAP
JULY 25, 2016

ARCADIS

FIGURE
6



Legend

- CCR Unit Boundary
- Stormwater Pond
- Hydraulic Monitoring Well
- Upgradient Monitoring Well
- Downgradient Monitoring Well
- Spillway Pipe
- Rivers and Streams

NOTES:
1. TOPOGRAPHY FROM AEP DRAWING 13-30500-11-A
   CONTOUR INTERVAL: 10 FEET
2. MONITOR WELL COORDINATES WERE SURVEYED BY AEP IN JUNE 2016
   (WEST VIRGINIA 1983 STATE PLANAR COORDINATES)

AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CURRENT MONITORING WELL NETWORK MAP

ARCADIS

FIGURE
7

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: tjscott
OH015976.0009.00001 (Mountaineer Ash Pond)
T:_ENV\AEP\Amos\mxd\Ash Pond Report\F7_Amos Ash Pond Well Network-Proposed Network Mapv21.mxd 9/1/2020 6:54:59 PM

APPENDIX A

Boring/Well Construction Logs

AEP 1995

Soil Boring Logs

MW-01 to MW-10

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 540,266.8 E 1,731,165.6

GROUND ELEVATION 581.5 SYSTEM STATE PLANE

BORING NO. AMW-01 DATE 11/17/95 SHEET 1 OF 2

BORING START 09/05/95 BORING FINISH 09/06/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 2.0 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 24.0 BOTTOM 34.0

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH=REB RIG CME-75

WATER LEVEL			
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1	SS	0.0	2.0	3-5-7-8	1.4			CL	GRAVELLY SANDY CLAY Mixture,4" plant fragments, hard, dry, no odor, angular-subangular, 10yr4\2, dark yellow brown, poorly sorted, second color 5yr3\2 grayish brown pebbles 4-6 mm areas, angular.	
2	SS	2.0	4.0	7-6-9-8	1.5			CL	SILTY CLAY 25%, 75%, <5% sand, moist, 5yr5\4 and 10yr 6\2, hard, dry, low plasticity, fine < 1/16 mm, no odor, no reaction to HCL.	
3	SS	4.0	6.0	4-5-8-7	1.9		5		SILTY CLAY 10%, 90%, sand <2%, 5yr5\6 and 10yr6\2, damp, very stiff.	
4	SS	6.0	8.0	4-5-6-8	2.0				Some small irregular, black, horizontal lens, 1/4-1/2 x 1/2, damp.	
5	SS	8.0	10.0	4-5-7-9	1.9		10		A few black lens, damp.	
	ST	10.0	12.0							
7	SS	12.0	14.0	4-5-77	1.8				Damp SANDY CLAY 30%, 70%, Moist, 5yr5\6, fine lining, v-fine, grains 1/16-1/8 mm, sand grains, soft-medium stiff, no odor	
8	SS	14.0	16.0	3-3-2-2	1.5		15	SC	CLAYEY SAND 30%, 70%, v-fine-fine, angular 1/16-1/4 mm, sand grains, well sorted, poorly graded, 10yr5\2, yellowish brown, moist, loose, no odor, easy to auger, no HCL, no lens.	
9	SS	16.0	18.0	1-2-2-3	2.0			SC	Wet	17.9 Top of seal.
10	SS	18.0	20.0	1-1-1-2	1.5		20	CL	SANDY CLAY 10%, 90%, Moist, 10yr5\4, v-soft, v-fine grain, sand grains, no odor, easy to auger, well sorted, no odor.	19.9 Top of sand.
11	SS	20.0	22.0	1-2-1-3	2.0					
12	SS	22.0	24.0	1-1-1-2	2.0					
13	SS	24.0	26.0	1-1-5-6	1.8		25	SP	10yr5\4-10yr5\2 SAND With little or no fines, medium 1/4-1/2 mm sub-angular sand grains, 5yr5\6-10yr5\6, light brown, well sorted, poorly graded, v-loose, no odor, no HCL, a clean sand, east to auger, wet to moist.	24.0 Top of screen.
14	SS	26.0	28.0	6-6-7-8	1.0				Moist	
15	SS	28.0	30.0	5-4-3-3	1.0				Medium course 1/2-1.0 mm sand	

Continued Next Page

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-01 DATE 11/17/95 SHEET 2 OF 2

BORING START 09/05/95 BORING FINISH 09/06/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
16	SS	30.0	32.0	2-2-3-2	1.4	
17	SS	32.0	34.0	1-1-1-2	0	
18	SS	34.0	36.0	2-3-3-5	2.0	
19	SS	36.0	38.0	2-2-3-5	1.8	
20	SS	38.0	40.0	3-4-5-8	2.0	
21	SS	40.0	42.0	5-6-8-8	1.9	
22	SS	42.0	44.0	4-6-7-8	1.7	
23	SS	44.0	46.0	4-4-6-6	1.9	
24	SS	46.0	48.0	8-9-9-9	1.4	
25	SS	48.0	50.0	15-11-8-11	.1	
26	SS	50.0	52.0	24-23-19-19	60	
27	SS	52.0	54.0	41-35-50-30	1.7	
28	SS	54.0	56.0	15-20-30-38	2.0	

DEPTH IN FEET: 35, 40, 45, 50, 55

SOIL / ROCK IDENTIFICATION (USCS):

SC — CLAYEY SAND 50%,50%, < 2% silt, fine-medium 1/8-1/2 mm, subangular to sub-rounded sand grains, 5yr5\6 and 10yr5\4, black smear n-1, no odor, easy to auger no HCL, moist, medium stiff.

CL — SANDY CLAY 30%, 70%, fine 1/8-1/4 mm, sub-angular sand, medium stiff to soft, well sorted, poorly graded, black smear N\1, no odor, no HCL, 10YR4\2 and 5YR5\6M, moist.

SC — CLAYEY SAND 25%, 75%, fine to medium 1/8-1/2 mm, sub angular-sub-rounded, medium stiff, well graded, no odor, moist to wet, 5yr5\6, light brown, medium to very hard to auger, no HCL.
CLAY 10% SAND 90%
Fines <5%, sand 95% 10yr4\2-5yr4\1 brownish gray

SP SC — CLAYEY GRAVELLY SAND 50%, 10%, 40%, Mixture, 5yr6\1 light olive gray, gravel pebbles 2-4 mm, medium sand 1/4-1/2 mm, angular-sub-angular, well sorted, poorly graded, no odor, moist, loose.

GC — Sand 25% clay 10% gravel 65% Moist.
More gravel, hard to auger,loose
medium dense-dense, damp

CL — CLAY Hard, dense, dry, 5yt2\2 dusky brown, no odor, no HCL, hard to auger.
Weathered rock

DRILLER'S NOTES:
34.0 Bottom of screen.
35.0 Bottom sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 5423
COMPANY APPALACHIAN POWER COMPANY
PROJECT W. VA. GROUND WATER STUDY
COORDINATES N 539,188.1 E 1,732,744.9
GROUND ELEVATION 585.1 SYSTEM STATE PLANE

BORING NO. AMW-02 DATE 11/17/95 SHEET 1 OF 1
BORING START 08/23/95 BORING FINISH 08/24/95
PIEZOMETER TYPE WELL TYPE OW
HGT. RISER ABOVE GROUND 1.64 DIA 2.0
DEPTH TO TOP OF WELL SCREEN 13.0 BOTTOM 23.0
WELL DEVELOPMENT YES BACKFILL QUICK GROUT
FIELD PARTY TJH=REB RIG CME-75

WATER LEVEL	13.8		
TIME			
DATE	8-23-95		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	2.0	2-3-4-5	1.5				GC	CLAYEY GRAVEL 45% 55%, first six inches includes plant material fragments, 5yr2\1, dry, <5% fines, 5yr3\2-5yr3\4, sub-angular, poorly sorted, poorly graded, no odor, no reaction to HCL, easy to auger.		
							5		CL	SANDY CLAY 20%, 80%, <5% fines, v-fine grain 1/16-1/8 mm, well sorted, poorly graded, 5YR4\2, 5YR4\4, sub-angular sand, moist, no odor, medium stiff, no reaction to HCL, wood fragments, easy to auger.		
2	SS	6.0	8.0	3-4-5-4	1.7							6.9 Top of seal.
												9.0 Top of sand.
							10					
3	SS	12.0	14.0	2-2-2-3	1.9					SANDY CLAY 40%, 60%, <2% silt, v-fine, sub-angular sub-rounded grains, well sorted, wet, soft, 5yr4\4-5yr4\6, no odor, grain size 1/16-1/8 mm, easy to auger.		13.0 Top of screen.
							15					
4	SS	18.0	20.0	1-1-1-3	1.8							
							20			5yr5\5, medium to stiff, soft, no odor, wet		
5	SS	22.0	24.0	1-2-2-2	2.0				SC	CLAYEY SAND 40%, 60%, wet		
									CL	SANDY CLAY 45%, 55%, wet, v-fine sand 1/16-1/8 mm, well sorted, poorly graded, 5yr5\5-5yr6\5, no odor, no reaction to HCL,		23.0 Bottom of screen.
												24.7 Bottom sand.

TYPE OF CASING USED

	NQ-2 ROCK CORE
X	6" x 3.25 HSA
	9" x 6.25 HSA
	HW CASING ADVANCER 4"
	NW CASING 3"
	SW CASING 6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 539,199.9 E 1,732,739.4

GROUND ELEVATION 585.2 SYSTEM STATE PLANE

WATER LEVEL	∇ 14.5	∇	∇
TIME			
DATE	8-23-95		

BORING NO. AMW-03 DATE 11/17/95 SHEET 1 OF 2

BORING START 08/22/95 BORING FINISH 08/23/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 2.18 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 46.9 BOTTOM 56.9

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH=REB RIG CME-75

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
1	SS	0.0	2.0	10-15-18-20	1.6	
2	SS	2.0	4.0	7-8-10-13	1.5	
3	SS	4.0	6.0	5-6-8-9	1.5	
4	SS	6.0	8.0	4-6-9-10	1.8	
5	SS	8.0	10.0	4-4-6-8	1.6	
6	SS	10.0	12.0	2-4-6-8	1.7	
7	SS	12.0	14.0	2-2-3-4	1.8	
8	SS	14.0	16.0	1-1-1-2	1.7	
9	SS	16.0	18.0	1-1-1-2	1.5	
10	SS	18.0	20.0	1-1-2-2	2.0	
11	SS	20.0	22.0	1-1-1-1	1.9	
12	SS	22.0	24.0	1-1-1-1	2.0	
13	SS	24.0	26.0	1-0-1-0	2.0	
14	SS	26.0	28.0	1-1-1-1	2.0	
15	SS	28.0	30.0	1-1-1-1	1.9	

DEPTH IN FEET: 5, 10, 15, 20, 25

USCS	SOIL / ROCK IDENTIFICATION
GC	CLAYEY GRAVEL 30%, 60%, silt 10%, poorly graded, v-course angular gravels and pebbles, 2-4 mm, 5yr2\1 mm, dry, no reaction to HCL, last 1.5 very hard, first 4" plant debris. Less gravel
CL	SANDY CLAY 20%, 80%, little of no silt, v-fine sand 1/16-1/8 mm well sorted, poorly graded, 5YR3\ 4-5YR2 \4, no odor, dry, hard, easy to auger. Sand 30%-clay70%, 5yr3\4. SANDY CLAY 40%-60%, <2% silt, v-fine-fine sub-rounded grains, 1/16-1/8 mm, well sorted, 5yr4\4-5yr4\6, no odor, dry, no reaction to HCL, medium stiff to soft. Moist. Sand 35%, moist, medium stiff. sand 45% clay 55%, wet, medium stiff-soft. 5yr4\4-5yr4\6, wet, soft. Wet. 5yr4\6 medium stiff-soft. 5yr5\5
SC	CLAYEY SAND 40%, 60%, v-fine sand, no odor.
CL	SANDY CLAY 40%, 60%, Wet. SANDY CLAY 40%, 60%, v-fine grain, 1/16-1/8 mm, sub-angular, well sorted, poorly graded, 5yr5\5, medium stiff-soft, no odor, no reaction to HCL, moist to wet, very easy to auger. Clay 65%-sand 35%, wet.
SC	CLAYEY SAND v-fine grain 1/16-1/8 mm, wet, odor.
CL	SANDY CLAY 55%, 45%, no odor, 5yr5\6, wet, medium stiff-soft, well sorted.
SC	
CL	

GRAPH LOG | WELL | DRILLER'S NOTES

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-03 DATE 11/17/95 SHEET 2 OF 2

BORING START 08/22/95 BORING FINISH 08/23/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
16	SS	30.0	32.0	2-1-1-1	1.8	
17	SS	32.0	34.0	1-1-1-1	2.0	
18	SS	34.0	36.0	2-1-1-1	2.0	
19	SS	36.0	38.0	2-2-1-1	2.0	
20	SS	38.0	40.0	2-2-3-4	2.0	
21	SS	40.0	42.0	2-4-4-4	1.6	
22	SS	42.0	44.0	2-2-4-5	1.7	
23	SS	44.0	46.0	2-4-5-6	1.5	
24	SS	46.0	48.0	5-6-8-4	.8	
25	SS	48.0	50.0	4-4-12-18	1.0	
26	SS	50.0	52.0	19-19-6-4	1.5	
27	SS	52.0	54.0	8-12-34-17	1.8	
28	SS	54.0	56.0	7-30-36-34	1.7	
29	SS	56.0	58.0	30-33-25-90	1.8	

DEPTH IN FEET: 35, 40, 45, 50, 55

USCS	SOIL / ROCK IDENTIFICATION
	CLAYEY SAND Fine sand 1/8-1/4 mm, wet, no odor.
	SANDY CLAY 35%, 65%, wet, easy to auger, soft, 5yr5\6-5yr6\6.
	5yr5\6=5yr5\3
SC	CLAYEY SAND 50%, 60%, wet, pale brown, 5YR5\2.
CL	SANDY CLAY 50%, 50%, <2% silt, v-fine sand 1/8-1/4 mm, sub-angular, well sorted, poorly graded, v-loose, wet, faint musky odor, (swamp like), 5yr5\2-5yr5\1, no reaction to HCL.
CL	SANDY CLAY 40%, 60%, <2% silt, well sorted, poorly grade, medium stiff, moist to wet, no odor, no reaction to HCL, easy to auger. Medium dark gray n\4, moist, no odor.
SC	CLAYEY SAND 35%, 65%, wet. CLAYEY SAND fine grain 1/8-1/4, wet sub-angular, sub-rounded,well sorted, poorly graded,n\5 medium gray, loose, no odor, no reaction to HCL. Small wood fragments.
SP	SAND Poorly graded, little or no fines, clay 10%, well sorted, medium course sand 1/4-1.0 mm, wet, 10yr6\2, sub-angular grains, loose, no odor, no reaction to HCL, easy to auger, wood fragments.
SP	SAND <2%, poorly graded, medium -course grain 1/4-1.0 mm, n\5-n\6, medium gray color, angular-sub-angular, very loose, no odor, wet, well sorted, last .5 small sub-angular gravels.
GC	GRAVELLY SAND With little fines or no fines, pebbles, a4-6 mm, poorly sorted, poorly graded, pebbles content 10%, loose-medium stiff, no odor, wet. Sand 60%, gravel 20%, pebbles 20%, 5yr6\1-5yr5\2, wet. Sand 60%, gravel 10%, pebbles 30%
	CLAYEY GRAVELLY SAND 20%, 30%, 50%. SANDY GRAVELLY CLAY Clay 40%, weathered bedrock, 5yr5\2-5yr5\6, sub-rounded-rounded, gravels and pebbles, hard to auger, refusal.

DRILLER'S NOTES

40.0 Top of seal.

42.7 Top of sand.

46.9 Top of screen.

56.9 Bottom of screen.

57.9 Bottom sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 5423
COMPANY APPALACHIAN POWER COMPANY
PROJECT W. VA. GROUND WATER STUDY
COORDINATES N 539,605.5 E 1,731,128.7
GROUND ELEVATION 585.7 SYSTEM STATE PLANE

BORING NO. AMW-04 DATE 11/17/95 SHEET 1 OF 2
BORING START 09/07/95 BORING FINISH 09/08/95
PIEZOMETER TYPE ______ WELL TYPE OW
HGT. RISER ABOVE GROUND 2.21 DIA 2.0
DEPTH TO TOP OF WELL SCREEN 24.0 BOTTOM 34.0
WELL DEVELOPMENT YES BACKFILL QUICK GROUT
FIELD PARTY JCM=REB RIG CME-75

WATER LEVEL	▽ 26.0	▼	▽
TIME			
DATE	9-7-95		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	11-15-50	1.1				SC	CLAYEY SAND AND GRAVEL 10%, 30%, 60%, mixture, first 3' plant fragments, gravels to cobbles, dry, 2-75 mm, fine to v-fine sand 1/16-1/4, very hard, 1-yr3\4=5yr3\4, hard to auger, no order.		
2	SS	6.0	6.9	4-50/.4	.8		5		CL	CLAY Lean, plant material through-out, medium stiff to soft, smooth texture, 5yr5\2-10yr4\2, moist, hard to auger, musky organic odor, low plasticity, no reaction to HCL, olive gray.		
							10					
3	SS	14.0	16.0	6-6-7-7	2.0		15					18.0 Top of seal.
4	SS	20.0	22.0	3-3-5-5	2.0		20		CL	SANDY CLAY 5%, 95%, v-fine sand, small amount of silt, small irregular horizontal blackish, two colors 5yr5\6 50%, n\6 50%, moist to wet, sand 1/16-1/8 mm, sub-angular, well sorted, poorly graded, no odor.		19.9 Top of sand.
5	SS	26.0	28.0	5-7-3-3	1.8		25		SP	SAND 95%, <5% fines, medium-fine grain sand, sub-angular-sub-rounded, 1/8-1/2 mm, poorly graded, 5yr4\4-5yr3\4, no odor, v-loose, wet.		24.0 Top of screen.

Continued Next Page

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-04 DATE 11/17/95 SHEET 2 OF 2

BORING START 09/07/95 BORING FINISH 09/08/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	SS	32.0	34.0	3-6-9-8	1.3		35			SAND Little of no fines, sub-angular to sub-rounded, course, medium grain, 1.0-1/2 mm, two colors n\3 dark gray =20% and 5yr6\6 light brown =80%, wet, no odor.		34.0 Bottom of screen. 35.0 Bottom sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 539,614.1 E 1,731,120.7

GROUND ELEVATION 585.1 SYSTEM STATE PLANE

BORING NO. AMW-05 DATE 11/17/95 SHEET 1 OF 2

BORING START 08/31/95 BORING FINISH 09/07/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 2.0 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 44.0 BOTTOM 54.0

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH=REB RIG CME-75

WATER LEVEL	23.8		
TIME			
DATE	9-1-95		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION
1	SS	0.0	2.0	3-7-12-15	1.67			GC	10YR2/4 - 5YR3/4 DK. RED BROWN CLAYEY GRAVEL, 25% CLAY, 30% FINE SAND, 45% ANGULAR, POORLY SORTED FINE TO COARSE GRAVEL, POORLY GRADED, NO HCl, NO ODOR, PLANT FRAGMENTS FIRST 4"
2	SS	2.0	4.0	12-9-6-6	1.33			SC	5YR4/4 - 5YR4/2 CLAYEY SAND, 55% FINE SAND, 40% CLAY, 5% GRAVEL, LOOSE, NO ODOR, DAMP
3	SS	4.0	6.0	3-3-5-5	1.91		5	CL	5YA5/2 - 5YR6/4 LEAN CLAY, 2% SAND, MED. STIFF, SMOOTH TEXTURE, NO ODOR, NO HCl, DAMP, MEDIUM PLASTICITY
4	SS	6.0	8.0	3-2-3-3	1.67				
5	SS	8.0	10.0	2-2-4-7	1.83				5YR5/2 - 5YR6/4 DRY, SEMI-SMOOTH TEXTURE, MED-LOW PLASTICITY
6	SS	10.0	12.0	5-6-9-11	2.0		10		
7	SS	12.0	14.0	2-5-9-11	1.83			CL	5YR5/2 - 5YR4/4 LEAN CLAY, LESS THAN 10% FINE SAND, STIFF, DRY, SMALL IRREGULAR BLACK LENSES, LOW PLASTICITY, NO ODOR
8	SS	14.0	16.0	4-5-7-9	1.83		15		INCREASED No. OF VERY SMALL HORIZONTAL IRREGULAR BLACK LENSES, 5YR4/4 - 5YR5/2
9	SS	16.0	18.0	3-4-7-8	1.75				ABSENCE OF BLACK LENSES, 5YR4/4, 5YR5/2, MOIST, NO ODOR, LESS THAN 5% FINE SAND
10	SS	18.0	20.0	2-4-5-7	1.75				5YR4/4 = 20%, 5YR5/2 =80%, MOIST-WET
11	SS	20.0	22.0	2-3-4-5	1.83		20		
12	SS	22.0	24.0	2-2-3-3	1.91				5YR4/4 < = 10%, 5YR5/2 > = 90%, MOIST, NO ODOR
13	SS	24.0	26.0	2-5-5-8	2.0				5YR4/4 = 20%, N5(MED GRAY) = 80%, MOIST, 5% V. FINE SAND
							25	SP SC	5YR4/4 - 5YR3/4 CLAYEY SAND, 10% CLAY, MEDIUM SAND, SUB-ANGULAR TO SUB ROUNDED, V. LOOSE, WELL SORTED, POORLY GRADED, WET, NO ODOR, NO HCl
14	SS	26.0	28.0	4-6-8-8	1.33			SP	5YR3/4 - 5YR2/2 SAND, <2% FINES, FINE TO MEDIUM GRAIN, V. LOOSE, WET, NO ODOR, SUB ANGULAR
15	SS	28.0	30.0	5-7-7-9	1.91				5YR5/6 LIGHT BROWN

Columns GRAPH LOG, WELL and DRILLER'S NOTES contain no text.

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-05 DATE 11/17/95 SHEET 2 OF 2

BORING START 08/31/95 BORING FINISH 09/07/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
16	SS	30.0	32.0	6-7-8-9	1.67	
17	SS	32.0	34.0	4-4-7-9	1.83	
18	SS	34.0	36.0	6-7-13-6	1.0	
19	SS	36.0	38.0	3-2-3-8	1.5	
20	SS	38.0	40.0	6-5-5-4	1.17	
21	SS	40.0	42.0	3-3-8-7	1.25	
22	SS	42.0	44.0	7-8-9-9	1.58	
23	SS	44.0	46.0	4-4-6-6	1.33	
24	SS	46.0	48.0	8-5-8-9	1.67	
25	SS	48.0	50.0	4-4-5-7	1.91	
25	SS	50.0	52.0	5-10-7-7	2.0	
27	SS	52.0	54.0	22-22-11-14	1.17	
28	SS	54.0	55.0	15-63-53/3	1.0	

DEPTH IN FEET: 35, 40, 45, 50, 55

SOIL / ROCK IDENTIFICATION (USCS):

SM — N5-N6 MED GRAY SAND WITH FINES, 10% CLAY, 10% SILT, FINE TO MEDIUM SAND ANGULAR TO SUB-ANGULAR, SOME BLACK STAINING, V. LOOSE, WELL SORTED, POORLY GRADED, UNCONSOLIDATED, WET, NO ODOR, NO HCl

SAND = 90%, CLAY = 5%, SILT = 5%, WET

SP — N6 MED LT GRAY TO 5YR6/1 SAND, FINE TO MEDIUM GRAIN, POORLY GRADED, V. LOOSE, WET, UNCONSOLIDATED, NO ODOR, NO HCl

SM — N5 - N4 SILTY SAND, 10% CLAY, 15% SILT, FINE TO MEDIUM GRAIN SAND, WELL SORTED, LOOSE, NO ODOR, WET

2" WEATHERED COAL DEPOSITS, WET

BOTTOM 6" 5YR6/1 LT. BROWNISH GRAY, WET

WEATHERED COAL DEPOSITS, WET, NO ODOR

WET

CL — 5YR3/4 - 5YR2/2 SANDY CLAY, 55% CLAY, FINE GRAIN, SUB ANGULAR SAND, LOOSE, WELL SORTED, POORLY GRADED, UNCONSOLIDATED, WET, NO ODOR

CL — 5YR3/4 - 5YR2/2 GRAVELLY CLAY, 15% SUB ANGULAR TO SUB ROUNDED GRAVEL (2 - 25 mm) POORLY SORTED, MOIST, NO ODOR, CONSOLIDATED

WEATHERED BEDROCK AT 55'

DRILLER'S NOTES:

36.2 Top of seal.

39.3 Top of sand.

44.0 Top of screen.

55.0 Bottom sand.

54.0 Bottom of screen.

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 5423
COMPANY APPALACHIAN POWER COMPANY
PROJECT W. VA. GROUND WATER STUDY
COORDINATES N 539,169.8 E 1,729,695.5
GROUND ELEVATION 587.5 SYSTEM STATE PLANE

WATER LEVEL	▽ 21.0	▼	▽
TIME			
DATE	8-30-95		

BORING NO. AMW-06 DATE 11/17/95 SHEET 1 OF 2
BORING START 08/29/95 BORING FINISH 08/30/95
PIEZOMETER TYPE ______ WELL TYPE OW
HGT. RISER ABOVE GROUND 2.0 DIA 2.0
DEPTH TO TOP OF WELL SCREEN 31.0 BOTTOM 41.0
WELL DEVELOPMENT YES BACKFILL QUICK GROUT
FIELD PARTY TJH=REB RIG CME-75

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1	SS	0.0	2.0	3-4-5-6	1.5		OL	TOP 3" PLANT FRAGMENTS	
							CL	OLIVE GRAY SANDY LEAN CLAY, 10% FINE TO COARSE SAND, NO ODOR, NO HCl, MOIST TO DAMP	
2	SS	2.0	4.0	3-3-5-7	1.7				
3	SS	4.0	6.0	7-7-4-6	1.7		CL	MEDIUM BROWN (5YR3/4) SANDY LEAN CLAY, 20% COARSE SAND, STIFF, NO ODOR, DAMP	
4	SS	6.0	8.0	4-4-3-4	1.8				
5	SS	8.0	10.0						
6	SS	10.0	12.0	2-2-4-5	1.5		CL	10YR5/4, 5GY6/1 SANDY CLAY, 40% FINE TO MEDIUM SAND, SOFT TO MEDIUM STIFF, NO ODOR, MOIST TO WET	
7	SS	12.0	14.0	1-1-2-5	1.8				
8	SS	14.0	16.0	2-2-4-5	.83				
9	SS	16.0	18.0	1-2-2-3	2.0		CH	BENTONITE CHIPS, 40% HYDRATED, BACKFILL SEAL, WET, 2' THICK	
10	SS	18.0	20.0	3-3-5-5	1.83		CL	5Y6/1 LEAN CLAY, LESS THAN 5% SAND, MEDIUM STIFF TO STIFF, MOIST, NO HCL	
11	SS	20.0	22.0	2-3-3-3	1.67			20' - 22' 5YR5/6 AND 10YR6/2	
12	SS	22.0	24.0	3-3-3-5	1.83			22' - 24' 10% SAND	
13	SS	24.0	26.0	3-3-4-6	1.91			SOME SMALL IRREGULAR HORIZONTAL LENSES 1.0 mm H X 1/4" L, N-1-N-2.	24.6 Top of seal.
14	SS	26.0	28.0	5-4-6-8	1.83			26'-28' 5YR5/6 LT. BROWN AND N-6 LT. GRAY	27.0 Top of sand.
15	SS	28.0	30.0	2-2-2-4	1.83			28'-30' LESS THAN 2% SAND, 5Y41 OLIVE	

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-06 DATE 11/17/95 SHEET 2 OF 2

BORING START 08/29/95 BORING FINISH 08/30/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	SS	30.0	32.0	2-2-3-5	2.0					GRAY, MUSKY ODOR, MOIST		
									SC	5Y4/1 CLAYEY SAND, 10% CLAY, FINE TO MEDIUM GRAIN, POORLY SORTED, NO ODOR, NO HCl		31.0 Top of screen.
17	SS	32.0	34.0	1-1-1-2	2.0				CL	SANDY LEAN CLAY, MOIST, 40% SAND		
18	SS	34.0	36.0	4-2-2-3	2.0				SW	5Y4/1 SAND FINE TO MEDIUM GRAIN, POORLY SORTED, NO ODOR, NO HCl, VERY LOOSE, WET		
19	SS	36.0	38.0	1-1-2-3	1.91		35		CL	5YR4/1 SANDY CLAY, 40% FINE SAND, BROWNISH GRAY, SOFT, MOIST NO ODOR 36' - 38' 20% SAND		
20	SS	38.0	40.0	3-2-3-3	1.91					38' - 40' 10% SAND		
21	SS	40.0	42.0	1-2-2-3	2.0		40			40' 42' LESS THAN 5% SAND		41.0 Bottom of screen.
22	SS	42.0	43.0	2-3	1.0					42' - 43' LESS THAN 2% SAND, 5Y6/1, MOIST, DAMP, NO ODOR		42.7 Bottom sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 537,838.4 E 1,731,735.7

GROUND ELEVATION 587.1 SYSTEM STATE PLANE

BORING NO. AMW-07 DATE 11/17/95 SHEET 1 OF 2

BORING START 08/30/95 BORING FINISH 08/31/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 1.62 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 28.0 BOTTOM 38.0

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH=REB RIG CME-75

WATER LEVEL	11.0		
TIME			
DATE	8-31-95		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1	SS	0.0	2.0	12-50/3	.5			OL	TOP 3" PLANT FRAGMENTS	
								SM	SILTY SAND, 50% SAND, 50% SILT, VERY FINE SAND, DRY, DUSTY, SOME GRANULES AND PEBBLES, VERY HARD, ONE LARGE COBBLE	
2	SS	2.0	4.0	10-5-5-6	1.83					
3	SS	4.0	6.0	6-5-5-5	1.17			CL	SANDY CLAY, 40% SAND, 40% CLAY, 20% SILT, VERY FINE (1/16-1/8) S.ANG. SAND, DAMP, 1ST COLOR 5Y6/1 LT. OLIVE GRAY, 2ND COLOR 5YRG/4 LT. BROWN, NO ODOR, NO HCl, LOOSE TO MED. DENSE	
4	SS	6.0	8.0	2-3-3-4	2.0		5			
5	ST	8.0	10.0					CL	10YR4/2 AND 5Y5/4 LEAN CLAY WITH SILT, DAMP, MED. STIFF TO STIFF, NO ODOR, LOW PLASTICITY	
6	SS	10.0	12.0	2-2-2-3	1.17		10	CL	SANDY CLAY, 5-10% V. FINE SAND, BOTTOM HALF OF SPOON WET, MED. PLASTICITY, SOFT TO V. SOFT, NO ODOR	
7	SS	12.0	14.0	2-2-2-3	2.0				12'-14' 10YR5/4	
8	SS	14.0	16.0	2-2-3-4	2.0		15		14'-16' A FEW SM. BLACK HORIZONTAL DEPOSITS, ONE BLACK (N-2) LENS, 1/2 mm H X 1/4" LONG, 10YR6/6 DK YEL-ORANGE AND N-7 LT. GRAY, MOIST	
9	SS	16.0	18.0	4-5-8-8	2.0					
10	SS	18.0	20.0	5-5-8-9	2.0				18'-20' CLAY W/V. FINE SAND AND SILTS, DAMP, NO ODOR, STIFF	
11	SS	20.0	22.0	3-5-5-7	1.91		20		20'-22' A FEW SM. IRREG. HORIZONTAL BLACK (N-2) LENSES AND DEPOSITS, DAMP	
12	SS	22.0	24.0	2-3-5-5	1.75				22'-24' (N-7) LT. GRAY = 80%, AND 5YR5/6 LT BROWN = 20%, NO DEPOSITS, DAMP	22.0 Top of seal.
13	SS	24.0	26.0	2-2-3-4	1.91					24.0 Top of sand.
14	SS	26.0	28.0	1-1-2-2	1.67		25		26' - 28' LESS THAN 2% SAND	
15	SS	28.0	30.0	1-1-2-2	1.91			SP	5YR4/1 OLIVE GRAY CLEAN SAND, MED (1/4-1/2 mm) S. ANG. SAND, WELL SORTED, POORLY GRADED, NO ODOR, NO HCl, VERY	28.0 Top of screen.

Continued Next Page

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER 5423
COMPANY APPALACHIAN POWER COMPANY
PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-07 DATE 11/17/95 SHEET 2 OF 2
BORING START 08/30/95 BORING FINISH 08/31/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	SS	30.0	32.0	2-3-2-3	2.0				CL	LOOSE, MOIST		
										LEAN CLAY, WITH MEDIUM TO FINE S. ANG. SAND, MOIST, NO ODOR		
17	SS	32.0	34.0	2-3-7-6	1.17				SW SC	N-4 MED. DK GRAY SAND, 5% SILT AND CLAY, FINE TO MEDIUM (1/8-1/2 mm) GRAIN SAND, S. ANG., POORLY SORTED, NO ODOR		
18	SS	34.0	36.0	5-3-6-8	1.67		35			34' - 36' MOIST TO DAMP		
19	SS	36.0	38.0	5-9-21-23	2.0					37' - 38' HARD, CLEAN, MOIST		38.0 Bottom of screen. 39.0 Bottom sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 536,151.7 E 1,732,198.9

GROUND ELEVATION 584.9 SYSTEM STATE PLANE

BORING NO. AMW-08 DATE 11/17/95 SHEET 1 OF 1

BORING START 09/13/95 BORING FINISH 09/13/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 1.78 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 10.0 BOTTOM 20.0

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY JCM=REB RIG CME-75

WATER LEVEL	10.3		
TIME			
DATE	8-29-95		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1	SS	0.0	2.0	8-16-14-8	1.67			OL	PLANT FRAGMENTS	
2	SS	2.0	4.0	6-7-11-9	1.67			CL	10RY5/4 AND 10YR5/6 GRAVELLY CLAY, 30% GRAVEL WITH SILT, 5% MEDIUM TO COARSE POORLY SORTED GRAVEL (2 - 75 mm), MOD. HARD, DRY, NO HCl, NO ODOR	
3	SS	4.0	6.0	5-7-3-3	2.0		5	SC	10YR6/2 AND 10YR6/4 CLAYEY SAND, 45% CLAY, SAND S. ANGULAR WITH 5% 2 TO 4 mm, LOOSE, DRY, NO ODOR, NO HCl 4' - 6' 5YR5/6 - 5YR6/6, DRY, 5% FINES	4.0 Top of seal.
4	SS	6.0	8.0	5-3-5-4	1.67			CL	5YR4/4 - 5YR4/6 SANDY CLAY, 45% VERY FINE S. ANG, WELL SORTED, POORLY GRADED SAND, MOIST, NO ODOR	6.0 Top of sand.
5	ST	8.0	10.0							
6	SS	10.0	12.0	2-2-2-1	1.17		10	SC	10YR5/4 - 5YR5/6 CLAYEY SAND, 50% VERY FINE TO FINE SAND, LOOSE, WET, NO HCl, NO ODOR	10.0 Top of screen.
7	SS	12.0	14.0	2-2-3-3	1.5				12'-14' SAND 65%, WET	
8	SS	14.0	16.0	1-1-3-3	1.5		15		14'-16' WET	
9	SS	16.0	18.0	2-2-3-2	1.67			CL	5YR5/4 - 5YR5/2 SANDY CLAY, 50% SAND, 50% CLAY, STIFF, MOIST, NO ODOR, NO HCl	
10	SS	18.0	20.0	1-1-2-3	1.83				18'-20' SANDY CLAY, SAND 40%, MOIST	
11	SS	20.0	22.0	8-10-9-4	1.83		20		20'-22' SAND 20%, DRY, N5 MED. GRAY = 40%, 5YR5/4 = 60%	20.0 Bottom of screen. 21.9 Bottom sand.

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 536,983.3 E 1,734,099.7

GROUND ELEVATION 586.8 SYSTEM STATE PLANE

BORING NO. AMW-09 DATE 11/17/95 SHEET 1 OF 2

BORING START 08/29/95 BORING FINISH 08/29/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 1.79 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 21.0 BOTTOM 31.0

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH=REB RIG CME-75

WATER LEVEL	13.5		
TIME			
DATE	8-29-95		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
1		0.0	2.0	8-24-45-60	1.0			GC	5YR4/4 - 5YR3/4 CLAYEY GRAVEL, 30% CLAY, S. ANG. POORLY SORTED GRAVEL 2-100 mm, VERY HARD, NO ODOR	
2		2.0	4.0							
3		4.0	6.0							
							5	CL	5YR5/4 - 5YR5/6 SANDY CLAY, 15% S ANG. 1/16 - 18 in. WELL SORTED SAND, MED. STIFF TO STIFF, LOW PLASTICITY, DRY, NO ODOR, NO HCl	
4		6.0	8.0	6-6-9-9	1.67					
5	ST	8.0	10.0							
6		10.0	12.0				10	CL	5YR5/4 - 5YR5/5 SANDY CLAY, FINE WELL SORTED SAND, MED. STIFF, NO ODOR, MOIST TO WET, LOW PLASTICITY 10'-12' MOIST	
7		12.0	14.0	3-4-5-6	2.0					
8		14.0	16.0				15			15.0 Top of seal.
9		16.0	18.0					SC	5YR5/4 TO 5YR4/4 CLAYEY SAND, FINE GRAIN S. ANGULAR SAND (1/8 - 1/4 mm), V. LOOSE, WELL SORTED, POORLY GRADED, WET, 30% CLAY, NO ODOR, NO HCl	17.0 Top of sand.
10		18.0	20.0							
11		20.0	22.0	1-1-1-2	2.0		20			21.0 Top of screen.
12		22.0	24.0							
13		24.0	26.0	1-1-1-2	2.0			SC	5YR4/4 CLAYEY SAND 50% CLAY, 50% MEDIUM TO FINE GRAIN ANGULAR TO SUB-ANGULAR, POORLY SORTED, POORLY GRADED SAND, LOOSE, WET, NO HCl	
14		26.0	28.0				25			
15		28.0	30.0					CL	5YR5/2 - 5YR5/4 SANDY CLAY, 15% VERY FINE TO FINE S. ANGULAR SAND, V. LOOSE, WET, NO ODOR, NO HCl	

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-09 DATE 11/17/95 SHEET 2 OF 2

BORING START 08/29/95 BORING FINISH 08/29/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPH LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16		30.0	32.0	1-1-1-1	2.0							31.0 Bottom of screen. 32.0 Bottom sand.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

COORDINATES N 536,989.9 E 1,734,094.7

GROUND ELEVATION 586.4 SYSTEM STATE PLANE

WATER LEVEL	14.8		
TIME			
DATE	9-6-95		

BORING NO. AMW-10 DATE 11/17/95 SHEET 1 OF 2

BORING START 08/24/95 BORING FINISH 08/28/95

PIEZOMETER TYPE ______ WELL TYPE OW

HGT. RISER ABOVE GROUND 2.09 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 47.5 BOTTOM 57.5

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH=REB RIG CME-75

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
1	SS	0.0	2.0	7-17-17-38	1.5	
2	SS	2.0	4.0	20-16-14-12	1.17	
3	SS	4.0	6.0	4-4-7-8	1.33	
4	SS	6.0	8.0	5-6-6-7	1.5	
5	SS	8.0	10.0	5-5-5-7	1.25	
6	SS	10.0	12.0	3-3-4-4	1.33	
7	SS	12.0	14.0	2-2-2-2	1.83	
8	SS	14.0	16.0	1-1-1-2	1.91	
9	SS	16.0	18.0	1-1-2-3	1.67	
10	SS	18.0	20.0	1-1-2-3	1.8.	
11	SS	20.0	22.0	1-2-1-3	1.67	
12	SS	22.0	24.0	1-1-3-3	1.5	
13	SS	24.0	26.0	1-1-1-2	1.0	
14	SS	26.0	28.0	1-2-1-2	1.83	
15	SS	28.0	30.0	1-1-2-2	1.5	

DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION
	OL	PLANT FRAGMENTS
	GC	5YR4/4 DARK RED-BROWN CLAYEY GRAVEL, 25% CLAY, 30% FINE SAND, 45% SUB-ANGULAR TO ANGULAR GRAVEL (2 TO 64 mm), POORLY SORTED, NO HCl, NO ODOR
5	ML	N2-N3 GRAYISH BLACK SANDY SILT, 40% VERY FINE SAND, 20% CLAY, MUSKY ODOR, DAMP. A FEW SMALL IRREGULAR HORIZONTAL (N1) BLACK LENSES (20 mm L X 1 mm H) THROUGHOUT, MED. STIFF 6'-7' FEWER LENSES, N4 - N5
10	CL	5YRB5/6 - 5YR4/4 SANDY CLAY, 30% VERY FINE TO FINE SAND, MED. STIFF TO STIFF, LOW PLASTICITY, NO ODOR, DAMP. 2 LARGER LENSES 5mm L X 111/8 TO 1//4 mm H.
15	SC	10YR5/4 YELLOW BROWN CLAYEY SAND, 35% CLAY, POORLY SORTED, GRADED FINE TO MEDIUM SAND, UNCONSOLIDATED, LOOSE. A FEW ROUND SMALL IRREGULAR BLACK (N2) DEPOSITS, WET
20, 25	CL	5YR4/4 - 5YR5/4 SANDY CLAY, 25% V. FINE SAND, SOFT, MED PLASTICITY, NO HCl, NO ODOR, MOIST 20'22' SAND 20% 22'-24' SAND 20% 24'-26' SAND 25% 26'-27.5' SAND 40%
	SC	5Y4/1 OLIVE GRAY CLAYEY SAND, 40% CLAY, VERY FINE TO FINE SAND, V. LOOSE TO LOOSE, WET, NO ODOR, NO HCl

WELL | DRILLER'S NOTES

Continued Next Page

TYPE OF CASING USED		
	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER DG

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER 5423

COMPANY APPALACHIAN POWER COMPANY

PROJECT W. VA. GROUND WATER STUDY

BORING NO. AMW-10 DATE 11/17/95 SHEET 2 OF 2

BORING START 08/24/95 BORING FINISH 08/28/95

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
16	SS	30.0	32.0	1-1-1-2	2.0	
17	SS	32.0	34.0	2-2-3-7	1.17	
18	SS	34.0	36.0	1-1-3-2	1.83	
19	SS	36.0	38.0	2-2-2-3	2.0	
20	SS	38.0	40.0	2-2-2-3	2.0	
21	SS	40.0	42.0	1-2-2-3	2.0	
22	SS	42.0	44.0	1-2-4-4	2.0	
23	SS	44.0	46.0	4-6-12-12	2.0	
24	SS	46.0	48.0	4-6-11-17	1.91	
25	SS	48.0	50.0	12-5-5-10	1.17	
26	SS	50.0	52.0	9-13-16-18	1.5	
27	SS	52.0	54.0	9-60-23-9	1.33	
28	SS	54.0	56.0	13-22-25-20	1.33	
29	SS	56.0	58.0	13-14-16-30	1.17	
30	SS	58.0	59.0	32-100/4	.67	

DEPTH IN FEET: 35, 40, 45, 50, 55

USCS	SOIL / ROCK IDENTIFICATION
	30'-32' 20% CLAY
CL	5Y4/1 OLIVE GRAY SANDY CLAY, 40% SAND
SC	10YR4/2 - 5YR4/6 MODERATE BROWN CLAYEY SAND, 10% CLAY, VERY FINE TO FINE SAND, POORLY SORTED, GRADED, UNCONSOLIDATED, LOOSE, WET, NO ODOR, NO HCl
CL	10YR4/4 SANDY CLAY, 10% VERY FINE TO FINE WELL SORTED SAND, SOFT TO MED. STIFF, MED. PLASTICITY, MOIST, NO ODOR, NO HCl 38'-40' 10YR4/2 AND 5YR5/6 40'-42' 30% SAND 42'-44' N4-N4 MED DARK GRAY, 40% SAND
SC	CLAYEY SAND, 20% CLAY, FINE TO MEDIUM GRAIN SAND, ANGULAR, POORLY SORTED, WELL GRADED, WET, LOOSE TO MED. DENSE, NO ODOR, NO HCl
SW	5Y6//1 LT. OLIVE GRAY SAND, 2% CLAY, MEDIUM TO COARSE GRAIN, WELL GRADED, MOIST TO WET, SUB-ANGULAR TO SUB-ROUNDED, NO ODOR, NO HCl
SC	5Y4/1 - 5Y6/1 OLIVE GRAY GRAVELLY, CLAYEY SAND, CLAY 20%, 30% FINE TO COARSE SUB-ROUNDED, FRIABLE SANDSTONE GRAVEL, 40% FINE TO MEDIUM GRAIN SUB-ANGULAR TO SUB-ROUNDED SAND, POORLY SORTED, NO ODOR, DRY TO MOIST
GC	5Y4/1 - 5Y6/1 OLIVE GRAY SANDY, GRAVELLY CLAY, 30% SUB-ROUNDED FRIABLE SANDSTONE GRAVEL, 20% SAND 54'-56' GRAVEL 35%, SAND 10%, GRAVEL 4 - 256mm, DAMP WEATHERED BEDROCK, 5YR4/4 - FFYR3/4 - MOD. BROWN, DRY

WELL

DRILLER'S NOTES

40.8 Top of seal.

43.0 Top of sand.

47.5 Top of screen.

57.5 Bottom of screen.

58.9 Bottom sand.

ARCADIS

AEP 1995

Well Construction Diagrams

MW-01 to MW-10

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

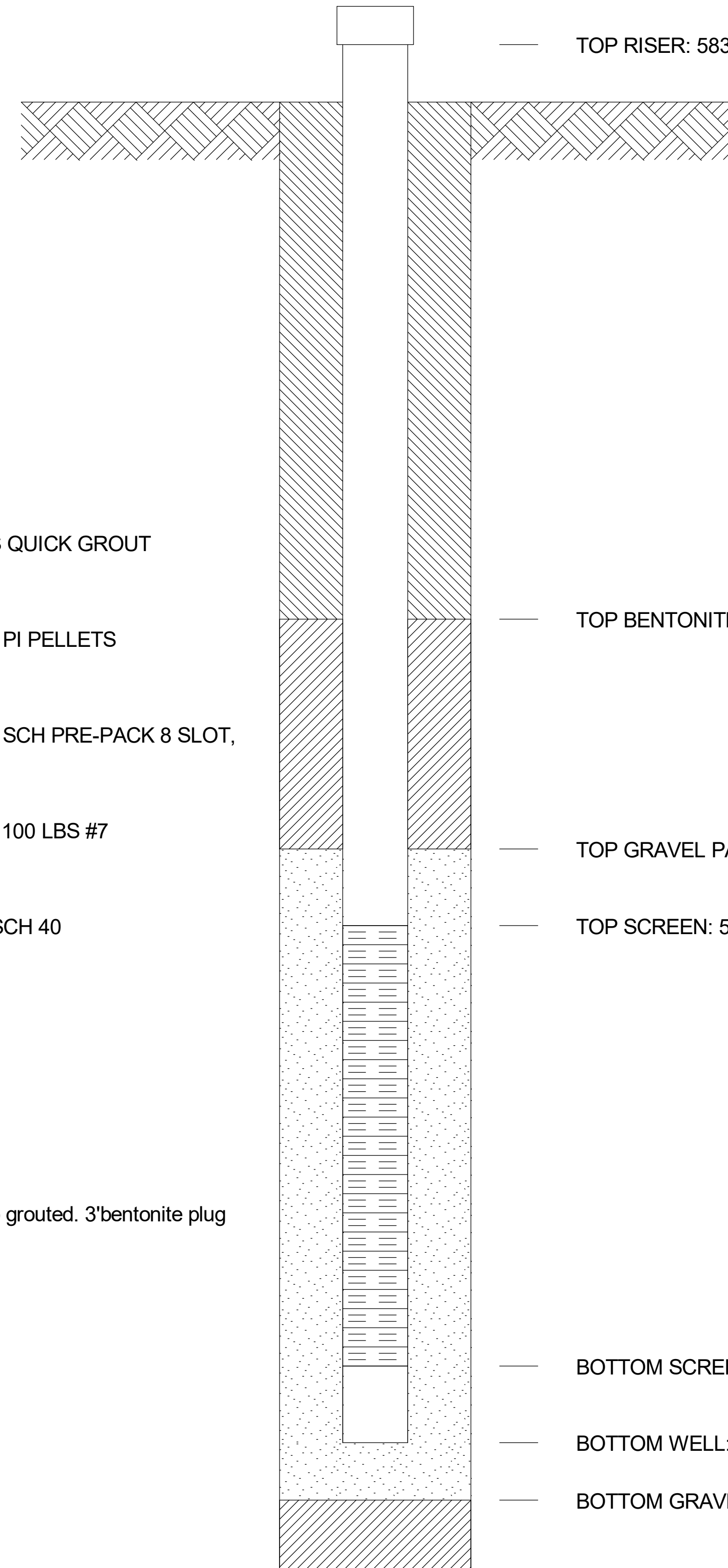
WELL No. **MW-1** BORING No. **AMW-01** INSTALLED **9/6/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 540,266.8 E 1,731,165.6**

SYSTEM **STATE PLANE**

GROUND ELEVATION 581.45 FT.



TOP RISER: 583.45 FT.

TOP BENTONITE SEAL: 563.55 FT.

TOP GRAVEL PACK: 561.55 FT.

TOP SCREEN: 557.45 FT.

BOTTOM SCREEN: 547.45 FT.

BOTTOM WELL: 546.45 FT.

BOTTOM GRAVEL PACK: 546.45 FT.

BOTTOM BORING: 525.45 FT.

GROUT SEAL: 75 GALLONS QUICK GROUT

BENTONITE SEAL: 225 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 575 LBS #5 100 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hydrated 1 hour prior to grouted. 3'bentonite plug 35' TO 38'.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER ____________

COMPANY ____________

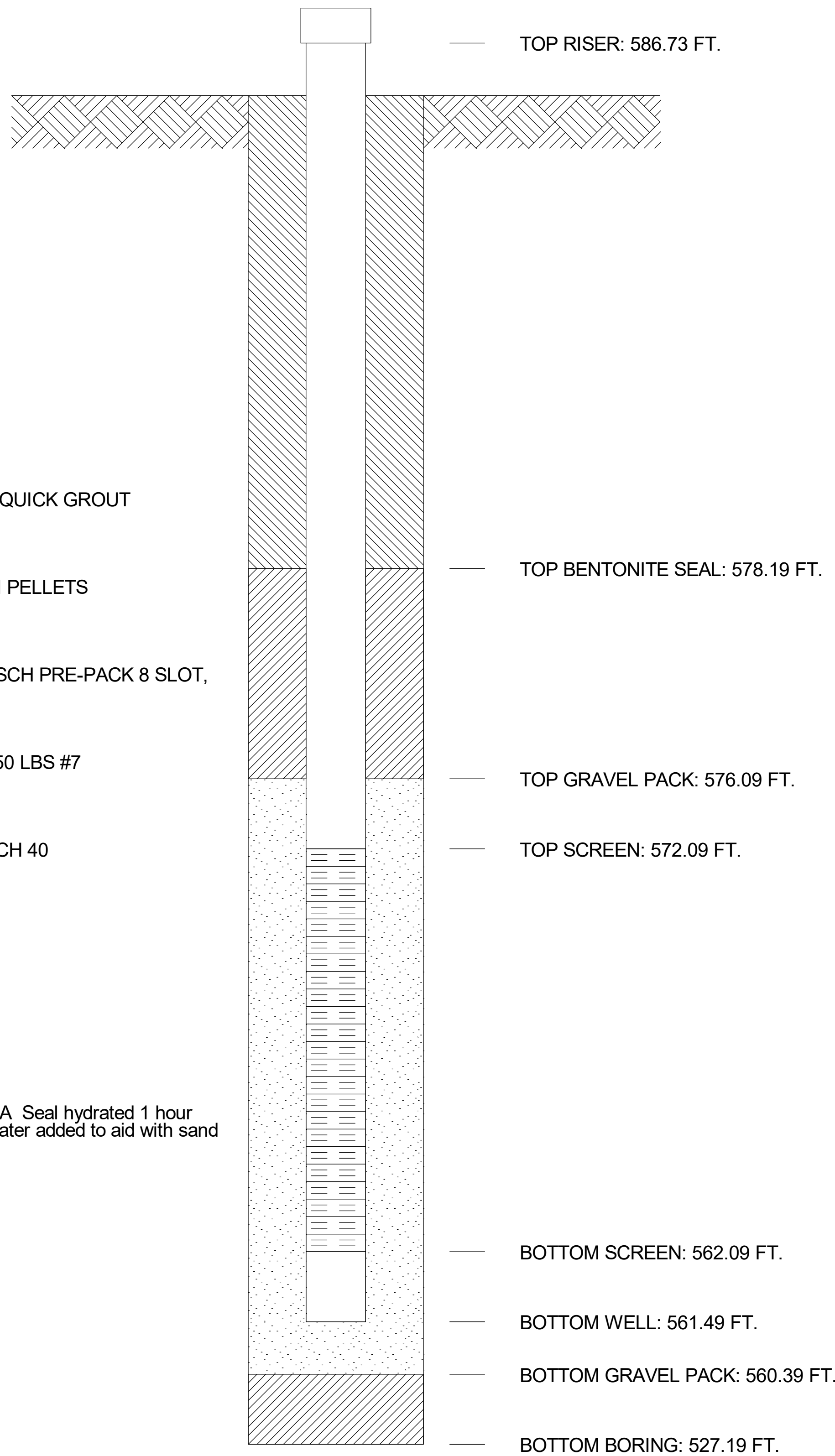
WELL No. **MW-2** BORING No. **AMW-02** INSTALLED **8/24/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 539,188.1 E 1,732,744.9**

SYSTEM **STATE PLANE**

GROUND ELEVATION 585.09 FT.



GROUT SEAL: 20 GALLONS QUICK GROUT

BENTONITE SEAL: 50 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 75 LBS #5 150 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Well installed through 4.25 HSA Seal hydrated 1 hour prior to grouting. Some water added to aid with sand placement.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER ____________

COMPANY ____________

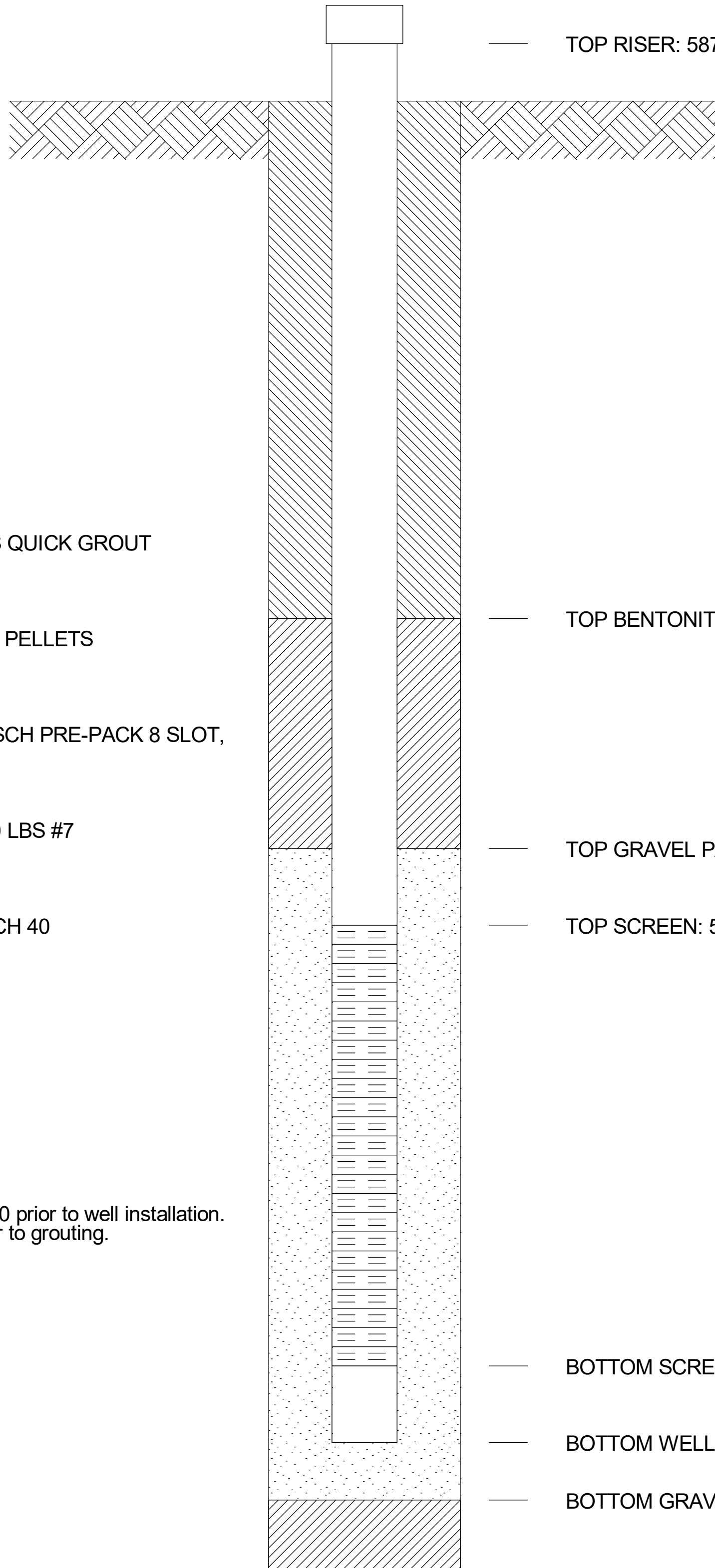
WELL No. **MW-3** BORING No. **AMW-03** INSTALLED **8/23/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 539,199.9 E 1,732,739.4**

SYSTEM **STATE PLANE**

GROUND ELEVATION 585.18 FT.



TOP RISER: 587.36 FT.

TOP BENTONITE SEAL: 545.18 FT.

TOP GRAVEL PACK: 542.48 FT.

TOP SCREEN: 538.28 FT.

BOTTOM SCREEN: 528.28 FT.

BOTTOM WELL: 527.78 FT.

BOTTOM GRAVEL PACK: 527.28 FT.

BOTTOM BORING: 527.18 FT.

GROUT SEAL: 100 GALLONS QUICK GROUT

BENTONITE SEAL: 50 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 75 LBS# 5 50 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Bailed open boring to approx. 40 prior to well installation. Seal hydrated 1 hour prior to grouting.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

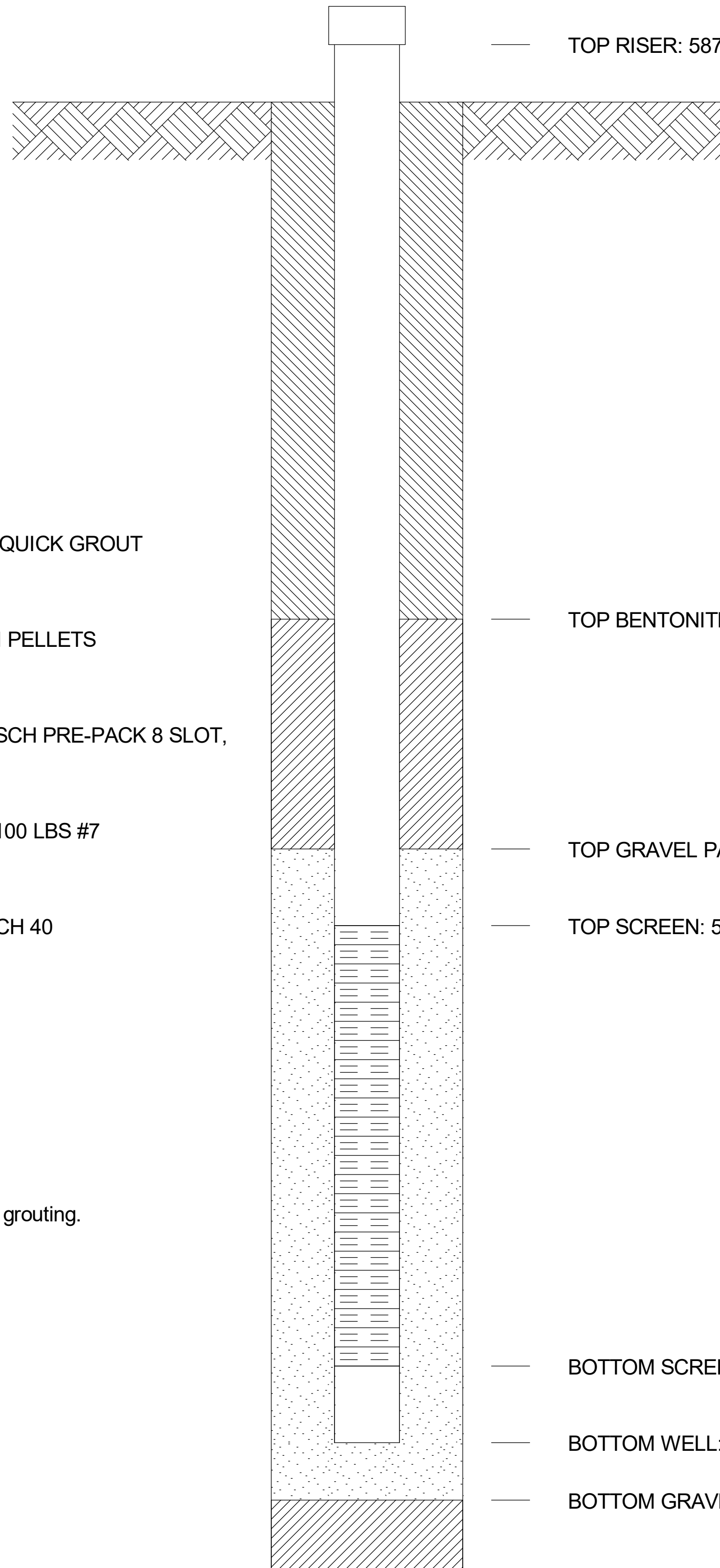
WELL No. **MW-4** BORING No. **AMW-04** INSTALLED **9/8/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 539,605.5 E 1,731,128.7**

SYSTEM **STATE PLANE**

GROUND ELEVATION 585.69 FT.



TOP RISER: 587.90 FT.

TOP BENTONITE SEAL: 567.69 FT.

TOP GRAVEL PACK: 565.79 FT.

TOP SCREEN: 561.69 FT.

BOTTOM SCREEN: 551.69 FT.

BOTTOM WELL: 550.69 FT.

BOTTOM GRAVEL PACK: 550.69 FT.

BOTTOM BORING: 550.69 FT.

GROUT SEAL: 60 GALLONS QUICK GROUT

BENTONITE SEAL: 60 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 250 LBS #5 100 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hydrated 1 hour prior to grouting.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

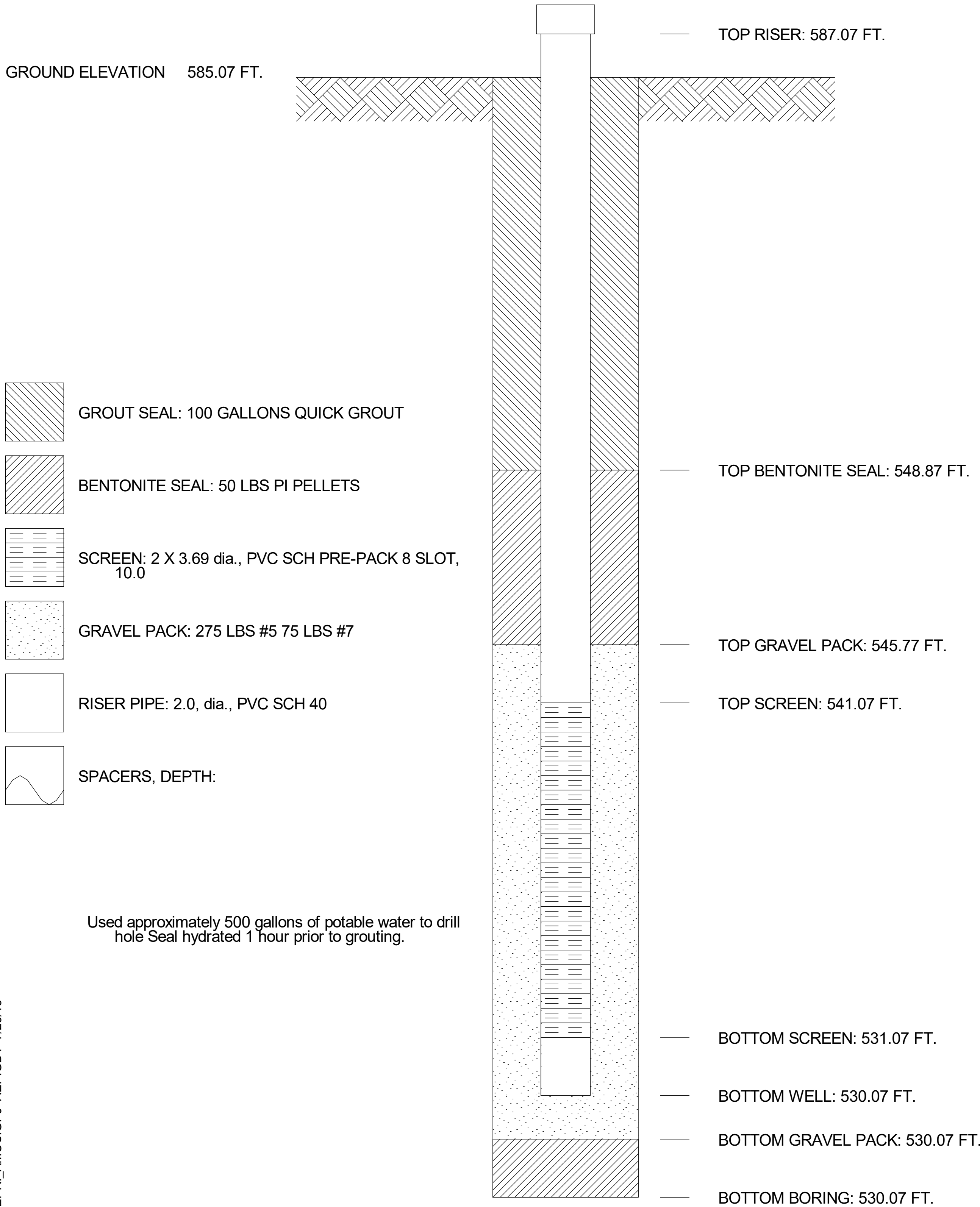
COMPANY

WELL No. **MW-5** BORING No. **AMW-05** INSTALLED **9/7/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 539,614.1 E 1,731,120.7**

SYSTEM **STATE PLANE**



Used approximately 500 gallons of potable water to drill hole Seal hydrated 1 hour prior to grouting.

GEOMCNST EPRI_AMOS.GPJ AEP.GDT 7/23/15

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

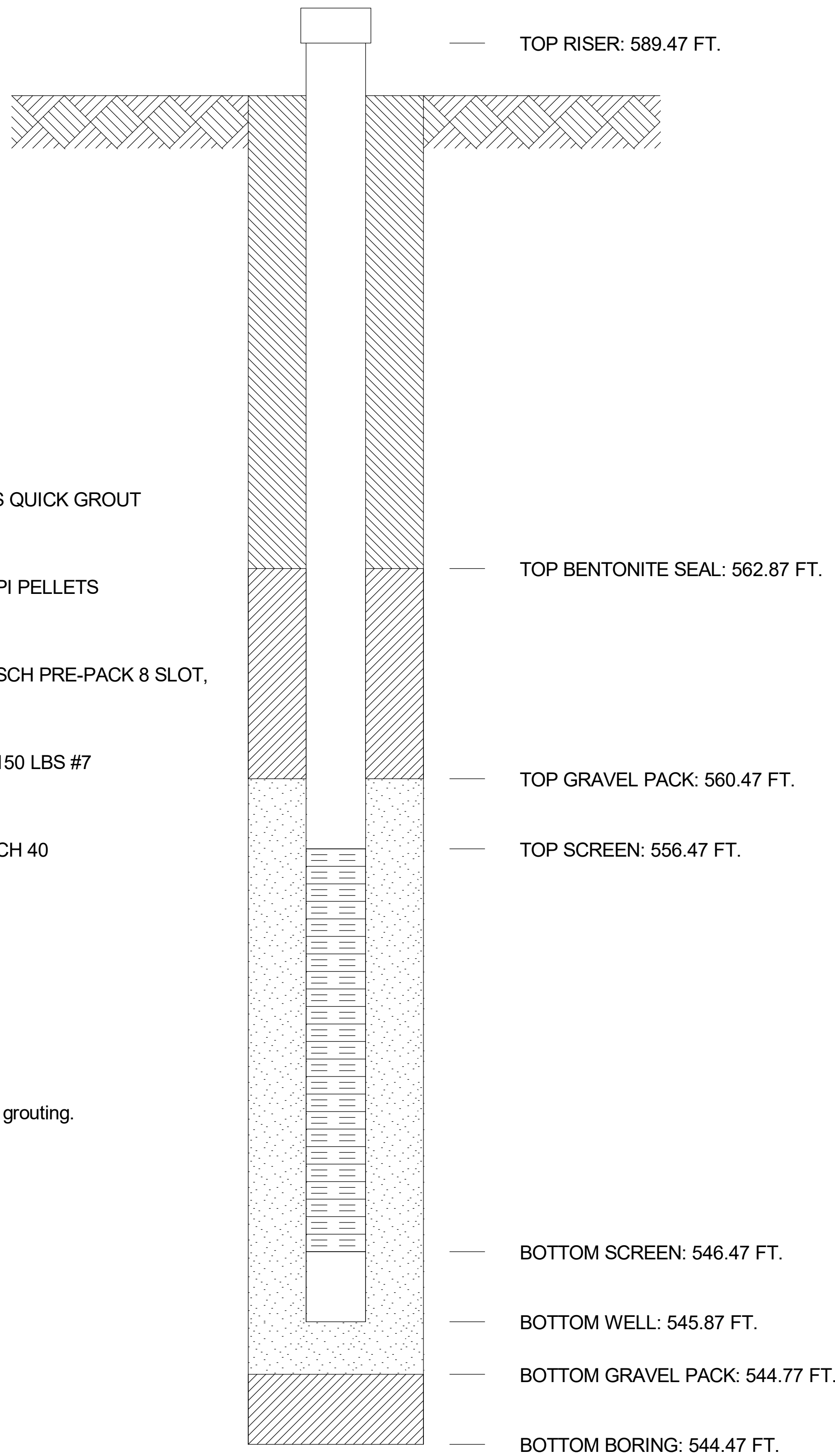
WELL No. **MW-6** BORING No. **AMW-06** INSTALLED **8/30/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 539,169.8 E 1,729,695.5**

SYSTEM **STATE PLANE**

GROUND ELEVATION 587.47 FT.



GROUT SEAL: 100 GALLONS QUICK GROUT

BENTONITE SEAL: 100 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 400 LBS #5 150 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hydrated 1 hour prior to grouting.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

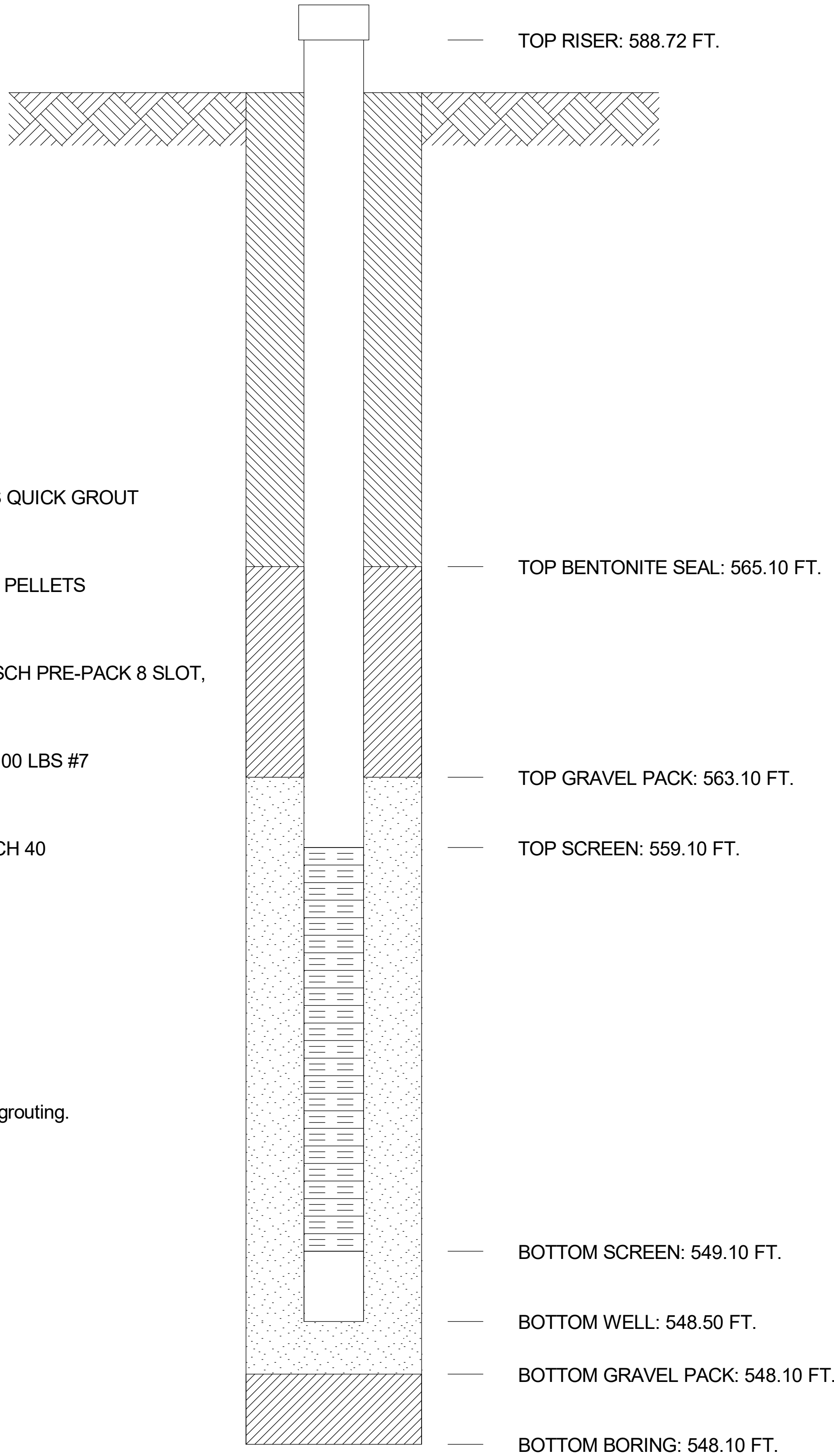
WELL No. **MW-7** BORING No. **AMW-07** INSTALLED **8/31/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 537,838.4 E 1,731,735.7**

SYSTEM **STATE PLANE**

GROUND ELEVATION 587.10 FT.



GROUT SEAL: 100 GALLONS QUICK GROUT

BENTONITE SEAL: 75 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 250 LBS #5 100 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hrdrated 1 hour prior to grouting.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

AEP

JOB NUMBER ____________

COMPANY ____________

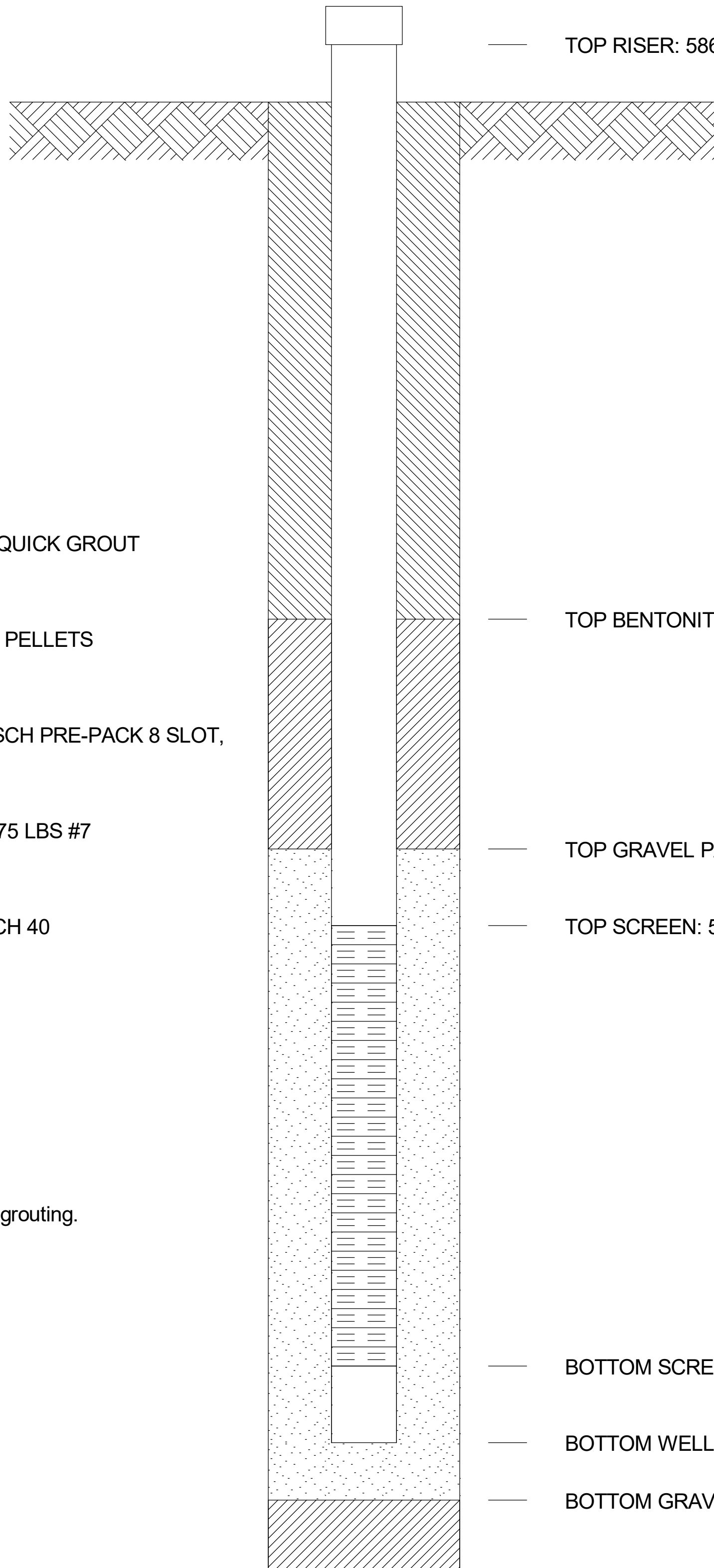
WELL No. **MW-8** BORING No. **AMW-08** INSTALLED **9/13/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 536,151.7 E 1,732,198.9**

SYSTEM **STATE PLANE**

GROUND ELEVATION 584.92 FT.



TOP RISER: 586.70 FT.

TOP BENTONITE SEAL: 580.92 FT.

TOP GRAVEL PACK: 578.92 FT.

TOP SCREEN: 574.92 FT.

BOTTOM SCREEN: 564.92 FT.

BOTTOM WELL: 563.02 FT.

BOTTOM GRAVEL PACK: 563.02 FT.

BOTTOM BORING: 560.92 FT.

GROUT SEAL: 10 GALLONS QUICK GROUT

BENTONITE SEAL: 75 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 475 LBS #5 75 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hydrated 1 hour prior to grouting.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

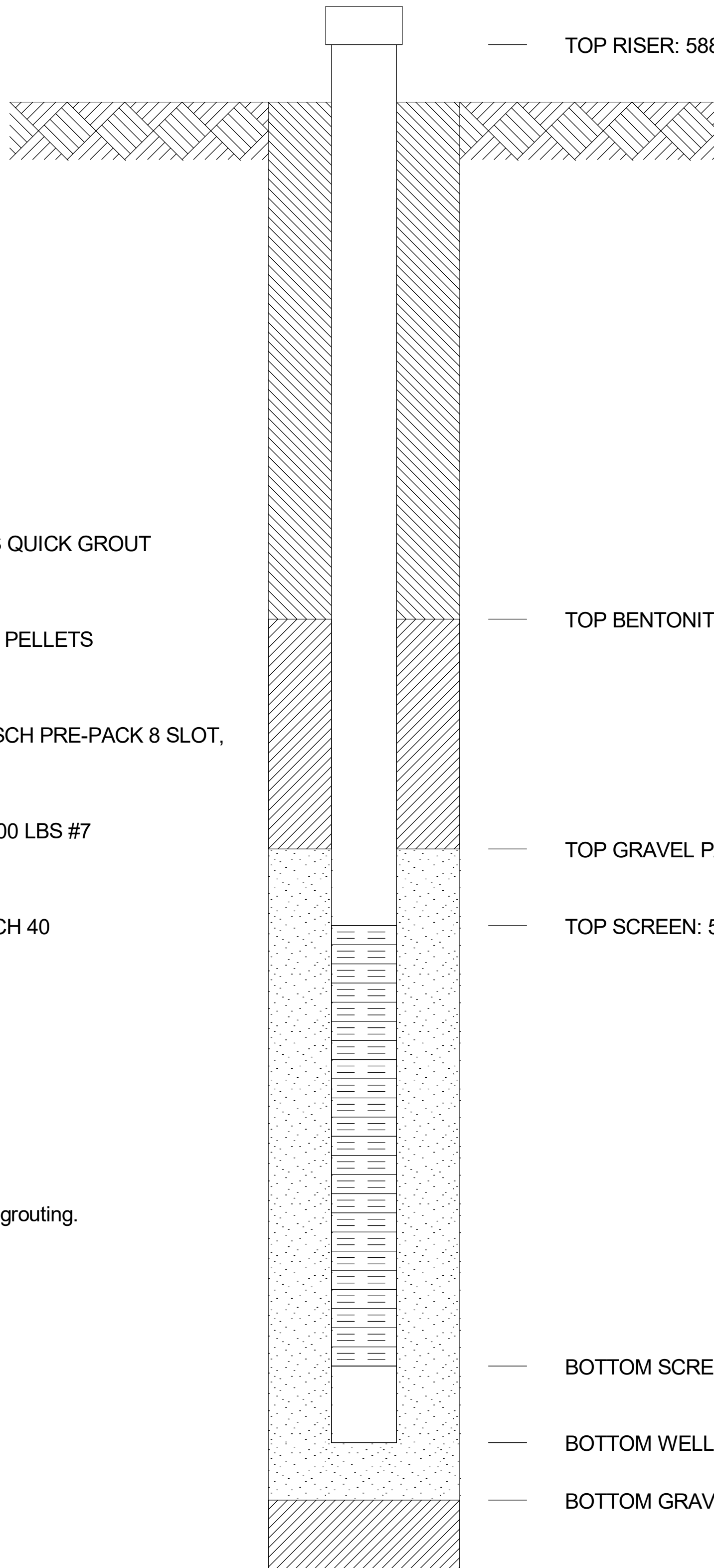
WELL No. **MW-9** BORING No. **AMW-09** INSTALLED **8/29/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 536,983.3 E 1,734,099.7**

SYSTEM **STATE PLANE**

GROUND ELEVATION 586.75 FT.



TOP RISER: 588.54 FT.

TOP BENTONITE SEAL: 571.75 FT.

TOP GRAVEL PACK: 569.75 FT.

TOP SCREEN: 565.75 FT.

BOTTOM SCREEN: 555.75 FT.

BOTTOM WELL: 555.15 FT.

BOTTOM GRAVEL PACK: 554.75 FT.

BOTTOM BORING: 554.75 FT.

GROUT SEAL: 100 GALLONS QUICK GROUT

BENTONITE SEAL: 60 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 450 LBS #5100 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hydrated 1 hour prior to grouting.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER ______

COMPANY ______

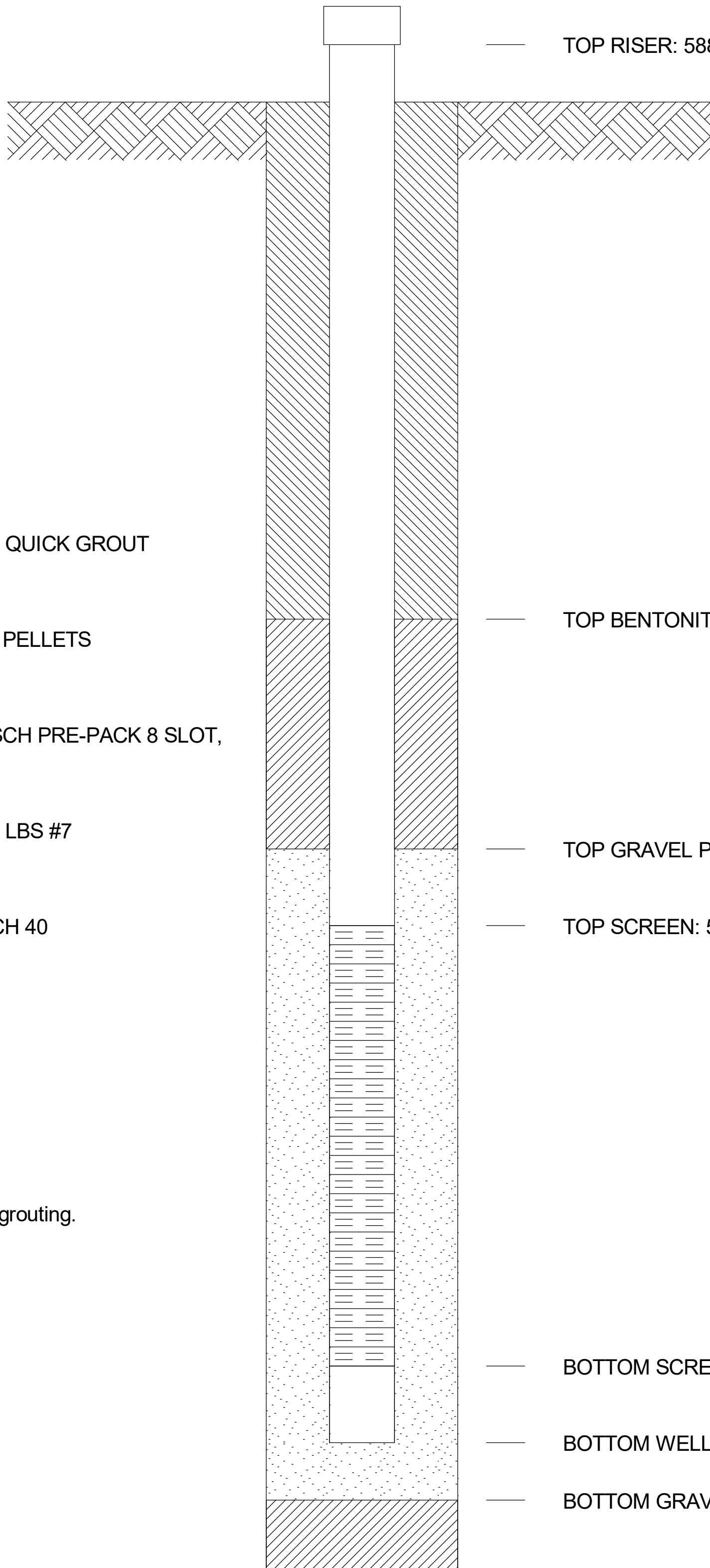
WELL No. **MW-10** BORING No. **AMW-10** INSTALLED **8/28/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 536,989.9 E 1,734,094.7**

SYSTEM **STATE PLANE**

GROUND ELEVATION 586.38 FT.



TOP RISER: 588.47 FT.

TOP BENTONITE SEAL: 545.58 FT.

TOP GRAVEL PACK: 543.38 FT.

TOP SCREEN: 538.88 FT.

BOTTOM SCREEN: 528.88 FT.

BOTTOM WELL: 528.28 FT.

BOTTOM GRAVEL PACK: 527.48 FT.

BOTTOM BORING: 527.38 FT.

GROUT SEAL: 100 GALLONS QUICK GROUT

BENTONITE SEAL: 50 LBS PI PELLETS

SCREEN: 2 X 3.69 dia., PVC SCH PRE-PACK 8 SLOT, 10.0

GRAVEL PACK: 65 LBS #5 75 LBS #7

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

Seal hydrated 1 hour prior to grouting.

ARCADIS

Geo/Environmental Associates, Inc. 2005

Piezometer Construction Diagrams

P1, P3, & P6

PIEZOMETER P1

7 of 9

HCN W/O 90979-059

PROJECT: AEP/ Bottom Ash Dam Evaluation Project

COORDINATES: 7' east of

DATE INSTALLED: 08/09/05

REF. DATUM EL. 586

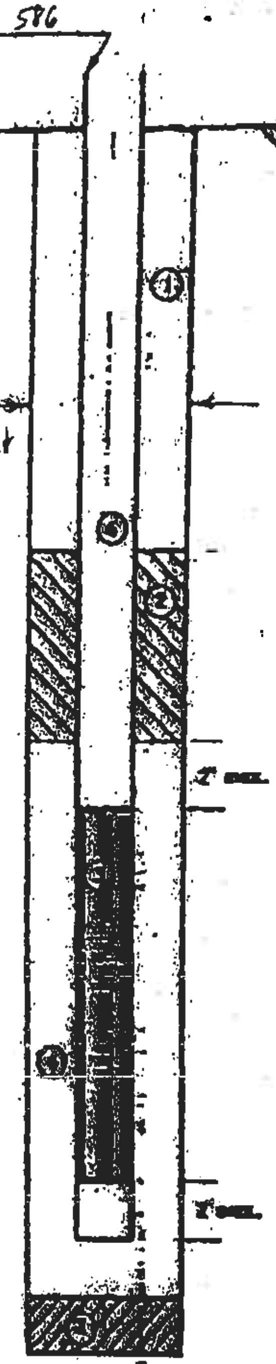
NOTE: CASING PROTECTOR DETAILS NOT SHOWN SEE CDS-... C

SUMMARY ELEVATIONS (FT. NGVD)

WELL NO. B-1 W

REF. DATUM EL. ______

GRADE 583



TOP OF BENTONITE SEAL 24.0

TOP OF GRAVEL PACK 26.0

1 GROUT SEAL MATERIAL: Type I Portland Cement

2 BENTONITE SEAL MATERIAL: 3/8" Coated Tablets

3 SCREEN SIZE: .010 Slot

4 GRAVEL PACK MATERIAL: Quartz Sand

5 BOREHOLE DIAMETER: 6" 5" MIN.

6 1" DIA. PVC CASING

TOP OF SCREEN 28.0'

BOTTOM OF SCREEN 38.0'

BOTTOM OF BLANK SEC. 28.0'

BOTTOM OF GRAVEL PACK 38.0'

BOTTOM OF BOREHOLE 38.0'

DRAFT

"No bentonite seal necessary" (KA, 08/09/05)

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0		OBSERVATION WELL
APP'D.	DR. J. ...	CK. JMK	DATE ...	
AMERICAN ELECTRIC POWER SERVICE CORP.			CDS — 04.1	SH. 1

AMERICAN ELECTRIC POWER
BOTTOM ASH DAM EVALUATION PROJECT
AMOS POWER PLANT, WEST VIRGINIA

GEOLOGIST/ENGINEER: Nick Cahill

7 - 9

PIEZOMETER P3

HCN W.O 90979-059

PROJECT AEP/ BOTTOM ASH DAM EVALUATION PROJECT

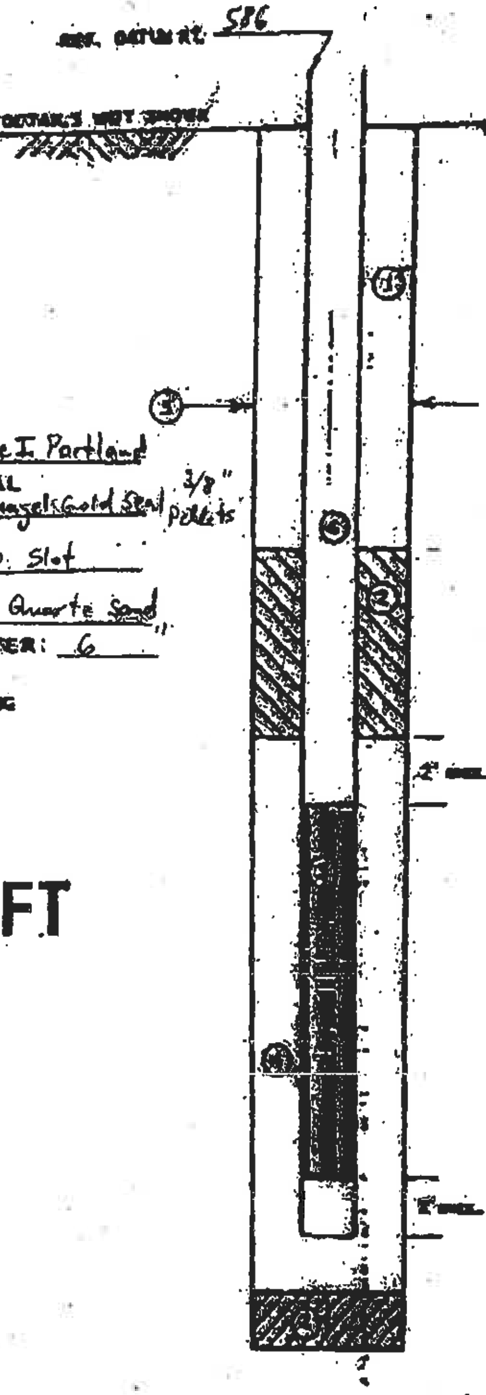
COORDINATES 5' east of B-3

DATE INSTALLED 08/07/05

SUMMARY ELEVATIONS (IN FEET)

WELL NO. B-3 U

REF. DATUM PT.



GRADE 583

TOP OF BENTONITE SEAL 23.0

TOP OF GRAVEL PACK 25.0

1 GROUT SEAL MATERIAL: Type I Portland

2 BENTONITE SEAL MATERIAL: Aquagel/Gold Seal 3/8" pellets

3 SCREEN SIZE: .010 Slot

4 GRAVEL PACK MATERIAL: Quartz Sand

5 BOREHOLE DIAMETER: 6" (6" MIN.)

6 1" DIA. PVC CASING

TOP OF SCREEN 27.0

BOTTOM OF SCREEN 32.0'

BOTTOM OF BLANK SEC. 27.0'

BOTTOM OF GRAVEL PACK 34.0

BOTTOM OF BOREHOLE 36.0'

DRAFT

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD	REVISION 0		OBSERVATION WELL
APP'D.	DR. J OKINS	CK. JHM DATE JUL 1, 1988	
AMERICAN ELECTRIC POWER SERVICE CORP.			GDS — 041 SH. 1

AMERICAN ELECTRIC POWER
BOTTOM ASH DAM EVALUATION PROJECT
AMOS POWER PLANT, WEST VIRGINIA

GEOLOGIST/ENGINEER: Nils Gudel

PIEZOMETER PG

7-C 9

HCN W.O 90979.059

PROJECT: AEP/ Bottom Ash Dam Evaluation Project

COORDINATES: 6' west of B-6.

DATE INSTALLED: 08/06/05

REF. DATUM EL.: 586

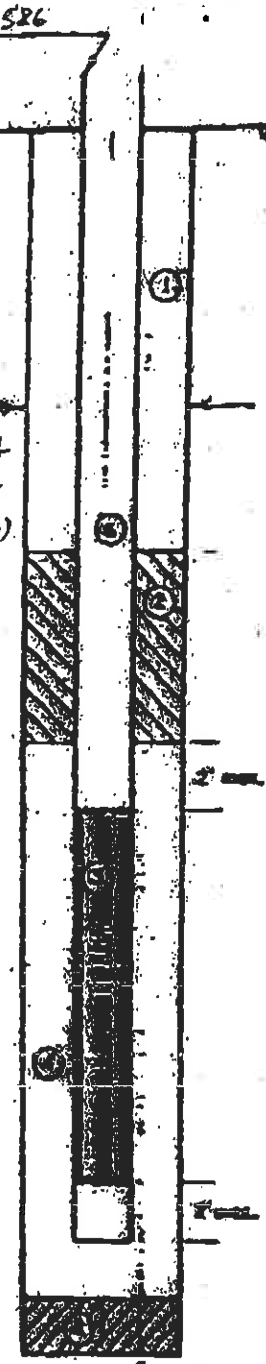
NOTE: CASING PROTECTOR DETAILS NOT SHOWN SEE CDS-04-C

SUMMARY ELEVATIONS (SHOWN)

WELL NO. B-6 H

REF. DATUM EL. ___

GRADE: 583



1 GROUT SEAL
MATERIAL: Type I Portland Cement

2 BENTONITE SEAL
MATERIAL: Aquagel Gold Seal (3/8" Pellets)

3 SCREEN
SIZE: 010 Slot

4 GRAVEL PACK
MATERIAL: Quartz Sand

5 BOREHOLE DIAMETER: 6
6" MIN.

6 1" SCH. PVC CASING

TOP OF BENTONITE SEAL: 10.5'

TOP OF GRAVEL PACK: 13.0'

TOP OF SCREEN: 15.0'

BOTTOM OF SCREEN: 25.0'

BOTTOM OF BLANK SEC.: 15.0'

BOTTOM OF GRAVEL PACK: 27.0'

BOTTOM OF BOREHOLE: 27.0'

DRAFT

GEOTECHNICAL ENGINEERING SECTION CIVIL DESIGN STANDARD		REVISION 0		OBSERVATION WELL
APP'D.	DR.	CK.	DATE	
AMERICAN ELECTRIC POWER SERVICE CORP.				CDS-04-A SH. 1

AMERICAN ELECTRIC POWER
BOTTOM ASH DAM EVALUATION PROJECT
AMOS POWER PLANT, WEST VIRGINIA

GEOLOGIST/ENGINEER:

Nils Guhl

H.C. Nutting Company 2005

Test Boring Logs

B-1 to B-8, B-11

CD/M

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 793 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 343 WALNUT STREET, STE 9, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-4, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-1
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/8/2005
Boring Location		Date Completed	8/8/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
583.00	0.0													
582.60	0.4	Topsoil with organics	0.4											
581.00	2.0	FILL: Brownish gray, silty sand with gravel (SM) nonplastic, dry, medium dense	1.6	1	SS	0.0-1.5	7-9-9 (18)	40						
		FILL: Reddish brown and gray, lean clay (CL) (shale fill), dry - very moist, stiff - medium stiff												
		- some semi-durable shale fragments at 6.0'		2	SS	5.0-6.5	5-6-5 (11)	100						
			13.0											
		- little sandy shale fragments at 11.0'		3	SS	10.0-11.5	1-4-4 (8)	80						2.0
		- very moist from 11.0'		1	ST	11.5-13.5		85						
568.00	15.0													
		FILL: Reddish brown, blueish gray, and yellowish gray, clayey gravel with sand (GC) (gravel=sandstone fragments), moist - very moist, loose - dense		4	SS	15.0-16.5	3-4-4 (8)	73						
				2	ST	17.5-19.5		80						
			9.0											
				5	SS	20.0-21.5	3-17-22 (39)	60						
559.00 ▽	24.0			6	SS	22.5-24.0	5-10-8 (18)	100						
		FILL: Reddish brown, lean clay (CL) (shale fill), wet, soft		7	SS	24.0-25.5	1-2-1 (3)	100						
			3.5											
555.50	27.5	- abundant non-durable to semidurable shale fragments												
		Gray, LEAN CLAY with SAND (CL), wet, very soft		8	SS	27.5-29.0	WOH-WOH-WOH	100						0.25
		- trace organics (wood and peat)	4.0											
551.50	31.5			3	ST	29.5-31.5		100						
▼		Gray, SILTY SAND (SM) low plasticity to non-plastic, wet, very loose - loose		9	SS	31.5-33.0	1-2-2 (4)	100						
			4.5											

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	SS/ST
Inspector	NG

Remarks

Located boring 1' off edge of Rd. (approx. 7' off Rd. CL) on natural side of dam. Water at completion measured through the augers. Boring caved at 34' after 24 hrs. Installed MW with screen from 28' to 38' in hole 7' east of B-1.

Water Level Observations

Immediate	24.0 ft. ▽
At Completion	24.2 ft. ▼
After 24 Hrs.	33.0 ft. ▼
Water used in drilling	31.5 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 540 WALNUT STREET, STE B LAWRENCEBURG, IN 47025 (812) 539-4500 FAX (812) 539-4501
BLUEGRASS REGION 470-B CONWAY CT, STE B-4 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-1
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/8/2005
Boring Location		Date Completed	8/8/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.		DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
547.00	36.0		- little organics (wood framents) throughout - clayey seams	10	SS	35.0-36.5	4-8-6 (14)	100						
		4.5	Gray, SILTY SAND with GRAVEL (SM) (gravel=sandstone fragments) non-plastic, wet, medium dense - loose - cobbles at 38.0' to 39.0' - trace organics (peat)											
542.50	40.5			11	SS	40.0-41.5	2-2-3 (5)	67						
		4.5	Gray, SILTY SAND (SM) non-plastic, wet, loose - trace coal fragments and organics (peat)											
538.00	45.0													
		8.5	Gray, POORLY GRADED SAND with SILT (SP-SM), wet, loose	12	SS	45.0-46.5	3-3-2 (5)	100						
			- trace organics (peat)											
				13	SS	50.0-51.5	3-3-7 (10)	100						
			- little gravel (sandy shale fragments) at 51.5'											
529.50	53.5													
		5.0	Blueish gray and reddish brown, LEAN CLAY with SAND (residual SHALE), wet - moist, stiff - very hard	14	SS	55.0-56.5	5-10-26 (36)	100						
524.50	58.5			15	SS	57.5-58.5	26-50/0.5	100						
			BORING COMPLETED @ 58.5'											

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	SS/ST
Inspector	NG

Remarks

Located boring 1' off edge of Rd. (approx. 7' off Rd. CL) on natural side of dam. Water at completion measured through the augers. Boring caved at 34' after 24 hrs. Installed MW with screen from 28' to 38' in hole 7' east of B-1.

Water Level Observations

Immediate	24.0	ft. ▽
At Completion	24.2	ft. ▼
After 24 Hrs.	33.0	ft. ▼
Water used in drilling	31.5	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 750 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT, STE B-8 LEXINGTON, KY 40511 (859) 406-8530 FAX (859) 406-8539

Client: American Electric Power
Project: Bottom Ash Dam Evaluation - Amos Plant, WV
Boring Location:
Elevation Ref.: AEP Boring Location Plan

Boring No.: B-2
Date Started: 8/1/2005
Date Completed: 8/2/2005
Work Order No.: 90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness) (visual classification unless otherwise noted)	Thickness	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
583.00	0.0	FILL: Brown, silty sand with gravel (SM) nonplastic, dry - moist, dense	5.5	1	SS	0.0-1.5	28-25-17 (42)	87						
577.50	5.5	FILL: Reddish brown, lean clay with sand (CL) (shale fill), dry - moist, stiff - very stiff	15.5	2	SS	5.0-6.5	7-6-7 (13)	67						
				1	ST	6.5-8.5		100						
		- little friable sandstone fragments at 10.0'		3	SS	10.0-11.5	5-6-10 (16)	100						
				2	ST	11.5-13.5		100						
		- multi-colored, moist, and trace organics (grass/roots) at 16.0'		4	SS	15.0-16.5	4-11-8 (19)	100						
				3	ST	16.5-18.5		100						
562.00	21.0			5	SS	20.0-21.5	3-4-14 (18)							
		FILL: Reddish brown and gray, sandy lean clay with gravel (CL) (gravel=sandstone fragments) (SPT Ns likely overstated due to coarse gravel), moist - wet, medium stiff - stiff - very gravelly at 21.5'	7.5	4	ST	21.5-23.5		60						
		- wet from 26.5'		6	SS	25.0-26.5	8-10-7 (17)	60						
				5	ST	26.5-28.5		90						
554.50	28.5	Gray, SANDY LEAN CLAY (CL), very moist - wet, soft	2.0											
552.50	30.5	Gray, SILTY SAND (SM) nonplastic, wet, loose	4.5	7	SS	30.0-31.5	1-2-4 (6)	100						
548.00	35.0													

DRAFT

General Notes
Driller: HCN
Rig No.: D. Smith
Rig Type: ATV
Method: NQ2/SS/ST
Inspector: NG

Remarks
Located boring 2' off Rd. CL on natural dam side. No indication of void noted in NQ2 #2. Material probably washed out due to short run.

Water Level Observations
Immediate: 26.5 ft. ▽
At Completion: 18.0 ft. ▼
After 24 Hrs. 16.0 ft. ▼
Water used in drilling: 35.0 ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 780 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 340 WALNUT STREET, STE 5 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

Client	American Electric Power	Boring No.	B-2
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/1/2005
Boring Location		Date Completed	8/2/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, POORLY GRADED SAND with SILT (SP-SM), wet, very loose - loose		8	SS	35.0-36.5	2-2-2 (4)							
				9	SS	40.0-41.5	10-10-9 (19)	80						
			15.0											
				10	SS	45.0-46.5	3-2-4 (6)	67						
533.00	50.0													
		Gray, SILTY SAND with GRAVEL (SM) (gravel=sandstone fragments), nonplastic, wet, medium dense	4.0	11	SS	50.0-51.5	4-5-11 (16)	80						
529.00	54.0													
527.00	56.0	Gray and brown, LEAN CLAY with SAND (CL) (residual sandy SHALE), wet, very stiff - hard	2.0	12	SS	55.0-56.0	26-50/0.5	90						
526.60	56.4	Gray, sandy SHALE, completely to highly weathered, extremely soft - very soft	0.4											
		Reddish brown, CLAYSTONE, completely to highly weathered, extremely soft - very soft	4.6	1	NQ2	56.0-60.4		98	0				0-1	
522.00	61.0			2	NQ2	60.4-61.0		0	0				0-1	
		BORING COMPLETED @ 61.0'												

DRAFT

General Notes

Driller	HCN
Rig No.	D. Smith
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring 2' off Rd. CL on natural dam side. No indication of void noted in NQ2 #2. Material probably washed out due to short run.

Water Level Observations

Immediate	28.5	ft. ▽
At Completion	16.0	ft. ▼
After 24 Hrs.	16.0	ft. ▼
Water used in drilling	35.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 348 WALNUT STREET STE 1, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-4, LEXINGTON KY 40511, (859) 425-8830, FAX (859) 425-8830

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-3
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/7/2005
Boring Location		Date Completed	8/7/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

DESCRIPTION OF MATERIALS
color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS
583.00	0.0		
580.00	3.0	3.0	FILL: Brown, silty sand with gravel (SM) non-plastic, dry - moist, medium dense
566.50	16.5	13.5	FILL: Reddish brown and multi-colored, lean clay (CL) (shale fill), moist, medium stiff - very stiff - little sandstone/sandy shale fragments
561.00	22.0	5.5	FILL: Brown and gray, clayey gravel with sand (GC) (gravel=sandstone fragments), moist, medium dense - very gravelly at 20.0' - clay component very moist to wet and soft at 21.0' to 21.5'
557.00	26.0	4.0	FILL: Brown and gray, silty gravel with sand (GM) (gravel=sandstone fragments) non-plastic, very moist, medium dense - very dense - thin clayey gravel seams
555.50	27.5	1.5	FILL/DISTURBED Material: brown and greenish gray, clayey gravel with sand (GC) (gravel=sandstone fragments), wet - very moist, very loose
555.00	28.0	0.5	
553.00	30.0	2.0	FILL/DISTRUBED MATERIAL: gray, lean clay (CL), slight organic odor, wet, soft
550.50	32.5	2.5	FILL/DISTRUBED MATERIAL: greenish gray, silty/clayey gravel with sand (GC/GM) (gravel=sandstone fragments), wet, very loose
			Gray, LEAN CLAY with SAND (CL), wet, very soft - soft

SAMPLE

NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
1	SS	0.0-1.5	4-9-7 (16)	80						
2	SS	5.0-6.5	7-4-4 (8)	93						
1	ST	6.5-8.5		80						
3	SS	10.0-11.5	4-3-6 (9)	93						
2	ST	11.5-13.5		100						
4	SS	15.0-16.5	3-7-9 (16)	100						
3	ST	16.5-17.0		100						
4	ST	18.5-20.0		67						
5	SS	20.0-21.5	11-6-5 (11)	80						
6	SS	22.0-23.2	7-17-50/0.2	117						
7	SS	25.0-26.5	38-19-6 (25)	100						
8	SS	26.5-28.0	4-2-2 (4)	87						<0.25
9	SS	28.0-29.5	3-1-2 (3)	47						
5	ST	30.0-32.0		100						
10	SS	32.0-33.5	2-5-4 (9)	100						

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring at edge of Rd. (approx. 6' off Rd. CL) on natural side of dam. ST#3 failed due to presence of gravel. ST#4 terminated at 20' due to presence of gravel. Installed MW with screen from 27.0' to 32.0' in hole 5' east of B-3.

Water Level Observations

Immediate	26.0	ft. ▽
At Completion	17.5	ft. ▽
After 24 Hrs.	20.5	ft. ▼
Water used in drilling	35.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
911 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
780 MORRISON ROAD
COLUMBUS, OH 43230
(614) [illegible]-3113
FAX (614) [illegible]-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) [illegible]
FAX (812) [illegible]

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-[illegible]
FAX (859) 455-[illegible]

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-3
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/7/2005
Boring Location		Date Completed	8/7/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)		SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		- trace wood and coal fragments at 34.0'		11	SS	35.0-36.5	3-4-2 (6)	100						
		Gray, SILTY SAND (SM) non-plastic, wet, loose *(LAYER CONTINUED DESCRIPTION REPEATED)* - trace peat	12.5											
				12	SS	40.0-41.5	2-4-6 (10)	100						
538.00	45.0													
		Gray, POORLY GRADED SAND with SILT (SP-SM), wet, medium dense		13	SS	45.0-46.5	5-6-6 (12)	100						
		- trace coal fragments at 50.0'	9.5	14	SS	50.0-51.5	4-6-14 (20)	100						
528.50	54.5													
		Blueish gray to reddish brown, LEAN CLAY with SAND (CL) (residual SHALE), very stiff - very hard	3.8	15	SS	55.0-56.5	21-44-25 (69)	100						
524.70	58.3			16	SS	57.5-58.3	30-50/0.3	100						
		Reddish brown and blueish gray, CLAYSTONE, completely to highly weathered, extremely soft - very soft	2.3											
522.40	60.6													
		Blueish gray, SANDY SILTSTONE, slightly weathered, soft - medium hard	2.7	1	NQ2	58.3-63.3		100	26				0-3	
519.70	63.3													
		BORING COMPLETED @ 63.3'												

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring at edge of Rd. (approx. 5' off Rd. CL) on natural side of dam. ST#3 failed due to presence of gravel. ST#4 terminated at 20' due to presence of gravel. Installed MW with screen from 27.0' to 32.0' in hole 5' east of B-3.

Water Level Observations

Immediate	26.0 ft. ▽
At Completion	17.5 ft. ▽
After 24 Hrs.	20.5 ft. ▼
Water used in drilling	35.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 700 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 540 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4500 FAX (812) 539-4501
BLUEGRASS REGION 470-B CONWAY CT., STE B-6 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-4
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/2/2005
Boring Location		Date Completed	8/3/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Stratum thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
583.00	0.0													
		FILL: Brown and gray, silty sand with gravel (SM) nonplastic, moist, dense - medium dense	5.0	1	SS	0.0-1.5	14-12-13 (25)	100						
578.00	5.0	FILL: Brown, sandy lean clay (CL), moist, soft	3.0	2	SS	5.0-6.5	2-1-2 (3)	87						
				1	ST	6.5-8.5		0						
575.00	8.0	FILL: Brown, silty/clayey sand (SC/SM), moist, loose - very loose	8.5	3	SS	10.0-11.5	3-4-6 (10)	100						
				4	SS	15.0-16.5	2-1-2 (3)	100						
566.50	16.5	FILL/DISTURBED MATERIAL: Grayish brown, silty sand (SM), nonplastic, very moist - wet, very loose - loose - wet from 18.0' - trace coal fragments/peat at 21'	10.5	5	SS	20.0-21.5	2-1-4 (5)	100						
		- some gravel (sandstone fragments) at 27.0'		6	SS	25.0-26.5	2-3-2 (5)	0						
556.00	27.0	Grayish brown, SILTY SAND (SM) nonplastic, wet, medium dense - trace peat		7	SS	26.5-28.0	9-8-3 (11)	67						
				8	SS	30.0-31.5	7-8-10 (18)	100						

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring 4' off Rd. CL on natural dam side. NQ2 #1 56.4'-58.5' no indication of void noted. Material probably washed out due to extremely soft HCSI. Boring caved at 18' upon completion and caved at 19' after 24 hrs.

Water Level Observations

Immediate	18.0 ft. ▽
At Completion	17.0 ft. ▼
After 24 Hrs.	18.0 ft. ▼
Water used in drilling	25.0 ft.

BF = BACKFILLED NW = NO WATER (Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 799 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 348 WALNUT STREET, STE B, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT, STE B-3, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-4
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/2/2005
Boring Location		Date Completed	8/3/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		16.0 Grayish brown, SILTY SAND (SM) nonplastic, wet, medium dense *(LAYER CONTINUED DESCRIPTION REPEATED)*	9	SS	35.0-36.5	6-8-5 (13)	100						
		- little coal fragments and peat at 41.0'	10	SS	40.0-41.5	7-9-11 (20)	73						
540.00	43.0												
		7.0 Gray, POORLY GRADED SAND with SILT (SP-SM), wet, medium dense - trace coal fragments at 46.0'	11	SS	45.0-46.5	4-7-5 (12)	73						
533.00	50.0												
		3.0 Gray, POORLY GRADED SAND with SILT and GRAVEL (SP-SM) (gravel=sandstone fragments), wet, dense	12	SS	50.0-51.5	5-20-18 (38)	67						
530.00	53.0												
		3.4 Reddish brown and gray, LEAN CLAY (CL) (residual SHALE), wet - moist, stiff - hard	13	SS	55.0-56.4	10-27-50/0.4	100						
526.60	56.4												
		5.1 Reddish brown and gray, CLAYSTONE, completely to highly weathered, extremely soft	1	NQ2	56.4-61.5		69	0				0	
521.50	61.5												
		BORING COMPLETED @ 61.5'											

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring 4' off Rd. CL on natural dam side. NQ2 #1 56.4'-58.5' no indication of void noted. Material probably washed out due to extremely soft HCSI. Boring caved at 18' upon completion and caved at 19' after 24 hrs.

Water Level Observations

Immediate	18.0 ft.
At Completion	17.0 ft.
After 24 Hrs.	18.0 ft.
Water used in drilling	25.0 ft.

BF = BACKFILLED NW = NO WATER (Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 911 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294 | CENTRAL OHIO REGION 780 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475 | INDIANA REGION 348 WALNUT STREET STE 5 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301 | BLUEGRASS REGION 470-8 CONWAY CT. STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8530

Client	American Electric Power	Boring No.	B-5
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/3/2005
Boring Location		Date Completed	8/13/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
583.00	0.0	FILL: Brownish gray, silty sand with gravel (SM) nonplastic, moist, dense - medium dense (5.5)	1	SS	0.0-1.5	10-15-15 (30)	100						
		- trace coal fragments at 5.0'											
577.50	5.5	Fill: Brown, poorly graded sand (SP), dry - moist, loose (3.5) - uniform appearance	2	SS	5.0-6.5	3-4-3 (7)	100						
574.00	9.0	FILL: Brown, poorly graded sand with silt (SP-SM), moist, loose (6.5) - uniform appearance	3	SS	10.0-11.5	2-1-4 (5)	100						
567.50	15.5	FILL: Brown, silty/clayey sand (SC/SM), very moist - wet, loose (2.5) - wet from 16.0' - uniform appearance	4	SS	15.0-16.5	4-3-2 (5)	100						
565.00	18.0	FILL: Grayish brown, silty sand (SM), nonplastic to low plasticity, wet, loose (4.0)	5	SS	20.0-21.5	1-2-4 (6)	100						
561.00	22.0	Brown and gray, SILTY SAND (SM), nonplastic to low plasticity, moist - wet, loose - medium dense	6	SS	25.0-26.5	5-5-9 (14)	73						
		- trace peat from 26.5'											
			7	SS	30.0-31.5	4-6-9 (15)	100						

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	SS
Inspector	NG

Remarks

Located boring 3' off Rd. CL on natural dam side. Boring caved at 18' after 24 hrs.

Water Level Observations

Immediate	16.5 ft. ▽
At Completion	17.5 ft. ▼
After	24 Hrs. NW ft.
Water used in drilling	20.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 780 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 345 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4600 FAX (812) 539-4301
BLUEGRASS REGION 410-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 458-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-5
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/3/2005
Boring Location		Date Completed	8/13/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Brown and gray, SILTY SAND (SM), nonplastic to low plasticity, moist - wet, loose - medium dense *(LAYER CONTINUED DESCRIPTION REPEATED)*	8	SS	35.0-36.5	2-5-6 (11)	100						
		32.5 - clayey seam at 36.0'											
			9	SS	40.0-41.5	3-5-8 (13)	100						
			10	SS	45.0-46.5	6-8-8 (16)	100						
		- little gravel (sandstone fragments) at 51.0'	11	SS	50.0-51.5	5-8-11 (19)	100						
528.50	54.5												
527.20	55.8	1.3 Reddish brown and gray, LEAN CLAY (CL) (residual SHALE), moist, hard	12	SS	55.0-55.8	30-50/0.3	100						
		BORING COMPLETED @ 55.8'											

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	SS
Inspector	NG

Remarks

Located boring 3' off Rd. CL on natural dam side. Boring caved at 18' after 24 hrs.

Water Level Observations

Immediate	16.5 ft. ▽
At Completion	17.5 ft. ▼
After 24 Hrs.	NW ft.
Water used in drilling	20.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY

APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711

EMPLOYEE OWNED

GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
911 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-[illegible]

CENTRAL OHIO REGION
750 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
340 WALNUT STREET, STE 6
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-3
LEXINGTON, KY 40511
(859) [illegible]
FAX (859) [illegible]

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-6
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/4/2005
Boring Location		Date Completed	8/5/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.		DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
583.00	0.0													
582.50	0.5	0.5	Topsoil	1	SS	0.0-1.5	3-5-4 (9)	100						
582.00	1.0	0.5	FILL: Gray, silty sand (SM), nonplastic, dry - moist, loose											
577.50	5.5	4.5	FILL: Brown, sandy lean clay (CL), moist, stiff											
572.50	10.5	5.0	FILL: Reddish brown and multicolored, lean clay with gravel (CL) (gravel=sandstone fragments) (shale fill), moist, stiff	2	SS	5.0-6.5	2-5-5 (10)	87						
				1	ST	6.5-8.5		85						
564.50 ▽	18.5	8.0	Brown to light brown, sandy lean clay (CL), moist, stiff - uniform appearance - trace organics (hair roots)	3	SS	10.0-11.5	4-8-7 (15)	100						
				4	SS	15.0-16.5	3-4-6 (10)	100						4.5
				2	ST	16.5-18.5		45						
561.00	22.0	3.5	FILL/DISTURBED MATERIAL, silty/clayey sand (SC/SM), wet, loose - uniform appearance	5	SS	20.0-21.5	3-5-2 (7)	100						
559.00	24.0	2.0	Brown, LEAN CLAY with SAND (CL), wet, soft - logged from cuttings and ST											
▼		11.5	Brown, SILTY SAND (SM), nonplastic, wet, loose	3	ST	23.0-25.0		100						
				6	SS	25.0-26.5	2-5-4 (9)	100						
				7	SS	30.0-31.5	2-3-2 (5)	100						

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	SS/ST
Inspector	NG

Remarks

Located boring 3' off Rd. edge (approx. 8' off Rd. CL) on natural dam side. Water level at completion measured through the augers. Installed MW with screen from 15.0' to 25.0' in hole 6' west of B-6.

Water Level Observations

Immediate	18.5 ft. ▽
At Completion	24.5 ft. ▼
After	24 Hrs. BF ft.
Water used in drilling	25.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 760 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 340 WALNUT STREET, STE 6 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT, STE B-9 LEXINGTON, KY 40511 (859) 455-8555 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-6
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/4/2005
Boring Location		Date Completed	8/5/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
547.50	35.5	Gray, POORLY GRADED SAND with SILT (SP-SM), wet, medium dense	8	SS	35.0-36.5	6-6-6 (12)	80						
		- trace peat											
		10.5	9	SS	40.0-41.5	4-7-8 (15)	87						
537.00	46.0		10	SS	45.0-46.5	6-7-7 (14)	80						
		3.0 Gray, POORLY GRADED SAND with SILT and GRAVEL (SP-SM) (gravel=sandstone fragments), wet, medium dense											
534.00	49.0												
		5.0 Gray, POORLY GRADED SAND (SP), wet, medium dense	11	SS	50.0-51.5	5-6-7 (13)	100						
529.00	54.0												
527.20	55.8	1.8 Blueish gray, SANDY LEAN CLAY (CL) (residual sandy SHALE), moist - dry, very stiff - very hard	12	SS	55.0-55.8	40-50/0.3	100						
		BORING COMPLETED @ 55.8'											

DRAFT

General Notes

Driller	HCN
Rig No.	J. Johnson
Rig Type	ATV
Method	SS/ST
Inspector	NG

Remarks

Located boring 3' off Rd. edge (approx. 8' off Rd. CL) on natural dam side. Water level at completion measured through the augers. Installed MW with screen from 15.0' to 25.0' in hole 6' west of B-6.

Water Level Observations

Immediate	18.5 ft. ▽
At Completion	24.5 ft. ▼
After 24 Hrs.	BF ft.
Water used in drilling	25.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 730 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 340 WALNUT STREET STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT. STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-7
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/11/2005
Boring Location		Date Completed	8/11/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness) (visual classification unless otherwise noted)	Thickness	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
568.00	0.0													
567.70	0.3	Topsoil	0.3											
		FILL: Reddish and yellowish brown, lean clay with sand (CL), dry, stiff - some semi-friable shale fragments	3.7	1	SS	0.0-1.5	3-4-10 (14)	100						
564.00	4.0	FILL: Gray, poorly graded gravel with silt and sand (GP-GM), wet, loose	5.5	2	SS	5.0-6.5	3-4-1 (5)	47						
558.50	9.5	FILL/DISTURBED MATERIAL, gravelly lean clay (CL), wet, soft - very soft	2.5	3	SS	10.0-11.5	3-2-1 (3)	40						
556.00	12.0	Gray, LEAN CLAY (CL), wet, very soft	2.5	1	ST	13.0-15.0		100						
553.50	14.5	Gray, SILTY SAND (SM), wet, very loose - loose - trace organics (wood fragments) at 16'	8.5	4	SS	15.0-16.5	1-2-2 (4)	100						
		- trace friable sandstone fragments and little coal fragments/peat at 21'		5	SS	20.0-21.5	1-3-4 (7)	100						
545.00	23.0	Gray, POORLY GRADED SAND with SILT (SP-SM), wet, loose - trace coal fragments/peat	12.5	6	SS	25.0-26.5	3-4-3 (7)	100						
				7	SS	30.0-31.5	3-2-3 (5)	100						

DRAFT

General Notes

Driller	HCN
Rig No.	J. Williams
Rig Type	Track
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring at dam toe, appr. 3.5' above creek. Hay stick used for sediment control. Water level upon completion measured through the augers before NQ2. 24 hr. water level measured through the augers. Installed MW with screen from 40.9' to 30.9'.

Water Level Observations

Immediate	4.0 ft. ▽
At Completion	3.0 ft. ▼
After 24 Hrs.	3.0 ft. ▼
Water used in drilling	20.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 780 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-5 LEXINGTON, KY 40511 (859) 455-3038 FAX (859) 455-8630

Client	American Electric Power	Boring No.	B-7
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/11/2005
Boring Location		Date Completed	8/11/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
532.50	35.5	2.5 Gray and multicolored, SILTY GRAVEL with SAND (GM) (gravel =sandstone fragments), nonplastic to low plasticity, wet, dense	8	SS	35.0-36.5	6-16-18 (34)	100						
530.00	38.0	2.9 Reddish brown and gray, LEAN CLAY with SAND (CL) (completely weathered sandy SHALE), moist - dry, very stiff - very hard	9	SS	40.0-40.9	30-50/0.4	100						
527.10	40.9	4.8 Reddish brown, CLAYSTONE, completely to highly weathered, extremely soft - very soft	1	NQ2	40.9-45.7		100	0				0-1	
522.30	45.7	BORING COMPLETED @ 45.7'											

DRAFT

General Notes

Driller	HCN
Rig No.	J. Williams
Rig Type	Track
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring at dam toe, appr. 3.5' above creek. Hay stick used for sediment control. Water level upon completion measured through the augers before NQ2. 24 hr. water level measured through the augers. Installed MW with screen from 40.9' to 30.9'.

Water Level Observations

Immediate	4.0 ft. ▽
At Completion	3.0 ft. ▽
After 24 Hrs.	3.0 ft. ▼
Water used in drilling	20.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 340 WALNUT STREET, STE B LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 473-B CONWAY CT., STE B-4 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	B-8
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/12/2005
Boring Location		Date Completed	8/12/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

DRAFT

ELEV. ft.	DEPTH ft.	Stratum thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
568.00	0.0													
567.70	0.3	0.3	Topsoil	1	SS	0.0-0.9	3-50/0.4	100						
567.10	0.9	0.6	FILL: Reddish brown, lean clay with sand (CL) (shale fill), moist, medium stiff											
		8.6	FILL: Greenish brown and gray, sandy shale and sandstone COBBLES (drill pressure at 8.0': 800 psi) - some clayey-soft seams	2	SS	5.0-6.5	33-22-7 (29)	93						
				3	SS	7.5-7.9	50/0.4	100						
558.50	9.5													
		7.0	Dark gray, LEAN CLAY (CL) (mostly liquid), wet, very soft	4	SS	10.0-11.5	1-WOH-WOH	100						
			- trace organics (wood) - slight organic odor	1	ST	11.5-13.5		0						
551.50	16.5			5	SS	15.0-16.5	WOH-WOH-1	100						
		16.0	Gray, SILTY SAND (SM), nonplastic, wet, loose	2	ST	17.0-19.0		55						
			- trace coal fragments at 21'	6	SS	20.0-21.5	2-2-3 (5)	100						
				7	SS	25.0-26.5	2-3-4 (7)	100						
			- trace wood, trace 0.25" coal fragments, and little gravel (sandstone fragments) at 30'	8	SS	30.0-31.5	4-4-3 (7)	100						
534.00	34.0													

General Notes

Driller	HCN
Rig No.	J. Williams
Rig Type	Track
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring at dam toe, appr. 3.5' above creek. Hay stick used for sediment control. Water level upon completion measured through the augers before NQ2. Recovery of ST-1 failed due to very soft material.

Water Level Observations

Immediate	6.0 ft. ▽
At Completion	1.5 ft. ▼
After 24 Hrs.	NA ft.
Water used in drilling	30 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER | CENTRAL OHIO REGION | INDIANA REGION | BLUEGRASS REGION

Client	American Electric Power	Boring No.	B-8
Project	Bottom Ash Dam Evaluation - Amos Plant, WV	Date Started	8/12/2005
Boring Location		Date Completed	8/12/2005
Elevation Ref.	AEP Boring Location Plan	Work Order No.	90979.059

DRAFT

ELEV. ft.	DEPTH ft.		DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
530.50	37.5	3.5	Gray, SILTY GRAVEL with SAND (GM) (gravel=sandstone fragments), nonplastic, wet, medium dense - dense *(LAYER CONTINUED DESCRIPTION REPEATED)*	9	SS	35.0-36.5	6-16-25 (41)	100						
527.60	40.4	2.9	Gray and Reddish brown, LEAN CLAY with SAND (CL) (residual SHALE), moist - dry, hard - very hard	10	SS	40.0-40.4	50/0.4	100						
522.60	45.4	5.0	Reddish brown and gray, CLAYSTONE, completely to highly weathered, extremely soft - very soft - bottom 2" residual soil	1	NQ2	40.4-45.4		100	0				0-1	
			BORING COMPLETED @ 45.4'											

General Notes

Driller	HCN
Rig No.	J. Williams
Rig Type	Track
Method	NQ2/SS/ST
Inspector	NG

Remarks

Located boring at dam toe, appr. 3.5' above creek. Hay stick used for sediment control. Water level upon completion measured through the augers before NQ2. Recovery of ST-1 failed due to very soft material.

Water Level Observations

Immediate	6.0	ft. ▽
At Completion	1.5	ft. ▼
After 24 Hrs.	NA	ft.
Water used in drilling	30	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
CORPORATE CENTER - 611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226 (513) 321-5816
FAX (513) 321-0294
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

APPALACHIAN REGION, 912 MORRIS STREET, CHARLESTON, WV 25031, (304) 344-0821, FAX (304) 342-4711
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

Client: AEP
Project: Amos RFD Retrofit
Boring Location: As Staked
Elevation Ref.: Exline Surveying

Boring No.: B-11
Date Started: 5/9/2005
Date Completed: 5/9/2005
Work Order No.: 90979.057

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	Qu tsf	PPR tsf
591.35	0.0	Brown SILTY CLAYEY SAND (SM), moist-loose (7.5)	1	SS	0.0-1.5	3-6-3 (9)	67						
			2	SS	2.5-4.0	4-3-5 (8)	100						
			3	SS	5.0-6.5	7-4-5 (9)	67						
583.85	7.5	Brown and gray mottled SILTY CLAY (CL-ML), moist-stiff to very stiff (7.5)	4	SS	7.5-9.0	5-5-7 (12)	100		19	34	12		1.75
			5	SS	10.0-11.5	6-8-11 (19)	100		19				2.75
576.35	15.0	Brown, fine to medium grained POORLY GRADED SAND (SP), wet-loose (5.0)	6	SS	15.0-16.5	5-3-2 (5)	100		22				
571.35 ▽	20.0	Brown SILTY WITH SAND (SM), trace clay, saturated-very loose (10.0)	7	SS	20.0-21.5	2-1-1 (2)	67						
	▼		8	SS	25.0-26.5	1-1-1 (2)	100						
561.35	30.0	Brown SILTY SAND (SM), saturated-loose (5.0)	9	SS	30.0-31.5	2-2-3 (5)	100						
556.35	35.0												

General Notes
Driller: D. Smith
Rig No.: B-57
Rig Type: Truck
Method: NQ/SS
Inspector:

Remarks
--60.9 tsf at 60.9'

Water Level Observations
Immediate: 20.0 ft. ▽
At Completion: 23.0 ft. ▼
After 0 Hrs. BF ft.
Water used in drilling 25.0 ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
CORPORATE CENTER - 611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226 (513) 321-5816
FAX (513) 321-0294
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

APPALACHIAN REGION
912 MORRIS STREET
CHARLESTON, WV 25031
(304) 344-0821
FAX (304) 342-4711

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	AEP	Boring No.	**B-11**
Project	Amos RFD Retrofit	Date Started	5/9/2005
Boring Location	As Staked	Date Completed	5/9/2005
Elevation Ref.	Exline Surveying	Work Order No.	90979.057

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness)		SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	Qu tsf	PPR tsf
		Brown SANDY SILT (ML), moist to wet-loose to medium dense		10	SS	35.0-36.5	2-3-3 (6)	100						
			10.0	11	SS	40.0-41.5	4-7-7 (14)	100						
546.35	45.0													
		Brown, fine to medium grained POORLY GRADED SAND WITH WITH GRAVEL (SP), wet-dense	5.0	12	SS	45.0-46.5	17-30-10 (40)	100						
541.35	50.0													
		Brown, fine to medium grained POORLY GRADED SAND (SP), wet-medium dense		13	SS	50.0-51.5	5-6-8 (14)	100						
			10.0	14	SS	55.0-56.5	5-6-6 (12)	100						
531.35	60.0													
		Brown, fine to medium grained POORLY GRADED SAND WITH GRAVEL (GP), wet-dense to very dense	5.0	15	SS	60.0-61.5	23-25-27 (52)	100						
526.35	65.0													
		Reddish-brown to gray, fine grained SILTY CLAYSTONE, thick to massive bedded, highly weathered, very soft to soft		16	SS	65.0-65.2	50/0.2	100						
				1	NQ	62.5-70.2		39	0			1-2 HCSI		

General Notes	
Driller	D. Smith
Rig No.	B-57
Rig Type	Truck
Method	NQ/SS
Inspector	

Remarks

-60.9 tsf at 60.9'

Water Level Observations

Immediate	20.0	ft. ▽
At Completion	23.0	ft. ▼
After	0 Hrs. BF	ft.
Water used in drilling	25.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
CORPORATE CENTER - 611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226 (513) 321-5816
FAX (513) 321-0294
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

APPALACHIAN REGION, 912 MORRIS STREET, CHARLESTON, WV 25031, (304) 344-0821, FAX (304) 342-4711
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	AEP	Boring No.	B-11
Project	Amos RFD Retrofit	Date Started	5/9/2005
Boring Location	As Staked	Date Completed	5/9/2005
Elevation Ref.	Exline Surveying	Work Order No.	90979.057

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	Qu tsf	PPR tsf
		10.2 Reddish-brown to gray, fine grained SILTY CLAYSTONE, thick to masive bedded, highly weathered, very soft to soft *(LAYER CONTINUED DESCRIPTION REPEATED)*	2	NQ	70.2-75.2		100	0				1-2 HCSI	
516.15	75.2	BORING COMPLETED @ 75.2'											

General Notes

Driller	D. Smith
Rig No.	B-57
Rig Type	Truck
Method	NQ/SS
Inspector	

Remarks

--60.9 tsf at 60.9'

Water Level Observations

Immediate	20.0	ft. ▽
At Completion	23.0	ft. ▼
After 0 Hrs.	BF	ft.
Water used in drilling	25.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. Nutting Company 2006

Test Boring Logs

B-0601 to B-0610

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0601**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/10/2006
Boring Location	N 538,936.4 E 1,729,204.2	Date Completed	3/10/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted))	Thickness	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
577.60	0.0	Brown, SILTY CLAY, moist, very soft	5.0	1	SS	0.0-1.5	0-0-1 (1)	100						
				1	ST	1.5-3.5		45						
572.60	5.0	Brown, SILTY CLAY, trace gravel, moist, very soft	5.4	2	SS	5.0-6.5	1-1-2 (3)	117						
				2	ST	6.5-8.5		15						
567.20	10.4	Gray, SILT, trace sand, trace gravel, moist, very loose	2.6	3	SS	10.0-11.5	0-2-2 (4)	80						
				3	ST	11.5-13.5		100						
564.60 ▽	13.0	Brown and gray, SILT with SAND, trace gravel, wet, loose	3.0											
561.60	16.0	Gray, SILT with SAND, trace gravel, moist, loose - medium dense	9.0	4	SS	15.0-16.5	2-3-4 (7)	100						
				5	SS	20.0-21.5	2-6-7 (13)	100						
552.60	25.0	Brown, SILT with SAND, moist, loose	6.0	6	SS	25.0-26.5	2-2-4 (6)	100						
546.60	31.0	Gray, SILT with SAND, trace gravel, moist, loose	4.0	7	SS	30.0-31.5	2-3-4 (7)	100						
542.60	35.0													

General Notes

Driller	Johnson
Rig No.	
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	Venu

Remarks

Water Level Observations

Immediate	13.0	ft. ▽
At Completion	3.0	ft. ▼
After	NA Hrs. NA	ft.
Water used in drilling	41.5	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0601**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/10/2006
Boring Location	**N** 538,936.4 **E** 1,729,204.2	Date Completed	3/10/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		6.0	Reddish brown, SHALE, completely weathered, extremely soft	8	SS	35.0-36.5	8-6-12 (18)	80						
536.60	41.0			9	SS	40.0-41.5	12-18-50/6"	100						
536.10	41.5	0.5	Gray, SHALE, completely weathered, extremely soft - soft											
533.80	43.8	2.3	Gray, SHALE, laminated, moderately weathered, soft	1	NQ2	41.5-46.3		83	73					
529.70	47.9	4.1	Reddish brown, SHALE, moderately weathered, soft High angle fracture at 44.3' to 44.5'											
526.30	51.3	3.4	Reddish and gray, SHALE, laminated, highly weathered, very soft	2	NQ2	46.3-51.3		74	48					
			BORING COMPLETED @ 51.3'											

General Notes

Driller	Johnson
Rig No.	
Rig Type	ATV
Method	NQ2/SS/ST
Inspector	Venu

Remarks

Water Level Observations

Immediate	13.0 ft. ▽
At Completion	3.0 ft. ▼
After	NA Hrs. NA ft.
Water used in drilling	41.5 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0602**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/9/2006
Boring Location	**N** 540,557.7 **E** 1,726,086.2	Date Completed	3/9/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
886.80	0.0													
885.50	1.3	1.3	Brown, CLAYEY SAND, little organics (roots), moist, soft	1	SS	0.0-1.5	1-1-2 (3)	100						
		8.7	Reddish brown, SANDY LEAN CLAY, trace rock fragments, moist, soft - medium stiff	2	SS	5.0-6.5	4-4-5 (9)	100						
876.80	10.0													
		3.3	Brown, SANDSTONE, fine grained, slightly weathered, medium hard	3	SS	10.0-10.3	50/4"	100						
			High angle fractures at 11.3' to 11.5' and 12.8' to 13.1'	1	NQ2	10.3-11.3		70	70				3	
873.50	13.3													
873.00	13.8	0.5	Brown, SHALE, laminated, moderately weathered, soft	2	NQ2	11.3-16.3		100	44				3-2	
871.10	15.7	1.9	Gray, SHALE, thinly laminated, slightly weathered, soft - medium hard											
		15.6	Gray, SANDSTONE, fine grained, micaceous, faintly weathered, medium hard - hard	3	NQ2	16.3-21.3		100	88				3-4	
				4	NQ2	21.3-26.3		100	92				3-4	
				5	NQ2	26.3-31.3		100	92				3-4	
855.50	31.3													
			BORING COMPLETED @ 31.3'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. BF	ft.
Water used in drilling	10.3	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0603**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/8/2006
Boring Location	**N** 540,310.5 **E** 1,726,267.7	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted))	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
940.80	0.0													
935.80	5.0	5.0	Brown, fine SAND, moist, medium dense	1	SS	0.0-1.5	3-4-12 (16)	100						
930.80	10.0	5.0	Reddish brown, SHALE, completely weathered, soft	2	SS	5.0-6.5	14-26-30 (56)	100						
925.60	15.2	5.2	Brown, SANDY SHALE, laminated, highly weathered, soft	3	SS	10.0-10.8	12-50/4"	38						
920.90	19.9	4.7	Brown, SANDSTONE, fine to medium grained, weakly cemented, micaceous, moderately weathered - slightly weathered, soft	1	NQ2	10.8-20.8		95	52				2	
919.40	21.4	1.5	Brown, SANDY SHALE, laminated, slightly weathered, very soft											
916.80	24.0	2.6	Reddish brown, SHALE, laminated, moderately weathered, soft Vertical fracture from 21.4' to 21.9'											
913.50	27.3	3.3	Brown and reddish brown, SHALE, laminated, slightly weathered, soft Vertical fracture from 25.9' to 26.7' High angle fracture from 26.7' to 26.9'	2	NQ2	20.8-30.8		95	46				2-1	
909.60	31.2	3.9	Gray, SHALE, laminated, moderately weathered, very soft - soft											
			Reddish brown, SHALE, slightly weathered, extremely soft - very soft											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate		ft.
At Completion		ft.
After	NA Hrs. NA	ft.
Water used in drilling	10.8	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

Client	American Electric Power	Boring No.	B-0603
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/8/2006
Boring Location	N 540,310.5 E 1,726,267.7	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
900.00	40.8	9.6	Reddish brown, SHALE, slightly weathered, extremely soft - very soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	3	NQ2	30.8-40.8		33	19				0-1	
896.30	44.5	3.7	Gray and reddish brown, SHALE, laminated, moderately weathered, soft	4	NQ2	40.8-50.8		98	80				2-3	
889.90	50.9	6.4	Gray, SILTSTONE, thinly bedded, fresh, soft - medium hard											
877.50	63.3	12.4	Gray, SANDSTONE, fine to medium grained, micaceous, fresh, hard	5	NQ2	50.8-60.8		100	98				4	
870.80	70.0	6.7	Brown, SANDSTONE, fine to medium grained, micaceous, fresh, hard	6	NQ2	60.8-70.8		95	95				4	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate		ft.
At Completion		ft.
After	NA Hrs. NA	ft.
Water used in drilling	10.8	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0603**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/8/2006
Boring Location	N 540,310.5 E 1,726,267.7	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, SANDSTONE, fine grained, micaceous, faintly weathered, hard											
		5.8	7	NQ2	70.8-75.8		100	100				4	
865.00	75.8												
		BORING COMPLETED @ 75.8'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate ______ ft.
At Completion ______ ft.
After NA Hrs. NA ft.
Water used in drilling 10.8 ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0604**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/8/2006
Boring Location	N 540,073.9 E 1,726,436.9	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
909.80	0.0													
		Brown, SANDY LEAN CLAY, moist, very stiff	5.0	1	SS	0.0-1.5	6-10-10 (20)	100						
904.80	5.0	Brown, SANDSTONE, fine grained, micaceous, highly weathered, medium hard	5.2	2	SS	5.0-5.0	50/0	0						
				1	NQ2	5.0-10.6		89	20				3	
899.60	10.2	Brown, SANDSTONE, fine to medium grained, micaceous, slightly weathered, medium hard Vertical fracture from 11.9' to 12.6'	3.9											
895.70	14.1	Brown, SANDSTONE, fine grained, micaceous, faintly weathered, medium hard	7.5	2	NQ2	10.6-20.6		100	79				3	
888.20	21.6	Brown, SANDSTONE, fine to coarse grained, slightly weathered, medium hard - hard	4.2											
884.00	25.8	Brown, SANDSTONE, fine grained, faintly weathered, hard	8.3	3	NQ2	20.6-30.6		0	98				3-4	
875.70	34.1													

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	NA Hrs. NA	ft.
Water used in drilling	5.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0604**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/8/2006
Boring Location	**N** 540,073.9 **E** 1,726,436.9	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
872.90	36.9	2.8	Gray, SANDSTONE, fine grained, faintly weathered, hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	4	NQ2	30.6-40.6		100	95				4	
867.40	42.4	5.5	Brown, SANDSTONE, fine to medium grained, slightly weathered, hard											
863.10	46.7	4.3	Gray, SANDSTONE, fine to medium grained, faintly weathered, hard	5	NQ2	40.6-50.6		0	75				4-3	
856.50	53.3	6.6	Brown, SANDSTONE, fine grained, faintly weathered, medium hard Shale interbeds from 47.4' to 47.9' and 50.1' to 50.6'											
851.00	58.8	5.5	Brown, SANDSTONE, fine grained, faintly weathered, hard Vertical fracture from 56.6' to 58.2'	6	NQ2	50.6-60.6		100	71				4-2	
849.20	60.6	1.8	Gray, SHALE, laminated, moderately weathered, soft											
847.80	62.0	1.4	Gray, SANDSTONE, fine grained, micaceous, slightly weathered, medium hard	7	NQ2	60.6-70.6		100	66				3	
		9.3	Gray, SHALE, laminated, slightly weathered, medium hard											

General Notes	
Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations	
Immediate	NW ft.
At Completion	NW ft.
After	NA Hrs. NA ft.
Water used in drilling	5.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0604**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/8/2006
Boring Location	N 540,073.9 E 1,726,436.9	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.		DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
838.50	71.3		Gray, SHALE, laminated, slightly weathered, medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	8	NQ2	70.6-72.6		100	100				3	
837.60	72.2	0.9	Reddish brown and gray, SHALE, laminated, faintly weathered, soft - medium hard											
837.20	72.6	0.4	Gray, SANDSTONE, fine grained, micaceous, fresh, medium hard											
			BORING COMPLETED @ 72.6'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	NA Hrs. NA ft.
Water used in drilling	5.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0605**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/7/2006
Boring Location	N 539,810.0 E 1,726,630.7	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	Thickness	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
793.70	0.0	Brown, SANDY LEAN CLAY, trace organics (roots), moist, soft	5.0	1	SS	0.0-1.5	1-1-2 (3)	100						
788.70	5.0	Reddish brown, SANDY LEAN CLAY, trace rock fragments, moist, stiff	10.0	2	SS	5.0-6.5	5-7-8 (15)	100						
				3	SS	10.0-11.5	4-2-10 (12)	100						
778.70	15.0	Gray, SHALE, laminated, moderately weathered, soft	0.2	4	SS	15.0-15.2	50/2"	100						
778.50	15.2	Gray, SANDSTONE, fine grained, micaceous, slightly weathered, soft - medium hard	12.8	1	NQ2	15.2-15.8		100	100				2	
				2	NQ2	15.8-20.8		100	94				2-3	
				3	NQ2	20.8-25.8		100	100				2-3	
765.70	28.0	Gray, SANDSTONE, fine grained, micaceous, faintly weathered, medium hard	1.0	4	NQ2	25.8-30.8		100	100				2-3	
764.70	29.0	Gray, SANDSTONE, medium grained, micaceous, fresh, medium hard	1.9											
762.80	30.9	Gray, SANDSTONE, fine to medium grained, micaceous, fresh, medium hard	3.4	5	NQ2	30.8-34.8		100	93				3-4	
759.40	34.3	Gray, SHALE, laminated, fresh, soft	0.5											
758.90	34.8													

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	NA Hrs. NA	ft.
Water used in drilling	12.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0605**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/7/2006
Boring Location	**N** 539,810.0 **E** 1,726,630.7	Date Completed	3/8/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		BORING COMPLETED @ 34.8'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	NA Hrs. NA	ft.
Water used in drilling	12.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0606**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/6/2006
Boring Location	N 539,359.8 E 1,727,154.3	Date Completed	3/6/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
746.30	0.0													
741.30	5.0	5.0	Brown, SANDY LEAN CLAY, trace rock fragments, moist, soft	1	SS	0.0-1.5	1-2-2 (4)	67						
735.80	10.5	5.5	Brown, SANDSTONE, fine to medium grained, completely weathered, very soft	2	SS	5.0-6.5	4-7-7 (14)	100						
731.30	15.0	4.5	Brown, SHALE, laminated, highly weathered, very soft	3	SS	10.0-11.5	8-12-17 (29)	100						
726.10	20.2	5.2	Reddish brown and gray, SHALE, laminated, moderately weathered, very soft	4	SS	15.0-16.5	9-27-36 (63)	100						
725.30	21.0	0.8	Brown, SANDSTONE, fine grained, moderately weathered, soft - medium hard	5	SS	20.0-20.2	50/0.2	100						
				1	NQ2	20.2-20.7		100	80				2-3	
723.00	23.3	2.3	Gray, SHALE, laminated, faintly weathered, soft Vertical fracture from 21.3' to 21.5'	2	NQ2	20.7-25.7		100	58				2	
716.40	29.9	6.6	Reddish brown, SHALE, faintly weathered, soft	3	NQ2	25.7-30.7		94	72				2	
715.60	30.7	0.8	Gray, SHALE, faintly weathered, soft											
			BORING COMPLETED @ 30.7'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. NA	ft.
Water used in drilling	20.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0607**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/6/2006
Boring Location	**N** 539,042.2 **E** 1,727,354.8	Date Completed	3/6/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	Thickness	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
740.60	0.0													
735.60	5.0	Brown, SANDY LEAN CLAY, trace organics, trace cinders, moist, medium stiff	5.0	1	SS	0.0-1.5	4-2-4 (6)	100						
730.60	10.0	Brown, SHALE, completely weathered, very soft	5.0	2	SS	5.0-6.5	3-4-5 (9)	100						
725.60	15.0	Reddish brown, SHALE, completely weathered, very soft	5.0	3	SS	10.0-11.5								
724.00	16.6	Gray, SHALE, laminated, moderately weathered, soft	1.6	4	SS	15.0-15.4								
				1	NQ2	15.5-16.0		100	0				2	
719.20	21.4	Reddish brown, SHALE, slightly weathered, soft	4.8	2	NQ2	16.0-21.0		90	70				2	
715.30	25.3	Gray, SANDSTONE, fine grained, faintly weathered, soft - medium hard Vertical fracture from 24.6' to 24.8'	3.9	3	NQ2	21.0-26.0		100	90				2-3	
713.10	27.5	Gray and reddish brown, SHALE, laminated, slightly weathered, soft	2.2											
712.10	28.5	Gray, SHALE, slightly weathered, extremely soft	1.0	4	NQ2	26.0-31.0		100	58				3-0	
705.60	35.0	Gray, SANDSTONE, fine grained, fresh, soft - medium hard	6.5	5	NQ2	31.0-35.0		98	88				2-3	

BORING COMPLETED @ 35.0'

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	24 Hrs. NA ft.
Water used in drilling	15.5 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	N 538,877.6 E 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft. 825.90	DEPTH ft. 0.0	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
820.90	5.0	Reddish brown, LEAN CLAY with SAND, trace gravel, moist, medium stiff	5.0	1	SS	0.0-1.5	2-2-3 (5)	100						
817.60	8.3	Brown, SANDSTONE, fine grained, moderately weathered, soft - medium hard	3.3	2	SS	5.0-5.2	50/0.2	100	100				2	
				1	NQ2	5.2-5.8		100						
				2	NQ2	5.8-10.8		100	34				2-3	
811.10	14.8	Brown, SHALE, laminated, highly weathered, soft Vertical fracture from 9.2' to 9.8'	6.5	3	NQ2	10.8-15.8		100	10				2	
808.80	17.1	Gray, SILTSTONE, moderately weathered, soft	2.3											
		Brown, SANDSTONE, fine grained, micaceous, moderately weathered, medium hard - hard		4	NQ2	15.8-20.8		96	74				2-4	
800.00	25.9	High angle fracture at 23.6' Shale layer at 25.2'	8.8	5	NQ2	20.8-25.8		100	90				3-4	
799.00	26.9	Gray, SANDSTONE, fine to medium grained, micaceous, moderately weathered, medium hard	1.0											
795.10	30.8	Brown, SHALE, laminated, moderately weathered, soft	3.9	6	NQ2	25.8-30.8		100	38				3-2	
793.90	32.0	Brown, SANDSTONE, fine grained, moderately weathered, medium hard	1.2											
791.50	34.4	Gray and brown, SHALE, laminated, moderately weathered, soft	2.4	7	NQ2	30.8-35.8		100	54				3-2	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. NA	ft.
Water used in drilling	5.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	N 538,877.6 E 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)
787.50	38.4	4.0	Brown, SANDSTONE, fine grained, micaceous, vertical fracture from 34.8' to 35.4', highly weathered, soft - medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***
787.10	38.8	0.4	Gray, SILTSTONE, moderately weathered, soft
778.50	47.4	8.6	Gray, SHALE, laminated, slightly weathered, soft - extremely soft High angle fracture at 41.9'
775.10	50.8	3.4	Brown, CLAYSTONE, slightly weathered, soft - extremely soft
768.50	57.4	6.6	Gray, SHALE, thinly laminated, slightly weathered, soft
767.40	58.5	1.1	Brown, SANDSTONE, fine grained, micaceous, high angle fracture at 57.5' to 57.7', moderately weathered, soft - medium hard
762.20	63.7	5.2	Brown, SANDSTONE, fine grained, micaceous, slightly weathered, medium hard
759.80	66.1	2.4	Gray, SANDSTONE, fine grained, micaceous, vertical fracture from 63.8' to 64.1', faintly weathered, medium hard
758.50	67.4	1.3	Dark gray, SHALE, thinly laminated, faintly weathered, very soft
		4.4	Black, COAL, blocky, fresh, soft

SAMPLE

NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
8	NQ2	35.8-40.8		100	82				3-0	
9	NQ2	40.8-45.8		100	90				0-2	
10	NQ2	45.8-50.8		100	96				0-2	
11	NQ2	50.8-55.8		100	84				2	
12	NQ2	55.8-60.8		100	84				2-3	
13	NQ2	60.8-65.8		100	92				3	
14	NQ2	65.8-70.8		92	44				1-2	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	24 Hrs. NA ft.
Water used in drilling	5.2 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	N 538,877.6 E 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.		DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted))	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
754.10	71.8		Black, COAL, blocky, fresh, soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***											
753.10	72.8	1.0	Gray, SHALE, fresh, very soft	15	NQ2	70.8-75.8		80	64				1-3	
748.70	77.2	4.4	Gray, SANDSTONE, fine grained, faintly weathered, medium hard											
746.60	79.3	2.1	Gray, SHALE, laminated, fresh, soft - medium hard	16	NQ2	75.8-80.8		100	100				3-2	
743.60	82.3	3.0	Gray, SILTSTONE, fresh, medium hard											
730.90	95.0	12.7	Gray, SHALE, thinly laminated, fresh, soft - medium hard Vertical fractures from 88.3' to 88.5' and 88.7' to 89.0'	17	NQ2	80.8-85.8		100	100				2-3	
				18	NQ2	85.8-90.8		100	50				2-3	
				19	NQ2	90.8-95.8		98	58				3-1	
727.70	98.2	3.2	Reddish brown, SHALE, fresh, very soft	20	NQ2	95.8-100.8		100	90				1-3	
723.90	102.0	3.8	Gray, SANDSTONE, fine grained, slightly weathered, medium hard											
722.50	103.4	1.4	Gray, SHALE, laminated, fresh, soft	21	NQ2	100.8-105.8		98	86				3-1	
720.90	105.0	1.6	Reddish brown, SHALE, fresh, very soft											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. NA	ft.
Water used in drilling	5.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	N 538,877.6 E 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.		DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
719.30	106.6	1.6	Gray, SHALE, laminated, fresh, soft											
717.30	108.6	2.0	Reddish brown, SHALE, laminated, few slickensided surfaces, fresh, soft - very soft	22	NQ2	105.8-110.8		98	82				2-1	
716.10	109.8	1.2	Gray, SHALE, laminated, slightly weathered, soft											
713.80	112.1	2.3	Gray, SANDSTONE, fine grained, micaceous, faintly weathered, medium hard Shale interbed at 110.9' to 111.6'											
710.50	115.4	3.3	Gray, SHALE, laminated, faintly weathered, soft	23	NQ2	110.8-115.8		98	82				3-2	
704.40	121.5	6.1	Gray, SANDSTONE, fine grained, faintly weathered - moderately weathered, medium hard - soft Vertical fracture from 118.6' to 120.3' High angle fracture (60°) from 120.8' to 121.2'	24	NQ2	115.8-120.8		100	44				3-2	
703.30	122.6	1.1	Brownish gray to gray, SHALE, laminated, slightly weathered, soft											
697.80	128.1	5.5	Reddish brown, SHALE, laminated, slightly weathered, very soft	25	NQ2	120.8-125.8		100	72				2-1	
693.40	132.5	4.4	Reddish brown and gray, SHALE, moderately weathered, extremely soft - very soft	26	NQ2	125.8-130.8		98	82				1-0	
692.30	133.6	1.1	Brown and gray, SANDSTONE, fine grained, slightly weathered, medium hard	27	NQ2	130.8-135.8		100	88				0-3	
		6.9	Browish gray to gray, SHALE, laminated, moderately fractured, slightly weathered, soft - medium hard Sandstone interbed at 135.1' to 135.8' Horizontal fracture at 136.1' Vertical fracture from 137.7' to 137.9'	28	NQ2	135.8-140.8		100	54				2-3	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. NA	ft.
Water used in drilling	5.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	N 538,877.6 E 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
685.40	140.5													
684.30	141.6	1.1	Reddish brown, SHALE, laminated, fresh, soft											
679.40	146.5	4.9	Brown, SHALE, laminated, fresh, soft Vertical fracture from 142.1' to 142.2'	29	NQ2	140.8-145.8		100	52				2	
674.10	151.8	5.3	Reddish brown and gray, SHALE, slightly weathered, very soft - soft 30° fracture at 149.1'	30	NQ2	145.8-150.8		86	32				1-2	
662.60	163.3	11.5	Reddish brown, CLAYSTONE, moderately weathered, very soft No recovery from 155.8 ft to 160.8 ft (inner barrel did not latch).	31	NQ2	150.8-155.8		100	26				1-2	
				32	NQ2	155.8-160.8		0	0				1	
657.30	168.6	5.3	Brown and reddish brown, SHALE, slightly weathered, very soft - soft Vertical fracture from 164.0' to 164.3' 10° fracture at 166.0' and 166.9' Horizontal fracture at 167.7'	33	NQ2	160.8-165.8		98	24				1-2	
654.60	171.3	2.7	Gray and reddish brown, SHALE, thinly laminated, slightly weathered, soft	34	NQ2	165.8-170.8		96	74				1-2	
		4.1	Gray, SANDSTONE, fine grained, fresh, medium hard - hard	35	NQ2	170.8-175.8		100	98				3-4	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	24 Hrs. NA ft.
Water used in drilling	5.2 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	N 538,877.6 E 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
650.50	175.4													
647.30	178.6	Gray and reddish brown, SHALE, laminated, slightly weathered, soft. High angle fracture (60°) at 177.7'	3.2	36	NQ2	175.8-180.8		100	80				2-3	
645.10	180.8	Gray, SANDSTONE, fine grained, faintly weathered, medium hard. High angle fracture (60°) from 178.8' to 179.1' and 179.8' to 179.9'	2.2											
641.10	184.8	Reddish brown, SHALE, laminated, slightly weathered, soft	4.0	37	NQ2	180.8-185.8		94	50				2-1	
				38	NQ2	185.8-190.8		94	32				1	
630.00	195.9	Reddish brown, CLAYSTONE, slightly weathered, very soft	11.1	39	NQ2	190.8-195.8		100	42				1	
625.90	200.0	Gray, SANDSTONE, fine grained, faintly weathered, medium hard	4.1	40	NQ2	195.8-200.8		96	86				3	
		Reddish brown, SHALE, thinly laminated, faintly weathered, soft	11.4	41	NQ2	200.8-205.8		100	96				2	
				42	NQ2	205.8-210.8		100	100				2	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After 24 Hrs.	NA	ft.
Water used in drilling	5.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	**N** 538,877.6 **E** 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
614.50	211.4		Reddish brown, SHALE, thinly laminated, faintly weathered, soft											
613.70	212.2	0.8	***(LAYER CONTINUED DESCRIPTION REPEATED)***	43	NQ2	210.8-215.8		100	100				2-4	
610.90	215.0	2.8	Gray, SANDSTONE, fine grained, faintly weathered, medium hard - hard; Gray, SHALE, thinly laminated, fresh, medium hard											
606.90	219.0	4.0	Gray, SANDSTONE, fine grained, fresh, medium hard. Shale interbed at 216.6' to 217.4'	44	NQ2	215.8-220.8		100	96				3-2	
603.20	222.7	3.7	Reddish brown, SHALE, laminated, claystone interbed at 221.0' to 221.3', faintly weathered, soft - medium hard	45	NQ2	220.8-225.8		100	52				3-2	
597.40	228.5	5.8	Reddish brown, CLAYSTONE, slickensided surfaces, few shale interbeds, few thin clay seams, faintly weathered, soft	46	NQ2	225.8-230.8		100	74				2-4	
588.90	237.0	8.5	Gray, SANDSTONE, fine grained, micaceous, medium to thinly bedded, fresh, medium hard - hard	47	NQ2	230.8-235.8		96	100				3-4	
583.30	242.6	5.6	Reddish brown to gray, SILTSTONE, very thinly bedded, clayey upper 1.5', faintly weathered, soft - medium hard	48	NQ2	235.8-240.8		100	100				4-2	
			Gray, SANDSTONE, fine grained, medium bedded, micaceous, faintly weathered - fresh, hard	49	NQ2	240.8-245.8		100	100				2-4	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	24 Hrs. NA ft.
Water used in drilling	5.2 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	**N** 538,877.6 **E** 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, SANDSTONE, fine grained, medium bedded, micaceous, faintly weathered - fresh, hard ***(LAYER CONTINUED DESCRIPTION REPEATED)*** 18.9	50	NQ2	245.8-250.8		100	100				4	
			51	NQ2	250.8-255.8		100	100				4	
			52	NQ2	255.8-260.8		100	100				4	
564.40	261.5												
		Light gray, SANDSTONE, medium to coarse grained, medium bedded, conglomeratic, faintly weathered, hard 3.0	53	NQ2	260.8-265.8		88	74				4-2	
561.40	264.5												
		Reddish brown, CLAYSTONE, slickensided surfaces, slightly weathered, soft 20.5	54	NQ2	265.8-270.8		84	42				2	
			55	NQ2	270.8-275.8		100	20				2	
			56	NQ2	275.8-280.8		92	72				2	

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	24 Hrs. NA ft.
Water used in drilling	5.2 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0608**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	2/27/2006
Boring Location	**N** 538,877.6 **E** 1,727,472.3	Date Completed	3/3/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
540.90	285.0	Reddish brown, CLAYSTONE, slickensided surfaces, slightly weathered, soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	57	NQ2	280.8-285.8		90	82				2-3	
534.10	291.8	6.8 Reddish brown to gray, SILTSTONE, medium bedded, slickensided surfaces, clayey, faintly weathered, soft - medium hard	58	NQ2	285.8-290.8		100	66				2-3	
529.10	296.8	5.0 Gray, SANDSTONE, very fine grained, thinly bedded, faintly weathered, medium hard - hard	59	NQ2	290.8-295.8		100	100				3-4	
525.90	300.0	3.2 Gray to reddish brown, CLAYSTONE, slickensided surfaces, slightly weathered, soft	60	NQ2	295.8-300.0		90	64				4-2	
		BORING COMPLETED @ 300.0'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu/B.B.

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. NA	ft.
Water used in drilling	5.2	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**B-0609**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/9/2006
Boring Location	**N** 538,813.6 **E** 1,728,060.6	Date Completed	3/9/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
664.00	0.0	Reddish brown, LEAN CLAY with SAND, moist, soft	4.0	1	SS	0.0-1.5	1-1-2 (3)	100						
660.00	4.0	Reddish brown and brown, SANDY SHALE, highly weathered, soft	7.0	2	SS	5.0-6.5	17-17-13 (30)	100						
653.00	11.0			3	SS	10.0-11.4	18-36-50/5"	100						
		Brown, SANDY SHALE, laminated, highly weathered - moderately weathered, soft	2.6											
650.40	13.6	Reddish brown, SHALE, laminated, moderately weathered, extremely soft - soft	9.8	1	NQ2	11.4-16.4		98	58				2-0	
				2	NQ2	16.4-21.4		100	84				2-0	
				3	NQ2	21.4-23.4		100	95				2-0	
640.60	23.4	BORING COMPLETED @ 23.4'												

General Notes	
Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW	ft.
At Completion	NW	ft.
After	24 Hrs. BF	ft.
Water used in drilling	11.4	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

Client	American Electric Power	Boring No.	**B-0610**
Project	John Amos Plant Access Road to Dewatering Island	Date Started	3/7/2006
Boring Location	N 538,986.3 E 1,728,717.8	Date Completed	3/7/2006
Elevation Ref.	Provided by American Electric Power	Work Order No.	90979.067

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Thickness	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
638.20	0.0													
		Brown, SANDY LEAN CLAY, trace organics (roots), moist, medium stiff	5.0	1	SS	0.0-1.5	1-4-5 (9)	100						
633.20	5.0	Reddish brown, SHALE, completely weathered, very soft	5.0	2	SS	5.0-6.5	14-21-25 (46)	100						
628.20	10.0	Brown, SANDSTONE, fine grained, weakly cemented, moderately weathered, soft	9.3	3	SS	10.0-10.4	50/5"	100						
				1	NQ2	10.4-15.4		74	40				2	
				2	NQ2	15.4-20.4		100	72				2-1	
618.90	19.3	Brown, SANDY SHALE, laminated, slightly weathered, very soft - soft	1.1											
617.80	20.4	Brown, SANDSTONE, fine grained, micaceous, slightly weathered, soft	5.7	3	NQ2	20.4-25.4		92	54				2	
612.10	26.1	Reddish brown, SHALE, slightly weathered, very soft - soft	5.5	4	NQ2	25.4-30.4		94	70				2-1	
606.60	31.6	Gray, SANDY SHALE, laminated, faintly weathered, soft	0.8	5	NQ2	30.4-32.4		100	100				2	
605.80	32.4	BORING COMPLETED @ 32.4'												

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	Venu

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	NA Hrs. NA ft.
Water used in drilling	10.4 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

TEST BORING JOHN AMOS DEWATERING PLANT ACCESS ROAD.GPJ HC NUTTING.GDT 10/25/11

Arcadis 2016

Soil Boring Logs

MW-1601 to MW-1606, SB-1601 to SB-1607

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES **N 538,186.6 E 1,731,490.3**

GROUND ELEVATION **586.5** SYSTEM

Water Level, ft	∇ 18.5	▼	▼
TIME			
DATE	4/26/2016		

BORING NO. **MW-1601** DATE **7/19/16** SHEET **1** OF **2**

BORING START **4/25/16** BORING FINISH **4/26/16**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.0'** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **28.61'** BOTTOM **38.0'**

WELL DEVELOPMENT **5/18 & 6/13/16** BACKFILL **NA**

FIELD PARTY **NA** RIG **Diedrich**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1/2"	0					No recovery.		
2	SS	1.5	3.0	1/2"	3					Ash, fine sand, trace silt, trace medium and coarse angular sand and slag, saturated, very soft, dark grayish brown (10YR 4/2).		
3	SS	3.0	4.5	1/2"	5							
4	SS	4.5	6.0	1-2-4/0"	7		5		CL	Clay, little silt, trace ash sand and gravel, moist, soft, reddish brown (5YR 4/3).		
									ML	Silt, little clay, medium stiff, low plasticity, moist, no dilatancy, dark gray (10YR 4/1).		
5	SS	6.0	7.5	2-5-5/0"	13				CL	Clay, little silt, medium stiff, medium plasticity, moist, dark yellowish brown (10YR 4/4).		
6	SS	7.5	9.0	2-2-4/0"	12							
7	SS	9.0	10.5	1-1-2/0"	12		10		CL	Clay, little silt, trace sand, very soft, medium plasticity, wet, dark yellowish brown with gray mottling (10YR 5/1).		
8	SS	10.5	12.0	2-4-5/0"	16				CL	Note: dark yellowish brown (10YR 4/3) with <1mm thick black laminations from 10.5 to 10.7 feet.		
9	SS	12.0	13.5	4-6-9/0"	16					Clay, some silt, trace sand, stiff, low plasticity, moist, dark yellowish brown with dark brown and gray (10YR 4/6).		
10	SS	13.5	15.0	4-7-11/0"	14		15					
11	SS	15.0	16.5	3-5-7/0"	16				ML	Silt and very fine sand, little clay, moist, medium stiff, non plastic, strong brown and gray (7.5YR 9/6). Note: stiff from 16.5 to 18.0 feet.		
12	SS	16.5	18.0	2-4-7/0"	16							
13	SS	18.0	19.5	4-4-6/0"	21						∇	
									SP	Sand, fine grain, well sorted, angular to round little silt and decreasing to trace at 19.0 feet, stiff, wet (7.5YR 4/6).		
14	SS	19.5	21.0	3-2-1/0"	15							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **K. Eldridge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1601** DATE **7/19/16** SHEET **2** OF **2**

PROJECT **John E. Amos Plant CCR** BORING START **4/25/16** BORING FINISH **4/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										Note: trace silt and clay from 19.5 to 21.0 feet. Note: some clay from 20.7 to 20.9 feet.		
15	SS	21.0	22.5	2-1-3/0"	17					Note: trace silt and clay from 21.0 to 22.5 feet.		
16	SS	22.5	24.0	2-2-3/0"	15					Note: trace silt and clay from 22.5 to 23 feet.		
17	SS	24.0	25.5	3-4-7/0"	15		25			Note: <2% silt and clay, trace small black subrounded gravel from 24.3 to 25.5 feet. Note: black lenses 1-2 mm thick at 24.5 and 25 feet.		
18	SS	25.5	27.0	3-5-6/0"	15					Note: trace small black subrounded gravel, <2% silt and clay from 25.5 to 27 feet. Note: dark brown to black horizontal lamination from 26.0 to 27.0 feet.		
19	SS	27.0	28.5	3-6-13/0"	14					Note: 5% silt and clay, dark yellowish brown from 27 to 27.5 feet. Note: sand, fine grain, well sorted, loose, 2% silt and clay, wet, strong brown, from 27.5 to 28.0 feet.		
20	SS	28.5	30.0	6-10-13/0"	13		30			Note: lighter in color from 29.5 to 30.0 feet.		
21	SS	30.0	31.5	9-8-10/0"	20					Note: <2% silt and clay from 30.0 to 31.5 feet.		
22	SS	31.5	33.0	2-3-8/0"	15					Note: 2-3 mm thick laminations of gray clay from 32.5 to 32.6 feet. Note: sand, fine to medium grain, well sorted, loose, wet, gray, angular to round from 32.6 to 33.0 feet.		
23	SS	33.0	34.5	2-5-11/0"	7					Note: 2-3 mm lamination of brown clay from 34.0 to 34.3 feet.		
24	SS	34.5	36.0	4-7-10/0"	12		35			Note: trace coarse sand, granules of coal from 34.5 to 36.0 feet.		
25	SS	36.0	37.5	2-3-12/0"	2					Note: trace coarse sand sized pieces of coal from 36.0 to 37.5 feet.		
26	SS	37.5	39.0	4-7-7/0"	9					Note: trace angular fine to coarse gravel from 37.5 to 39.0 feet.		
27	SS	39.0	40.5	6-6-9/0"	14		40		SP	Sand, fine grained well-sorted, angular to round, loose, grayish brown, wet (10YR 5/2).		
28	SS	40.5	42.0	6-6-8/0"	14							
										Note: 1-2 mm thick lamination of black coal from 40.0 to 40.5 feet. End of boring at 42.0 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** | BORING NO. **MW-1602A** | DATE **7/19/16** | SHEET **1** OF **3**

PROJECT **John E. Amos Plant CCR** | BORING START **5/25/16** | BORING FINISH **5/25/16**

COORDINATES **N 537,031.1 E 1,730,894.1** | PIEZOMETER TYPE **NA** | WELL TYPE **OW**

GROUND ELEVATION **598.0** SYSTEM | HGT. RISER ABOVE GROUND **3.0'** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **48.4'** BOTTOM **58.0'**

WELL DEVELOPMENT **6/14/2016** BACKFILL **NA**

FIELD PARTY **NA** RIG **Diedrich**

Water Level, ft	▽ 15.8	▼	▼
TIME			
DATE	5/25/2016		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5							Hydro-Vac 0.0 to 6.0 feet.		
2	SS	1.5	3.0									
3	SS	3.0	4.5									
4	SS	4.5	6.0				5					
5	SS	6.0	7.5	4-4-3/0"	6				GM	Small subangular gravel, some silt, trace medium sand, trace gravel, fine sand, stiff, moist, red brown, non plastic, no dilatancy (5YR 4/6).		
6	SS	7.5	9.0	2-2-6/0"	0					Note: gravel clogged in shoe from 7.5 to 9.0 feet.		
7	SS	9.0	10.5	4-6-7/0"	13		10		SP	Fine sand, very uniform grain size, trace silt (3-5%), moist, medium stiff, no dilatancy, non plastic, moist (5YR 4/6).		
8	SS	10.5	12.0	3-2-3/0"	12				CL ML	Silty clay, little silt, mottled red brown/gray, stiff, high plasticity, no dilatancy (5YR 4/6-5YR 5/1).		
9	SS	12.0	13.5	2-1-1/0"	0				SP	Fine sand, very uniform grain size, trace silt (3-5%), moist, medium stiff, no dilatancy, non plastic, moist (5YR 4/6).		
10	SS	13.5	15.0	1-1-0/0"	16		15		SP SM	Fine sand, some silt, trace organics, roots, wood, soft, moist, medium dilatancy, low-no plasticity (5YR 5/1). Note: color change 5YR 3/1 at 14.5 feet.		
11	SS	15.0	16.5	1-1-1-0/0"	16					Note: water at 15.75 feet, very soft and rapid dilatancy.	▽	
12	SS	16.5	18.0	1-1-2/0"	10					Note: trace organics from 16.3 to 16.5 feet. Note: color shift 0.5-10 mm alternating laminate of fine sand, trace silt at 16.5 feet.		
13	SS	18.0	19.5	1-2-2/0"	12				SP	Fine sand, trace silt, very soft, wet, uniform grain size, poorly sorted, gray, trace black sand, medium dilatancy, non plastic (7.5YR 5/1).		
14	SS	19.5	21.0	2-2-2/0"	0							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1602A** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **5/25/16** BORING FINISH **5/25/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										Note: subrounded sandstone gravel clogged shoe from 19.5 to 21.0 feet.		
16	SS	21.0	22.5	1-1-1/0"	18					Note: very fine sand, trace silt, wet from 21.5 to 22.5 feet.		
17	SS	22.5	24.0	1-1-2/0"	5.5					Note: trace (1 piece) of small subrounded gravel in run at 16.5 feet.		
18	SS	24.0	25.5	1-1-1/0"	11		25		ML	Very fine sand, little silt (2%), very soft, moist-wet, medium dilatancy, no plasticity, gray, poorly graded (7.5YR 5/1).		
19	SS	25.5	27.0	1-2-2/0"	12.5					Note: trace clay, low plasticity from 25.9 to 28.0 feet.		
20	SS	27.0	28.5	1-1-1/0"	16							
21	SS	28.5	30.0	3-2-4/0"	4.5					Note: clay content no longer present, no plasticity, wet at 28.0 feet.		
22	SS	30.0	31.5	2-3-4/0"	16.5		30			Note: addition of trace clay, moist, medium stiffness from 30.4 to 31.9 feet.		
23	SS	31.5	33.0	3-4-5/0"	15.5					Note: moist not wet, slow dilatancy from 31.9 to 33.0 feet.		
24	SS	33.0	34.5	3-3-5/0"	14				ML	Very fine sand, some silt, trace (8-10%) clay, soft, moist-wet, low-medium plasticity, slow dilatancy, gray, grains of micah/muscovite visible (7.5YR 5/1).		
25	SS	34.5	36.0	3-3-4/0"	17		35		ML	Very fine sand, little silt (2%), very soft, moist-wet, medium dilatancy, no plasticity, gray, poorly graded (7.5YR 5/1).		
26	SS	36.0	37.5	2-3-4/0"	13					Note: 3-5 mm laminate of fine sand in shoe, silt, trace frequency at 34.8 feet.		
27	SS	37.5	39.0	2-2-4/0"	17					Note: trace amounts of clay, low plasticity from 37.5 to 38.7 feet.		
28	SS	39.0	40.5	2-2-3/0"	19.5		40					
29	SS	40.5	42.0	2-2-2/0"	17				SW	Fine sand, trace silt (10%), very soft, wet, medium-rapid dilatancy, no plasticity, gray, muscovite grains visible (7.5YR 5/1). Note: 5-10 mm laminations of silt rich deposits, fine sand with little silt (25%) at 41.0 feet.		
30	SS	42.0	43.5	1-1-3/0"	13					Note: wet from 42.0 to 43.5 feet.		
31	SS	43.5	45.0	3-14-14/0"	14				SW	Fine sand with little subangular to angular small sandstone gravel, trace silt (5%), wet, stiff, no dilatancy, non plastic, sandstone, fine sand clast size (7.5YR 5/1).		
32	SS	45.0	46.5	6-7-11/0"	10.5		45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1602A** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **5/25/16** BORING FINISH **5/25/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										Note: less sandstone gravel, trace (5-8%), very wet, rapid dilatancy from 46.0 to 46.5 feet.		
33	SS	46.5	48.0	10-10-13/0"	13				SP	Fine sand, trace silt, uniform sand grain size, soft, wet, rapid dilatancy, no plasticity, gray (7.5YR 5/1).		
34	SS	48.0	49.5	8-9-13/0"	9.5					Note: 3-4 mm bands/laminate of black sand, same grain size, trace frequency from 48.0 to 49.5 feet.		
35	SS	49.5	51.0	6-5-10/0"	12.5		50			Note: 1" black bank/lamination of black material (small gravel to fine sand in size) within band there is no regular material at 49.5 feet.		
36	SS	51.0	52.5	14-11-7/0"	10					Note: slight color shift (7.5YR 5/2), silt (3-5%) contains dispersed in run, black material in trace amounts 3-5% from 51.0 to 52.5 feet.		
37	SS	52.5	54.0	6-5-6/0"	7							
38	SS	54.0	55.5	4-7-8/0"	9		55			Note: laminae 2-3mm of black sand (fine size) present from 54.5 to 55.7 feet.		
39	SS	55.5	57.0	7-8-10/0"	9.5							
40	SS	57.0	58.5	6-8-14-3/0"	14					Note: trace amounts (3%) of small angular sandstone gravel from 57.0 to 58.5 feet.		
41	SS	58.5	60.0	9-10-23/0"	7							
										Weathered sandstone.		
							60			End of boring at 60 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** | BORING NO. **MW-1603A** | DATE **7/19/16** | SHEET **1** OF **2**

PROJECT **John E. Amos Plant CCR** | BORING START **5/23/16** | BORING FINISH **5/24/16**

COORDINATES **N 538,963.7 E 1,729,315.5** | PIEZOMETER TYPE **NA** | WELL TYPE **OW**

GROUND ELEVATION **584.1** SYSTEM | HGT. RISER ABOVE GROUND **3.0'** | DIA **2"**

DEPTH TO TOP OF WELL SCREEN **38.0'** BOTTOM **43.0'**

WELL DEVELOPMENT **6/14/2016** | BACKFILL **NA**

FIELD PARTY **NA** | RIG **Diedrich**

Water Level, ft	▽ 19.1	▼	▼
TIME			
DATE	5/24/2016		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5							Hydrovac from 0.0 to 6.0 feet. Fill materials, large cobbles to small gravel, limestone.		
2	SS	1.5	3.0									
3	SS	3.0	4.5									
4	SS	4.5	6.0				5					
5	SS	6.0	7.5	5-3-3/0"	7				CL	Clay with little silt, soft, high plasticity, moist, gray (7YR 4/1), no dilatancy. Note: sandstone plug from sluff in shoe for first 1/2 of run (6.0 to 7.5 and 7.5 to 9.0 feet).		
6	SS	7.5	9.0	3-2-3/0"	4.5							
7	SS	9.0	10.5	2-2-2/0"	9		10			Note: gray (7YR 4/1) mottling, trace (1%) grains of medium to coarse sand.		
8	SS	10.5	12.0	2-1-2/0"	20							
9	SS	12.0	13.5	1-1-1/0"	22				SW	Sand, medium to fine with little silt, soft, wet, gray (10YR 4/1), rapid dilatancy, no plasticity, trace amounts of oxidized mudstone.		
10	SS	13.5	15.0	1-1-1/0"	12		15		ML	Silt with trace clay, medium plasticity, very uniform, moist gray (10YR 4/1), trace organics (wood, organics, roots), soft, dilatancy.		
11	SS	15.0	16.5	3-1-1/0"	15					Note: little clay from 16.0 to 16.5 feet.		
12	SS	16.5	18.0	1-2-2/0"	10							
13	SS	18.0	19.5	1-1-2/0"	15						▽	
14	SS	19.5	21.0	2-2-2/0"	15.5				SW	Fine sand, little silt, well sorted, poorly graded, soft, wet, gray, uniform, grain size, trace oxidized		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1603A** DATE **7/19/16** SHEET **2** OF **2**

PROJECT **John E. Amos Plant CCR** BORING START **5/23/16** BORING FINISH **5/24/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									ML	sandstone pieces. Note: water at 19.1 feet.		
15	SS	21.0	22.5	1-1-2/0"	13				ML	Silt with little clay, medium plasticity, moist, stiff, no diltancy, trace root structures.		
16	SS	22.5	24.0	4-4-6/0"	22				SM	Silt with little clay, medium plasticity, moist, stiff, no diltancy, trace root structures. Fine sand with some silt, trace medium sand, wet, soft, non plastic, rapid dilatancy, trace amounts of black/oxidized material, coarse sand sized subangular.		
17	SS	24.0	25.5	4-3-6/0"	22		25			Weathered sandstone, small gravel sized, angular clasts with fine sand with some silt, stiff, moist, wet, no dilatancy, non plastic.		
18	SS	25.5	27.0	2-2-2/0"	7							
19	SS	27.0	28.5	1-2-2/0"	10					Note: yellow (2.5Y 6/6) fine sand seam at 26.7 feet.		
20	SS	28.5	30.0	3-3-4/0"	17.5				ML	Note: oxidized sandstone, angular, small gravel, wet from 28.0 to 28.2 feet. Silt with little clay, stiff, moist, no dilatancy, moderate plasticity, uniform texture.		
21	SS	30.0	31.5	4-5-6/0"	20		30					
22	SS	31.5	33.0	2-3-4/0"	16				SM	Weathered sandstone, small angular gravel with little fine sane, little silt, wet, no dilatancy, no plasticity, well graded, stiff. Sandy silt, some fine sand, wet, stiff, trace amount of clay, low to no plasticity, slow dilatancy.		
23	SS	33.0	34.5	2-2-3/0"	23				SM	Silty sand, fine with some silt, wet, fast dilatancy, very soft, poorly graded, very uniform, grain size, some 1-2" bands of more silt, rich sediment, these are slightly stiff and more moist/wet.		
24	SS	34.5	36.0	2-2-5/0"	21		35		ML	Silt with trace clay, trace fine sand bands (some 30%) of more clay rich sediment 1/2 to 1" thick laminae, moist, moderately stiff, no dilatancy, medium plasticity.		
25	SS	36.0	37.5	3-1-5/0"	22							
26	SS	37.5	39.0	3-6-6/0"	14					Note: trace fine sand, wet (saturated) at 38.3 with 2" band of fine sand with trace silt.		
27	SS	39.0	40.5	3-5-5/0"	14		40			Weathered sandstone, small, angular gravel with trace silt, little fine sand, trace coarse sand, stiff, wet, non plastic, no dilatancy. Note: trace small oxizided gravel at 39.0 feet.		
28	SS	40.5	42.0	3-5-5/0"	14					Note: some fine sand and trace oxidized sand veins at 40.5 feet.		
29	SS	42.0	43.5	4-7-44/0"	14							
30	SS	43.5	45.0	50-3/0"	15		45			Weathered sandstone (fairly competent) dry with some moisture (localized).		
										End of boring at 45.0 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES **N 539,459.6 E 1,729,931.7**

GROUND ELEVATION **586.0** SYSTEM

BORING NO. **MW-1604** DATE **7/19/16** SHEET **1** OF **3**

BORING START **5/5/16** BORING FINISH **5/6/16**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.0'** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **33.9'** BOTTOM **43.5'**

WELL DEVELOPMENT **5/18/2016** BACKFILL **NA**

FIELD PARTY **NA** RIG **Diedrich**

Water Level, ft	▽ 18.8	▼	▼
TIME			
DATE	5/6/2016		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1-0-0/0"	0					No recovery, rock (limestone), clogged shoe.		
2	SS	1.5	3.0	1-1-1/0"	5				GM	Silty gravel and sand, silt some fine sand, little small subangular gravel, soft, wet, slow dilatancy, non plastic, brown, trace organics and root fibers.		
3	SS	3.0	4.5	1-1-1/0"	5							
4	SS	4.5	6.0	2-2-3/0"	11.5		5		ML	Silt with fine sand, very fine sand, soft, moist, no diltancy, moderate plasticity, brown (10YR 4/4), uniform texture, trace small black sand inclusions (1 mm).		
5	SS	6.0	7.5	2-3-5/0"	16							
6	SS	7.5	9.0	3-4-6/0"	15.5					Note: more stiff, trace root fibers, trace small (2-3 mm) areas of gray (10YR 4/4) coloration from 7.5 to 9.0 feet.		
7	SS	9.0	10.5	3-4-4/0"	0		10			Note: sandstone (very fine grain) clogged shoe on run from 9.0 to 10.5 feet, subangular medium gravel size.		
8	SS	10.5	12.0	3-4-6/0"	16.5				ML	Silty sand, fine, little silt, stiff, uneven distribution of sand, moist, no diltancy, non plastic, gray brown (10YR 4/2).		
9	SS	12.0	13.5	9-15-13/0"	18					Ash mixture (small black gravel inclusions-angular).		
10	SS	13.5	15.0	5-7-10/0"	11.5		15		ML	Silt with very fine sand, little very fine sand, stiff, red brown (5YR 4/3), no dillatancy, no to low plasticity.		
11	SS	15.0	16.5	5-8-14/0"	12					Platy mudstone, interbedded with silt and very fine sand.		
12	SS	16.5	18.0	5-8-8/0"	15					Silty sand, fine, little to trace silt, very soft, moist, non plastic, brown, gray (2.5Y 4/2), no dilatancy, trace small, soft, sandstone, rounded gravel.		
13	SS	18.0	19.5	4-4-5/0"	13					Note: water at 18.75 feet, rapid dilatancy.	▽	
14	SS	19.5	21.0	5-7-11/0"	19							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1604** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **5/5/16** BORING FINISH **5/6/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										Note: color change to 7.5YR 4/2 at 19.9 feet.		
15	SS	21.0	22.5	3-4-5/0"	16.5					Note: oxidation/iron staining, color change to 7.5YR 5/8 at 20.7 feet.		
16	SS	22.5	24.0	3-7-10/0"	17							
17	SS	24.0	25.5	5-6-9/0"	15.5				SP	Poorly graded sand, fine, trace silt (5-8%), very soft, rapid dilatancy, brown, no plasticity, poorly graded.		
							25			Note: 0.2' layer of silt with fine sand at 24.7 feet. Note: color change to 7.5YR 5/8 at 24.8 feet.		
18	SS	25.5	27.0	9-7-6/0"	12					Note: heaving sand at 25.5 feet.		
19	SS	27.0	28.5	3-4-4/0"	15.5					Note: small (1mm) layers of black sand (2 layers) at 26.9 feet. Note: contains trace small (5mm) layers of sandy silt, color change to 7.5YR 4/3 from 27.0 to 28.5 feet.		
20	SS	28.5	30.0	2-2-1/0"	19					Note: black material from 28.8 to 28.9 feet. Note: band of oxidation/iron staining at 29.25 feet, 0.4' thick, 7.5YR 5/8.		
21	SS	30.0	31.5	1-2-3/0"	11.5		30					
22	SS	31.5	33.0	3-2-3/0"	15					Note: 0.3' band of 10YR 6/6 coloration at 31.0 feet.		
23	SS	33.0	34.5	3-3-4/0"	16					Note: colored bands (5-10mm) 7.5YR 4/1 at 33.0 feet.		
24	SS	34.5	36.0	3-4-10/0"	10		35			Note: very soft, very wet, trace silt (3-5%) at 34.5 feet.		
25	SS	36.0	37.5	4-5-8/0"	12					Note: slightly stiff, 3% silt, very poorly graded, well sorted from 36.0 to 37.5 feet.		
26	SS	37.5	39.0	4-5-6/0"	11.5					Note: trace angular sandstone, small gravel (one clast per 18"), slight stiff, 3% silt from 37.5 to 39.0 feet.		
27	SS	39.0	40.5	7-10-11/0"	17					Note: color grey 1 5G-/1, poorly cemented (3-5% silt) from 39.0 to 40.5 feet.		
							40					
28	SS	40.5	42.0	5-6-8/0"	12.5							
29	SS	42.0	43.5	7-11-10/0"	7.5					Note: trace silt (3-4%) from 42.0 from 43.5 feet. Note: rock stuck in shoe (sandstone) at 42.5 feet.		
30	SS	43.5	45.0	6-5-4/0"	14.5					Note: 10mm thick bands of higher concentration of silt and little amount of silt, 25% of run at 43.5 feet.		
31	SS	45.0	46.5	3-5-8/0"	16		45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1604** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **5/5/16** BORING FINISH **5/6/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										End of boring at 46.5 feet.		

AEP - AEP.GDT - 7/19/16 15:49 - C:\USERS\SBREWER\DOCUMENTS\AEP\AEP WINFIELD WV.GPJ

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES **N 540,038.8 E 1,731,401.7**

GROUND ELEVATION **583.4** SYSTEM

BORING NO. **MW-1605** DATE **7/19/16** SHEET **1** OF **3**

BORING START **4/29/16** BORING FINISH **5/2/16**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **3.0'** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **26.3'** BOTTOM **41.0'**

WELL DEVELOPMENT **5/18/2016** BACKFILL **NA**

FIELD PARTY **NA** RIG **Diedrich**

Water Level, ft	▽ 18.0	▼	▼
TIME			
DATE	5/2/2016		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	0-1-0/0"	4				SM	Sandy silt, little fine sand, trace coarse sand, moist, soft, no dilatancy, low plasticity, 2.5YR 4/6.		
2	SS	1.5	3.0	1-0-0/0"	2					Note: trace amounts of small angular limestone gravel (roadbed) from 1.5 to 3.0 feet.		
3	SS	3.0	4.5	1-0-0/0"	5.5					Note: wet, slightly stick from 3.0 to 4.5 feet.		
4	SS	4.5	6.0	2-2-4/0"	5.5		5					
5	SS	6.0	7.5	5-11-8/0"	12.5							
6	SS	7.5	9.0	4-5-7/0"	7.5					Note: at 6.75 feet rock fragment stuck in spoon, from 6.0 to 6.76 wet, from 6.76 to 7.5 dry. Note; trace small rounded gravel (3%) from 7.0 to 7.5 feet. Note: root structures (2-3%) from 7.3 to 9.0 feet.		
7	SS	9.0	10.5	2-3-6/0"	13					Note: little small gravel from 7.9 to 9.0 feet. Note: sandstone lodged in spoon at 8.8 feet.		
8	SS	10.5	12.0	3-4-6/0"	16.5		10		SM	Silt, trace medium sand, little fine sand, stiff, brown, moist, no dilatancy, 10YR 3/1.		
9	SS	12.0	13.5	2-4-7/0"	13.5				ML	Silt, very fine sand, stiff, moist, grey mottling (3%), non plastic, no dilatancy 2.5Y 5/6.		
10	SS	13.5	15.0	5-5-7/0"	19					Note: slightly more stiff from 13.0 to 13.5 feet. Note: higher silt concentration, little amount of very fine sand (20%).		
11	SS	15.0	16.5	2-2-3/0"	17		15		ML	Silt, little fine sand (25%), moderate stiff, moist, low plasticity, 2.5Y 5/6. Note: moisture increases from 15.0 to 16.5 feet.		
12	SS	16.5	18.0	2-1-3/0"	21.5					Note: 2" thick layers of higher dilatancy, silt concentration more stiff, less moisture (40% of total run) from 16.5 to 18.0 feet.		
13	SS	18.0	19.5	1-2-2/0"	14					Note: wet, medium dilatancy, very soft, no water in spoon from 18.0 to 19.5 feet. Note: water at 18.0 feet.	▽	
14	SS	19.5	21.0	2-1-2/0"	16.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1605** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/29/16** BORING FINISH **5/2/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
15	SS	21.0	22.5	1-2-2/0"	16	
16	SS	22.5	24.0	1-2-2/0"	15.5	
17	SS	24.0	25.5	3-4-9/0"	12	
18	SS	25.5	27.0	2-5-6/0"	11.5	
19	SS	27.0	28.5	4-5-9/0"	12	
20	SS	28.5	30.0	4-7-7/0"	16.5	
21	SS	30.0	31.5	4-5-8/0"	16	
22	SS	31.5	33.0	3-4-4/0"	18	
23	SS	33.0	34.5	4-3-6/0"	16	
24	SS	34.5	36.0	4-5-6/0"	16.5	
25	SS	36.0	37.5	6-3-6/0"	10.5	
26	SS	37.5	39.0	2-3-4/0"	12.5	
27	SS	39.0	40.5	3-3-2/0"	14	
28	SS	40.5	42.0	6-2-6/0"	17	
29	SS	42.0	43.5	10-6-7/0"	24	
30	SS	43.5	45.0	5-3-4/0"	3	
31	SS	45.0	46.5	8-4-6/0"	10	

DEPTH IN FEET: 25, 30, 35, 40, 45

USCS	SOIL / ROCK IDENTIFICATION
SM	Sandy silt with some fine sand, wet, soft, rapid dilatancy, low plasticity, high quantity of water in spoon, 2.5Y 5/6. Note: saturated, slightly less silt and more sand, very soft from 23.5 to 24.0 feet.
SM	Silty sand, fine sand, trace silt (10%), very soft, wet, rapid dilatancy, non plastic, poorly graded, 2.5Y 5/6. Rock lodged into shoe at 25.5 feet. Chert fractures, no cleavage, angular, all fresh breaks from split spoon. Chalky inclusions. Heaving sand encountered at 25.5 feet.
SP	Poorly graded fine sand, trace (3%) silt, very soft, brown, wet, non plastic, rapid dilatancy, poorly graded, 2.5Y 5/6. Note: trace 5mm layers of black sand from 28.5 to 30.0 feet. Note: 2.5" band of silty sand, wet, stiff to moderately stiff, fine sand, little silt at 30.4 feet. Note: 5mm layers of black sand (trace amounts) from 30.8 to 31.5 feet. Note: oxidation/iron staining, 5YR 5/8 at 32.6 feet. Note: color change at 32.8 feet 5Y 5/1. Note: very abrupt and clear color shift to Gley 1 4N at 33.3 feet. Note: color change to 7.5YR 4/1 at 35.25 feet. Note: 2-3" trace/little amounts of black material in 2mm bands at 36.8 feet. Note: little black material, slightly more stiff, 10YR 2/1 at 38.2 feet. Note: color change at 38.5 feet to 10YR 5/8.
SP	Poorly graded, fine sand, trace to little silt (10-12%), very soft, wet, brown, no plasticity, rapid dilatancy. Note: sand grain size slightly larger at 40.5 feet. Note: trace silt from 42.0 to 43.5 feet. Note: angular piece of sandstone matching sand in color, small gravel size at 43.0 feet. Note: heaving sand encountered at 43.5 feet. Note: pieces of platy mudstone within sand in shoe, small gravel sized, very soft rock, subangular at 44.7 feet.

GRAPHIC LOG | WELL | DRILLER'S NOTES

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1605** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/29/16** BORING FINISH **5/2/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	2-6-8/0"	11.5					Note: color change to 7.5YR 4/1 at 45.0 feet. Note: 2" band of silt with very fine sand layered 50/50. Note: heaving sand encountered at 46.5 feet.		
33	SS	48.0	49.5	6-5-7/0"	14.5					Note: trace small gravel, subangular from 47.8 to 48.0 feet.		
34	SS	49.5	51.0	4-7-10/0"	20		50			Note: 0.5mm seam of black material, coarse to fine sand size and slight color change from 48.0 to 49.0 feet. Note: well graded, little rounded small gravel from 50.4 to 51.0 feet.		
										End of boring at 51.0 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES **N 539,197.0 E 1,731,559.3**

GROUND ELEVATION **580.8** SYSTEM

BORING NO. **MW-1606** DATE **7/19/16** SHEET **1** OF **3**

BORING START **5/2/16** BORING FINISH **5/3/16**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.0** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **24.32** BOTTOM **39.0**

WELL DEVELOPMENT **NA** BACKFILL **NA**

FIELD PARTY **NA** RIG **Diedrich**

Water Level, ft	∇ 12.0	▼	▼
TIME			
DATE	5/3/2016		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1-0-0/0"	0					No recovery.		
2	SS	1.5	3.0	1-0-0/0"	4				ML	Note: grade is sandy silt, topsoil, silt, trace fine sand, trace medium sand, root structures (5%), soft, low plasticity, no dilatancy, moist, brown (5YR 3/1).		
3	SS	3.0	4.5		2					Note: only recovery is inside shoe from 3.0 to 4.5 feet.		
4	SS	4.5	6.0	9-10-14/0"	0		5			Note: rock lodged in shoe, sandstone, no recovery from 4.5 to 6.0 feet.		
5	SS	6.0	7.5	8-9-7/0"	6.5				ML	Silt, trace fine sand, brown, moist, moderate plasticity, no dilatancy, soft, very uniform texture (10YR 4/4).		
6	SS	7.5	9.0	2-2-4/0"	15				SM SM	Some fine sand, trace medium sand, soft, moist, no dilatancy, low plasticity, root structures (3%) (10YR 3/3).		
7	SS	9.0	10.5	4-4-7/0"	17				SM	Silt, some fine sand, stiff, moist, low plasticity, no dilatancy (10YR 3/3).		
8	SS	10.5	12.0	1-1-2/0"	21		10			Fine sand, little silt, soft, moist, no dilatancy, no plasticity, higher moisture content at bottom of 10.5 feet (10YR 5/6).		
9	SS	12.0	13.5	2-2-3/0"	22					Note: wet, very soft from 12 to 13.5 feet. Note: water at 12.0 feet.	∇	
10	SS	13.5	15.0	2-2-3/0"	22							
11	SS	15.0	16.5	2-1-3/0"	14		15					
12	SS	16.5	18.0	3-5-4/0"	14					Note: very soft from 16.5 to 18 feet. Slight color shift to 10YR 4/6 at 16.7 feet.		
13	SS	18.0	19.5	5-4-7/0"	14					Note: heaving sand encountered at 18 feet. Flushed with water, not enough to push down added mud.		
14	SS	19.5	21.0	5-7-10/0"	12							

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **MW-1606** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **5/2/16** BORING FINISH **5/3/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	5-8-10/0"	13					Note: band of black/dark brown and, 1 cm thick (5Y 3/2), trace silt, same characteristics. Note: same band of dark brown/black sand, trace silt from 21.0 to 21.1 feet. Color change to 7.5YR 5/6 with band layers of 5YR 5/3 (25%) heavily oxidized.		
16	SS	22.5	24.0	5-10-13/0"	13							
17	SS	24.0	25.5	7-10-13/0"	12.5					Note: abrupt color change to 10YR 6/6 at 23.7 feet.		
18	SS	25.5	27.0	3-8-8/0"	10		25			Note: slight shift in color, back to 7.5YR 5/8 oxidized slightly paler at 25.5 feet (10YR 6/6).		
19	SS	27.0	28.5	3-3-6/0"	1				SM	Note: color change to 10YR 4/8, trace silt at 26.5 feet. Silty sand, fine sand, trace silt, trace medium sand, little medium sand size subangular bits of black material (coal 15%), wet, soft-medium stiff, no dilatancy, no plasticity, gray, small bands of oxidation (5 mm) (5Y 5/1).		
20	SS	28.5	30.0	6-4-4/0"	12.5							
21	SS	30.0	31.5	7-3-3/0"	17.5		30			Note: slightly darker coloration, no oxidation coloration, trace amounts of medium sand sized coal fragments from 30 to 31.5 feet.		
22	SS	31.5	33.0	9-7-7/0"	17				SP	Poorly graded sand, fine sand, little medium sand, subangular, trace silt (3%), gray, wet, no dilatancy, soft, no plasticity (5Y 5/1).		
23	SS	33.0	34.5	4-3-3/0"	15.5				SP	Poorly graded sand, fine sand, trace silt (3%), soft, wet, no plasticity, no dilatancy, red-gray (7.5YR 5/3).		
24	SS	34.5	36.0	3-3-5/0"	13.5		35					
25	SS	36.0	37.5	2-3-3/0"	13.5							
26	SS	37.5	39.0	2-3-6/0"	18					Note: 5 mm bands of trace medium sand with fine sand from 37.5 to 39.0 feet.		
27	SS	39.0	40.5	4-4-6/0"	10		40			Note: 10 mm band of black sand at 39.9 feet.		
28	SS	40.5	42.0	4-7-8/0"	13					Note: red streak on side of spoon (10YR 4/6), very fine sand from 40.5 to 42.0 feet.		
29	SS	42.0	43.5	3-4-5/0"	12.5					Note: trace medium sand (5-7%), slight color change to 10YR 5/8 from 42.8 to 43.5 feet.		
30	SS	43.5	45.0	3-3-6/0"	13.5					Note: 0.3" layer of little amount of coal bits ranging in size from fine to coarse, fine-little medium coarse sand at 44.25 feet.		
31	SS	45.0	46.5	3-4-9/0"	16		45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER OH015976.0007

COMPANY American Electric Power

PROJECT John E. Amos Plant CCR

BORING NO. MW-1606 DATE 7/19/16 SHEET 3 OF 3

BORING START 5/2/16 BORING FINISH 5/3/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	12-19-22/0"	11.5				SW	Note: trace rounded small gravel at 46.4 feet.		
									SW	Well graded sand, fine sand, little medium sand, trace coarse sand, little small rounded gravel, wet, soft, non plastic, no dilatancy.		
33	SS	48.0	49.5	50-4/0"	0					Well graded sand, fine sand, trace medium sand, trace coarse sand (5Y 5/1), little angular to subangular small gravel sized pieces of sandstone (Gley 1 5/N) and mudstone (2.5YR 3/6).		
34	SS	49.5	51.5	50-2/0"	0					Note: nothing in shoe or spoon, likely a medium to large cobble from 48.0 to 49.5 feet.		
										End of boring at 49.7 feet due to refusal.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES

GROUND ELEVATION SYSTEM

Water Level, ft	▽ 9.0	▼	▼
TIME			
DATE	4/26/2016		

BORING NO. **SB-1601** DATE **7/19/16** SHEET **1** OF **3**

BORING START **4/25/16** BORING FINISH **4/26/16**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **Sandpack/Grout**

FIELD PARTY **NA** RIG **Hollow Stem Auger 2"**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1-0-0/0"	0.2					Ash, fine sand, trace medium angular sand, greenish gray, moist, very soft, no dilatancy, moderate plasticity (Gley 1 5/N).		
2	SS	1.5	3.0	1-1-0/0"	0.2					Note: trace organics, root fibers from 1.8 to 3.0 feet.		
3	SS	3.0	4.5	5-5-10/0"	1.1				CL	Clay, little silt, trace medium sand sized coal and ash bits (angular) very stiff, moist, greenish gray, no dilatancy, low placticity (Gley 1 5/N).		
5	SS	4.5	6.0	14-9-10/0"	1.3		5			Ash, some fine sand, trace medium subangular sand, very stiff, moist, greenish gray, no dilatancy, low plasticity (Gley 1 5/N).		
6	SS	6.0	7.5	5-7-5/0"	0.1					Note: addition of organics, root fibers and trace coarse sand-subangular from 6.2 to 7.5 feet.		
7	SS	7.5	9.0	5-3-3/0"	0.8					Ash, some fine sand, trace medium subangular sand, soft, trace silt, moist, slow dilatancy (Gley 1 5/N).		
8	SS	9.0	10.5	2-2-2/0"	0.7		10			Note: saturation encountered from 9.0 to 10.5 feet.	▽	
9	SS	10.5	12.0	2-2-3/0"	0.8					Note: small-medium sand, pieces of brick from 10.5 to 12.0 feet.		
10	SS	12.0	13.5	3-3-5/0"	0.7							
11	SS	13.5	15.0	6-9-10/0"	0.7					Note: layer of finer material, some fine sand (70%), little medium sand (15%), little silt (25%) from 13.1 to 13.5 feet.		
12	SS	15.0	16.5	5-5-7/0"	0.9		15			Note: laminae/layers of black "bottom ash" admist gray ash 0.75/1.0 cm spacing (approximately) 0.25 cm thick.		
13	SS	16.5	18.0	6-9-10/0"	1.1							
14	SS	18.0	19.5	8-10-9/0"	0.9							
15	SS	19.5	21.0	7-8-9/0"	1					Note: black layers are not present from 19.5 to		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1601** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/25/16** BORING FINISH **4/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										21.0 feet.		
16	SS	21.0	22.5	4-8-5/0"	1.1							
17	SS	22.5	24.0	5-2-1/0"	0.8							
18	SS	24.0	25.5	2-2-3/0"	0.9		25		ML	Silt, some clay, soft, medium sized pieces of muscovite, brown-gray, moist, dilatancy, high plasticity, uniform texture (Gley 1 6/N).		
19	SS	25.5	27.0		0					No recovery.		
20	SS	27.0	28.5	1-1-0/0"	1.4				SP	Medium sand, some fine sand, trace silt, moderate dilatancy, low plasticity, moist, very soft (Gley 1 5/N.		
21	SS	28.5	30.0	1-1-5/0"	1							
22	SS	30.0	31.5	2-3-3/0"	1.3		30					
23	SS	31.5	33.0	3-4-6/0"	1.1							
24	SS	33.0	34.5	9-2-1/0"	0.9							
25	SS	34.5	36.0	2-3-3/0"	1.73		35		SM	Medium sand, subangular, trace fine sand, trace silt, brown, wet, rapid dilatancy, low plasticity, very soft (7.5YR 4/2).		
26	SS	36.0	37.5	4-5-5/0"	1.55							
27	SS	37.5	39.0	2-2-5/0"	1.45					Note: higher concentration of silt (15%) from 36.8 to 37.1 feet.		
									ML	Silt, trace fine sand, trace medium angular sand, little organics, root fibers, bits of wood (0.25 - 0.75 cm) (7.5YR 4/2).		
28	SS	39.0	40.5	3-2-6/0"	1.25				SM	Medium sand, subangular, trace fine sand, trace silt, brown, wet, rapid dilatancy, low plasticity, very soft (7.5YR 4/2).		
29	SS	40.5	42.0	3-7-9/0"	1.25		40			Note: layer of silt, trace fine sand, very uniform from 39.3 to 39.5 feet.		
30	SS	42.0	43.5	7-8-10/0"	0.95					Note: stiff from 40.5 to 42.0 feet. Note: trace subrounded gravel (small) from 41.7 to 42.0 feet.		
31	SS	43.5	45.0	6-6-6/0"						Note: medium gravel, piece plugged shoe briefly at 43.0 feet.		
32	SS	45.0	46.5	3-6-9/0"	17		45			Note: brown laminae/layers at 45.0 feet.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1601** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/25/16** BORING FINISH **4/26/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
33	SS	46.5	48.0	6-7-11/0"	14.5					Note: color change to Gley 1 5/N at 46.8 feet.		
34	SS	48.0	49.5	5-7-6/0"	16.25							
35	SS	49.5	51.0	3-6-5/0"	0		50		SW	No recovery.		
36	SS	51.0	52.5	3-5-14/0"	16.25				SW	Medium sand, little fine sand, soft, wet, no plasticity, no dilatancy, gray, sand, subangular (Gley 1 5/104).		
37	SS	52.5	54.0	10-17-17/0"	6				SW	Medium sand, little fine sand, subangular, little coarse subangular sand, trace subrounded small gravel, well graded (Gley 1 5/GN).		
38	SS	53.0	54.5	20-20-38/0"	15				SW	Note: more small gravel (litle) from 53.0 to 54.5 feet.		
39	SS	54.5	56.0	20-20-38/0"	15		55		SW	Medium sand, some fine sand, trace coarse sand, subangular, wet, soft, low plasticity, no dilatancy, gray (Gley 1 5/GN).		
40	SS	55.0	56.5	18-40-50-4/0"	10.5					Medium sand, little coarse sand, trace small subangular gravel, trace medium subangular gravel, soft, trace fine sand (Gley 5/N).		
										Weathered sandstone, moist, very stiff, no plasticity, no dilatancy, uniform texture, gray mottling throughout (10R 3/6).		
										End of boring at 57.5 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER OH015976.0007

COMPANY American Electric Power

PROJECT John E. Amos Plant CCR

COORDINATES

GROUND ELEVATION SYSTEM

BORING NO. SB-1602 DATE 7/19/16 SHEET 1 OF 3

BORING START 4/26/16 BORING FINISH 4/27/16

PIEZOMETER TYPE NA WELL TYPE NA

HGT. RISER ABOVE GROUND NA DIA NA

DEPTH TO TOP OF WELL SCREEN NA BOTTOM NA

WELL DEVELOPMENT NA BACKFILL NA

FIELD PARTY NA RIG Hollow Stem Auger 2"

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1-0-0/0"	1					Ash, fine sand, little medium sand, some silt, very soft, moist, gray (Gley 1 6/N) no plasticity, no dilatancy.		
2	SS	1.5	3.0	1-0-0/0"	2					Ash, fine sand, some silt, trace medium sand, trace coarse sand, subangular, moist, gray (Gley 1 6/N), low plasticity, no dilatancy.		
3	SS	3.0	4.5	1-1-0/0"	15					Note: little wood pieces 0.50-1.0cm in size, trace amounts rounded small gravel from 3.4 to 4.5 feet.		
4	SS	4.5	6.0	3-3-6/0"	14.5		5		SM	Silt, little fine sand, trace medium subangular sand, brown (2.5Y 3/3), medium stiffness, no plasticity, moist, well graded.		
5	SS	6.0	7.5	2-3-4/0"	12.5					Note: color change to 10YR 5/6, from 6.0 to 7.5 feet.		
6	SS	7.5	9.0	2-3-5/0"	12					Note: micaceous from 7.5 to 9.0 feet. Note: hardness change from 7.7 to 8.7 feet.		
7	SS	9.0	10.5	3-5-9/0"	14		10			Note: stiff, gray mottling (Gley 1 7/N) from 9.3 to 12.0 feet.		
8	SS	10.5	12.0	3-6-8/0"	14					Note: trace amounts of organics/roots from 11.3 to 12.0 feet.		
9	SS	12.0	13.5	3-5-7/0"	16					Note: interbedded layers of silty clay, grey (10YR 5/6), stiff, moist from 12.3 to 13.5 feet.		
10	SS	13.5	15.0	2-3-7/0"	15					Note: no grey mottling from 13.5 to 15.0 feet.		
11	SS	15.0	16.5	3-4-5/0"	18		15		SM	Fine sand, little silt, trace medium sand, soft, brown, moist, low plasticity, no dilatancy.		
12	SS	16.5	18.0	3-3-3/0"	24					Note: uniform texture, poorly graded, well sorted from 16.5 to 18.0 feet.		
13	SS	18.0	19.5	2-2-2/0"	18							
14	SS	19.5	21.0	2-2-2/0"	20							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER T. Runge

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1602** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/26/16** BORING FINISH **4/27/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	SS	21.0	22.5	1-1-1/0"	20				SM	Fine sand, some silt, very soft, wet, rapid dilatancy, brown (10YR 4/6), no plasticity. Note: silt (30%), very wet, very soft from 21.0 to 22.5 feet.		
16	SS	22.5	24.0	1-1-1/0"	19				SM	Fine sand, some silt, very wet, very soft.		
17	SS	24.0	25.5	3-2-4/0"	18		25		SP	Fine sand, trace silt, soft, brown (10YR 4/6), rapid dilatancy, no plasticity, wet, silt ~10%.		
18	SS	25.5	27.0	4-4-7/0"	14					Note: heaving sand encountered (1' up auger) at 25.5 feet, trace medium sand subrounded from 25.8 to 26.4 feet.		
19	SS	27.0	28.5	9-11-12/0"	15				SW	Fine sand, little subangular medium sand, trace coarse sand, silt 5%, soft, wet, no plasticity.		
20	SS	28.5	30.0	6-7-11/0"	17.5					Note: small laminate of fine sand only, 1-1.5 cm thick from 28.5 to 30.0 feet.		
21	SS	30.0	31.5	5-6-16/0"	19		30			Note: fine medium sand, trace coarse sand from 30.0 to 39.0 feet.		
22	SS	31.5	33.0	10-12-9/0"	10.5					Note: color change to 10YR 4/6 at 32.1 feet.		
23	SS	33.0	34.5	3-3-8/0"	11							
24	SS	34.5	36.0	8-7-5/0"	16		35			Note: black staining present, piece of sandstone was lodged in shoe from 34.1 to 34.5 feet. Note: 0.5-1.5 cm layers of black staining present, very wet from 34.5 to 35.8 feet.		
25	SS	36.0	37.5	4-5-12/0"	13					Note: color change to 5YR 5/8 from 36.5 to 37.5 feeet.		
26	SS	37.5	39.0	6-7-8/0"	17							
27	SS	39.0	40.5	5-3-5/0"	16		40			Fine sand, trace medium sand, trace silt, wet, soft, no plasticity, rapid dilatancy, piece of sandstone in shoe. Note: color change to Gley1 6/N at 39.7 feet.		
28	SS	40.5	42.0	7-7-6/0"	14.5							
29	SS	42.0	43.5	3-3-7/0"	15					Note: color change to 2.5Y 4/2 from 42.3 to 43.5 feet.		
30	SS	43.5	45.0	3-4-5/0"	9.5				SW	Fine sand, trace medium sand, trace silt, wet, soft, no plasticity, no dilatancy, trace very coarse sand, subangular.		
31	SS	45.0	46.5	5-1-5/0"	11.5		45		SW	Fine sand, trace medium sand, trace silt, trace subangular coarse sand, wet, slow dilatancy, soft,		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1602** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/26/16** BORING FINISH **4/27/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										brown gray (7YR 5/2), no plasticity.		
32	SS	46.5	48.0	4-3-4/0"	20							
									SP	Fine sand, trace medium sand, trace silt, wet, soft, rapid dilatancy, brown gray (7YR 5/2).		
33	SS	48.0	49.5	7-5-7/0"	22							
34	SS	49.5	51.0	8-7-10/0"	18		50			Note: black laminated/stained sand layers 0.25-0.5 cm in thickiness from 49.2 to 49.5 feet. Note: black mottling (7YR 5/2) from 49.5 to 51.0 feet. Note: color change to 10YR 5/3 at 51.0 feet.		
35	SS	51.0	52.5	8-7-9/0"	16							
36	SS	52.5	54.0	7-9-12/0"	19							
37	SS	53.0	54.5	4-4-9/0"	11.5				SW	Fine sand, trace medium sand, trace silt, trace coarse sand, trace small subangular gravel, brown (10YR 5/3), soft, well graded, wet, no plasticity, rapid dilatancy.		
									SP	Fine sand, trace silt, trace medium sand, wet, soft, poorly graded, no plasticity, moderate dilatancy, brown (10YR 5/3).		
38	SS	54.5	56.0	9-11-16/0"	18							
39	SS	55.0	56.5	4-23-28/0"	14		55					
									SW	Fine sand, trace medium sand, little subangular, small gravel, wet, soft, rapid dilatancy, no plasticity, brown (10YR 5/3), well graded. Note: trace silt from 57.3 to 58.4 feet.		
40	SS	57.5	59.0	12-58-4/0"	6							
										Red and gray (10YR 3/4) weathered mudstone, weathered. Weathered gray (Gley1 6/N) sandstone at 59.5 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** — BORING NO. **SB-1603** — DATE **7/19/16** — SHEET **1** OF **3**

PROJECT **John E. Amos Plant CCR** — BORING START **4/27/16** — BORING FINISH **4/28/16**

COORDINATES — PIEZOMETER TYPE **NA** — WELL TYPE **NA**

GROUND ELEVATION — SYSTEM — HGT. RISER ABOVE GROUND **NA** — DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **NA**

FIELD PARTY **NA** RIG **Hollow Stem Auger 2"**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1-1-1/0"	6.5				Ash, fine sand, trace medium sand, little silt, soft, moist, non sticky, gray, no dilatancy, no plasticity, Gley 1 4/N.		
2	SS	1.5	3.0	1-0-0/0"	3.5				Note: some inclusions of brown sand in small spots (medium) 5Y 5/4 from 1.5 to 3.0 feet.		
3	SS	3.0	4.5	1-2-3/0"	14			SM	Silt, some fine sand, little medium sand, subangular, soft, brown, no dilatancy, moist, medium plasticity 5Y 4/4.		
4	SS	4.5	6.0	2-1-2/0"	15.5		5	SM	Silt, fine sand, little silt, trace medium sand, brown, soft, moist, no dilatancy, low plasticity, 5Y 4/4.		
5	SS	6.0	7.5	3-2-4/0"	14			SM	Silt, fine sand, some silt, brown, soft, moist, no diltancy, moderate plasticity, 5Y 4/4.		
6	SS	7.5	9.0	3-4-5/0"	15.5				Note: color change to 2.5Y 5/6, gray fine sand seams (5%) from 7.5 to 9.8 feet.		
7	SS	9.0	10.5	3-3-5/0"	17		10	SM	Silt, little fine sand, brown, grey mottling, trace root fibers/organics, soft, moist, gray, medium plasticity, no dilatancy, 2.5Y 5/6.		
8	SS	10.5	12.0	4-4-7/0"	17			SM	Silty sand, fine sand, some silt, veins of oxidation, black veins (5%), soft, brown, moist, no diltancy, moderate plasticity, 2.5Y 5/6.		
9	SS	12.0	13.5	3-5-8/0"	17						
10	SS	13.5	15.0	3-4-7/0"							
11	SS	15.0	16.5	3-4-5/0"	16.5		15	SM	Fine sand, little silt, soft, veins of oxidized sand/silt (5%), gray, no dilatancy, moderate plasticity, trace black sand (5%), 2.5Y 4/3. Note: bottom 0.1' was wet. Note: 10YR 3/2 band, approximately 2" thick at 21.9 feet.		
12	SS	16.5	18.0	2-3-3/0"	17						
13	SS	18.0	19.5	2-2-4/0"	16.5				Note: medium dilatancy, more moisture from 18.0 to 19.5 feet.		
14	SS	19.5	21.0	2-2-3/0"	18						

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1603** DATE **7/19/16**

PROJECT **John E. Amos Plant CCR** BORING START **4/27/16** BORING FINISH **4/28/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	SS	21.0	22.5	4-5-6/0"	21							
17	SS	22.5	24.0	3-2-3/0"	16				SM	Fine sand, little silt, medium stiff, grey, slow dilatancy, moderate plasticity, 7.5YR 5/2. Note: 10YR 3/2 band approximately 2" thick at 21.9 feet.		
18	SS	24.0	25.5	3-3-9/0"	22		25			Note: no oxidation indicators, wet, very soft, color change to 10YR 5/4 at 24.0 feet.		
19	SS	25.5	27.0	3-3-5/0"	18				SM	Fine sand, trace silt, trace medium subangular sand, medium stiff, wet, black, 0.50-0.25 cm veins, medium dilatancy, low plasticity, interbedded layers 1-3 cm containing little silt, 10YR 5/4.		
20	SS	27.0	28.5	2-2-6/0"	13							
21	SS	28.5	30.0	5-7-10/0"	15		30			Note: heaving sand at 28.5 feet.		
22	SS	30.0	31.5	4-8-9/0"	13							
23	SS	31.5	33.0	3-4-9/0"	17					Note: seams of black sand 0.5-1 cm thick from 32.1 to 33.0 feet.		
24	SS	33.0	34.5	10-9-15/0"	14					Note: color band (oxidized) 7YR 5/8 from 33.1 to 33.3 feet.		
25	SS	34.5	36.0	6-9-9/0"	13		35			Note: oxidized color change 7YR 5/8 at 35.25 feet.		
26	SS	36.0	37.5	5-5-7/0"	17							
27	SS	37.5	39.0	4-4-6/0"	14							
28	SS	39.0	40.5	3-4-6/0"	15		40			Note: color change to 7YR 4/2 at 38.7 feet. Note: 0.75" layer of weathered shale encountered, slight color shift 7YR 4/1 at 39.7 feet.		
29	SS	40.5	42.0	6-6-11/0"	6					Note: piece of sandstone lodged in shoe and another small gravel sized piece at 40.6 feet.		
30	SS	42.0	43.5	7-8-11/0"	11							
31	SS	43.5	45.0	5-6-9/0"	11.5		45					
32	SS	45.0	46.5	3-6-9/0"	18				SM	Silty sand, fine sand, little medium sand, trace silt, very soft, wet, no dilatancy, no plasticity, 1 cm		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1603** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/27/16** BORING FINISH **4/28/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
33	SS	46.5	48.0	5-7-9/0"	17					bands of higher concentrations of medium sand, gray brown 10YR 4/1. Note: trace rounded small gravel from 46.5 to 47.2 feet.		
34	SS	48.0	49.5	6-5-6/0"	19							
35	SS	49.5	51.0	4-6-8/0"	10		50			Note: trace coarse sand, subrounded from 49.5 to 51.0 feet.		
36	SS	51.0	52.5	3-4-8/0"	12							
37	SS	52.5	54.0	5-6-9/0"	13					Note: black/stained sand in end of shoe at 52.5 feet.		
38	SS	54.0	55.5	7-10-12/0"	12.5		55					
39	SS	55.5	57.0	11-13-10/0"	14				SW	Well graded sand, fine sand, some medium sand, little coarse subangular sand, little small subrounded gravel, soft, no dilatancy, no plasticity, 10YR 4/1.		
40	SS	57.0	58.5	16-50-4/0"	10.5					Weathered mudstone with small gravel sized pieces of gray sandstone (trace amount), Gley 1 6/N.		
41	SS	58.5	67.5	50-2/3"	5.5							
										End of boring at 59 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES

GROUND ELEVATION SYSTEM

BORING NO. **SB-1604** DATE **7/19/16** SHEET **1** OF **3**

BORING START **4/28/16** BORING FINISH **4/29/16**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **NA**

FIELD PARTY **NA** RIG **Hollow Stem Auger 2"**

Water Level, ft	▽ **10.5**	▼	▼
TIME			
DATE	**4/29/2016**		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5		2					Ash, fine sand, some silt, trace small angular gravel, soft, moist, no dilatancy, low plasticity, gray (Gley 1 5/N).		
2	SS	1.5	3.0	1-1-0/0"	4							
3	SS	3.0	4.5	1-1-0/0"	3					Note: no angular gravel present from 3 to 4.5 feet.		
4	SS	4.5	6.0	2-4-8/0"	13.5		5		ML	Silt, trace fine sand, trace coarse subangular sand (3%), brown, stiff, moist, no dilatancy, low plasticity, sandstone chunk in shoe (2.5Y 4/3).		
5	SS	6.0	7.5	8-14-15/0"	16.5							
6	SS	7.5	9.0	6-8-15/0"	12					Ash, fine sand, trace medium sand, little silt, soft, grey, no dilatancy, low plasticity, moist (Gley 1 5/N).		
7	SS	9.0	10.5	4-6-7/0"	14.5		10			Note: concentrated area of fine sand and silt from 8.7 to 8.9 feet. Note: wet, slow dilatancy at 9.3 feet.		
8	SS	10.5	12.0	2-3-4/0"	13.5					Note: wet from 10.5 to 12 feet. Note: water at 10.5 feet.	▽	
9	SS	12.0	13.5	3-2-2/0"	16.5							
10	SS	13.5	15.0	1-1-2/0"	19.5		15			Note: black angular bottom ash, trace amount, coarse sand to small gravel size subangular to angular from 13.5 to 14.7 feet.		
11	SS	15.0	16.5	9-3-2/0"	14					Ash, fine sand, little silt, trace medium sand, trace angular coarse sand, wet, gray, soft, moderate dilatancy, low plasticity (Gley 1 5/N).		
12	SS	16.5	18.0	2-1-2/0"	24					Note: coarse sand (3%) from 16.5 to 18 feet.		
13	SS	18.0	19.5	2-1-1/0"	20							
14	SS	19.5	21.0	1-1-1/0"	21.5					Note: trace silt present, moderate stiffness from		

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1604** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/28/16** BORING FINISH **4/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										19.5 to 21 feet.		
16	SS	21.0	22.5	3-1-1/0"	22					Note: very wet and slightly less angular coarse sand (bottom ash) 3-5% from 21 to 22.5 feet.		
17	SS	22.5	24.0	4-1-1/0"	24							
18	SS	24.0	25.5	2-3-5/0"	21		25			Note: moderate stiffness from 24 to 25.4 feet.		
19	SS	25.5	27.0	3-6-4/0"	12					Note: color change to Gley 1 2.5/10GY at 25.4 feet. Note: heaving sand encountered at 25.5 feet.		
20	SS	27.0	28.5	3-3-2/0"	16.5				SM	Fine sand, little medium sand, trace coarse angular sand, trace silt, soft, wet, no dilatancy, no plasticity (Gley 1 5/10Y).		
21	SS	28.5	30.0	2-1-2/0"	16				SM	Note: trace angular-subangular small gravel (Gley 1 4/5G 2) from 26.5 to 26.8 feet. Note: no coarse sand and little silt, stiff from 27.3 to 28.7 feet.		
22	SS	30.0	31.5	1-1-2/0"	0		30			Silty sand, fine sand, trace medium sand, trace silt, medium stiff, wet, rapid dilatancy, brown gray (5Y 4/3).		
23	SS	31.5	33.0	1-2-3/0"	12					Note: no recovery from 30 to 31.5 feet. Note: little silt from 31.5 to 31.7 feet. Note: color change to 2.5Y 5/4 from 32.1 to 32.9 feet.		
24	SS	33.0	34.5	2-1-1/0"	10							
25	SS	34.5	36.0	2-3-4/0"	10.5		35		SM	Fine sand, little silt, soft, very wet, rapid dilatancy, moderate plasticty, brown gray (5Y 4/3).		
26	SS	36.0	37.5	3-2-9/0"	15							
27	SS	37.5	39.0	6-8-6/0"	12.5					Note: trace medium sand from 36.9 to 37.4 feet.		
28	SS	39.0	40.5	7-8-6/0"	14.5				SM	Fine sand, trace silt, soft, rapid dilatancy, wet, low-moderate plasticity, gray, poorly graded (5Y 4/3).		
29	SS	40.5	42.0	5-6-6/0"	5		40			Note: end of boring at 45.0 feet on 4/28/2016.		
30	SS	42.0	43.5	2-2-6/0"	18							
31	SS	43.5	45.0	5-3-5/0"	16							
32	SS	45.0	46.5	5-5-7/0"	16.5		45		SM	Fine sand, trace medium sand, trace siilt, medium stiff, wet, rapid dilatancy, moderate plasticity, gray		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1604** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/28/16** BORING FINISH **4/29/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
33	SS	46.5	48.0	2-6-13/0"	15.5					(5Y 4/3).		
34	SS	48.0	49.5	6-6-14/0"	11					Note: no medium sand, 0.5 cm black sand veins at 48.7 feet.		
35	SS	49.5	51.0	9-10-9/0"	12		50					
36	SS	51.0	52.5	2-2-3/0"	22							
37	SS	52.5	54.0	3-3-10/0"	22							
38	SS	54.0	55.5	19-26-28/0"	17.5		55					
39	SS	55.5	57.0	9-11-21/0"	2				SW SW	Fine sand, little medium sand, trace coarse angular sand, trace (sandstone), small gravel, subrounded, few layers of sandstone 2-3 cm, sandstone (Gley 1 6N).		
40	SS	57.0	58.5	9-30-50-3/0"	17					Fine sand, trace (sandstone), small subrounded gravel, little silt, moist, soft to medium stiff, low plasticity, no dilatancy (5Y 4/3). Note: weathered sandstone, little small subrounded gravel from 57.4 to 58.4 feet.		
41	SS	58.5	67.5	9-30-50-3/0"	3.5					End of boring at 58.4 feet.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power**

PROJECT **John E. Amos Plant CCR**

COORDINATES

GROUND ELEVATION SYSTEM

BORING NO. **SB-1605** DATE **7/19/16** SHEET **1** OF **3**

BORING START **4/29/16** BORING FINISH **5/2/16**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **NA**

FIELD PARTY **NA** RIG **Hollow Stem Auger 2"**

Water Level, ft	▽ **17.8**	▼	▼
TIME			
DATE	**5/2/2016**		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5						SM	Sandy silt, little fine sand, trace medium sand, moist, wet, very soft, brown, no dilatancy (7YR 5/6).		
2	SS	1.5	3.0	1-1-0/0"	3					Note: trace coarse angular sand, very wet from 1.5 to 3.0 feet.		
3	SS	3.0	4.5	1-1-2/0"	7.5					Road base fill, limestone, small/medium gravel (7YR 4/6).		
4	SS	4.5	6.0	6-6-8/0"	11.5		5		SM	Silt, some fine sand, moist, medium stiff, brow/dark brown, no dilatancy, low plasticity (7YR 4/6). Note: layer of black/dark brown 7YR from 4.2 to 4.4 feet. Note: color change to gray at 5.5 feet.		
5	SS	6.0	7.5	8-4-2/0"	12				SM	Silt, trace fine sand, stiff, low plasticity, no dilatancy, gray mottling, moist (7YR 4/6).		
6	SS	7.5	9.0	3-7-9/0"	14.5							
7	SS	9.0	10.5	8-6-9/0"	2					Note: color shift to 2.54 at 9.22 feet and gray fine sand veins (5%).		
8	SS	10.5	12.0	2-3-5/0"	15		10					
9	SS	12.0	13.5	3-4-5/0"	21					Note: lower recovery, rock jammed shoe from 12.0 to 13.5 feet.		
10	SS	13.5	15.0	3-3-4/0"	1.5					Note: higher moisture content from 14.5 to 15.0 feet.		
11	SS	15.0	16.5	5-2-3/0"	10		15		ML	Silt, trace fine sand, stiff, brown, moist, low plasticity, no dilatancy ((Gley 1 4/10Y). Note: color change to 10YR 5/6, higher moisture content and little fine sand from 15.6 to 15.9 feet.		
12	SS	16.5	18.0	3-2-3/0"	18						▽	
13	SS	18.0	19.5	2-2-2/0"	18					Note: wet at 17.75 feet.		
14	SS	19.5	21.0	4-2-2/0"	14.5							

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **T. Runge**

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1605** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/29/16** BORING FINISH **5/2/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									SM	Fine sand, trace medium sand, trace silt (10%), soft, wet, rapid dilanacy, no plasticity (10YR 5/6).		
15	SS	21.0	22.5	6-4-3/0"	12							
										Note: slightly more silt (15%) from 21.7 to 22.0 feet.		
16	SS	22.5	24.0	5-5-5/0"	10.5							
17	SS	24.0	25.5	4-4-5/0"	8					Note: low recovery due to rock stuck in shoe, sandstone (cobble size) from 24.0 to 25.0 feet.		
							25					
18	SS	25.5	27.0	10-8-10/0"	3					Note: color change to 10YR 3/2 from 25.5 to 26.7 feet.		
19	SS	27.0	28.5	9-13-15/0"	15					Note: color change to 10YR 5/8 from 26.7 to 27.0 feet. Note: color change to 10YR 6/8 from 27.2 to 28.0 feet.		
20	SS	28.5	30.0	5-8-10/0"	7							
							30					
21	SS	30.0	31.5	8-9-9/0"	24							
22	SS	31.5	33.0	6-5-8/0"	16					Note: color change to 5YR 5/8 from 30.0 to 31.6 feet. Note: color change to 5Y 5/2 from 31.6 to 33.0 feet.		
23	SS	33.0	34.5	9-6-7/0"	12							
									SM	Fine sand, trace silt, trace medium sand, wet, brown/tan/gray, soft, rapid dilatancy, no plasticity.		
24	SS	34.5	36.0	6-5-6/0"	24					Note: heaving sand encountered at 34.5 feet.		
							35					
25	SS	36.0	37.5	6-3-4/0"	7.5					Note: color shift to 10YR 4/3 at 36.0 feet.		
26	SS	37.5	39.0	2-3-4/0"	21.5							
27	SS	39.0	40.5	2-4-5/0"	8							
							40					
28	SS	40.5	42.0	4-3-5/0"	11							
29	SS	42.0	43.5	3-4-6/0"	16					Note: slight color shift to 10YR 4/4 at 42.0 feet. Note: end of boring at 42.0 feet 4/29/2016.		
30	SS	43.5	45.0	10-3-5/0"	10.5							
							45					
31	SS	45.0	46.5	4-5-6/0"	10				SM	Fine sand, trace silt, trace medium sand (1 to 3%), wet, brown/gray, soft to medium stiff, rapid		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1605** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/29/16** BORING FINISH **5/2/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	WELL	DRILLER'S NOTES
32	SS	46.5	48.0	8-4-6/0"	17						
33	SS	48.0	49.5	2-3-4/0"	10.5						
34	SS	49.5	51.0	3-2-3/0"	13.5		50				
35	SS	51.0	52.5	10-6-12/0"	14						
36	SS	52.5	54.0	18-38-43/0"	12						
37	SS	54.0	55.5	35-21-17/0"	11		55				
38	SS	55.5	57.0	20-21-25/0"	11.5						
39	SS	57.0	58.5	8-22-50/0"	20						
40	SS	59.5	61.0	23-43-52/0"	13						

SOIL / ROCK IDENTIFICATION

dilatancy, no plasticity (10YR 4/3).
Note: color change to 10YR 5/1 from 46.5 to 48.0 feet.

Note: little black pieces of medium size sand, angular coal from 48.7 to 49.4 feet.

Note: trace medium sand from 50.3 to 51.0 feet.

Weathered sandstone, gray with some red/oxidized inclusions, fine sand throughout sand (25%), sandstone (75%).

Mudstone/shale, dark gray (2.5YR 7/4).

Weathered sandstone (2.5YR 7/4).

Weathered red sandstone (2.5YR 7/4).

Weathered mudstone/shale, dark gray (2.5YR 7/4).

Weathered red mudstone with sandstone inlusions.

Wethered sandstone/mudstone/shale, moist (2.5YR 7/4).

Weathered shale, dark gray, dry (2.5YR 7/4).

Red weathered mudstone.

Gray sandstone, very fine grain (2.5YR 7/4).

End of boring at 59.5 feet.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** | BORING NO. **SB-1606** | DATE **7/19/16** | SHEET **1** OF **3**

PROJECT **John E. Amos Plant CCR** | BORING START **5/11/16** | BORING FINISH **5/12/16**

COORDINATES | PIEZOMETER TYPE **NA** | WELL TYPE **NA**

GROUND ELEVATION | SYSTEM | HGT. RISER ABOVE GROUND **NA** | DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **NA**

FIELD PARTY **NA** RIG **Diedrich**

Water Level, ft	∇ 8.2	▼	▼
TIME			
DATE	5/12/2016		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SS	0.0	1.5	1/2"	3				ML	Poor recovery due to air knife, silt, some clay and sand, fine to medium, topsoil (10YR 5/6).		
2	SS	1.5	3.0	1-1-1/0"	9							
3	SS	3.0	4.5	1/2"	5.5							
4	SS	4.5	6.0	1-3-4/0"	18		5					
5	SS	6.0	7.5	3-7-5/0"	18				SP	Sand, little clay, little silt, subround, poorly sorted, well graded, very loose, moist, dark gray mottling (10YR 5/6). Note: no mottling from 6.0 to 7.5 feet.		
6	SS	7.5	9.0	2-3-5/0"	18					Note: wet at 8.2 feet.	∇	
7	SS	9.0	10.5	1-2-3/0"	13		10			Note: wet, minor dark gray mottling from 9.0 to 10.5 feet.		
8	SS	10.5	12.0	1-2-2/0"	18				CL	Clay and fine sand, some silt. Note: some sand from 11.3 to 12 feet.		
9	SS	12.0	13.5	1-1-2/0"	18							
10	SS	13.5	15.0	2-2-2/0"	15		15		CL	Clay, some silt, little sand (fine), medium to high plasticity, slow dilatancy, wet, grayish brown (10YR 5/2).		
11	SS	15.0	16.5	1-1-1/0"	18					Note: more silt and trace very fine sand, rapid dilatancy, low plasticity from 15.0 to 16.5 feet.		
12	SS	16.5	18.0	1-1-2/0"	18					Note: more silt than clay and some very fine sand, still wet from 16.5 to 18.0 feet. End of boring at 16.5 feet (5-11-2016).		
13	SS	18.0	19.5	1-1-2/0"	18							
14	SS	19.5	21.0	2-1-3/0"	16					Note: very thin zone of micaceous minerals, sandstone at 18.9 feet.		

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **L. Martin**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER OH015976.0007

COMPANY American Electric Power

PROJECT John E. Amos Plant CCR

BORING NO. SB-1606 DATE 7/19/16 SHEET 2 OF 3

BORING START 5/11/16 BORING FINISH 5/12/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									CL	Clay, little silt, little very fine sand, moist, medium plasticity (10YR 5/2).		
16	SS	21.0	22.5	1-2-2/0"	18					Note: very soft, almost vesicles present "spongy" appearance, possibly lacustrine from 15.0 to 22.5 feet.		
17	SS	22.5	24.0	2-3-3/0"	18					Note: minor mottling, very dark gray from 22.5 to 24.0 feet. Note: some very fine sand from 23.2 to 23.5 feet.		
18	SS	24.0	25.5	1-1-1/0"	18					Note: moist from 24.0 to 25.5 feet.		
							25					
19	SS	25.5	27.0	1-1-2/0"	18					Note: small white spots, very soft, possible weathered shell fragments from 26.0 to 27.0 feet.		
20	SS	27.0	28.5	1-2-4/0"	18							
21	SS	28.5	30.0	3-4-6/0"	18					Note: large pebbles of sandstone, weathered from 29.5 to 30.0 feet.		
							30					
22	SS	30.0	31.5	3-4-6/0"	18					Note: soft to medium stiff (10YR 4/4) from 30.0 to 31.5 feet.		
23	SS	31.5	33.0	3-5-6/0"	18					Note: minor oxidation staining around sandstone, 10YR 5/2 at 32.0 feet.		
24	SS	33.0	34.5	3-3-5/0"	18					Note: ~5% sand/sandstone inclusions smaller ~1-2mm from 33.0 to 34.5 feet.		
25	SS	34.5	36.0	4-7-9/0"	18					Note: medium stiff to stiff from 34.5 to 36.0 feet.		
							35					
26	SS	36.0	37.5	4-6-8/0"	15					Note: color change to reddish gray (5YR 5/2) at 35.5 feet. Note: sandstone, weathered at 36.6 feet.		
27	SS	37.5	39.0	3-5-9/0"	18					Note: sandstone ~5% at 37.5 feet. Note: sandstone ~25% from 38 to 38.7 feet.		
28	SS	39.0	40.5	6-6-9/0"	18					Note: large weathered sandstone at 39.2 feet. Note: small cobble inclusions at 39.5 feet.		
							40					
29	SS	40.5	42.0	5-6-9/0"	18					Note: color change to dark yellowish brown (10YR 4/4) from 40.5 to 42.0 feet.		
30	SS	42.0	43.5	4-6-9/0"	18					Note: few weathered sandstone inclusions <1% and very small from 42.0 to 43.5 feet.		
31	SS	43.5	45.0	4-7-9/0"	18							
							45					
32	SS	45.0	46.5	4-6-10/0"	18							

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER OH015976.0007

COMPANY American Electric Power | BORING NO. SB-1606 | DATE 7/19/16 | SHEET 3 OF 3

PROJECT John E. Amos Plant CCR | BORING START 5/11/16 | BORING FINISH 5/12/16

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
33	SS	46.5	48.0	4-6-10/0"	18				CL	Clay, some silt, some sand (very fine to fine), stiff, low plasticity, moist-dry, no dilatancy (10YR 4/4). Note: minor mottling ~15% from 46.5 to 48.0 feet.		
34	SS	48.0	49.5	5-7-10/0"	18					Note: no more weathered sandstone inclusions from 48.0 to 49.5 feet.		
35	SS	49.5	51.0	5-7-9/0"	18		50					
36	SS	51.0	52.5	3-4-8/0"	18					Note: soft from 51 to 51.9 feet. Note: zone of very fine to fine sand and silt, trace clay, wet, loose, subround, well sorted.		
37	SS	52.5	54.0	6-11-16/0"	18					Note: stiff to very stiff, reddish brown (5YR 4/3) with brownish yellow (10YR 6/8), mottling ~5%, very dark gray mottling ~3%, and red (2.5YR 4/6) mottling ~2% from 52.5 to 54 feet.		
38	SS	54.0	55.5	5-10-19/0"	18		55			Note: trace sand stone cobbles and large pebbles from 54.0 to 55.5 feet.		
39	SS	55.5	57.0	7-18-48/0"	18				ML	Silt, clay, very soft, slow dilatancy, wet, medium plasticity (2.5YR 3/4).		
									SP	Sand, medium, subround, well sorted, wet, loose.		
40	SS	57.0	58.5	25-44-50-3/0"	13				ML	Silt, some clay, non plastic, no dilatancy, dry, hard, dark reddish brown (2.5YR 3/4). Note: trace very fine sand from 57.0 to 58.5 feet.		
41	SS	58.5	67.5	24-50-4/0"	10					Very weathered shale/siltstone, reddish brown.		
							60			Refusal at 59.4 feet, augered to 60.0 feet.		
										Weathered bedrock, dry.		
										End of boring at 61.9 feet.		

AEP - AEP.GDT - 7/19/16 15:50 - C:\USERS\SBREWER\DOCUMENTS\AEP\AEP WINFIELD WV.GPJ

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER OH015976.0007

COMPANY American Electric Power | BORING NO. SB-1607 | DATE 7/19/16 | SHEET 1 OF 3

PROJECT John E. Amos Plant CCR | BORING START 4/27/16 | BORING FINISH 4/28/16

COORDINATES | PIEZOMETER TYPE NA | WELL TYPE NA

GROUND ELEVATION | SYSTEM | HGT. RISER ABOVE GROUND NA | DIA NA

DEPTH TO TOP OF WELL SCREEN NA | BOTTOM NA

WELL DEVELOPMENT NA | BACKFILL NA

FIELD PARTY NA | RIG Diedrich

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
1	SS	0.0	1.5	1/2"		
2	SS	1.5	3.0	1/2"	6	
3	SS	3.0	4.5	1/2"	3.5	
4	SS	4.5	6.0	1-1-4/0"	11	
5	SS	6.0	7.5	1-1-5/0"	18	
6	SS	7.5	9.0	4-5-9/0"	12	
7	SS	9.0	10.5	2-3-3/0"	18	
8	SS	10.5	12.0	3-3-3/0"	18	
9	SS	12.0	13.5	3-3-2/0"	18	
10	SS	13.5	15.0	2-2-2/0"	18	
11	SS	15.0	16.5	2-1-3/0"	18	
12	SS	16.5	18.0	2-2-3/0"	18	
13	SS	18.0	19.5	2-2-3/0"	18	
14	SS	19.5	21.0	2-3-3/0"	18	

DEPTH IN FEET: 5, 10, 15

U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
	No recovery.		
ML	Poor recovery, slow from air knife. Silt and clay, some sand, medium plasticity, slow dilatancy, moist, very soft, yellowish brown (10YR 5/6). Note: some very dark grayish brown ~15% mottled (10YR 4/2).		
	No recovery.		
SP	Silt and clay, some sand, medium plasticity, slow dilatancy, moist, very soft, yellowish brown (10YR 5/6).		
CL	Sand, trace silt, very fine grain, very loose, well sorted, moist, subangular.		
	Clay, little silt, small slough.		
SP	Sand, very fine to fine, subangular, well sorted, little clay, trace silt, moist, loose, yellowish brown (10YR 5/6). Note: compacted from 7.5 to 8.0 feet.		
	Sand, trace silt, very fine grain, very loose, well sorted, moist, subangular. Note: little clay and silt from 9.2 to 9.5 feet. Note: little clay, oxidation at 10.8 feet. Note: little clay, oxidation at 11.2 feet. Note: little clay, oxidation at 11.3 feet. Note: sand, very fine to medium, mottled 7.5YR at 11.4 feet.		
CL	Note: some clay, little silt, grayish brown (10YR 5/2) from 12.1 to 12.3 feet.		
SP	Note: some clay, little silt, grayish brown (10YR 5/2) from 12.6 to 12.7 feet.		
CL	Note: some clay, little silt, grayish brown (10YR 5/2) from 13.4 to 13.5 feet.		
SP			
CL	Clay, some silt, little very fine sand, medium plasticity, no dilatancy, moist, soft, gray (10YR 5/1).		
	Sand, medium, well sorted, dry, loose, wet.		
	Clay.		
	Sand, medium, well sorted, dry, loose, wet.		
CH			

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER L. Martin

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1607** DATE **7/19/16** SHEET **2** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/27/16** BORING FINISH **4/28/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %
15	SS	21.0	22.5	2-4-5/0"	16	
16	SS	22.5	24.0	2-5-7/0"	13	
17	SS	24.0	25.5	3-5-10/0"	15	
18	SS	25.5	27.0	4-6-9/0"	18	
19	SS	27.0	28.5	3-13-11/0"	18	
20	SS	28.5	30.0	6-7-10/0"	18	
21	SS	30.0	31.5	5-6-8/0"	18	
22	SS	31.5	33.0	3-4-7/0"	18	
23	SS	33.0	34.5	4-6-9/0"	18	
24	SS	34.5	36.0	9-6-9/0"	16	
25	SS	36.0	37.5	3-4-7/0"	18	
26	SS	37.5	39.0	3-5-7/0"	18	
27	SS	39.0	40.5	12-50-4/0"	18	
28	SS	40.5	42.0	8-6-14/0"	13	
29	SS	42.0	43.5	4-8-12/0"	18	
30	SS	43.5	45.0	5-8-11/0"	18	
31	SS	45.0	46.5	6-8-50-4/0"	16	

DEPTH IN FEET: 25, 30, 35, 40, 45

GRAPHIC LOG | USCS | SOIL / ROCK IDENTIFICATION | WELL | DRILLER'S NOTES

Sand, fine-medium, trace clay and silt, subangular, well sorted, wet, loose.

CL — Clay, little silt, trace fine sand, high plasticity, no dilatancy, moist, soft, dark gray brown (10YR 4/2).
Note: very soft, little, wet from 18.0 to 18.5 feet.
Note: little silt and sand, very soft, wet from 18.5 to 19 feet.
Note: clay from 19.0 to 19.5 feet.

CL ML — Clay, some silt, medium plasticity.
Note: <5% light olive (10YR 5/4), medium grained, very small ~0.3" from 20.7 to 21.0 feet.
Clay, large sand inclusions, fine to coarse sand, medium stiff at 21.8 feet.
Silt and fine sand, clay, little fine sand, ????, stiff, non plastic, oxidized with dark yellowish brown mottling (10YR 4/6).
Note: some sand, stiff, no-low plasticity, mottled, grayish brown (10YR 4/2) 50%, dark yellowish brown (10YR 4/6) 33%, brownish gray (10YR 6/8) 10%, grayish (Gley 1 6/10GY) 5% from 25.5 to 27.0 feet.

CL ML — Note: dry-moist from 27.0 to 28.0 feet.
Sand, subangular, well sorted, loose, dry, yellowish brown (10YR 5/8).
Clay and silt.
Note: trace gravel (large pebble-small pebble) from 28.5 to 30.0 feet.
Note: silt and clay at 29.8 feet.
Note: more mottled ~20% 7.5YR 5/8 from 30.5 to 31.5 feet.
Note: large micaceous sandstone at 30.4 feet.

Note: large pebble, weathered micaceous sandstone at 36.0 feet.

Weathered sandstone, 0.7' cobbles (2.5Y 5/6).

CL ML — Clay and silt, large sandstone pebbles.

Note: large cobble sandstone from 45.5 to 45.9

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **OH015976.0007**

COMPANY **American Electric Power** BORING NO. **SB-1607** DATE **7/19/16** SHEET **3** OF **3**

PROJECT **John E. Amos Plant CCR** BORING START **4/27/16** BORING FINISH **4/28/16**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										feet.		
32	SS	46.5	48.0	50-3/0"	3					Weathered sandstone (2.5Y 5/6). No recovery, cobble.		
33	SS	48.0	49.5	17-9-15/0"	18				CL ML	Clay and silt, large sandstone pebbles (2.5Y 5/6). Note: cobbles from 48.7 to 49.1 feet.		
34	SS	49.5	51.0	7-5-9/0"	14		50			Note: cobbles from 50.0 to 50.2 feet.		
35	SS	51.0	52.5	4-8-44/0"	18							
36	SS	52.5	54.0	3-36-16/0"	17					Note: very large pebble from 52.3 to 52.4 feet. Note: cobble, weathered sandstone from 53.1 to 53.6 feet.		
37	SS	54.0	55.5	10-13-14/0"	18		55			Note: cobble, weathered sandstone or schist (highly micaceous) from 54.9 to 55.3 feet.		
38	SS	55.5	57.0	4-7-10/0"	18					Note: cobbles/pebbles more common and less weathered from 55.5 to 57.0 feet.		
39	SS	57.0	58.5	8-10-15/0"	18					Note: less gravel and sand from 57.0 to 57.4 feet.		
40	SS	58.5	60.0	5-8-12/0"	18		60					
41	SS	60.0	61.5	8-26-50-5/0"	18				ML	Silt, some sand, little clay, no plasticity, dry, hard (2.5Y 5/6).		
42	SS	61.5	63.0	14-27-50-3/0"	18					Note: trace granules, reddish brown (2.4YR 4/3) from 61.5 to 63.0 feet.		
43	SS	63.0	64.5	29-50-3/0"	18					Note: shale/siltstone, very weathered, dry from 63.5 to 64.2 feet.		
44	SS	64.2	65.4		14					End of boring at 64.2 feet. No water detected in borehole.		

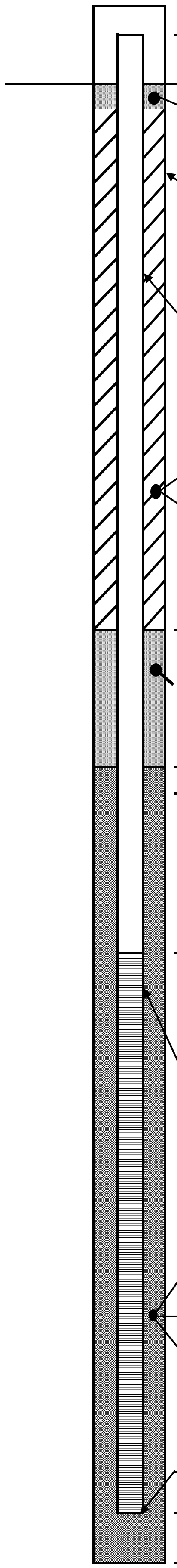
Arcadis 2016

Well Construction Diagrams

MW-1601 to MW-1606

WELL CONSTRUCTION LOG
(Unconsolidated)

ARCADIS Design & Consultancy for natural and built assets



3.0' (Pro-Cover stick-up)
ft (#4 Sand 0.5 Bentonite Chips)
LAND SURFACE

Bentonite Chips

8.25 inch diameter drilled hole

Well casing,
2 inch diameter,
PVC

☐ Backfill
☒ Grout 0.0 to 18.1'

18.1 ft* Top of pellet seal

Bentonite ☐ slurry
24 ft* ☒ pellets
25.4 ft* (100 lbs-2 buckets)
(# 4 Sand-20 lbs-1/2 bag)

28.4 ft* Top of screen

Well Screen.
2 inch diameter
PVC , 0.10 slot
Total screen length 9.6'

☐ Gravel Pack
☒ Sand Pack #5 (225 lbs-4.5 bags)
☐ Formation Collapse

38.0 ft* Bottom of Screen
38.5 ft* Bottom of Screen Cap
40.5 ft* Bottom of Sand Pack

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.
* Depth Below Land Surface

Project AEP - Amos Plant Well MW-1601

Town/City Winfield

County Putnam State Ohio

Permit No.

Land-Surface (LS) Elevation and Datum:

TOC 589.48 feet ☒ Surveyed
☐ Estimated

Installation Date(s) 5/10/2016

Drilling Method Hollow Stem Auger

Drilling Contractor AEP Service Corp.

Drilling Fluid Water ~300 gallon for drilling
~400 gallons for well installation (amount of return water
not measured).

Development Technique(s) and Date(s)
Foot valve and surge block with centrifugal pump 5/18/16
and 6/13/16.

Fluid Loss During Drilling NM gallons

Water Removed During Development 44.6 (5/18/16) gallons
44.1 (6/13/16)

Static Depth to Water 14.60 feet below M.P.

Pumping Depth to Water 14.62 feet below M.P.

Pumping Duration 1 hr 10 min hours

Yield NM gpm Date NA

Specific Capacity NM gpm/ft

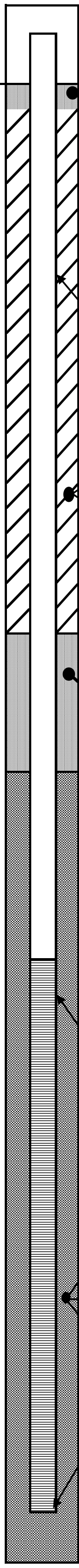
Well Purpose Monitoring well

Remarks Square aluminum stick-up casing. Used
100 # of quick grout about 45 gallons total for grout.
Global sand used.

Prepared by Kari Eldridge

WELL CONSTRUCTION LOG
(Unconsolidated)

ARCADIS Design & Consultancy for natural and built assets



3.0' (Pro-Cover stick-up)
ft (Sand #4)
LAND SURFACE

Bentonite chips

8.25 inch diameter drilled hole

Well casing,
2 inch diameter,
PVC

☐ Backfill
☒ Grout 0.0 to 39.0'
50 gallons/100 lbs

39.0 ft* Top of seal

Bentonite ☐ slurry

43.4 ft* ☒ pellets
44.8 ft* (100 lbs - 3/8" coated pellets-2 buckets)
(# 7 Sand 35 lbs)

48.4 ft* Top of screen

Well Screen.
2 inch diameter
PVC, 0.10 slot
Total screen length 14.7'

☐ Gravel Pack
☒ Sand Pack #6 (Global-300 lbs)
☐ Formation Collapse

56.0 ft* End of #5 Sand-50 lbs
58.0 ft* Bottom of Screen

58.5 ft* Bottom of Screen Cap

59.5 ft* Bottom of Sand Pack

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.
* Depth Below Land Surface

Project AEP - Amos Plant Well MW-1602A

Town/City Winfield

County Putnam State Ohio

Permit No.

Land-Surface (LS) Elevation and Datum:

TOC 601.40 feet ☒ Surveyed

☐ Estimated

Installation Date(s) 5/25/2016

Drilling Method Hollow Stem Auger

Drilling Contractor AEP Service Corp.

Drilling Fluid Water ~250 gallons used

Development Technique(s) and Date(s)
Foot valve and surge block with centrifugal pump 6/14/16.

Fluid Loss During Drilling NM gallons

Water Removed During Development 67.0 gallons

Static Depth to Water 24.56 feet below M.P.

Pumping Depth to Water 24.92 feet below M.P.

Pumping Duration 50 min hours

Yield NM gpm Date NA

Specific Capacity NM gpm/ft

Well Purpose Monitoring well

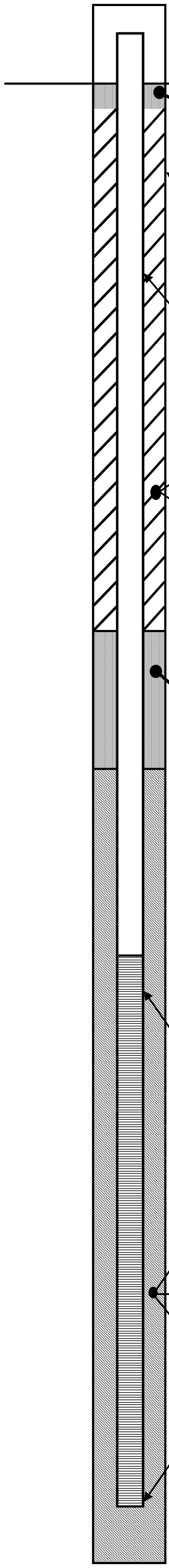
Remarks Square aluminum stick-up casing. 8x8' pad.
Sand #5 used from 56.0 to 59.5'
Sand #6 used fom 44.8 to 56.0'

Prepared by Taylor Runge

WELL CONSTRUCTION LOG

(Unconsolidated)

ARCADIS Design & Consultancy for natural and built assets



3.0' (Pro-Cover stick-up)

ft (Sand #4)

LAND SURFACE

Bentonite chips

8.25 inch diameter drilled hole

Well casing,

2 inch diameter,

PVC

☐ Backfill

☒ Grout 0.0 to 28.0'

50 gallons - 100 lbs

28.0 ft*

Bentonite ☐ slurry

34.0 ft* ☒ pellets

(100 lbs - 3/8" coated pellets-2 buckets)

37.0 ft*

(Sand # 6-100 lbs)

38.0 ft* Top of screen

Well Screen.

2 inch diameter

PVC , 0.10 slot

Total screen length 14.49'

☐ Gravel Pack

☒ Sand Pack #5 (230 lbs)

☐ Formation Collapse

43.0 ft* Bottom of Screen

43.4 ft* Bottom of Screen Cap

45.0 ft* Bottom of Sand Pack

Measuring Point is Top of Well Casing Unless Otherwise Noted.

* Depth Below Land Surface

Project AEP - Amos Plant Well MW-1603A

Town/City Winfield

County Putnam State Ohio

Permit No.

Land-Surface (LS) Elevation and Datum:

TOC 586.86 feet ☒ Surveyed

☐ Estimated

Installation Date(s) 5/24/2016

Drilling Method Hollow Stem Auger

Drilling Contractor AEP Service Corp.

Drilling Fluid Water ~300 gallons used

Development Technique(s) and Date(s)

Foot valve and surge block with centrifugal pump 6/14/16.

Fluid Loss During Drilling NM gallons

Water Removed During Development 60.9 gallons

Static Depth to Water 7.60 feet below M.P.

Pumping Depth to Water 9.75 feet below M.P.

Pumping Duration 40 min hours

Yield NM gpm Date NA

Specific Capacity NM gpm/ft

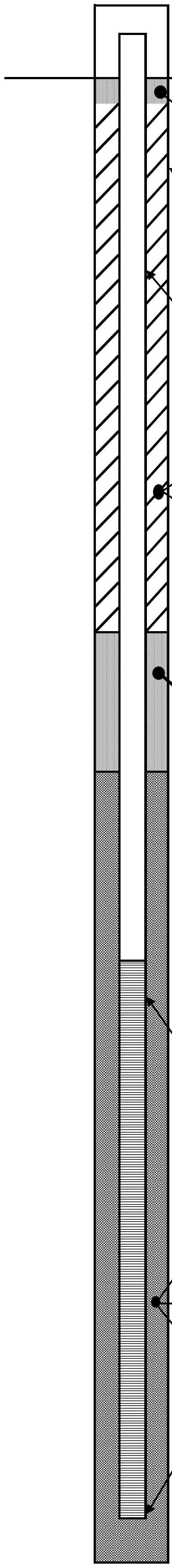
Well Purpose Monitoring well

Remarks Square aluminum stick-up casing. 8x8' pad.

Global sand used. 50 gallons/100 lbs of grout was used.

Prepared by Taylor Runge

WELL CONSTRUCTION LOG
(Unconsolidated)



3.0' (Pro-Cover stick-up)
ft (Sand #4)
LAND SURFACE

Bentonite Chips

8.25 inch diameter drilled hole

Well casing,

2 inch diameter,
PVC

☐ Backfill

☒ Grout 0.0 to 22.0'

22.0 ft* Top of pellet seal

Bentonite ☐ slurry

29.0 ft* ☒ pellets
(Sand #4-60 lbs 1.5 bags)

32.0 ft*
(#5 Sand 400 lbs-8 bags)
(100 lbs-2 buckets)
33.9 ft*
(Top of screen)

Well Screen.
2 inch diameter
PVC , 0.10 slot
Total screen length 9.6'

☐ Gravel Pack

☒ Sand Pack #6 (Global-300 lbs)

☐ Formation Collapse

43.5 ft* Bottom of Screen

44.0 ft* Bottom of Screen Cap

45.0 ft* Bottom of Sand Pack

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.
* Depth Below Land Surface

Project AEP - Amos Plant Well MW-1604

Town/City Winfield

County Putnam State Ohio

Permit No.

Land-Surface (LS) Elevation and Datum:

TOC 589.05 feet ☒ Surveyed

☐ Estimated

Installation Date(s) 5/6/2016

Drilling Method Hollow Stem Auger

Drilling Contractor AEP Service Corp.

Drilling Fluid Water ~500 gallons used

Development Technique(s) and Date(s)
Foot valve and surge block with centrifugal pump 5/18/16.

Fluid Loss During Drilling NM gallons

Water Removed During Development 51.7 gallons

Static Depth to Water 20.81 feet below M.P.

Pumping Depth to Water 21.78 feet below M.P.

Pumping Duration 1 hr 15 min hours

Yield NM gpm Date NA

Specific Capacity NM gpm/ft

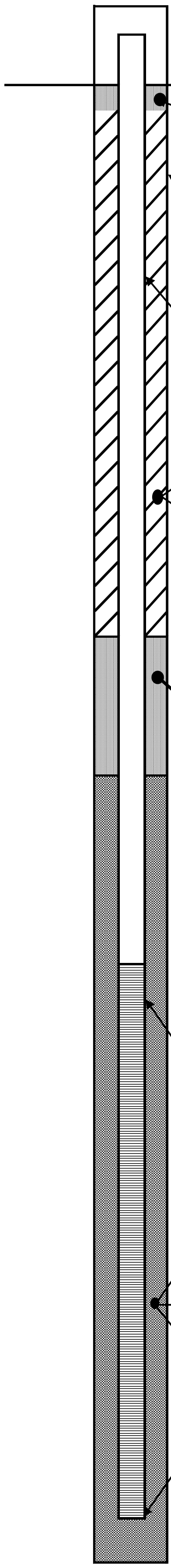
Well Purpose Monitoring well

Remarks Square aluminum stick-up casing. 8x8' pad.
Formation collapse (45.0 to 48.0') water pressure in
screened interval required #4 Sand to settle out
sandpack.

Prepared by Taylor Runge

WELL CONSTRUCTION LOG
(Unconsolidated)

ARCADIS Design & Consultancy for natural and built assets



3.0' (Pro-Cover stick-up) ft
LAND SURFACE

Bentonite Chips

8.25 inch diameter drilled hole

Well casing,
2 inch diameter,
PVC

☐ Backfill
☒ Grout
0.0 to 17.5' 250 gallons 100 lbs per 55 gallon of grout

17.3 ft* top of seal

Bentonite ☐ slurry
22.6 ft* ☒ pellets
(#6 Sand 50 lbs-1 bag)

23.0 ft*
(#5 Sand 450 lbs-9 bags)

26.3 ft*
(Top of screen)

Well Screen.
2 inch diameter
PVC , 0.10 slot
Total screen length 9.6'

☐ Gravel Pack
☒ Sand Pack #5 (Global-300 lbs)
☐ Formation Collapse

41.0 ft* Bottom of Screen
41.5 ft* Bottom of Screen Cap
42.5 ft* Bottom of Sand Pack

Measuring Point is Top of Well Casing Unless Otherwise Noted.
* Depth Below Land Surface

Project: AEP - Amos Plant Well: MW-1605

Town/City: Winfield

County: Putnam State: Ohio

Permit No.

Land-Surface (LS) Elevation and Datum:

TOC 586.40 feet ☒ Surveyed ☐ Estimated

Installation Date(s): 5/4/2016

Drilling Method: Hollow Stem Auger

Drilling Contractor: AEP Service Corp.

Drilling Fluid: Water ~500 gallons used

Development Technique(s) and Date(s)
Foot valve and surge block with centrifugal pump 5/17/16.

Fluid Loss During Drilling: NM gallons

Water Removed During Development: 43.03 gallons

Static Depth to Water: 17.39 feet below M.P.

Pumping Depth to Water: 33.89 feet below M.P.

Pumping Duration: 1hr 15 min hours

Yield: NM gpm Date: NA

Specific Capacity: NM gpm/ft

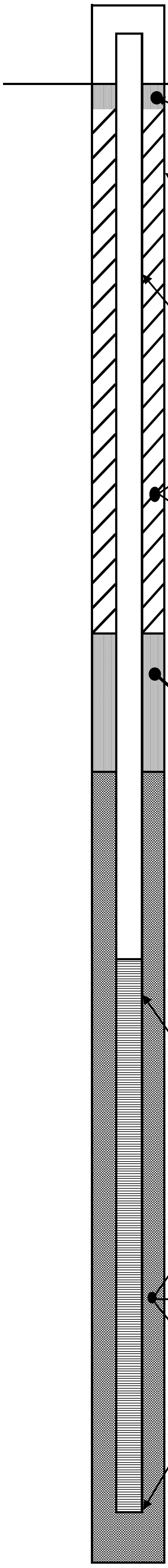
Well Purpose: Monitoring well

Remarks: Square aluminum stick-up casing. 8x8' pad.
Global sand used.

Prepared by: Taylor Runge

WELL CONSTRUCTION LOG
(Unconsolidated)

ARCADIS Design & Consultancy for natural and built assets



3.0' (Pro-Cover stick-up)
ft
LAND SURFACE

Bentonite Chips

8.25 inch diameter
drilled hole

Well casing,
2 inch diameter,
PVC

☐ Backfill
☒ Grout 0-0 to 15.0'

15.0 ft*
(top of seal-110 lbs-2 1/8 bags)

Bentonite ☐ slurry

20.19 ft* ☐ pellets
(#6 Sand 50 lbs-1 bag)

21.20 ft*
(#5 Sand 495 lbs-10 bags)

24.32 ft*
(Top of screen)

Well Screen.
2 inch diameter
PVC, 0.10 slot
(0.19' dead screen @ joint)

☐ Gravel Pack
☒ Sand Pack #5 (Global-495 lbs)
☐ Formation Collapse

39.0 ft* Bottom of Screen

39.5 ft* Bottom of Screen Cap

40.5 ft* Bottom of Sand Pack

Measuring Point is
Top of Well Casing
Unless Otherwise Noted.
* Depth Below Land Surface

Project AEP - Amos Plant Well MW-1606

Town/City Winfield

County Putnam State Ohio

Permit No.

Land-Surface (LS) Elevation and Datum:

TOC 583.88 feet ☒ Surveyed

☐ Estimated

Installation Date(s) 5/3/2016

Drilling Method Hollow Stem Auger

Drilling Contractor AEP Service Corp.

Drilling Fluid Water ~500 gallons/mud when needed (quick gel 50 lbs per 35 gallons) ~35 gallons used.

Development Technique(s) and Date(s)
Foot valve and surge block with centrifugal pump 5/17/16.

Fluid Loss During Drilling NM gallons

Water Removed During Development 68.14 gallons

Static Depth to Water 11.23 feet below M.P.

Pumping Depth to Water 11.78 feet below M.P.

Pumping Duration 1.5 hours

Yield NM gpm Date N/A

Specific Capacity NM gpm/ft

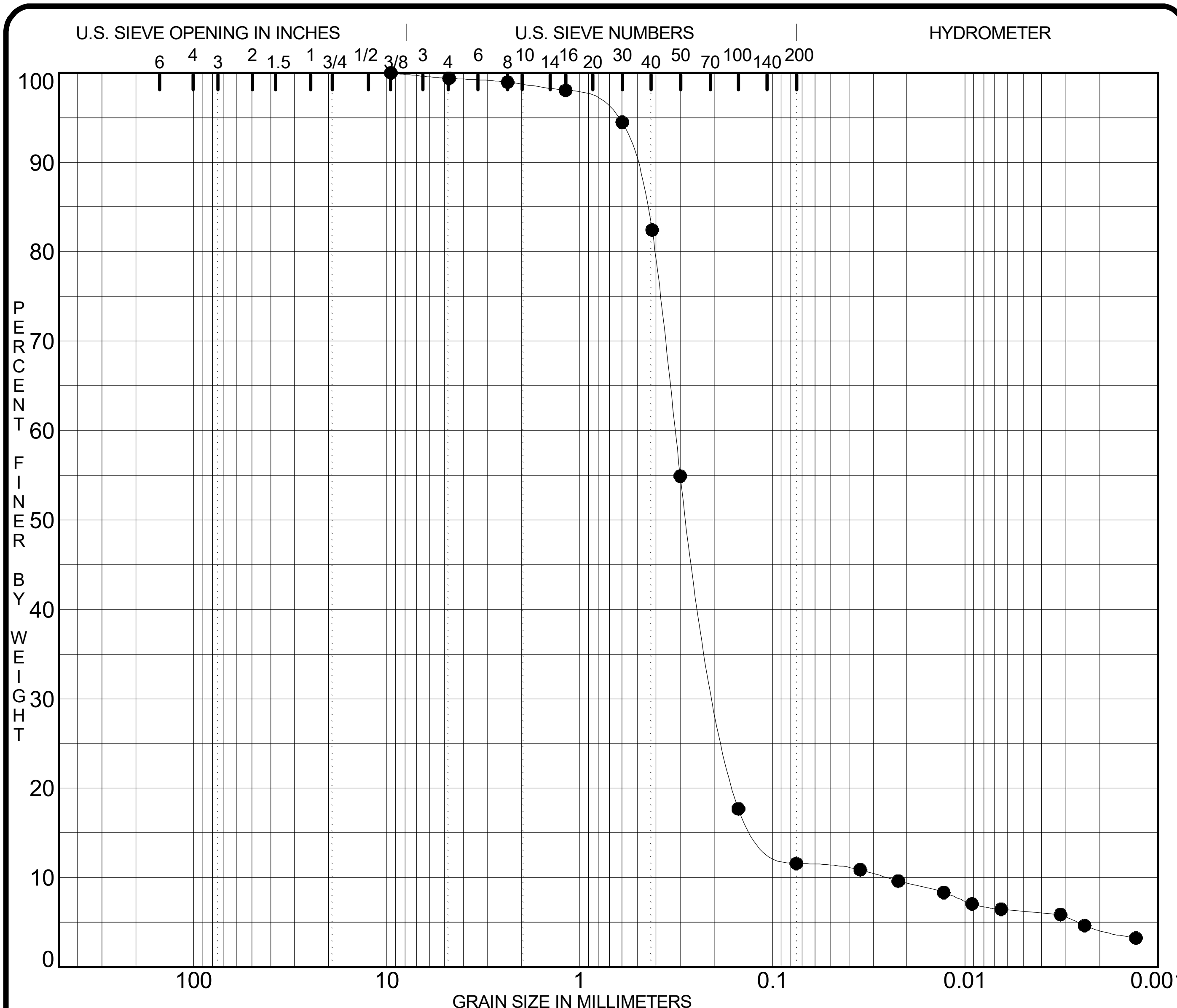
Well Purpose Monitoring well

Remarks Square aluminum stick-up casing. 8x8' pad.
Global sand used.

Prepared by Taylor Runge

APPENDIX B

Grain Size Analysis Lab Reports



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● MW-1601 27-39		23.0	NP	NP	NP	
	POORLY GRADED SAND with SILT SP-SM					
	ELEVATION					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%clay
● MW-1601 27-39	9.500	0.319	0.189	0.025	0.6	87.8	5.3	6.3

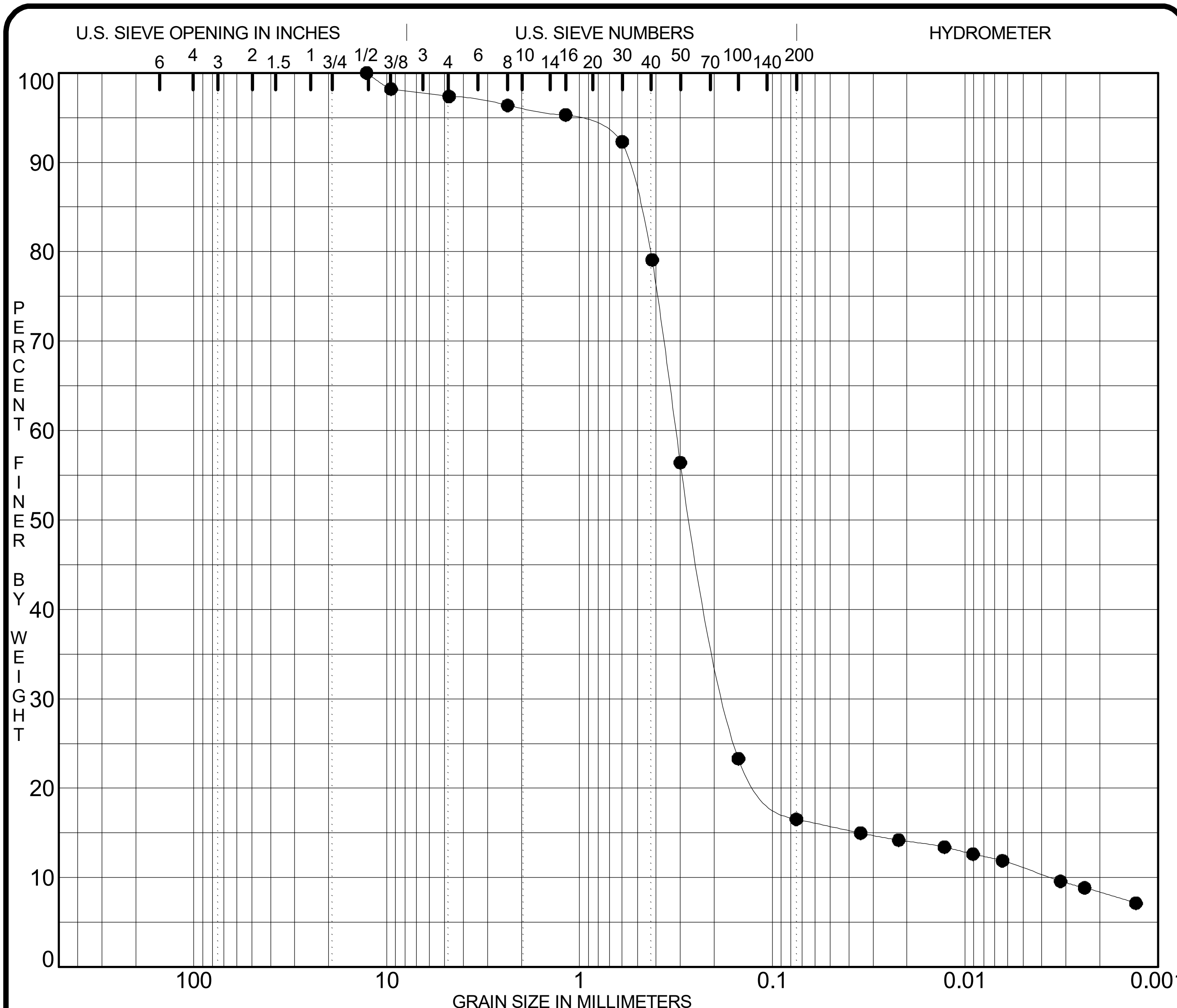
PROJECT **AM BAC CCR Compliance - Amos**

JOB NO.

DATE **7/15/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● **MW-1602a 48-58**		**21.9**	**NP**	**NP**	**NP**		
	SILTY SAND SM						
	ELEVATION						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%clay
● **MW-1602a 48-58**	**12.700**	**0.316**	**0.173**	**0.004**	**2.6**	**80.8**	**5.5**	**11.1**

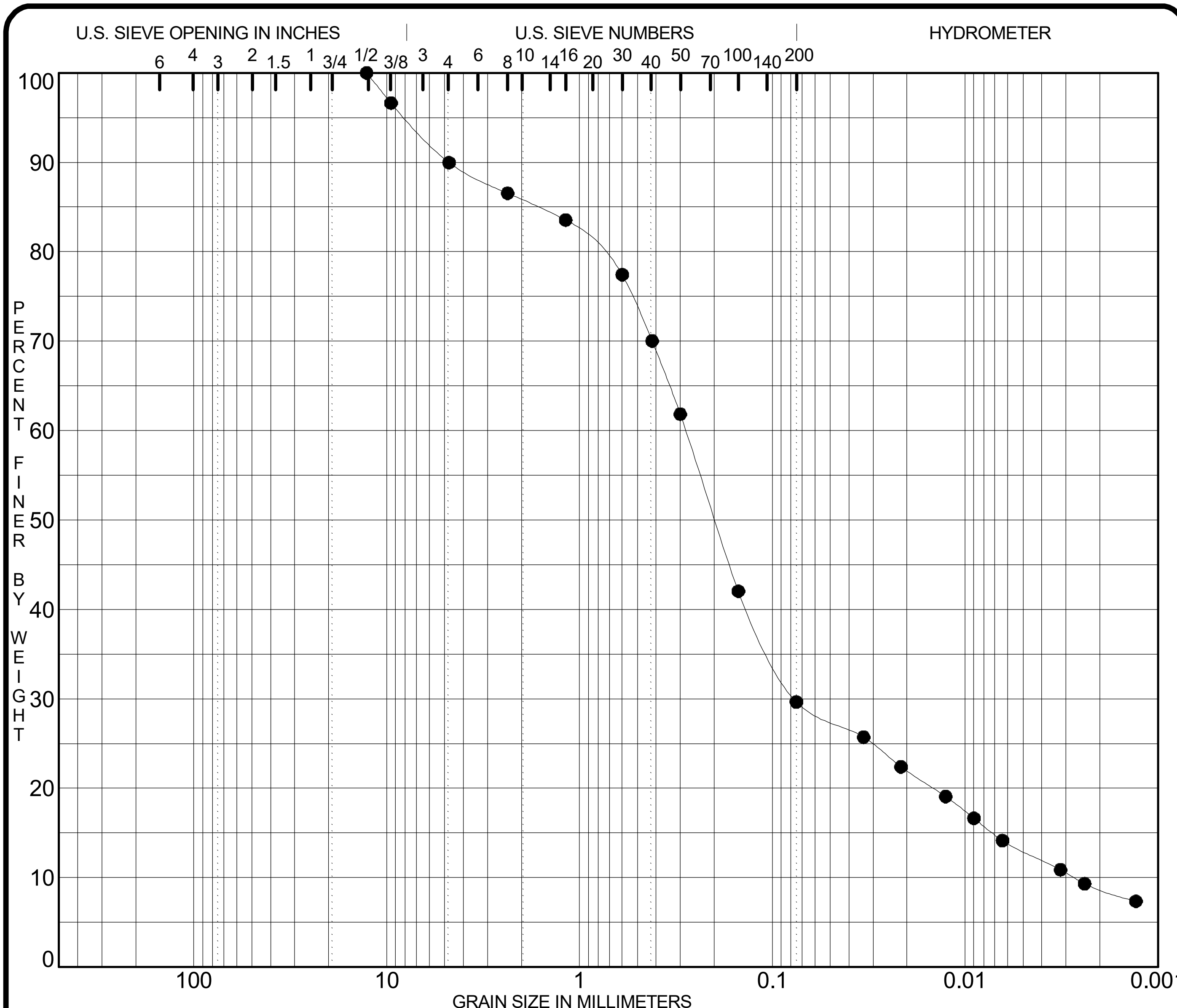
PROJECT **AM BAC CCR Compliance - Amos**

JOB NO.

DATE **7/15/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1603 38.0-43.0**		**20.3**	**NP**	**NP**	**NP**	
	SILTY SAND SM					
	ELEVATION					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%clay
● **MW-1603 38.0-43.0**	**12.700**	**0.281**	**0.076**	**0.003**	**10.0**	**60.3**	**16.7**	**13.0**

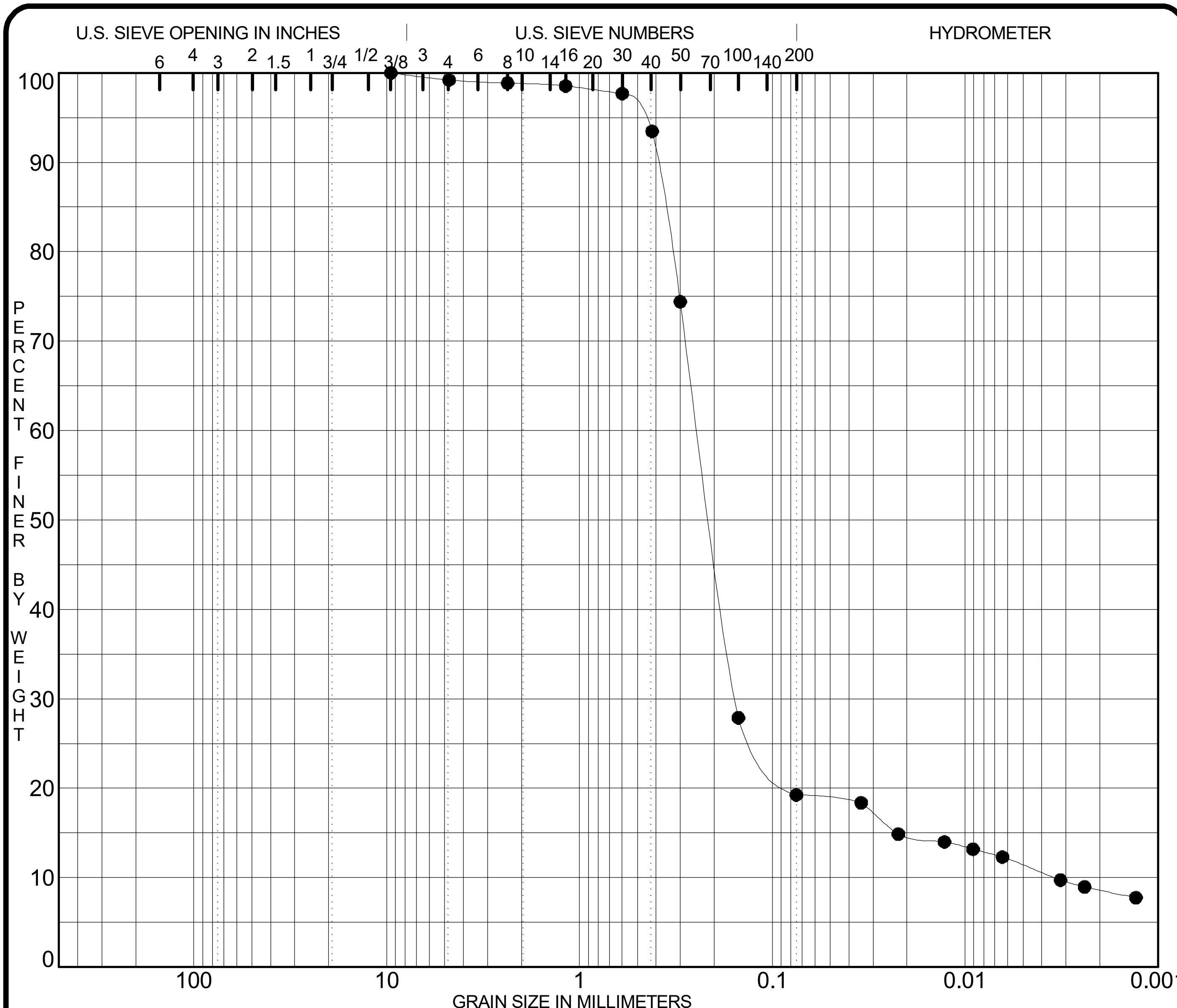
PROJECT **AM BAC CCR Compliance - Amos**

JOB NO.

DATE **7/15/16**

GRADATION CURVES

American Electric Power Service Corp.



<table>
<tr><td rowspan="2">COBBLES</td><td colspan="2">GRAVEL</td><td colspan="3">SAND</td><td rowspan="2">SILT</td><td rowspan="2">CLAY</td></tr>
<tr><td>coarse</td><td>fine</td><td>coarse</td><td>medium</td><td>fine</td></tr>
</table>

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1604 33.0-43.5**		**23.8**	**NP**	**NP**	**NP**	
	SILTY SAND SM					
	ELEVATION					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%clay
● **MW-1604 33.0-43.5**	**9.500**	**0.242**	**0.155**	**0.003**	**0.8**	**80.0**	**7.9**	**11.4**

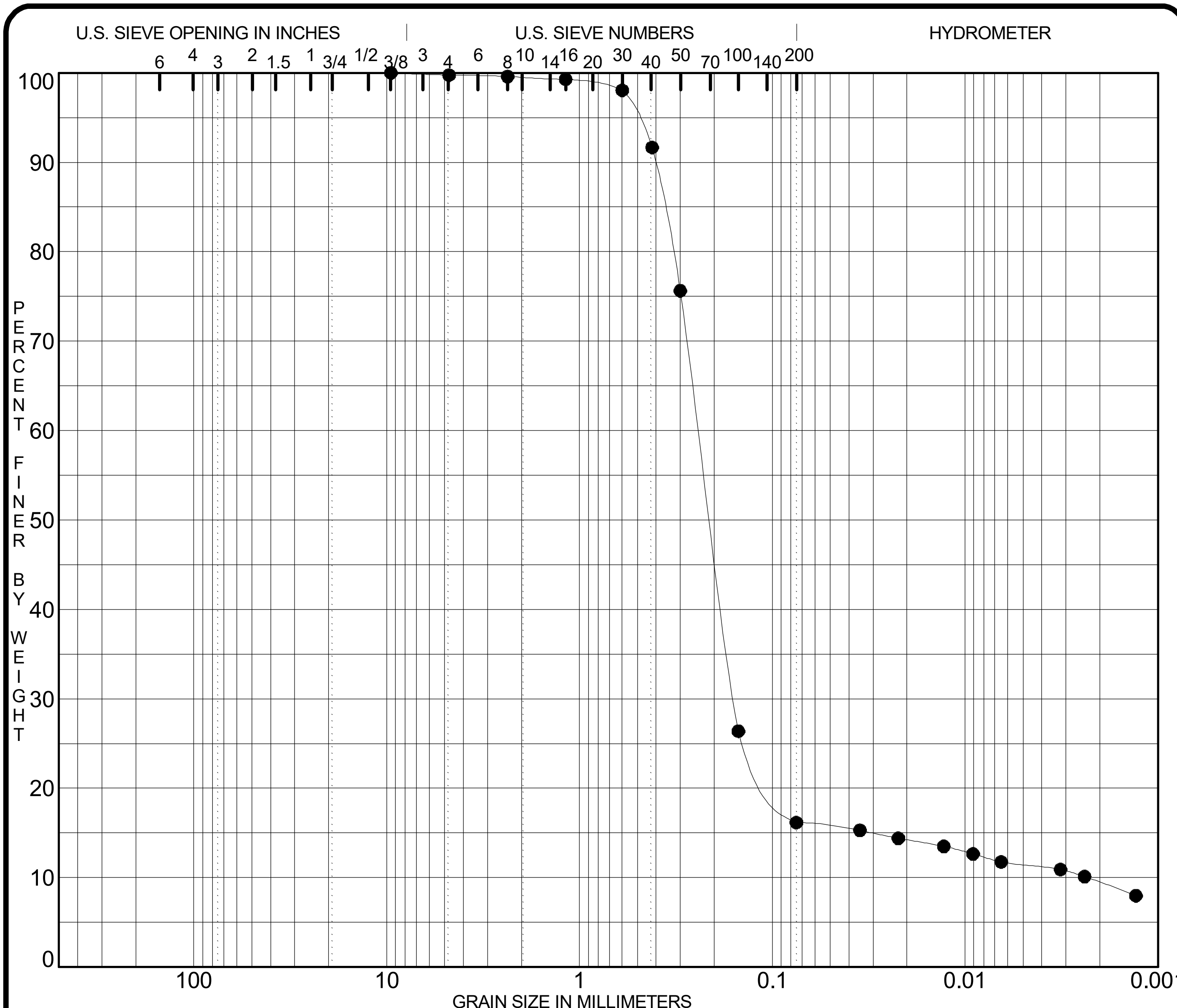
PROJECT **AM BAC CCR Compliance - Amos**

JOB NO.

DATE **7/15/16**

GRADATION CURVES

American Electric Power Service Corp.



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.	
● MW-1605 25.5-42.0		25.5	NP	NP	NP		
	SILTY SAND SM						
	ELEVATION						

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%clay
● MW-1605 25.5-42.0	9.500	0.241	0.158	0.002	0.2	83.6	4.7	11.4

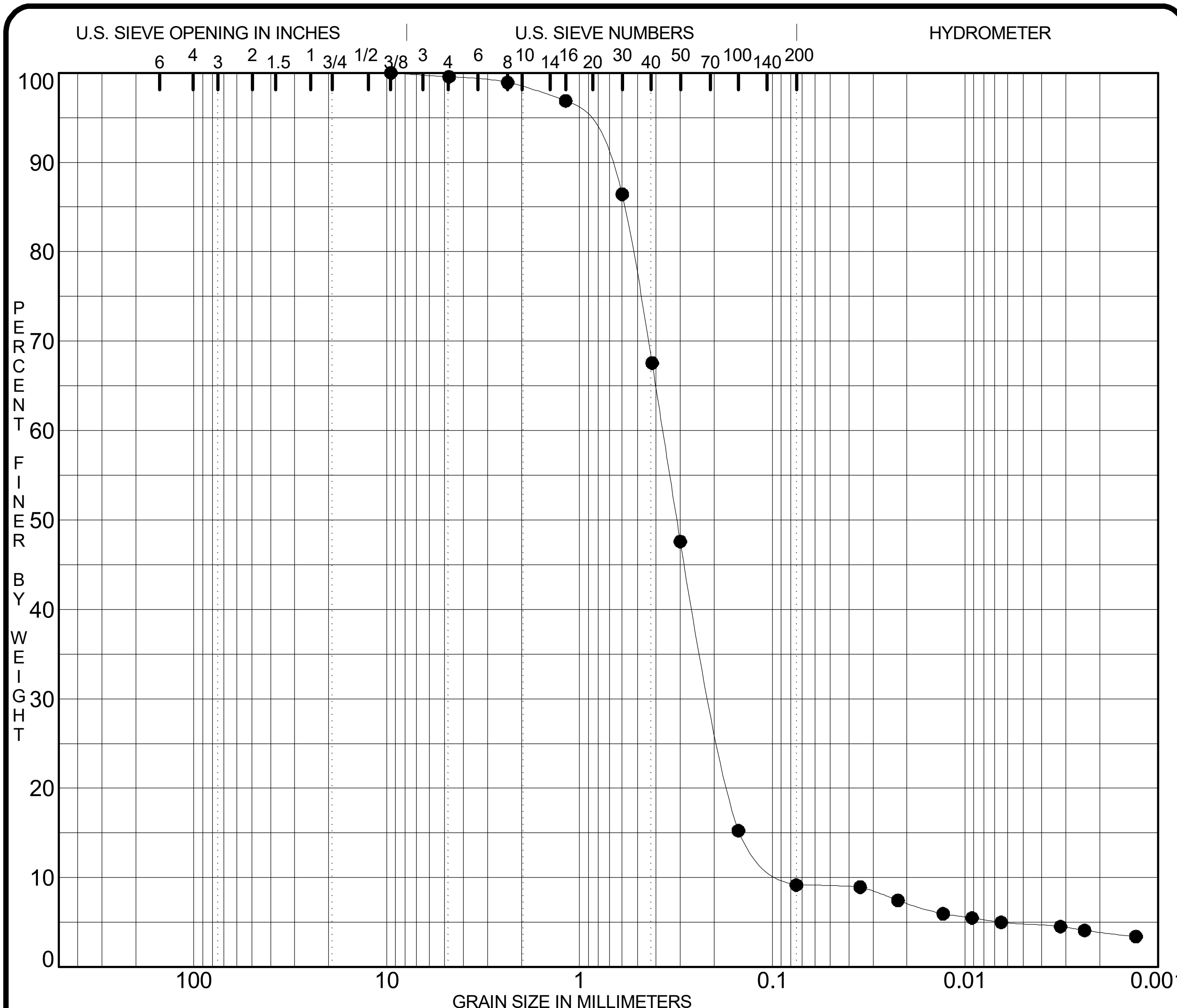
PROJECT **AM BAC CCR Compliance - Amos**

JOB NO.
DATE **7/15/16**

GRADATION CURVES

American Electric Power Service Corp.

AEP



COBBLES	GRAVEL		SAND			SILT	CLAY
	coarse	fine	coarse	medium	fine		

Specimen Identification	Classification	MC%	LL	PL	PI	Sp.Gr.
● **MW-1606 29.0-39.0**		**23.4**	**NP**	**NP**	**NP**	
	POORLY GRADED SAND with SILT SP-SM					
	ELEVATION					

Specimen Identification	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%clay
● **MW-1606 29.0-39.0**	**9.500**	**0.370**	**0.206**	**0.082**	**0.4**	**90.4**	**4.3**	**4.8**

PROJECT **AM BAC CCR Compliance - Amos**

JOB NO.

DATE **7/15/16**

GRADATION CURVES

American Electric Power Service Corp.

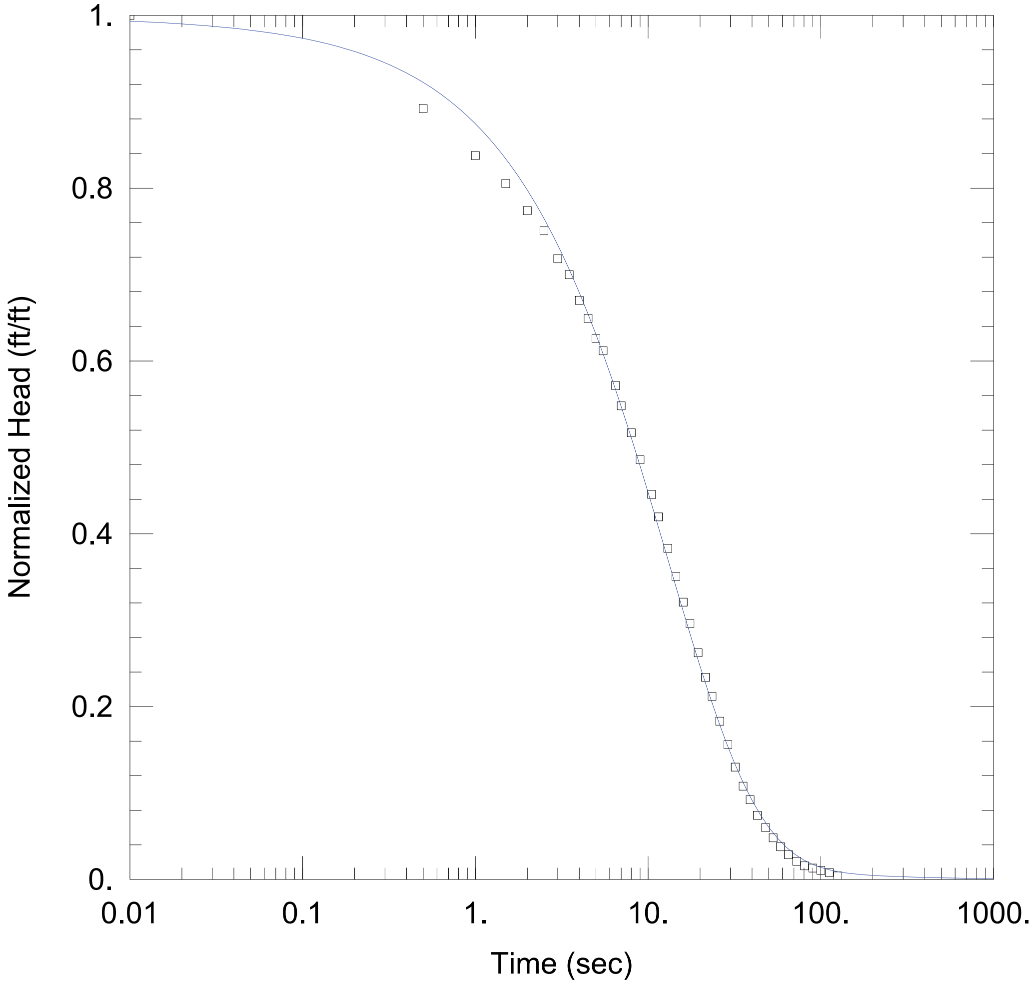
AEP

APPENDIX C

Hydraulic Testing Reports

MW-1602A Rising Head Test 2

Prepared By: ARCADIS	Prepared For: AEP
Project: OH015976.0007	Location: Amos, WV



SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0044 cm/sec Ss = 7.5E-5 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 19. ft

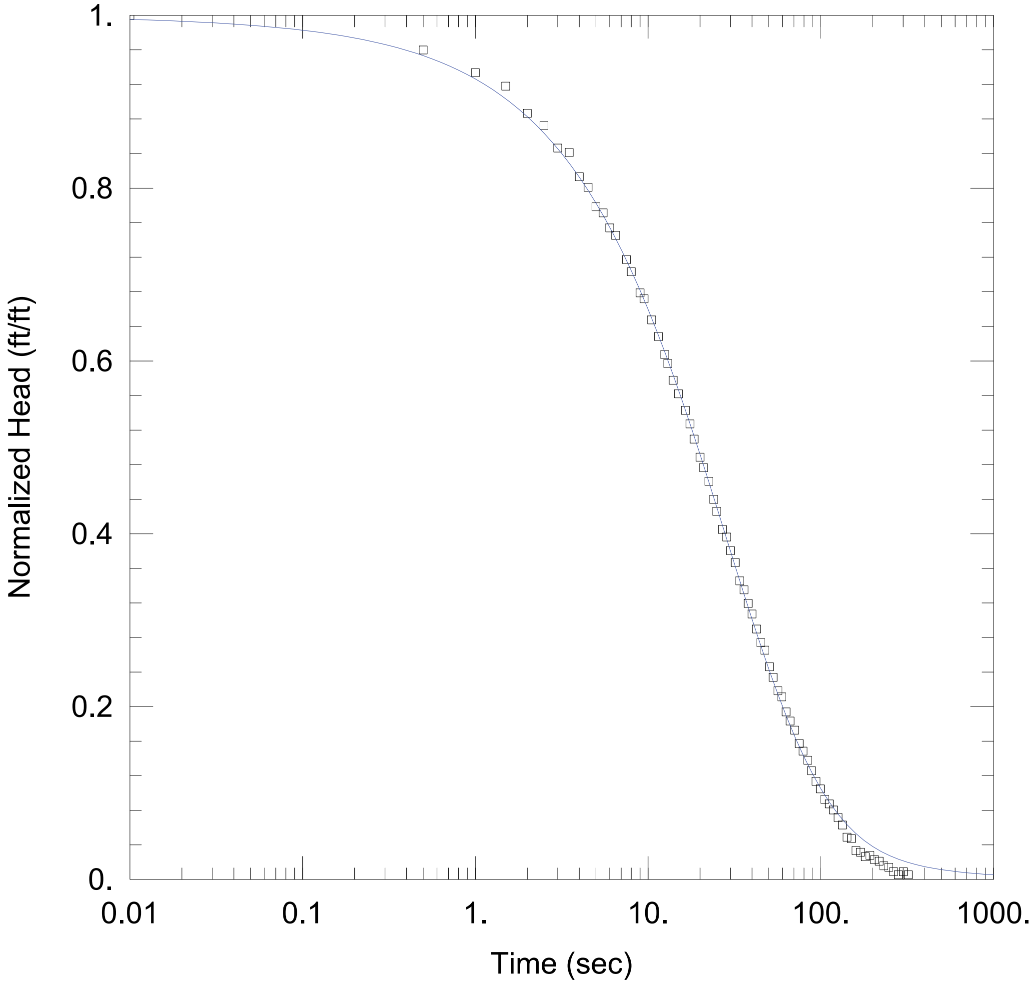
WELL DATA (MW-1602A Test 2)

Initial Displacement: 0.77 ft
Static Water Column Height: 40.95 ft
Total Well Penetration Depth: 40.95 ft
Screen Length: 10. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3437 ft

ARCADIS

MW-1603A Rising Head Test 2

Prepared By: ARCADIS	Prepared For: AEP
Project: OH015976.0007	Location: Amos, WV



SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0031 cm/sec Ss = 0.00022 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 5. ft

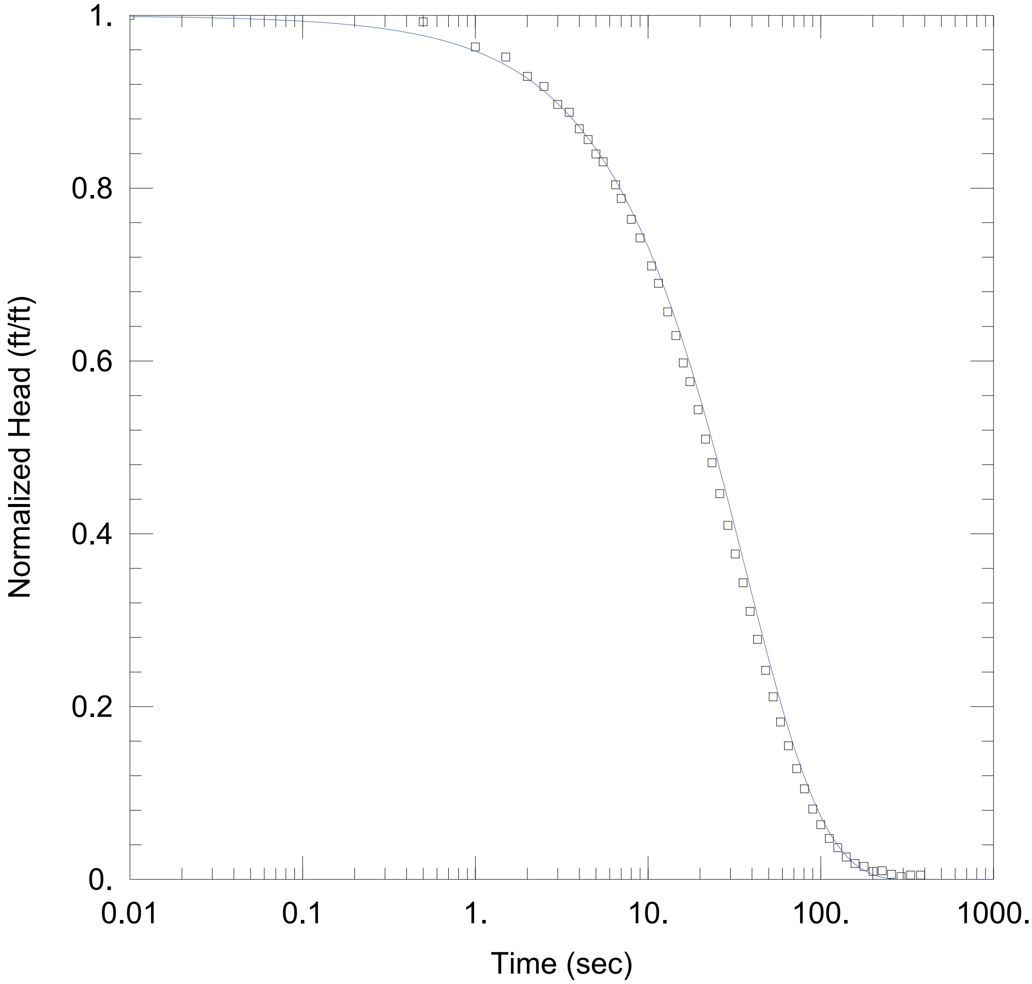
WELL DATA (MW-1603A Test 2)

Initial Displacement: 0.573 ft
Static Water Column Height: 39.04 ft
Total Well Penetration Depth: 39.04 ft
Screen Length: 5. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3437 ft

ARCADIS

MW-1604 Rising Head Test 3

Prepared By: ARCADIS	Prepared For: AEP
Project: OH015976.0007	Location: Amos, WV



SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 0.00096 cm/sec   Ss = 2.4E-6 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 27.25 ft

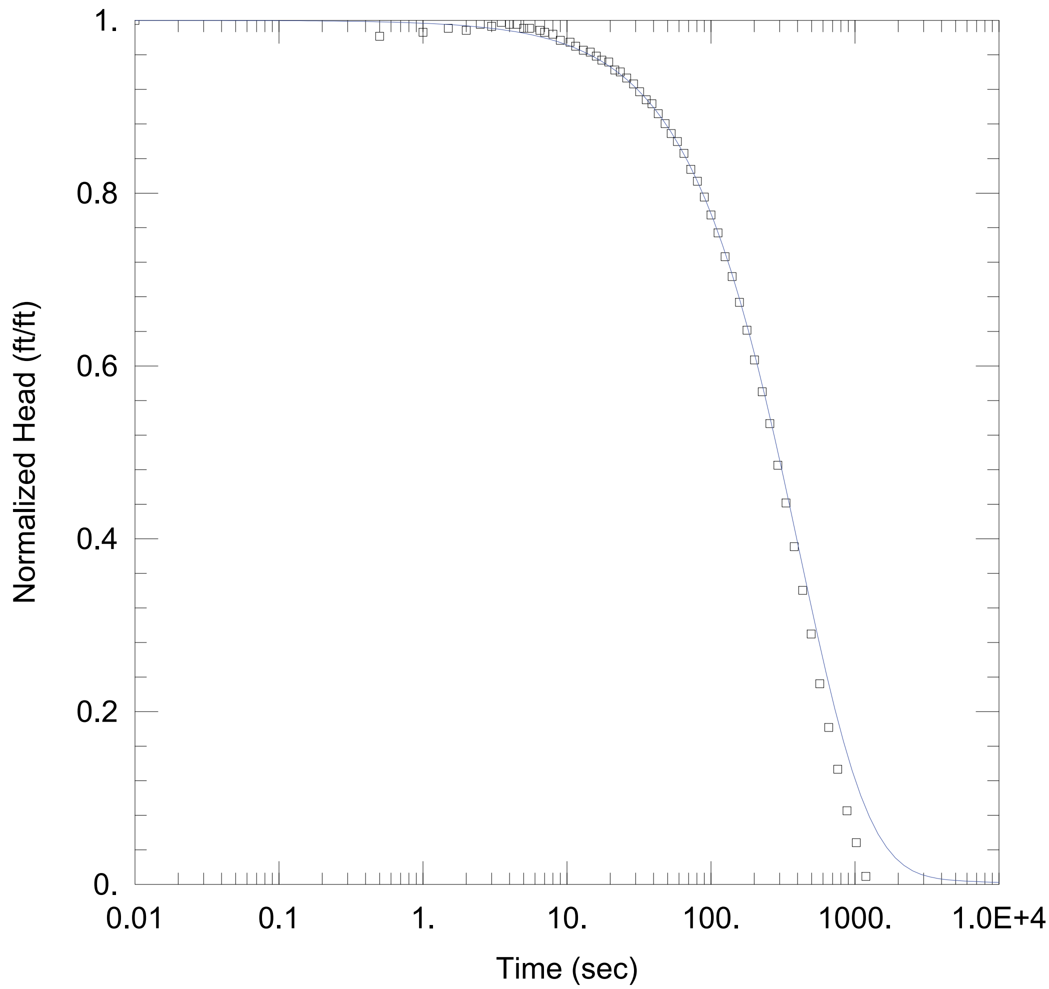
WELL DATA (MW-1604 Test 3)

Initial Displacement: 1.203 ft
Static Water Column Height: 25.95 ft
Total Well Penetration Depth: 25.95 ft
Screen Length: 10. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3437 ft

ARCADIS

MW-1605 Rising Head Test 1

Prepared By: ARCADIS	Prepared For: AEP
Project: OH015976.0007	Location: Amos, WV



SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.00026 cm/sec Ss = 3.8E-9 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 31. ft

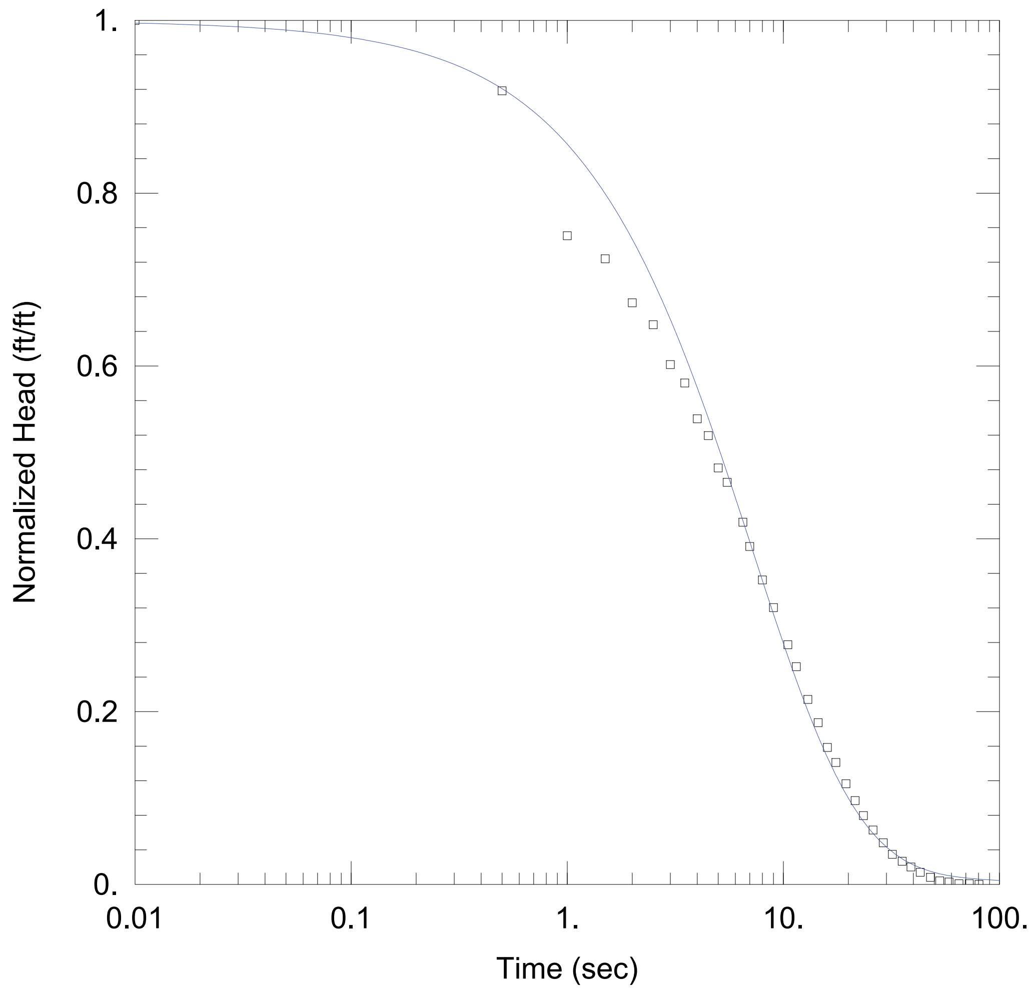
WELL DATA (MW-1605 Test 1)

Initial Displacement: 0.435 ft
Static Water Column Height: 27.3 ft
Total Well Penetration Depth: 27.3 ft
Screen Length: 15. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3437 ft

ARCADIS

MW-1606 Rising Head Test 1

Prepared By: ARCADIS	Prepared For: AEP
Project: OH015976.0007	Location: Amos, WV



SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 0.0033 cm/sec   Ss = 6.1E-7 ft^{-1}
Kz/Kr = 1.

AQUIFER DATA

Saturated Thickness: 39.7 ft

WELL DATA (MW-1606 Test 1)

Initial Displacement: 1.496 ft
Static Water Column Height: 32.39 ft
Total Well Penetration Depth: 32.39 ft
Screen Length: 15. ft
Casing Radius: 0.0833 ft
Well Radius: 0.3437 ft

ARCADIS

APPENDIX D

Field Methodology and Geophysical Investigation

APPENDIX D

FIELD METHODOLOGY AND GEOPHYSICAL INVESTIGATION

Based on the recommended well network modifications, the following generalized tasks were completed:

- Installation and development of 6 new monitoring wells
- Installation of 6 confirmatory soil borings
- Redevelopment and repair of 8 existing monitoring wells
- Electrical resistivity survey of ash pond system

Field activities began with the electrical resistivity survey, performed by Arcadis from December 7 to December 11, 2016. Utility clearance activities were conducted from April 4 to April 6, 2016 in preparation for well installation. Arcadis provided oversight for the installation of 6 monitoring wells by an AEP drilling crew, which began on April 25, 2016 and ended on May 26, 2016. Well development activities began on May 17, 2016 and were completed on June 15, 2016. The following sections provide detail on methodology for each component of field activities.

Staking, Surveying, and Utilities Clearance

All proposed new monitoring well locations were staked by an AEP surveyor prior to drilling. AEP surveyed the spatial northing and easting coordinates as well as the ground surface elevation of each staked monitoring well location prior to drilling. The accuracy of elevation measurements was at least to the nearest 0.01 foot. An Arcadis representative contacted 8-1-1 to assess the presence of underground utilities near the new monitoring well and boring locations prior to drilling activities. AEP completed a plant dig permit, which identified private plant utilities near the new monitoring well and borings locations. Arcadis retained the services of a utility locating subcontractor to perform a geophysical survey (e.g. ground penetrating radar, electromagnetic survey, etc.) over an area of 25 feet by 25 to locate utilities at each new monitoring well location. An Arcadis representative will completed a visual inspection of the proposed well sites prior to drilling to assess the presence of any previously unidentified subsurface utilities. Prior to drilling, the new monitoring well locations were soft cleared using hand augering or air knife techniques to a diameter at least 10 percent larger than the largest diameter tooling to be used during drilling. Soft digging was completed to a minimum depth of 5 feet below ground surface (bgs).

Decontamination

All down-hole tools or equipment were decontaminated in accordance with ASTM D5088 prior to the start of drilling and between each borehole location. At a minimum, the tooling was washed with detergent solution followed by a potable water rinse within the decontamination pad. The use of a pressure washer was used when possible. A decontamination was constructed for decontamination of the down-hole tools. The decontamination pad was constructed at a location near the existing AEP Amos Plant ash ponds in a manner such that all decontamination water would flow to the existing ash pond system. Containerization was not required for decontamination water, if directed to the ash pond system. Water for decontamination or drilling was potable and obtained from the AEP Amos Plant.

Drilling – New Unconsolidated Monitoring Wells

Boreholes for unconsolidated monitoring wells were drilled using standard hollow-stem auger methods in accordance with ASTM D5784. Augers with a hollow-stem inside diameter of 4 and ¼ inches were used to drill and install the unconsolidated monitoring wells. Continuous spit-spoon sampling and standard penetration testing was performed in accordance with ASTM D1586 to the total boring depth. An Arcadis representative logged, classified, and recorded all samples in accordance with ASTM D5434 and D2488. No petroleum based lubricants or other VOC based liquids were used on down-hole tools.

Drilling – Confirmatory Soil Borings

Six boreholes to verify depth of ash were drilled using standard hollow-stem auger methods in accordance with ASTM D5784. Augers with a hollow-stem inside diameter of 4 and ¼ inches were used to drill and install the boreholes. Continuous spit-spoon sampling and standard penetration testing was performed in accordance with ASTM D1586 to the total boring depth. All borings were backfilled upon completion. Borings deeper than 20 feet were tremmie grouted using Benseal or equivalent bentonite grout. Borings less than 20 feet were backfilled with drill cuttings, provided drill cuttings did not show visual signs of potential impact. An Arcadis representative logged, classified, and recorded all samples in accordance with ASTM D5434 and D2488 using USCS classification. Soil boring logs are included in **Appendix A**. No petroleum based lubricants or other VOC based liquids will be used on down-hole tools.

Geologic Sample Analysis

An Arcadis representative retained selected split-spoon soil samples from the unconsolidated monitoring well locations for particle-size analysis by sieving and hydrometer in accordance with ASTM D421, D422, and D4718 and moisture content in accordance with ASTM D2216. Split spoon samples selected for particle-size analysis corresponded to the final screened interval for the given unconsolidated monitoring well. For each new monitoring well location, the selected split spoon samples from the screened interval were composited into a single 16-ounce glass sample container, which was appropriately labeled according to the monitoring well identification number. Samples were transported to the AEP Dolan Civil Engineering Laboratory in Groveport, Ohio for particle-size analysis.

New Monitoring Well Construction

All monitoring wells were constructed with 2-inch nominal diameter casing consisting of schedule 40 PVC pipe extending 3.0 feet above ground surface. All wells were constructed with 10-slot, schedule 40 PVC well screen. All monitoring wells used a primary filter pack consisting of a Global No. 5 to No. 7 brand or equivalent sand based on field observations. The filter pack was placed in the annular space between the borehole and the screened interval, extending from 1.0 feet below the bottom of the screen to 3.0 feet above the top of the screen. A secondary filter pack consisting of Global No. 6 or No. 7 brand sand or equivalent was placed in all wells. The secondary filter pack was placed in the annulus, extending from the top of the primary filter pack to 1.0 feet above the primary filter pack. Final placement of the primary and secondary filter packs were modified at some wells based on field conditions. Complete well construction details are provided in **Appendix A**. If backfilling of the borehole was necessary to set the monitoring well, the backfill consisted of bentonite pellets. A minimum of one foot of filter sand separated the bottom of the well screen and the backfill material.

A bentonite pellet seal was placed in the annulus immediately above the secondary filter pack in all monitoring wells. The bentonite pellet seal extended from the top of the secondary filter pack to at least 3.0 feet above the top of the secondary filter pack, which was below the water table. The bentonite pellet seal was allowed to hydrate for two hours prior to placing the overlying grout. A high-solids bentonite grout was placed using a tremmie pipe in the remaining annulus to near ground surface. The high-solids bentonite grout consisted of bentonite grout and water mixture with a minimum of 20 percent solids, mixed and placed in accordance with the manufacturer's written instructions (i.e. 66.75 lbs of grout to 40 gallons of water for Halliburton quick grout). Placement of bentonite grout was done in a controlled manner so as not to contaminate the well.

Lockable steel protective casings were installed over the PVC casings in accordance with ASTM D5787. The protective casing was at least 2 inches in diameter greater than the PVC casing above grade and was centered in a concrete pad measuring 4 feet by 4 feet and 6-inches thick. The steel outer casing was 3-inches in diameter greater than the well casing (5-inches) and extended 4 feet below the ground surface and at least 2 feet above the ground surface. There were no signs of grout or concrete on the steel protective casing. The concrete pad was constructed so that there is slope away from the protective casing. Two weep holes were drilled on opposite sides at the base of the protective cap. The annular space between the PVC casing above grade and the steel protective casing was filled with washed pea gravel up to 4 inches below the top of the PVC casing. A watertight locking well cap was placed at the top of the PVC casing. A minimum of four concrete-filled barrier posts/bollards were installed around monitoring wells located in high-traffic areas to protect the monitoring wells from damage. The barrier posts were installed either at each corner of the pad or the midpoint of each side of the pad. The barrier posts were painted a high-visibility yellow color. An Arcadis representative produced a typed log of geologic materials encountered and of borehole and monitoring well construction details. A log was also filed with the West Virginia Department of Environmental Protection (WVDEP) in accordance with their recordkeeping requirements.

Monitoring Well Development

Well development was completed at all newly-installed wells, as well as existing wells to be retained in the monitoring well network. At existing wells, the well screens and casings were brushed using a tight fitting brush to dislodge encrusted materials prior to beginning the surge and pump cycles described below. The well was then purged with a pump or by air-lifting to remove dislodged material from the well. Well development at new wells was performed a minimum of 48 hours after the completion of well construction. The static water level was measured in the well prior to initiation of development. All wells were developed through a pump and surge method in accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011. The well was initially purged with a pump to remove loose material and fines from the well. A surge cycle was then be performed across the screen using a surge block. A second pumping cycle shall be performed until the discharge water has good visual clarity, followed by second surge cycle with the double disk surge block.

A final pumping cycle was performed to the following criteria: 1) a minimum of 10 casing volumes were purged from the well, and 2) field water quality parameters including temperature, pH, conductivity, oxidation-reduction potential, and turbidity were stable within applicable criteria (temperature stabilizes within ±0.50C, pH stabilizes within ±0.2 units, conductivity stabilizes within ±3 percent, and turbidity is less than 10 nephelometric turbidity units). Well development logs are included as an attachment to **Appendix D**.

Monitoring Well Restoration

Surface completions (e.g. concrete pads, steel protective casings) of existing wells that were to be retained in the monitoring well network were inspected by Arcadis personnel. If the surface completions were not in good condition as described above in the Monitoring Well Construction section, then actions were taken to improve the deficiencies and to be consistent with new monitor well construction.

FIELD METHODOLOGY – ELECTRICAL RESISTIVITY SURVEY

Electrical Resistivity Method

The electrical resistivity method consists of injecting electrical current into the subsurface and simultaneously measuring the potential difference along the subsurface within the vicinity of where the current is being injected using a series of electrodes at the ground surface - generally two current electrodes and two potential electrodes in various arrangements and separations called arrays. The injected current and measured potential values are quantified and recorded by the instrument. From these data the electrical resistance (in Ohms) is calculated using Ohm's Law (R = V/I). The apparent electrical resistivity (in Ohm-meters) is calculated from the resistance using volumetric geometrical scale factors related to the electrode arrangement (array). These geometric factors are what distinguish the various array types. The horizontal and vertical sensitivities, as well as the penetration ability vary between array types, and the array type choice is dependent on the project objectives. For this project, a dipole-dipole array was selected as a suitable option. This array type offers rapid data acquisition, a data-dense profile, good subsurface penetration, high data collection efficiency, and good sensitivity to both lateral and vertical variations in electrical resistivity.

Electrical resistivity is an intrinsic property of materials that varies widely in the subsurface and is often correlative with lithology and geochemistry. For soils and rock, resistivity is a function of porosity, ionic content of the pore fluids (usually groundwater), and electrically conductive/reactive minerals such as pyrite and some clay minerals. By measuring the distribution of resistivity values in the subsurface, the presence and structure of geologic features can be inferred.

Once the electrical resistivity data set was collected, the data is downloaded to a computer for processing. Since the true resistivity structure of the earth is the desired outcome, the apparent resistivity data were inverse-modeled using the software Earth Imager v 2.42 to obtain true resistivity[1] cross-sections of the subsurface.

---

[1] The terms apparent versus true resistivity refers to whether the value is essentially a vertical average of the measured quantity, represented as an apparently equivalent uniform value, or whether the values are a portrayal of the actual resistivity or conductivity of the earth materials.

Data Acquisition Procedures

For the 2-dimensional (2D) ER survey conducted at the AEP Amos Plant, five ER transect lines ranging from 291 meters (approximately 950 ft.) to 333 meters (1,100 feet) long were installed to assess the ash pond system area (**Figure D-1**). The lines were identified as Line ER-1, Line ER-2, Line ER-3, Line ER-4, and Line ER-5. For each survey line, up to 112 non-corrosive stainless-steel electrode stakes were used, which were separated by a distance of three meters (approximately 6.6 feet), and inserted into surface soils with an approximate constant spacing along a relatively straight transect. The electrode stakes penetrated the subsurface from approximately 4 to 6 inches bgs to make electrical contact with the soil. The electrode stakes were connected to a specially designed cable that allowed contact with various combinations of electrodes from the meter controlling the data collection process. During the survey, current was injected into the subsurface through two of the electrodes and the potential difference (voltage) created by the flow of current was measured between one or more pairs of voltage electrodes along the survey transect. The pairs of electrodes were arranged in an approximately straight transect, although obstructions and topographic differences prevented perfectly straight transects. The spacing between the electrodes and the geometry of the current electrodes to the voltage electrodes are referred to as an “array type.”

Various array types have advantages and disadvantages depending on the site setting and the objective(s). For this project the dipole-dipole array was used, which generally produces high resolution for both lateral and vertical heterogeneities but may have a limited depth penetration and is susceptible to electrical noise from metallic structures such as pipes.

“Apparent resistivity” is reported in units of ohm-meters and is defined as the bulk, average resistivity of all subsurface materials influencing the current, not the true resistivity of a material at a specific depth, and once the apparent resistivity data set is acquired, the data must be processed using an inversion modelling program to resolve an estimate of the true resistivity distribution of the subsurface.

ER equipment used during this investigation consisted of an Advanced Geosciences, Inc. (AGI) (Austin, Texas), SuperSting™ R8/IP earth resistivity system with a 56 electrode switch box, electrode cables with 3-meter connector spacing, and stainless-steel electrodes. Resistivity data were stored in the internal memory of the SuperSting™ R8/IP and downloaded to a laptop computer. Field data files were assigned a name that included transect name and array type. After each survey was complete, the downloaded data were processed (i.e., inverted) in the field using AGI’s proprietary EarthImager 2D software (Lagmanson and Yang 2002) to evaluate data quality and provide preliminary images to guide subsequent transect alignments.

Data Position Control

The locations of the EMI and resistivity data points were controlled using a Hemisphere A325 mapping grade GPS receiver, equipped with real-time differential correction (i.e., OmniSTAR). The accuracy of this GPS receiver is one meter or less under typical conditions.

Data Processing and Presentation

Once the data are acquired, they are transferred to a computer and processed to create modelled cross-sections that are prepared for geologic interpretation by an experience geophysicist. The 2D ER data were processed using the program EarthImager™ 2D v2.4.2. Build 627 software program by AGI (Lagmanson and Yang 2002). Prior to data modelling, a number of pre-processing steps were completed, including removal of data with voltage spikes, poor voltage decay, and low data quality readings in the raw field data.

Resistivity data were processed using a damped least-squares or smooth model inversion method using a finite element mesh to generate a 2D model of resistivity versus depth. The primary objective of inversion is to reduce data misfits between field measurements and calculated data of a reconstructed model.

Data from resistivity lines ER-1, ER-2, ER-4, and ER-5 are depicted graphically as cross-sectional images with annotations of the interpreted geologic conditions (**Figures D-2** through **D-5**). Note that output from Line ER-3 was omitted from this report due to poor data quality. The cross-sections were made using the inverted ERI model resistivity data output from the EarthImager™ modeling program; they were gridded and contoured using Golden Software Surfer® 12 software. The descriptive geologic information from previous borings and Spring 2016 confirmation borings (SB-1601 through SB-1605, MW-1604, MW-1606) were superimposed on the cross-sections and interpretations made of the aquifer boundaries and other geologic information.

Sources of ER Data Interference

Some of the ERI datasets contained interference potentially caused by a combination of such factors as: 1) poor electrical contact between electrode and soil; 2) high contact resistance; 3) the presence of conductive subsurface infrastructure including metallic piping; and, 4) stray electrical currents and spontaneous potentials in the subsurface. Data artifacts attributed to interference caused by buried metal piping are shown in **Figure D-3** and **Figure D-5,** with the approximate extent of the affected data marked in gray fill.

ER RESULTS AND GEOLOGIC INTERPRETATIONS

Typically, lithologies can be distinguished by their ranges of electrical resistivity values. In freshwater environments, native sand and gravel are usually the most resistive material, and silt and clay are the least resistive materials. Non-native fill materials, such as those observed at the site, can also display a range of electrical resistivity values with coarser sand/gravel fill materials typically displaying higher resistivity values compared to finer-grained clayey fill materials that typically display lower resistivity values. Fly ash fill materials in particular are generally observed to have an elevated electrical conductivity in comparison to most native soils due to the fine grained nature of the fly ash (large amount of surface area) and the leachable materials such as iron and aluminum oxides and other elements such as Ca, K, Mg, Mn, Na, Sr, Ti, and S that are in large enough concentration to potentially increase total dissolved solids (TDS) levels and electrical conductivity if dissolved. Groundwater quality can also be assessed using electrical resistivity, with impacts associated with fly ash being significantly more electrically conductive (less resistive) than ambient groundwater conditions.

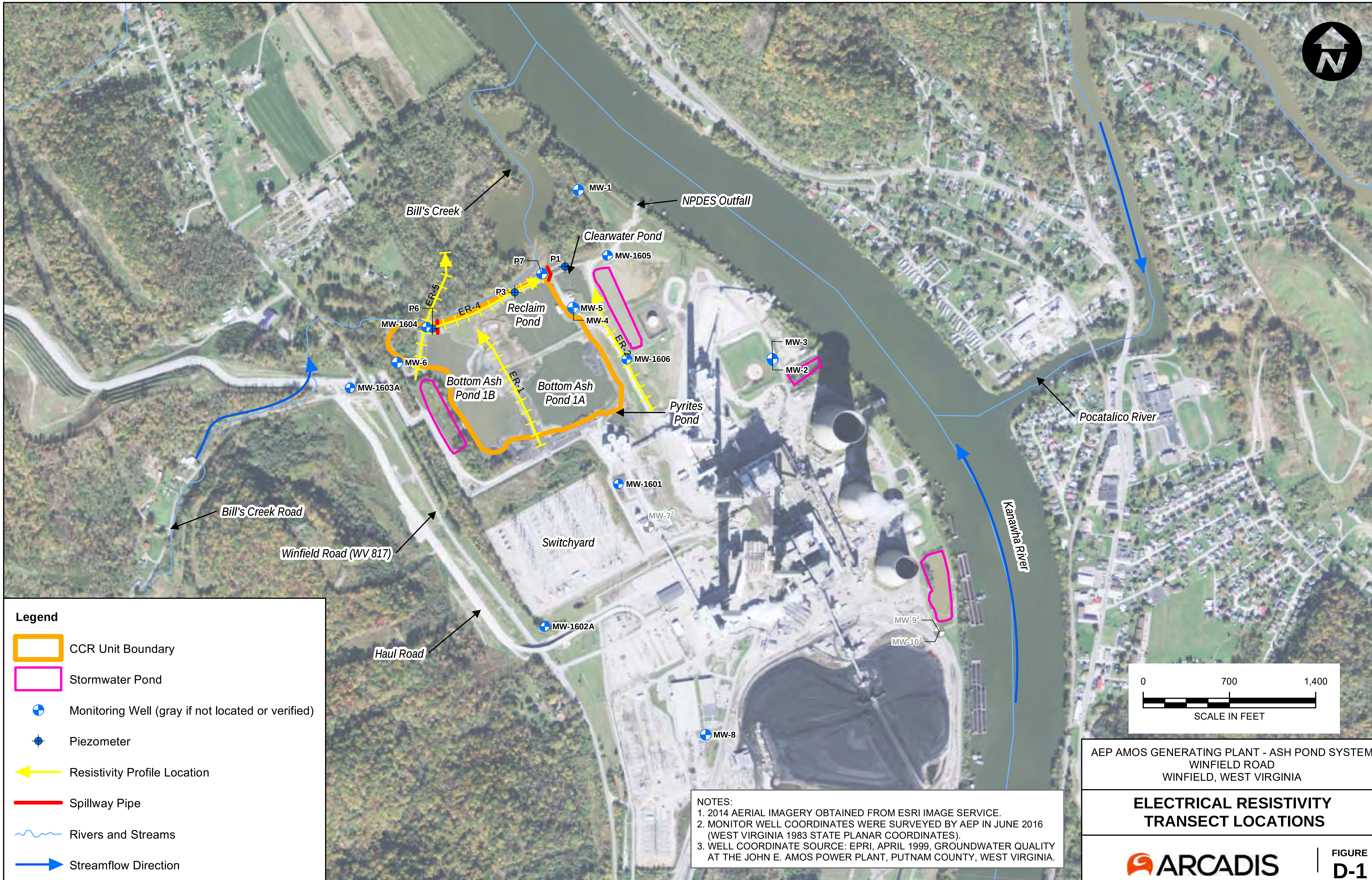
The electrical resistivity cross-section provides the foundation for the geoelectrical structure of the subsurface at the site, with the presumption that the bulk soil response approximates variations in lithologic materials and groundwater conductivity (see table below).

Material Types	Electrical Resistivity Cross-section (Ohm-meters)
Competent sandstone bedrock (background)	>800
Unconsolidated native sand/gravel soils, sand/gravel fill materials, (background)	100 to 800
Fly ash fill materials, clayey fill materials, unconsolidated native clay soils, shale bedrock (background)	10 to 100
Soil containing increasing total dissolved solids (anomalous)	<5.0

The calculated apparent resistivity values ranged over four orders of magnitude at the site from approximately 1 Ohm-meters to greater than 1000 Ohm-meters. Background resistivity values for sandstone bedrock observed in Line ER-5 data (**Figure D-5**) are greater than Ohm-meters (red to purple color range) which is consistent for competent sedimentary bedrock. Unconsolidated native sand/gravel soils or sandy fill materials fall in the range of about 100 to 800 Ohm-meters (green to red color range), which is consistent with fill materials and native soils with varying sand, silt, and gravel content. Unconsolidated native clay soils, clay fill materials, or fine-grained fly ash fill deposits fall in the range of about 10 to 100 Ohm-meters (blue to green color range). As depicted in **Figure D-2** and **Figure D-5,** anomalous zones of significantly low anomalous resistivity less than 10 ohm-meters are shown (dark blue to white color range). These zones of anomalous low resistivity are not likely due to naturally occurring soils/geologic conditions, but are rather due to man-made external influences, such as the presence of geochemically impacted groundwater or metallic features (site structures or subsurface utility lines). Based on the presence of fly ash deposits above the significantly low resistivity zones observed in **Figure D-2** and **Figure D-5**, these zones are interpreted to indicate saturated soils impacted by high TDS groundwater. Furthermore, the coarser-grained sand (SA) and sandy gravel (SG) soils observed at boring SB-1602 and SB-1603 (**Figure D-2**) and boring SB-1604 (**Figure D-5**) that lie at depths intersecting the interpreted high TDS zones, suggest a likely preferential pathway for groundwater flow. As noted in **Figure D-5**, the origin of coarser-grained material shown at SB-1604 is likely channel fill based on the depiction of a historic stream channel shown in 1909, 1931, and 1958 site topographic maps.

The geologic framework at the site has been previously reported to be an unconsolidated aquifer consisting of saturated alluvial sediments beneath and surrounding the site. The upper limit of the uppermost aquifer is defined by the elevation of the sand saturated zone, which ranges from approximately 550 to 560 ft. Using both boring log observations and resistivity values, the interpreted upper and lower extent of sand saturated zone is delineated by black dashed lines as shown in **Figures D-2** through **D-5**. An interpreted groundwater surface is also shown as a blue dashed line in **Figures D-2** through **D-5.**

It should be noted that known fly ash deposits at the site, confirmed by Spring 2016 soil borings, exhibit resistivity values that fall in same range as native soils and therefore the sole use of resistivity values displayed in the cross-section cannot be used to distinguish ash deposits from native soils.



NOTES:
1. 2014 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. MONITOR WELL COORDINATES WERE SURVEYED BY AEP IN JUNE 2016 (WEST VIRGINIA 1983 STATE PLANAR COORDINATES).
3. WELL COORDINATE SOURCE: EPRI, APRIL 1999, GROUNDWATER QUALITY AT THE JOHN E. AMOS POWER PLANT, PUTNAM COUNTY, WEST VIRGINIA.

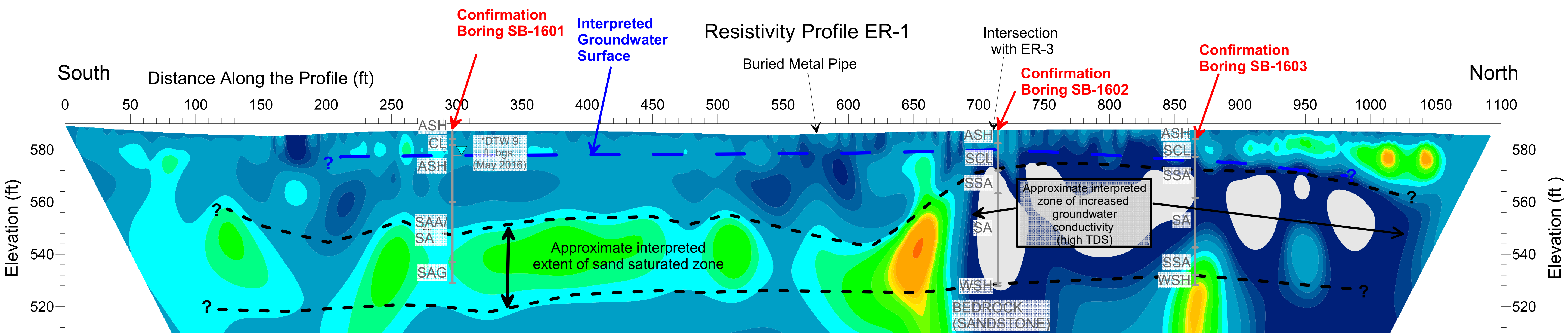
AEP AMOS GENERATING PLANT - ASH POND SYSTEM
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

ELECTRICAL RESISTIVITY TRANSECT LOCATIONS

ARCADIS

FIGURE
D-1

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISPROJECTS_ENV\AEP\Amos\mxd\Ash Pond Report\D1_ Amos Ash Pond Well Network-Ash Pond Layout and Well Location Map_ResistivityTransects.mxd 9/2/2016 8:19:32 AM

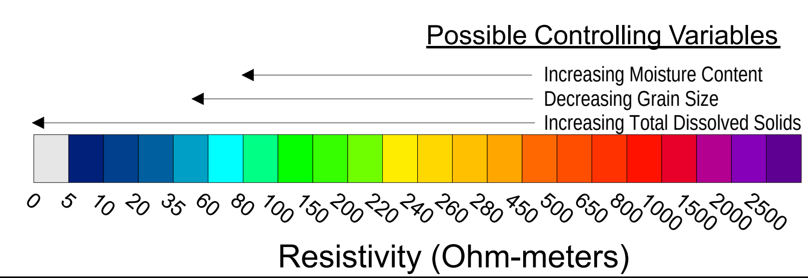


Horizontal Scale: 1" = 80'
Vertical Scale: 1" = 40'

Vertical Exaggeration = 2x

LITHOLOGY

CL - Clay
SCL - Sandy Clay
SSA - Silty Sand
SA - Sand
SAG - Sandy Gravel
GR - Gravel
WSS - Weathered Sandstone
WSH - Weathered Shale

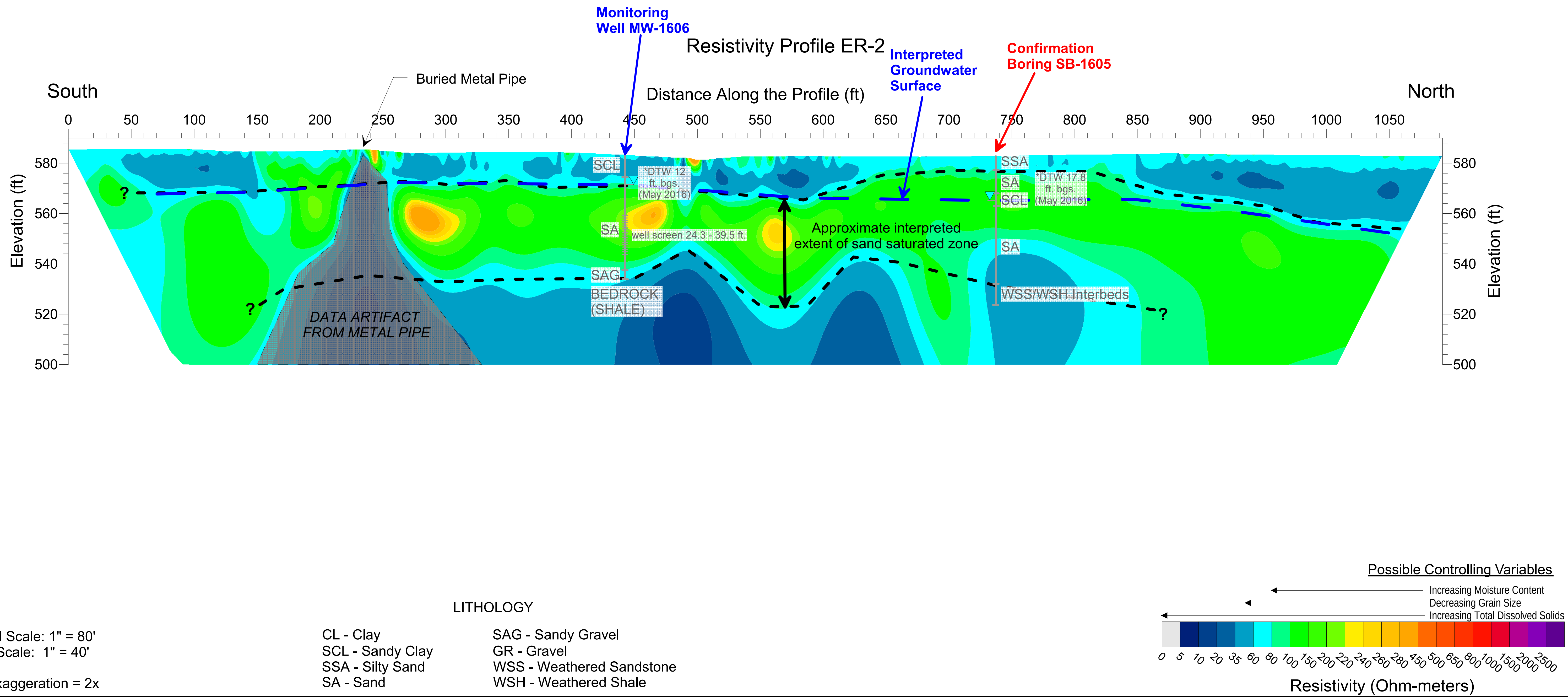


ARCADIS Design & Consultancy for natural and built assets

Line ER-1 2D Electrical Resistivity Modeling Results

AEP AMOS Generating Plant - Ash Pond Complex
Winfield Road
Winfield, West Virginia

FIGURE D-2



LITHOLOGY

Horizontal Scale: 1" = 80'
Vertical Scale: 1" = 40'

Vertical Exaggeration = 2x

CL - Clay
SCL - Sandy Clay
SSA - Silty Sand
SA - Sand

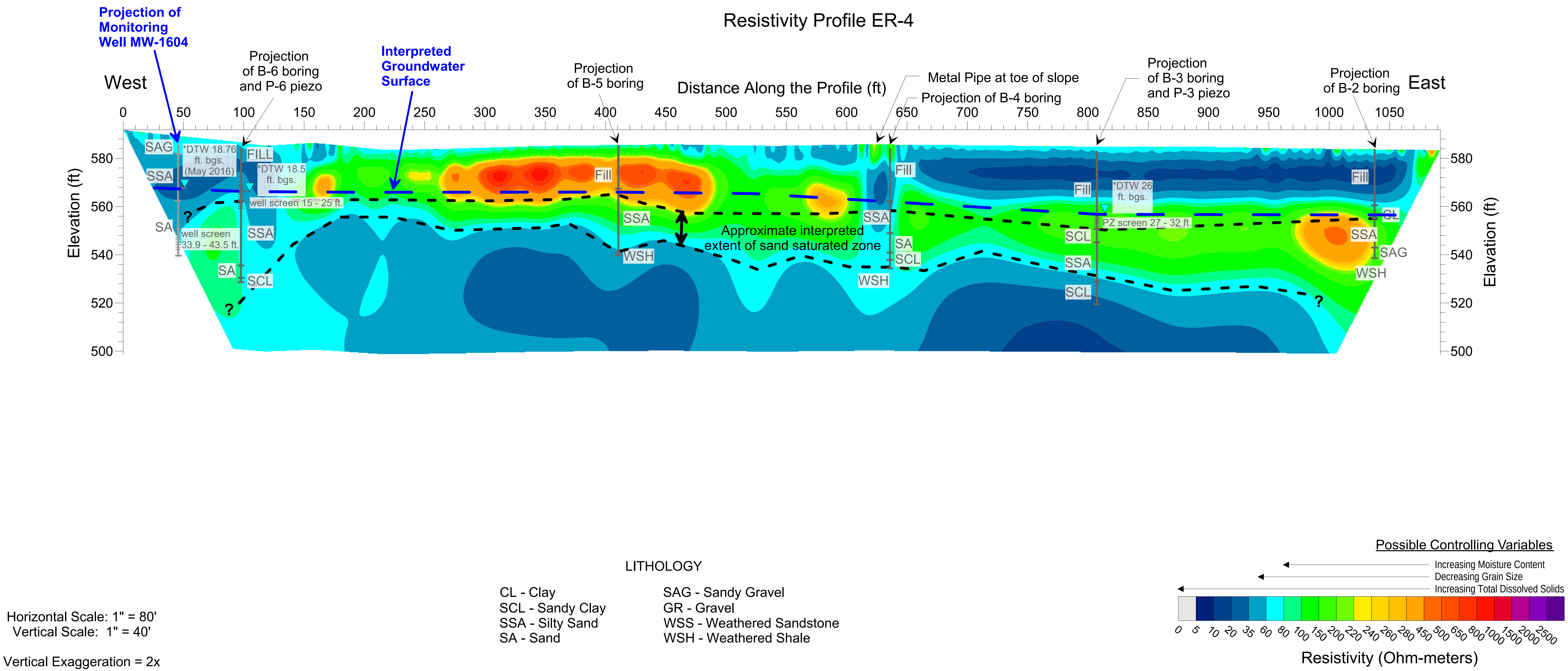
SAG - Sandy Gravel
GR - Gravel
WSS - Weathered Sandstone
WSH - Weathered Shale

ARCADIS Design & Consultancy for natural and built assets

Line ER-2 2D Electrical Resistivity Modeling Results

AEP AMOS Generating Plant - Ash Pond Complex
Winfield Road
Winfield, West Virginia

FIGURE D-3

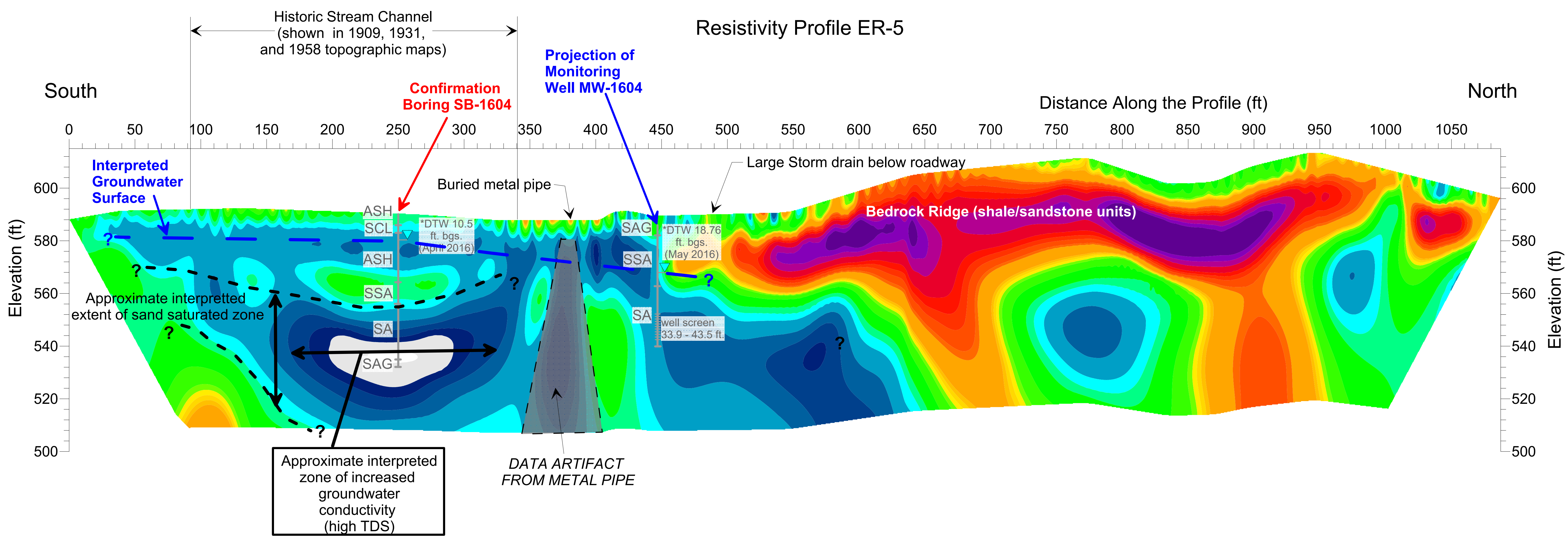


ARCADIS Design & Consultancy for natural and built assets

Line ER-4 2D Electrical Resistivity Modeling Results

AEP AMOS Generating Plant - Ash Pond Complex
Winfield Road
Winfield, West Virginia

FIGURE D-4

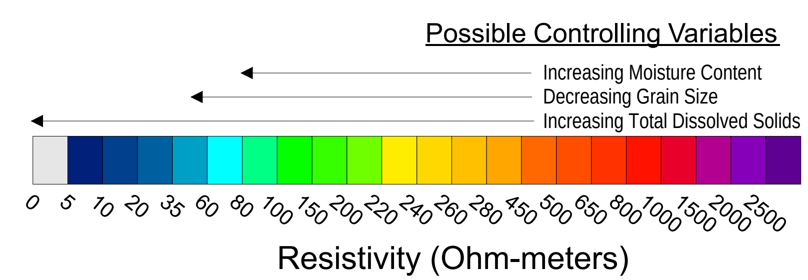


LITHOLOGY

CL - Clay	SAG - Sandy Gravel
SCL - Sandy Clay	GR - Gravel
SSA - Silty Sand	WSS - Weathered Sandstone
SA - Sand	WSH - Weathered Shale

Horizontal Scale: 1" = 80'
Vertical Scale: 1" = 40'

Vertical Exaggeration = 2x



ARCADIS Design & Consultancy for natural and built assets

Line ER-5 2D Electrical Resistivity Modeling Results

AEP AMOS Generating Plant - Ash Pond Complex
Winfield Road
Winfield, West Virginia

FIGURE D-5

Well Development Logs

WELL DEVELOPMENT LOG

Site/Well No. MW-1

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location | Date

Weather | Development Time Begin 6/15/16 09:20 AM | End 6/15/16 10:05 AM

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	190
Land Surface Elevation (ft)		Evacuation Method	Submersible Proactive Pump
Sounded Well Depth (ft bmp)	36.35	Volumes Purged	
Depth to Water (ft bmp)	17.21		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	19.14	Color	Clear
Casing Diameter/Type	2	Odor	None
Gallons in Well	3.06	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature ($^oF/^oC$)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
9:20	0:00	29.00	17.53	190	0.464	20.40	18.64	4.91	217	8.77	Initial		Clear; no odor
9:25	0:05	29.10	17.60	190	0.507	19.90	15.48	5.00	228	5.38	1st		Clear; no odor
9:30	0:10	29.20	17.60	180	0.506	7.60	15.39	4.92	238	4.20	2nd		Clear; no odor
9:35	0:15	29.30	17.60	180	0.500	4.30	15.33	4.90	245	3.60	3rd		Clear; no odor
9:40	0:20	29.40	17.60	180	0.496	3.90	15.44	4.97	244	3.30	4th		Clear; no odor
9:50	0:30	29.50	17.60	180	0.487	1.80	15.79	5.01	249	2.50	5th		Clear; no odor
9:55	0:35	29.60	17.54	180	0.476	2.30	15.62	5.04	254	2.30	6th		Clear; no odor
10:00	0:40	29.70	17.40	180	0.470	1.40	15.70	5.07	260	2.22	7th		Clear; no odor
10:05	0:45	29.80	17.33	180	0.466	1.90	15.74	5.05	213	2.15	8th		Clear; no odor

Development Personnel: K. Swiadek

Notes: Removed 30 gallons with surge block and proactive pump. Turb never high during development.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride		
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

WELL DEVELOPMENT LOG

Site/Well No. MW-2

Project AEP Amos Plant   Project No. OH015976.0007   Page 1 of 1

Site Location Winfield, WV   Date 5/20/2016

Weather 66F, Sunny   Development Time Begin 10:20   End 11:31

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	55.00
MP Elevation (ft)	N/A	Pumping Rate (gpm)	580
Land Surface Elevation (ft)		Evacuation Method	Foot Valve Proactive Pump
Sounded Well Depth (ft bmp)	59.05	Volumes Purged	
Depth to Water (ft bmp)	13.07		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	45.98	Color	Tan
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	7.36	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature ($^oF/^oC$)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
10:25	0:00	65.77	14.11	580	0.651	87.40	20.72	6.45	-69	0.56	Initial		Tan; no odor
10:30	0:05	66.54	14.00	580	0.614	32.90	19.13	6.60	-71	3.15	1st		Clear; no odor
10:35	0:10	67.31	13.90	580	0.616	27.80	19.08	6.55	-65	1.02	2nd		Clear; no odor
10:40	0:15	68.08	13.95	580	0.616	17.60	18.36	6.60	-67	2.40	3rd		Clear; no odor
10:45	0:20	68.85	13.95	580	0.623	15.10	18.55	6.69	-63	2.58	4th		Clear; no odor
10:50	0:25	69.62	13.95	580	0.633	8.45	18.47	6.68	-62	3.01	5th		Clear; no odor
10:55	0:30	70.39	13.95	580	0.643	6.12	18.44	6.72	-61	2.61	6th		Clear; no odor
11:00	0:35	71.16	13.95	580	0.638	4.07	18.67	6.69	-62	3.22	7th		Clear; no odor
11:10	0:45	71.93	13.95	580	0.605	5.36	18.69	6.67	-57	0.80	8th		Clear; no odor
11:15	0:50	72.70	13.95	580	0.603	4.97	18.71	6.68	-61	0.90	9th		Clear; no odor
11:20	0:55	73.47	13.95	580	0.603	5.23	19.13	6.67	-55	0.96	10th		Clear; no odor
11:25	1:00	74.34	13.95	580	0.309	3.92	18.33	6.74	-62	0.23	11th		Clear; no odor
11:30	1:05	75.01	13.95	580	0.604	1.97	18.23	6.74	-62	2.09	12th		Clear; no odor

Development Personnel: T. Runge

Notes: Sheen observed on purge water. 65 gallons removed with a foot valve/surge block & proactive pump (40 surged). Lid and stick-up bent and broken. Not 3' tall; no sand, pad dimensions/condition unkown. Bollards need painted.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

WELL DEVELOPMENT LOG

Site/Well No. MW-3

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/19/2016

Weather 64F, Sunny | Development Time Begin 15:05 | End 16:05

Evacuation Data

Measuring Point	TOC
MP Elevation (ft)	N/A
Land Surface Elevation (ft)	
Sounded Well Depth (ft bmp)	25.38
Depth to Water (ft bmp)	12.70
Water-Level Elevation (ft)	
Water Column in Well (ft)	12.68
Casing Diameter/Type	2" PVC
Gallons in Well	2.02

Sample Pump Intake Setting (ft bmp)	
Pumping Rate (gpm)	580
Evacuation Method	Foot Valve Proactive Pump
Volumes Purged	12

Field Parameters

Color	clear
Odor	None
Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
15:10	0:05	16.77	13.42	580	0.393	12.60	19.91	6.05	136	3.26	Initial		Clear; no odor
15:15	0:10	17.54	13.31	580	0.431	7.20	19.49	6.13	116	1.61	1st		Clear; no odor
15:20	0:15	18.31	13.23	580	0.416	12.30	17.88	6.12	113	3.16	2nd		Clear; no odor
15:25	0:20	19.08	13.21	580	0.416	8.70	18.50	6.10	130	1.93	3rd		Clear; no odor
15:30	0:25	19.85	13.21	580	0.418	6.40	17.52	6.15	133	2.64	4th		Clear; no odor
15:35	0:30	20.02	13.21	580	0.405	5.30	20.04	6.15	155	2.10	5th		Clear; no odor
15:40	0:35	21.39	13.20	580	0.410	4.80	19.28	6.31	144	3.14	6th		Clear; no odor
15:50	0:45	22.16	13.21	580	0.405	5.10	19.16	6.19	156	2.89	7th		Clear; no odor
15:55	0:50	22.93	13.20	580	0.411	3.00	18.89	6.14	153	1.00	8th		Clear; no odor
16:00	0:55	23.70	13.20	580	0.408	2.10	18.46	6.16	156	2.38	9th		Clear; no odor
16:05	1:00	24.47	13.20	580	0.405	0.70	18.57	6.18	152	2.79	10th		Clear; no odor

Development Personnel: T. Runge

Notes: 16 gallons purged with foot valve and surge block. Well stick-up lid is bent and broken; well stickup is less than 3' tall; cannot see/tell what size pad is, if it's even present. No sand in stickup; bollards need repainting.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

WELL DEVELOPMENT LOG

Site/Well No. MW-4

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/19/2016

Weather 64F, Sunny | Development Time Begin 11:25 | End 12:05

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	30.00
MP Elevation (ft)	N/A	Pumping Rate (gpm)	880
Land Surface Elevation (ft)		Evacuation Method	Foot Valve Proactive Pump
Sounded Well Depth (ft bmp)	36.93	Volumes Purged	10
Depth to Water (ft bmp)	17.05		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	19.8	Color	clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	3.18	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
11:25	0:05	28.16	17.23	880	0.225	24.30	18.77	5.68	65	2.39	Initial		Clear; no odor
11:30	0:10	29.19	17.23	780	0.219	21.20	18.81	5.71	61	2.47	1st		Clear; no odor
11:35	0:15	30.09	17.26	680	0.219	39.00	18.48	5.60	78	0.96	2nd		Clear; no odor
11:40	0:20	30.90	17.27	680	0.219	32.60	18.51	5.62	80	0.60	3rd		Clear; no odor
11:45	0:25	31.89	17.27	680	0.219	30.80	18.41	5.61	79	0.54	4th		Clear; no odor
11:50	0:30	32.79	17.28	680	0.222	23.50	18.69	5.66	73	1.22	5th		Clear; no odor
11:55	0:35	33.69	17.27	680	0.219	31.80	18.60	5.62	76	1.83	6th		Clear; no odor
12:00	0:40	34.59	17.27	680	0.218	15.40	18.57	5.66	76	0.99	7th		Clear; no odor
12:05	0:45	35.49	17.28	680	0.219	9.60	19.21	5.65	74	0.97	8th		Clear; no odor

Development Personnel: T. Runge

Notes: 27 gallons pumped via foot valve. Stick-up less than 3' tall; 2x2' pad, stick-up lid hinge broken. No sand in stick-up.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-5

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/19/2016

Weather 61F, Sunny | Development Time Begin 9:55 | End 11:17

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	50.50
MP Elevation (ft)	N/A	Pumping Rate (gpm)	580
Land Surface Elevation (ft)		Evacuation Method	Proactive Pump
Sounded Well Depth (ft bmp)	55.5	Volumes Purged	10
Depth to Water (ft bmp)	16.99		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	38.51	Color	clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	6.16	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)	Remarks
10:00	0:05	48.77	17.17	580	0.197	23.30	16.39	5.69	23	1.65	Initial	Clear; no odor
10:05	0:10	49.67	17.16	680	0.194	6.84	16.68	5.82	18	1.58	1st	Clear; no odor
10:10	0:15	50.87	17.16	680	0.191	6.31	17.24	5.88	13	2.54	2nd	Clear; no odor
10:15	0:20	51.34	17.16	580	0.192	6.90	17.30	5.86	16	1.75	3rd	Clear; no odor
10:20	0:25	52.11	17.16	580	0.191	4.20	17.44	5.81	23	2.99	4th	Clear; no odor
10:25	0:30	52.88	17.16	580	0.191	3.50	17.43	5.72	26	1.74	5th	Clear; no odor
10:30	0:35	53.78	17.16	680	0.191	4.75	17.45	5.69	24	1.58	6th	Clear; no odor
10:35	0:40	54.68	17.16	680	0.190	3.88	17.85	5.70	24	1.86	7th	Clear; no odor
10:40	0:45	55.58	17.16	680	0.191	2.37	17.70	5.74	28	1.26	8th	Clear; no odor
10:45	0:50	56.61	17.16	780	0.190	2.89	17.71	5.75	28	1.01	9th	Clear; no odor
10:50	0:55	57.64	17.16	780	0.190	3.00	17.70	5.75	28	0.99	10th	Clear; no odor
10:55	1:00	58.67	17.16	780	0.191	4.11	17.76	5.76	27	1.78	11th	Clear; no odor
11:00	1:05	59.70	17.16	780	0.192	2.67	17.84	5.78	26	1.91	12th	Clear; no odor
11:10	1:15	60.73	17.16	780	0.192	3.49	17.79	5.77	27	3.64	13th	Clear; no odor
11:15	1:20	61.76	17.16	780	0.190	4.01	17.69	5.74	28	5.15	14th	Clear; no odor

Development Personnel: T. Runge

Notes: Well stick-up <3' and lid hinge rusted off/broken. 2'x2' pad; no sand in stick-up.
40 gal removed with foot valve and surge block.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-6

Project AEP Amos Plant — Project No. OH015976.0007 — Page 1 of 1

Site Location Winfield, WV — Date 5/19/2016

Weather 64F, Sunny — Development Time Begin 13:35 — End 14:25

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	580
Land Surface Elevation (ft)		Evacuation Method	Foot Valve Proactive Pump
Sounded Well Depth (ft bmp)	43.82	Volumes Purged	10
Depth to Water (ft bmp)	16.76		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	27.06	Color	clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	4.33	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
13:35	0:05	40.77	28.87	580	0.226	24.20	19.10	6.31	-76	3.04	Initial		Clear; no odor
13:40	0:10	41.54	28.90	580	0.229	21.30	19.08	6.20	-65	1.86	1st		Clear; no odor
13:45	0:15	42.31	27.85	580	0.223	7.00	17.92	6.25	-68	1.89	2nd		Clear; no odor
13:50	0:20	43.08	27.05	580	0.222	2.50	17.18	6.10	-57	1.55	3rd		Clear; no odor
13:55	0:25	43.85	26.96	580	0.222	2.10	16.94	6.22	-63	2.30	4th		Clear; no odor
14:00	0:30	44.62	26.91	580	0.224	1.50	16.55	6.28	-66	1.58	5th		Clear; no odor
14:05	0:35	45.34	26.84	580	0.223	0.50	16.78	6.23	-64	1.89	6th		Clear; no odor
14:10	0:40	46.16	26.80	580	0.224	0.50	16.91	6.19	-62	1.94	7th		Clear; no odor
14:15	0:45	46.43	26.79	580	0.222	0.30	16.81	6.34	-70	1.60	8th		Clear; no odor
14:20	0:50	47.70	26.71	580	0.224	0.10	16.79	6.32	-70	1.49	9th		Clear; no odor
14:25	0:55	48.47	26.65	580	0.225	1.10	16.31	6.33	-71	1.38	10th		Clear; no odor

Development Personnel: T. Runge

Notes: Bollards in bad condition - 1 bent. Stick-up lid broken and stick-up <3' tall. 2x2' pad. In swamp; poor access,

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

WELL DEVELOPMENT LOG

Site/Well No. MW-8

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/20/2016

Weather 64F, Sunny | Development Time Begin 12:00 | End 13:06

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	580
Land Surface Elevation (ft)		Evacuation Method	Foot Valve Proactive Pump
Sounded Well Depth (ft bmp)	43.82	Volumes Purged	10
Depth to Water (ft bmp)	16.76		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	27.06	Color	clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	4.33	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
12:04	0:05	15.77	10.50	580	0.446	530.00	18.60	6.63	68	3.45	Initial		Tan; no odor
12:09	0:10	16.54	10.25	580	0.386	146.00	17.81	6.59	89	2.68	1st		Tan; no odor
12:14	0:15	17.31	10.14	580	0.304	98.80	17.44	6.32	623	0.15	2nd		Clear; no odor
12:19	0:20	18.08	10.09	580	0.312	42.30	17.15	6.29	1023	0.17	3rd		Clear; no odor
12:24	0:25	18.85	10.08	580	--------------	15.58	--------------	--------	------	-------------	4th		Clear; no odor
12:29	0:30	19.62	10.15	580	--------------	9.10	--------------	--------	------	-------------	5th		Clear; no odor
12:34	0:35	20.39	10.18	580	--------------	4.09	--------------	--------	------	-------------	6th		Clear; no odor
12:39	0:40	21.16	10.21	580	--------------	3.18	--------------	--------	------	-------------	7th		Clear; no odor
12:44	0:45	21.93	10.20	580	--------------	2.16	--------------	--------	------	-------------	8th		Clear; no odor
12:49	0:50	22.70	10.20	580	--------------	1.20	--------------	--------	------	-------------	9th		Clear; no odor
12:54	0:55	23.47	10.20	580	--------------	1.09	--------------	--------	------	-------------	10th		Clear; no odor
12:59	1:00	24.24	10.21	580	--------------	0.97	--------------	--------	------	-------------	11th		Clear; no odor
13:04	1:05	25.01	10.21	580	--------------	0.70	--------------	--------	------	-------------	12th		Clear; no odor

Development Personnel: T. Runge

Notes: 15.0 gallons removed via proactive/foot valve/surge. Horiba not functioning at 1220. Stick-up below 3', hinge broken, 2'x2' pad.
ORP at 1214 and 1219 likely an error with probe.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1601

Project AEP Amos Plant   Project No. OH015976.0007   Page 1 of 1

Site Location Winfield, WV   Date 5/18/2016

Weather 54F, Rain   Development Time Begin 16:32   End 17:54

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	36.0
MP Elevation (ft)	N/A	Pumping Rate (gpm)	608
Land Surface Elevation (ft)		Evacuation Method	Proactive Pump
Sounded Well Depth (ft bmp)	41.70	Volumes Purged	10.18
Depth to Water (ft bmp)	14.60		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	27.1	Color	Clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	4.34	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
16:37	0:05	40.16	14.62	608	0.164	659.0	16.55	5.78	32	1.42	Initial		Tan; no odor
16:42	0:10	40.32	14.62	608	0.164	618.0	16.21	5.77	52	2.80	1st		Tan; no odor
16:57	0:25	40.64	14.62	608	0.164	604.0	16.28	5.74	56	1.65	2nd		Tan; no odor
17:02	0:30	40.96	14.63	608	0.173	614.0	16.52	5.78	53	1.64	3rd		Tan; no odor
17:07	0:35	41.28	14.63	608	0.173	605.0	16.25	5.78	54	2.04	4th		Tan; no odor
17:12	0:40	41.60	14.62	608	0.172	417.0	16.24	5.81	50	2.56	5th		Tan; no odor
17:17	0:45	41.92	14.62	608	0.171	312.0	16.18	5.80	50	2.50	6th		Tan; no odor
17:22	0:50	42.24	14.63	608	0.172	302.0	16.18	5.81	51	2.60	7th		Tan; no odor
17:27	0:55	42.56	14.63	608	0.171	206.0	16.17	5.81	48	2.58	8th		Tan; no odor
17:32	1:00	42.88	14.63	608	0.173	114.0	16.15	5.89	52	2.66	9th		Tan; no odor
17:37	1:05	43.20	14.61	608	0.174	90.0	16.16	5.84	53	1.64	10th		Milky; no odor
17:42	1:10	43.52	14.61	608	0.173	63.0	16.22	5.86	51	1.53	11th		Milky; no odor
17:47	1:15	43.84	14.61	608	0.175	42.0	16.18	5.87	54	1.40	12th		Milky; no odor
17:52	1:20	44.16	14.61	608	0.174	39.0	16.19	5.83	51	1.81	13th		Clear; no odor
					.								

Development Personnel: T. Runge

Notes: 40 gal removed with foot valve/surge block. Pump rate would not go lower.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1602A

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 6/14/2016

Weather 80F, Sunny | Development Time Begin 10:05 | End 12:30

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	250
Land Surface Elevation (ft)		Evacuation Method	Submersible Proactive Pump
Sounded Well Depth (ft bmp)	60.40	Volumes Purged	
Depth to Water (ft bmp)	24.56		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	35.84	Color	Clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	5.7	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
11:40	0:05	65.00	25.12	250	0.458	151.0	17.25	6.39	-19	13.56	Initial		Clear; no odor
11:45	0:10	65.20	25.69	270	0.437	112.0	17.24	6.32	-16	3.88	1st		Clear; no odor
11:50	0:15	65.40	25.30	200	0.444	82.6	16.15	6.35	-34	2.26	2nd		Clear; no odor
11:55	0:20	65.60	25.21	200	0.441	74.3	16.22	6.48	-59	1.64	3rd		Clear; no odor
12:00	0:25	65.80	25.00	180	0.426	68.4	16.94	6.50	-68	1.38	4th		Clear; no odor
12:05	0:30	66.00	24.92	180	0.430	60.2	17.11	6.53	-74	1.22	5th		Clear; no odor
12:10	0:35	66.20	29.88	180	0.438	48.9	17.18	6.56	-78	1.02	6th		Clear; no odor
12:15	0:40	66.40	29.88	180	0.441	36.0	17.40	6.58	-80	1.02	7th		Clear; no odor
12:20	0:45	66.60	29.85	180	0.430	34.3	17.56	6.61	-83	0.97	8th		Clear; no odor
12:25	0:50	66.80	29.85	180	0.445	33.6	17.36	6.62	-85	0.90	9th		Clear; no odor
12:30	0:55	67.00	29.86	180	0.446	33.4	17.54	6.64	-88	0.86	10th		Clear; no odor

Development Personnel: K. Swiadek

Notes: Removed 65 gallons with Waterra and proactive pump. Very fine sand/silt.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1603A

Project AEP Amos Plant — Project No. OH015976.0007 — Page 1 of 1

Site Location Winfield, WV — Date 6/14/2016

Weather 80F, Sunny — Development Time Begin 14:10 — End 16:10

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	260
Land Surface Elevation (ft)		Evacuation Method	Submersible Proactive Pump
Sounded Well Depth (ft bmp)	46.40	Volumes Purged	
Depth to Water (ft bmp)	7.60		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	38.8	Color	Clear
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	6.2	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
15:30	0:00	60.00	11.30	260	0.267	116.0	16.78	6.29	-12	10.80	Initial		Clear; no odor
15:35	0:05	60.20	11.23	260	0.269	97.5	16.66	6.45	-65	3.60	1st		Clear; no odor
15:40	0:10	60.30	10.33	220	0.264	79.9	16.65	6.63	-87	2.50	2nd		Clear; no odor
15:45	0:15	60.40	9.81	210	0.262	45.4	16.55	6.68	-96	1.9	3rd		Clear; no odor
15:50	0:20	60.50	9.75	210	0.262	31.9	16.61	6.73	-101	1.60	4th		Clear; no odor
15:55	0:25	60.60	9.75	210	0.261	26.8	16.63	6.79	-107	1.35	5th		Clear; no odor
16:00	0:30	60.70	9.73	210	0.261	19.8	16.74	6.83	-112	1.16	6th		Clear; no odor
16:05	0:35	60.80	9.72	210	0.261	11.7	16.99	6.77	-106	1.10	7th		Clear; no odor
16:10	0:40	60.90	9.73	210	0.261	9.7	17.08	6.79	-109	1.03	8th		Clear; no odor

Development Personnel: K. Swiadek

Notes: Removed 60 gallons with surge block and pump.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1604

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/18/2016

Weather 54F, Rain | Development Time Begin 13:18 | End 14:45

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	42.0
MP Elevation (ft)	N/A	Pumping Rate (gpm)	591
Land Surface Elevation (ft)		Evacuation Method	Proactive Pump
Sounded Well Depth (ft bmp)	47.33	Volumes Purged	12.19
Depth to Water (ft bmp)	20.81		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	26.52	Color	Tan
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	4.24	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
13:23	0:05	40.78	21.89	591	0.212	239.0	17.29	5.90	-16	4.60	Initial		Tan; no odor
13:28	0:10	41.56	21.71	591	0.211	178.0	17.68	6.14	-15	3.06	1st		Tan; no odor
13:33	0:15	42.34	21.58	591	0.211	161.0	17.91	6.15	-16	3.91	2nd		Tan; no odor
13:38	0:20	43.12	21.43	591	0.207	138.0	18.05	6.19	-21	2.06	3rd		Tan; no odor
13:43	0:25	43.90	21.91	591	0.216	103.0	18.23	6.13	-14	2.19	4th		Tan; no odor
13:48	0:30	44.68	21.95	591	0.218	141.0	18.23	6.14	-15	1.66	5th		Tan; no odor
13:53	0:35	45.46	21.96	591	0.209	129.0	18.19	6.13	-14	1.88	6th		Tan; no odor
13:58	0:40	46.24	21.98	591	0.216	134.0	18.21	6.15	-15	1.60	7th		Tan; no odor
14:03	0:45	47.02	21.78	591	0.213	176.0	18.24	6.08	-8	2.27	8th		Tan; no odor
14:08	0:50	47.80	21.70	591	0.142	159.0	18.07	6.07	-11	8.77	9th		Tan; no odor
14:13	0:55	48.58	21.73	591	0.219	109.0	18.11	6.09	-12	8.74	10th		Tan; no odor
14:18	1:00	49.36	21.75	591	0.219	118.0	18.05	6.06	-14	8.63	11th		Tan; no odor
14:23	1:05	50.14	21.72	591	0.219	90.0	18.13	6.07	-13	2.49	12th		Tan; no odor
14:28	1:10	50.92	21.68	591	0.217	167.0	18.14	6.09	-14	3.65	13th		Tan; no odor
14:32	1:14	51.70	21.69	591	0.215	151.00	18.17	6.08	-17	4.51	14th		Tan; no odor

Development Personnel: T. Runge

Notes: 40 gal removed with foot valve and surge block.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1605

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/18/2016

Weather 54F, Rain | Development Time Begin 10:45 | End 12:00

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	34.0
MP Elevation (ft)	N/A	Pumping Rate (gpm)	993.6
Land Surface Elevation (ft)		Evacuation Method	Proactive Pump
Sounded Well Depth (ft bmp)	44.76	Volumes Purged	12.19
Depth to Water (ft bmp)	17.39		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	27.37	Color	Tan
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	4.37	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
10:50	0:05	40.26	36.97	993.6	0.485	358.0	16.18	6.30	24	8.81	Initial		Tan; no odor
10:55	0:10	40.52	35.89	993.6	0.473	218.0	16.33	6.24	27	9.96	1st		Tan; no odor
11:00	0:15	40.75	35.58	869.4	0.479	163.0	16.32	6.18	29	1.24	2nd		Tan; no odor
11:05	0:20	40.94	35.29	709.8	0.481	150.0	16.34	6.01	30	7.18	3rd		Tan; no odor
11:10	0:25	41.13	35.18	709.8	0.489	115.0	16.32	5.96	32	6.43	4th		Tan; no odor
11:15	0:30	41.32	35.01	709.8	0.488	110.0	16.29	5.81	49	6.26	5th		Tan; no odor
11:20	0:35	41.51	34.97	709.8	0.473	30.7	16.32	6.06	36	2.80	6th		Clear; no odor
11:25	0:40	41.70	34.96	709.8	0.473	13.7	16.35	6.11	28	2.58	7th		Clear; no odor
11:30	0:45	41.89	32.90	725	0.491	34.8	16.34	6.23	21	10.13	8th		Clear; no odor
11:35	0:50	42.08	32.85	725	0.492	25.9	16.27	6.03	33	10.01	9th		Clear; no odor
11:40	0:55	42.27	32.74	725	0.474	15.3	16.33	6.21	33	4.41	10th		Clear; no odor
11:45	1:00	42.46	32.69	725	0.472	10.9	16.35	6.11	34	3.41	11th		Clear; no odor
11:50	1:05	42.65	32.59	725	0.462	7.7	16.43	6.09	31	2.61	12th		Clear; no odor
11:55	1:10	42.84	32.51	725	0.464	19.7	16.41	6.10	36	4.80	13th		Clear; no odor
12:00	1:15	43.03	32.56	725	0.461	12.20	16.44	6.05	32	2.78	14th		Clear; no odor

Development Personnel: T. Runge

Notes: 40 gal removed with foot valve and surge block.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1606

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 5/17/2016

Weather 61F, Clouds/Rain | Development Time Begin 13:30 | End 15:00

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	300oz/min (8872.06 ml/min)
Land Surface Elevation (ft)		Evacuation Method	Proactive Pump
Sounded Well Depth (ft bmp)	42.48	Volumes Purged	13.63
Depth to Water (ft bmp)	11.23		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	31.25	Color	Tan
Casing Diameter/Type	2" PVC	Odor	None
Gallons in Well	5.00	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
1:30	0:05	32.34	11.81	8872	0.454	883.0	15.71	5.57	37	10.13	Initial		------------------
1:35	0:10	34.68	11.70	8872	0.415	737.0	15.71	5.69	19	10.09	1st		------------------
1:40	0:15	37.02	11.62	8872	0.394	498.0	15.67	5.78	22	1.38	2nd		------------------
1:45	0:20	39.36	11.50	8872	0.392	334.0	15.60	5.78	39	2.33	3rd		------------------
1:50	0:25	41.70	11.41	8872	0.382	235.0	15.51	5.81	39	5.84	4th		------------------
1:55	0:30	44.04	11.85	8872	0.376	213.0	15.62	5.80	38	1.90	5th		------------------
2:00	0:35	46.38	11.79	8872	0.376	190.0	16.62	5.77	39	2.88	6th		------------------
2:05	0:40	48.72	11.81	8872	0.384	174.0	15.63	5.76	38	1.97	7th		------------------
2:10	0:45	51.06	11.80	8872	0.384	157.0	15.63	5.76	38	1.28	8th		------------------
2:15	0:50	53.40	11.78	8872	0.386	141.0	15.63	5.74	32	3.12	9th		------------------
2:20	0:55	55.74	11.71	8872	0.386	121.0	15.62	5.77	36	2.27	10th		------------------
2:25	1:00	58.08	11.54	8872	0.373	111.0	15.59	5.78	40	1.02	11th		------------------
2:30	1:05	60.42	11.34	8872	0.371	102.0	15.62	5.78	40	0.57	12th		------------------
2:35	1:10	62.76	11.31	8872	0.383	92.1	15.65	5.77	47	10.51	13th		------------------
2:40	1:15	65.10	11.35	8872	0.384	103.0	15.57	5.77	47	10.43	14th		------------------
2:45	1:20	65.80	11.33	2957	0.382	76.4	15.57	5.76	42	8.79	15th		------------------
2:50	1:25	66.58	11.30	2957	0.382	63.8	15.54	5.75	42	9.30	16th		------------------
2:55	1:30	67.36	11.29	2957	0.383	75.1	15.55	5.76	42	9.15	17th		------------------
3:00	1:35	68.14	11.33	2957	0.384	73.20	15.58	5.76	44	6.17	18th		------------------

Development Personnel: T. Runge

Notes: Parameters were collected when centrifugal/proactive pump was used

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

WELL DEVELOPMENT LOG

Site/Well No. MW-1605

Project AEP Amos Plant | Project No. OH015976.0007 | Page 1 of 1

Site Location Winfield, WV | Date 6/15/2016

Weather 80F, Cloudy | Development Time Begin ____ End ____

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	
MP Elevation (ft)	N/A	Pumping Rate (gpm)	
Land Surface Elevation (ft)		Evacuation Method	Bailer
Sounded Well Depth (ft bmp)	43.15	Volumes Purged	
Depth to Water (ft bmp)	3.60		
Water-Level Elevation (ft)		**Field Parameters**	
Water Column in Well (ft)	39.55	Color	Tan
Casing Diameter/Type	1" PVC	Odor	None
Gallons in Well	2.37	Appearance	

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature ($^oF/^oC$)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)		Remarks
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------
---------	------	-----------	-----	-------	----------------	---------	----------	--------	-----	-----------	-----	-------	--------

Development Personnel: K. Swiadek

Notes: Removed 25 gallons with Waterra. Turbidity >1000 throughout.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potentia
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units		
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter		
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

APPENDIX E

Record of Changes

RECORD OF CHANGES

Revision No	Revision Date	Description
0	10/18/2016	Original Well Network Evaluation Report
1	10/22/2020	Revised Sections 2.2.1, 2.2.2, and 2.2.4 to remove the Pyrites Pond from the description of the BAP CCR unit. Updated the CCR unit outline on all figures to remove the Pyrites Pond and include the Clearwater Pond. Added Appendix E–Record of Changes.

FLY ASH POND CCR GROUNDWATER MONITORING WELL NETWORK EVALUATION

Amos Plant

Winfield Road

Putnam County

Winfield, West Virginia

April 17, 2019

FLY ASH POND CCR GROUNDWATER MONITORING WELL NETWORK EVALUATION

Amos Plant
Winfield Road
Putnam County
Winfield, West Virginia

Prepared for:

American Electric Power Service Corporation

Everett Fortner III, PG
Senior Geologist

Matthew J. Lamb
Project Manager

Todd Minehardt, PE
Principal Engineer

Prepared by:

Arcadis U.S., Inc.
100 E Campus View Boulevard
Suite 230
Columbus
Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

Our Ref.:

WV015976.0005

Date:

April 17, 2019

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power Service Corporation
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
gpm	gallon per minute
SRF	stress relief fracturing
USGS	United States Geological Survey

1 INTRODUCTION

This report was prepared by Arcadis U.S., Inc. (Arcadis) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the fly ash pond (FAP, CCR Unit) located approximately 1.5 miles southwest of the AEP Generating Plant (Plant) located on Winfield Road in Winfield, West Virginia (**Figure 1**). Specifically, this Groundwater Monitoring Well Network Evaluation report is intended to address the requirements of 40 CFR 257.91 paragraphs (b), (c) and (e) regarding the adequacy of the groundwater monitoring system. The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit in the uppermost aquifer and an evaluation of whether the CCR unit meets up to 5 location restrictions. The restrictions include: 1) the base of the CCR unit is 5 feet (ft) above and isolated from the uppermost aquifer, and the CCR unit may not be located 2) in a wetland, 3) within 200 ft of the damage zone of a fault that has displacement during the Holocene, 4) within a seismic impact zone, or 5) in an unstable area. The objective of this report is to present an evaluation of the adequacy of the groundwater monitoring well network in the uppermost aquifer at the FAP (Site). The evaluation of the five location restriction criteria is not included in this report and will be completed under separate cover.

Two other regulated CCR units associated with the Plant were identified for review, which include the onsite ash pond system and the offsite flue gas desulfurization (FGD) landfill (**Figure 2**). The evaluations of the onsite ash pond system and offsite FGD landfill are not included in this report and were completed under separate cover.

An initial evaluation of the monitoring well network was completed in May 2017 and included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the FAP, as well as publicly-available geologic and hydrogeologic data. Based on this initial evaluation, gaps in the monitoring well network were identified. Additional monitoring wells were installed from November 2017 through July 2018. Drilling activities were performed by West Virginia-licensed drilling contractors (AEP and DLZ) with Arcadis personnel completing borehole logging and well installation oversight. During well installation, borehole packer testing was performed by the drilling contractor at select boreholes. Additionally, borehole geophysical logging was completed at select boreholes by Marshall Miller & Associates, Inc. The following report presents the current Conceptual Site Model (CSM) based on historical Site information including geologic and hydrogeologic data. This report also includes a description of the uppermost aquifer and the current monitoring well network. The monitoring well network was determined to adequately monitor up gradient, down gradient, and background areas adjacent to the FAP in the uppermost aquifer and hydraulically connected units; therefore, the report objective has been met.

2 BACKGROUND INFORMATION

The following section provides background information for the AEP Amos Generating Plant FAP that was used to support the groundwater monitoring well network evaluation.

2.1 Facility Location Description

The FAP is located in Putnam County approximately 1.5 miles southwest of the Plant and approximately 0.5 miles west of Winfield Road (WV 817) (**Figures 1** and **2**). The Site occupies approximately 170 total acres (Terracon, 2017a). The FAP is located in an isolated area surrounded by undeveloped wooded areas. Residential areas are located within one half mile from the Site to the north, west, and southwest; and mixed residential-industrial land use is located south of interstate 64. The FAP is approximately 0.75 miles north of the intersection of interstate 64 and the Kanawha River.

2.2 Description of Fly Ash Pond CCR Unit

The following section will discuss the FAP configuration, area, volume, construction and operational history, and surface water control associated with the FAP.

2.2.1 Impoundment Configuration

The FAP is located in a valley at the headwaters of Little Scary Creek and is surrounded by ridges on most sides (Stantec, 2012). The southwestern corner of the FAP consists of a zoned earthen dam that is approximately 220 ft tall with a crest elevation of 875 ft above mean sea level (amsl). The dam is approximately 30 ft wide and 2,000 ft long. The upstream slope of the dam ranges from 2.5:1 to 3:1 (horizontal: vertical), while the downstream slope ranges from 2:1 to 2.5:1 (Stantec, 2012). The surface of the FAP impoundment is covered with an engineered cover consisting of subgrade fill (fly ash and onsite borrow material), flexible membrane and geotextile layers, and soil/vegetative layers. General construction of the landfill and landfill closure is further detailed in the Phase I, Phase II, and Phase III *Construction Certification Reports* (Terracon, 2016; 2017a; 2017b) and the *Design Basis Report* for the Site (Stantec, 2012).

2.2.2 Area/Volume

The total area of the Site is approximately 170 acres which includes both disposal and non-disposal areas. Prior to FAP closure, the approximate surface area of the FAP at normal pool (860 ft amsl) was 166 acres (Stantec, 2012). After closure, the final design permitted surface area of the FAP at normal pool was 120 acres. The maximum permitted reservoir volume before and after pond closure was 10,735 and 7,056 acre-ft., respectively (AEP, 2012) (**Figure 3**).

2.2.3 Construction and Operational History

The FAP began receiving fly ash in October 1971, the final of three construction stages for the unlined impoundment was completed in 1978 (Electric Power Research Institute [EPRI], 1999), and operations continued until 2010. The zoned dam was constructed in three stages via conventional downstream construction methodology, with an inclined upstream impervious zone and downstream zones of earth and rockfill (Stantec, 2012). Since 1973, the FAP received only sluiced fly ash from Unit 3 at the Plant at an average rate of 214,300 dry tons per year. Periodically, a polymer would be added to the sluiced fly ash to facilitate settling (EPRI, 1999). A concrete principal spillway decant riser structure was constructed that included discharge piping located in an undisturbed area on the northwest end of the dam. The decant piping discharged via a tunnel into an adjacent un-named tributary to Little Scary Creek on the west side of the FAP. Since 2010, the principal pool elevation was controlled by a reclaim water pump system. The principal spillway was abandoned via in-place grouting during FAP closure. Post closure water management includes an emergency open channel spillway excavated through bedrock on the west side of the FAP (Stantec, 2012).

In 2010, the FAP reached its maximum capacity, Unit 3 had been converted to a dry system, and fly ash was being disposed at the Amos FGD Landfill. In 2012, the FAP *Design Basis Report* (Stantec, 2012) was approved by the Dam Safety Section of the West Virginia Division of Environmental Protection and closure activities (i.e. capping) of the FAP commenced. The initial closure plan is described in detail in the *Design Basis Report*, and details regarding final FAP closure are described in the Amos FAP Closure *Phase I Construction Certification Report* (Terracon, 2016), *Phase II Construction Certification Report* (Terracon, 2017a), and *Phase III Construction Certification Report* (Terracon, 2017b). In general, the FAP cap consists of the following layers:

- Subgrade preparation (in-place fly ash and onsite borrow material dewatering, excavating, grading)
- 40-mil linear low-density polyethylene flexible membrane liner
- 8 ounce geotextile cushion layer
- 18 inches of protective soil cover layer
- 6 inches of vegetative cover layer
- Drainage structures
- Seeding and mulching

The closure plan of the FAP specified the following construction phases, or activities (Stantec, 2012):

- Phase I – Initial mass grading
- Phase II – Close dredge containment areas and grade dredged areas
- Phase III – Continue closure
- Phase IV – Completion of diversion network
- Phase V – Final closure operations

These five closure construction activities were performed in three separate phases: Phase I (eastern portion of FAP), Phase II (central portion of FAP), and Phase III (western portion of FAP). In May 2015, a pilot test pad was constructed to test the integrity of geosynthetic components of the liner after placement of protective cover soils. The pilot test pad construction methods were utilized for all full-scale liner deployment.

Phase I geosynthetic construction began on June 25, 2015 and was completed on November 5, 2015. Phase I protective soil cover construction began on July 7, 2015 and was completed on November 18, 2015. A total of approximately 95 acres of geomembrane and geotextile placement with 85 acres of protective cover was placed during Phase I construction activities (Terracon, 2017a). Phase II geosynthetic construction began on May 31, 2016 and was completed on September 15, 2016. Phase II protective soil cover construction began on June 7, 2016 and was completed on October 18, 2016. A total of 60 acres of geomembrane and geotextile placement with 49 acres of protective cover was placed during Phase II construction activities (Terracon, 2017a). Phase III geosynthetic construction began on April 13, 2017 and was completed on July 15, 2017. Phase III protective soil cover construction began on April 24, 2017 and was completed on July 20, 2017. Final Phase III construction activities included construction of the final spill way (Terracon, 2017b).

2.2.4 Surface Water Control

Prior to 2010, surface water elevation control at the Site was maintained by the concrete principal spillway, which was designed to safely accommodate a 100-year storm event, that discharged to Little Scary Creek via a National Pollutant Discharge Elimination System permitted outfall (EPRI, 1999). A reclaim water pump system was installed in 2010, which then served as the primary surface water elevation control. The reclaim water pump system conveyed flow from the FAP and discharged to the bottom ash pond at the Plant, including contact water stored within the FAP footprint (Stantec, 2012). During FAP closure beginning in 2012, storm water runoff was managed through a series of sloped surfaces, drainage channels, channel cuts, and temporary contact water containment ponds. Contact water drainage channels and containment ponds were located to contain runoff water that contacted CCR materials during various phases of FAP cap construction. Permanent drainage channels were constructed as two-staged channels with a small “bankfull” channel and a broader shallow floodplain (Stantec, 2012). The banks of these channels are lined with geo-composite installed over geotextile. A protective 12-inch soil cover was placed in the channel, followed by an additional geotextile and number 3 stone (Terracon, 2017a). There has been no active surface water control at the FAP since the majority of Phase III construction activities concluded in July 2017. Additional earthwork was performed in November 2017 due to insufficient protective cover depth in some areas of the FAP.

2.3 Previous Investigations

In 1969 and into the 1970s, Acres American Incorporated and Woodward-Moorhouse & Associates, Inc. (later Woodward-Clyde Consultants) completed several geotechnical investigations of the FAP area. These investigations included extensive soil and rock boring and logging, test trench excavation and logging, borehole water pressure tests, piezometer installation and water level measurement in the dam area and overburden and bedrock laboratory geotechnical analysis (Acres American Incorporated, 1971; 1975a).

From 1995 to 1996, site investigation activities were completed including the drilling and installation of seven bedrock monitoring wells (MW-1 through MW-7), geophysical logging of three boreholes (MW-2, MW-4, and MW-5), and packer testing of three boreholes (MW-2, MW-4, and MW-5). Packer test data was qualitatively reviewed to compare relative hydraulic productivity of rock units and was used to assist with well screen placement of these wells. Additionally, water samples were collected from both the FAP outfall and FAP surface water (EPRI, 1999).

In late 2007 and early 2008, H.C. Nutting, Inc. completed site investigation activities associated with raising the FAP dam. This included the completion of 15 soil and bedrock borings with standard penetrometer testing and Shelby tube sampling. Additionally, six pneumatic piezometers were installed in select borings for water level measurements (B-2, B-3, B-4, B-14, B-16, and B-17). Six packer tests were also conducted during this investigation at borings B-1, B-2, B-4, B-5, B-6, and B-10. One additional boring, B-17, was used for cone penetrometer testing (H.C. Nutting, 2008).

Also in 2008, AEP completed rock coring along a constructed haul road and test pit logging associated with a study of borrow sites at the FAP. Samples were also collected for unconfined compressive test analysis. In total, seven haul road boring were completed and logged, five test pits were logged, and 18 rock cores were submitted for unconfined compressive test analysis (AEP, 2008).

Throughout the lifespan of the FAP, routine visual inspection and stability analyses were completed. The most recent inspection during the FAP operational lifespan was documented in the *2011 Dam and Dike Inspection Report, John Amos Power Station, St. Albans, West Virginia* (Stantec, 2011). The results of this inspection indicated that the FAP was in good condition, although some seepage and erosion issues were noted. This inspection also included a quantitative analysis of horizontal and vertical movements of the FAP dam measured in reference to surveyed reference points or monuments. This assessment concluded that no unusual movement was observed (Stantec, 2011).

In 2012, Stantec completed design efforts for FAP closure and cap construction (Stantec, 2012). As part of the closure design, Stantec completed an evaluation of the stormwater management design, discussed above in Section 2.2.4 and below in Section 2.4.1. In addition, this 2012 investigation included a geotechnical evaluation of settlement, slope stability, and liquefaction potential. No new data was collected as part of the geotechnical evaluation, and all material properties used in geotechnical modeling were derived from review of previous site investigations (Acres American Incorporated, 1974; 1975b; 1975c; H.C. Nutting, 2008).

In 2017 and 2018, Arcadis completed a comprehensive groundwater site investigation that included well installation activities to augment the CCR monitoring well network at the FAP. This work included rock coring at locations around the FAP. Boreholes were continuously logged and advanced to at least the depth of the Morgantown sandstone. After completion of the boreholes, vertical geophysical logging was conducted at five locations (MW-1801, MW-1802, MW-1805, MW-1806, and MW-1808). Data collected during geophysical logging was used in combination with rock core logging to interpret and correlate bedrock units across the Site. Geophysical data included natural gamma, neutron porosity, temperature, delta temperature, fluid conductivity, 16-64 normal resistivity, lateral resistivity, spontaneous potential, single point resistance, and caliper width. Finally, hydraulic testing was completed at select boreholes (via straddle packer tests) and monitoring wells (via drawdown and recovery yield tests) to quantify hydraulic parameters of groundwater zones and to assist in final placement of well screen intervals. A complete description of field methodology is provided in **Appendix A**. Results of geophysical logging and hydraulic testing is discussed in Section 3.1 of this report.

2.4 Hydrogeologic Setting

The geologic setting surrounding the Site consists of ridges formed by the Pennsylvanian age Monongahela and Conemaugh Formations. The Monongahela and Conemaugh Formations consist of sandstones, shales, limestones, and coal. A generalized stratigraphic column is included on **Figure 4**. These rocks have been fractured as stress declined during erosion, leading to expansion of the rock and a system of fractures throughout the bedrock. This process is called stress relief fracturing (SRF) and is more prevalent in shallow bedrock. Groundwater is present at the Site within these fracture systems (secondary porosity), while groundwater within primary porosity components (i.e., pore spaces) is less significant. Stress relief fractures occur more abundantly in brittle lithologic units (e.g. sandstone and limestone), and less likely to occur in shaley units (EPRI, 1999). The uppermost aquifer present at the Site has been determined to be the SRF (variable thickness), which includes the Upper Connellsville sandstone (approximately 10 to 20 ft thick). Secondary groundwater-bearing zones that are not aquifers include the highly fractured and weathered shale within the Clarksburg clay-shale (approximately 10 ft thick), and upper and lower depositional contacts of the Morgantown sandstone (**Figure 4**). Despite relatively low groundwater flow rates associated with these secondary groundwater-bearing zones, there is hydraulic connection between the SRF/Upper Connellsville sandstone via open vertical fractures and horizontal bedding planes. The lines of evidence for the SRF hydraulic connection from ridge to valley is provided in Section 3.2.3.

Based on boring logs of rock cores and vertical borehole geophysics conducted during monitoring well installations in 2017 and 2018 at the FAP, the three uppermost sandstone units are found only in ridges surrounding the FAP. The Lower Pittsburgh sandstone occurs from a lower elevation of approximately 913 ft to an upper elevation of approximately 935 ft above mean sea level (amsl) and is present at MW-8 and MW-9 in ridges to the north of the FAP. This elevation is above the regional water table and the sandstone unit is not saturated. The Upper Connellsville sandstone is generally 20 to 30 ft thick and because of the general northwesterly dip and varying thickness of the Upper Connellsville sandstone, the unit elevation is variable across the Site. The lower elevation occurs as low as approximately 804 ft, and the upper elevation occurs as high as 854 ft amsl. The Upper Connellsville sandstone is discontinuous by topography, truncates at the FAP valley walls, and is connected with the SRF system. The Lower Connellsville sandstone is present; however, it is extensively interbedded with shale. Fracturing in the Lower Connellsville sandstone and interbedded shale is not prevalent. The Lower Connellsville stratigraphic interpretation was based on the presence and elevation of the Little Clarksburg Coal at boring B-0608 northeast of the FAP, which marks the base of the Connellsville sandstone group deposition (Cross, A.T and M.P. Shemel, 1956; Latimer, W.J., et al., 1911; Orsborn, N.P., 2008; Reger, D.B., et al., 1918).

The Clarksburg shale is between the Lower Connellsville sandstone and Morgantown sandstone and occurs as a thick sequence of shale interbedded with siltstone and occasional sandstone. It ranges in thickness from approximately 90 to 110 ft. There is a laterally continuous fissile shale interval observed within the Clarksburg shale that is a secondary groundwater-bearing zone. Geophysical and rock core logs suggest the fissile shale may be related to fresh water deposition and the top of the fissile shale may be characterized as a stratigraphic disconformity.

The Morgantown sandstone is laterally continuous beneath the entire FAP area and is regionally present underlying valleys. The understanding of this unit structure and continuous occurrence was used to help guide 2017 and 2018 boring locations and monitoring well placement. It is up to 30 ft thick regionally and occurs at the Site at elevations ranging from as low as approximately 610 ft to as high as 665 ft amsl. The Morgantown sandstone pinches out south of the FAP towards the city of Teays Valley (EPRI, 1999) and truncates into the Kanawha River valley wall to the east. Secondary groundwater-bearing zones in the Morgantown sandstone occur primarily along the upper and lower erosional contacts.

Unconsolidated deposits are virtually absent in the ridges surrounding the FAP except for some minor residuum. Unconsolidated deposits are present with appreciable thicknesses in the Little Scary Creek valley southwest of the FAP and dam. The thickness of unconsolidated sediments southwest of the FAP ranges from approximately 8.5 ft at boring 2008-1 to 31 ft at MW-2. Sediments are poorly sorted and consist of gravel through sand, but generally coarsen downward. Weathered rock fragments are encountered near the soil-rock interface. The unconsolidated zone is not considered a water-bearing unit because groundwater generally occurs deeper and is associated with the SRF. During a site visit on April 19, 2017 by Arcadis, Little Scary Creek was observed to flow on top of bedrock southwest of the dam near MW-2.

These features are further illustrated on three lines of cross section through the FAP. Two lines trend from southwest to northeast and northwest to southeast through the central portion of the FAP (A-A', and B-B', respectively), and the other trends from west to east across ridges along the northern portion of the FAP (C-C'). The cross section location map is included as **Figure 5** and the cross sections are included as **Figure 6**. Boring logs and well construction diagrams are included in **Appendix B**.

2.4.1 Climate and Water Budget

The climate of Winfield, West Virginia is characterized as humid continental with an average rainfall of approximately 40 inches annually. The average maximum temperature is 66 ºF and the average minimum temperature is 44 ºF based on information from Southeast Regional Climate Center (2017).

The results of a numerical water budget analysis performed as part of the October 2012 *Design Basis Report* is described in detail in Appendix C of that report (Stantec, 2012). The primary objective of this analysis was to evaluate the adequacy of reservoir capacity under a variety of precipitation and runoff scenarios. It was determined that the reservoir capacity was not exceeded under any of the simulated scenarios (Stantec, 2012).

Numerical groundwater modeling efforts completed by Arcadis in 2019 included both steady-state and transient flow analysis. Based on model calibrations, it is estimated that approximately 11 inches of precipitation reaches the underlying aquifers in the form of recharge per year.

2.4.2 Regional and Local Geologic Setting

2.4.2.1 Unconsolidated

The Site is located in the Appalachian Plateau physiographic province, and unconsolidated soils are limited in extent and are residual and colluvial in origin. Soils consist of gravel, sand, silt, or clay. Based on review of site boring logs, the soil-rock interface is abrupt with little to no occurrence of weathered bedrock or residuum. Soil thickness ranges from nearly 0 ft in the ridges (MW-1809) to greater than 30 ft in the valleys (e.g. MW-2).

2.4.2.2 Bedrock

The primary regional bedrock units encountered are Pennsylvanian age sedimentary rocks of the Monongahela Formation and Conemaugh Formation, in descending order from youngest to oldest. The depositional environment for these formations is characterized by a gradually subsiding shallow sea with alternating marine and freshwater strata. The sedimentary package associated with the Monongahela and Conemaugh Formations consists of alternating shale and sandstone units, with occasional thin limestone and coal beds. Several coal horizons are present in the region and often serve as marker beds for unit identification. The principal regional marker bed is the Pittsburgh Coal (i.e. No. 8 Coal), which marks the transition from the Monongahela and Conemaugh Formations (EPRI, 1999). However, the Pittsburgh Coal is not represented in Site borings. The Pittsburgh Limestone has been identified in two borings at the FAP, MW-3 and 2008-26, and is used to mark the Monongahela-Conemaugh transition at the Site. Additionally, the Little Clarksburg Coal has been identified at FAP boring B-0608 to the northeast and is used to mark the base of the Connellsville sandstone deposition (Latimer, W.J., et al., 1911). Deeper bedrock units produce oil and gas. Associated active oil and gas wells are located in the vicinity of the FAP. The location of these wells is shown on **Figure 3**.

The Monongahela Formation is found capping the hills surrounding the Site. The Conemaugh Formation is also found in the hills surrounding the Site, underlying the Monongahela Formation, and extending into the valley floor beneath the FAP. Bedrock occurrence is illustrated on cross sections (**Figure 6**) and detailed in boring logs included in **Appendix B**.

The Site is situated between the Parkersburg Syncline to the northwest and the Byrnside Anticline to the southeast, with regional geologic structure characterized by very gently northwestward-dipping bedding planes toward the Parkersburg Syncline (EPRI, 1999). Bedding planes of the nearby Amos FGD landfill have been reported as striking to the east-northeast and dip to the north-northwest at approximately 20 ft per mile (GAI, 2006).

Arcadis completed additional geologic structure analysis in 2017. This analysis included a review of bedding plane attitudes measured by AEP in 1975 from test trenches surrounding the FAP (AEP drawing no. SK-3826-C-17). Arcadis also computed bedding plane attitudes via boring log correlation and multi-point gradient computations based on fence diagrams and cross sections generated during the EPRI groundwater study (EPRI, 1999). Finally, bedding plane dip as depicted in geologic cross sections of the Amos Quarrier Ash Landfill were approximated (EPRI, 1999). These analyses suggest that bedrock geologic structure at the Site consists primarily of north-northeasterly striking beds that dip very shallowly (i.e. generally less than 1 degree) to the west-northwest. Additionally, evaluation of the few fractures (joint) measurements within the sandstone units indicate near vertical fractures with a strike of 70 degrees from north.

In 2018, Arcadis developed a visual three-dimensional CSM of the Site using Earth Volumetric Studio (CTech, 2017). The CSM was constructed using lithologic data collected during well installation and sequentially producing an area-wide stratigraphic structural model. Layers were included to focus on main stratigraphic and hydrostratigraphic layers (geospatial, followed by hydrostratigraphic). The resulting three-dimensional CSM was used to interpret the lateral extent of each bedrock unit at the Site beyond the known data points.

2.4.3 Surface Water and Surface Water Groundwater Interactions

The FAP is located within the Little Scary Creek watershed, which flows from the toe of the dam southwest of the FAP. While the FAP was in operation, Little Scary Creek received impoundment discharge via a National Pollutant Discharge Elimination System permitted outfall located in an unnamed tributary west of the FAP. Little Scary Creek flows south from the FAP into Teays Valley and discharges into the Kanawha River (EPRI, 1999). Groundwater from Little Scary Creek Valley, in which the FAP is located, discharges either to Little Scary Creek and its tributaries, other unnamed tributaries of the Kanawha River, or further down-valley in the Teays Valley and Kanawha River alluvium.

Groundwater flow direction typically follows topographic relief and fracture orientation (horizontal bedding plane and stress relief) but is also influenced by stored water within the FAP. The FAP provides recharge and contributes to radial groundwater flow in the transmissive bedrock zones that are in contact with the saturated fly ash. The FAP has been completely capped and water levels are declining due to reduced recharge.

As the water in the FAP declines, water levels in higher elevation bedrock are also expected to decline. In addition, the confinement of the FAP is likely to transition from unconfined to confined or semi-confined based on the cap limiting barometric (atmospheric) pressure interaction. To evaluate these effects of FAP capping, barometric pressure data, precipitation, and water level data from January 2012 through April 2018 was compiled. Data was processed for the following wells and piezometers: STN-12-4 (multi-port well), STN-12-8, STN-12-9, MW-8, and MW-9. The STN piezometers represent the FAP hydraulics and MW-8/9 represented the Upper Connellsville sandstone-SRF outside of the cap on the northeast portion of the Site. The resulting hydrograph is shown as **Figure 7** that includes piezometer and well locations. The continuous data was collected every 12-hours from pressure transducers in STN-12-8 and STN-12-9. Data processing was completed to evaluate the barometric pressure relationship to water levels from the pre-capping to the post-capping periods. The results indicated that a transition occurred, and a correction was applied to the post-capping water levels based on estimated barometric efficiencies of 40% for STN-12-8 and 30% for STN-12-9. Water levels at STN-12-4, STN-12-8, and STN-12-9 are generally decreasing for the post-capping period. There are fluctuations post-capping within STN-12-8 and STN-12-9 that are likely related to seasonal recharge from the surrounding ridges.

2.4.4 Water Users

There are no active groundwater production wells at the Site. In 2017, a water well inventory for the Amos Plant indicated no information regarding the use of wells located within a half mile of the Site was available (Banks, 2017). However, non-production groundwater wells that were identified are registered with the United States Geological Survey (USGS) and appear to have been used for groundwater monitoring. Six of the ten well locations referenced in that report were located on or immediately adjacent to the Amos Plant, northeast of the FAP. Of those wells not obviously related to the Plant, one is located approximately 1,500 ft west of the Plant's onsite ash pond system, one mile north of the FAP. The other three well locations are located approximately 3,500 to 5,000 ft south of the Plant's onsite ash pond system, greater than 2,000 ft east of the FAP. The Banks water well report is included in **Appendix C**.

An additional off-site well survey of properties surrounding the FAP was completed by Arcadis in 2018. The purpose of this survey was to determine if surrounding properties had a connection to public water service by the Putnam Public Service District for Putnam County or served by another potential source (cistern or groundwater). The Putnam Public Service District source water is from the Poplar Fork Creek water shed located over 4 miles to the northwest of the Site. The water is pumped to a reservoir and subsequently treated at the water treatment plant. The resulting survey results are present in **Appendix C** (Table C-1 and Figure C-1). The table is organized by parcel identification in numerical order with additional information, if available, including physical address, year constructed, land use type, owner and owner address. This parcel information was provided to the Kanawha-Charleston Health Department to verify public water supply to that parcel or if there is a known private well on the property. Of the 217 parcels identified within approximately one mile of the FAP during this survey, 144 parcels were confirmed to have a municipal potable water source. Land use at these 144 parcels includes, but is not limited to, one- and two-family residences, vacant residential lots, mixed residential/commercial lots, mobile homes, and active farms. The remaining 73 parcels with no confirmed public potable source did not have physical addresses, which likely means the parcel has not been developed and does not have a need for potable water.

Regionally, the Kanawha River alluvial aquifer is used as a source of water for public, industrial, and domestic supply. However, given its relatively lower specific capacity (11.8 gallons per minute [gpm]/ft median), it is used less frequently than the Ohio River alluvial aquifer. The Teays River Valley alluvial aquifer, which is similar in composition to the Kanawha River alluvial aquifer, is also used for potable water. Regionally, wells drilled in the Conemaugh and Monongahela Groups have median specific capacities ranging from 0.50 to 0.75 gpm/ft (USGS, 2001). In 2018, Arcadis conducted well yield testing at select wells screened within the Upper Connellsville sandstone, SRF system, Clarksburg shale, and Morgantown sandstone. The short duration yield tests had sustainable yields that were generally maintained for 30 to 60 minutes with complete testing duration of less than 4 hours and is further discussed in Section 3.1.3.2. Maximum pumping rates across all units were generally less than 1 gpm, except for stress relief fracture system wells MW-6, and MW-1809A (3.8 and 1.1 gpm, respectively). As a result, bedrock units found at the site are unlikely to be used regionally for public water supply.

3 MONITORING WELL NETWORK EVALUATION

An initial evaluation of the monitoring well network present at the Site was performed in May 2017 to determine if any of the wells were viable for continued use as part of the groundwater quality monitoring well network or retained for the purpose of water level measurement as part of a larger groundwater hydraulic monitoring well network. As part of this review, hydrogeologic conditions were evaluated to determine if the defined uppermost aquifer unit had an adequate monitoring well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer up gradient and down gradient of the Site. Following the initial evaluation, additional monitoring wells were installed and existing wells were re-developed. A summary table of well development activities is provided in **Appendix D**. Background groundwater quality is monitored at wells that are either hydraulically up gradient or hydraulically separated from the FAP. Down gradient wells are placed down gradient (horizontal and vertical) of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

The uppermost aquifer is the first encountered aquifer that is horizontally continuous across the site. The uppermost aquifer at the Site is defined by the saturated portion of the SRF system and includes the Upper Connellsville sandstone. The SRF is independent of lithologic unit and was examined to confirm hydraulic connection from ridge to valley using multiple lines of evidence that are discussed in Section 3.2.2. The Upper Connellsville sandstone and the SRF system laterally surrounds the FAP and occurs across the region. The SRF system extends vertically down ridges to the valley floors. The SRF system occurs in both the Conemaugh and Monongahela Formations and is hydraulically connected with deeper bedrock units (e.g., Clarksburg shale, Morgantown sandstone) via open fractures and horizontal bedding planes. The Clarksburg shale occurs throughout the FAP area and truncates at ridges. The Morgantown sandstone occurs below the base of the FAP and is present throughout the regional area. Vertical down gradient groundwater flow to deeper units (Clarksburg shale and Morgantown sandstone) likely occurs. However, groundwater yield in the Clarksburg shale and Morgantown sandstone are low and not sustainable, indicating that these secondary groundwater bearing zones are not aquifers at the Site. In similar SRF systems, groundwater is generally unconfined but water levels in wells can exhibit a semi-confined to confined behavior in valley floors and/or if low-transmissivity sediments (i.e. clay) are present (USGS 1981).

The upper limit of the uppermost aquifer is defined by the top of the potentiometric surface in the Upper Connellsville sandstone and SRF system, which is hydraulically connected to the saturated portion of the FAP. The potentiometric surface occurs at elevations as high as 865 ft amsl in the vicinity of the FAP. The base of the CCR unit occurs as low as 675 ft amsl. This is illustrated on cross sections A to A’, B to B’, and C to C’ (**Figure 6**).

3.1.2 Overall Flow Conditions

To assist with understanding of overall flow conditions, Arcadis updated the original numerical groundwater flow model. A brief description of the revised groundwater flow model is provided in **Appendix E**. The primary model updates involved modification of the model structure to reflect the updated hydrostratigraphic interpretation from the visual three-dimensional CSM. The revised groundwater model was discretized vertically into ten (10) model layers to provide a vertical profile representative of the Site hydrostratigraphic framework. Additionally, a refined hydraulic conductivity zone was incorporated into the model to better represent the SRF system in all model layers and low permeable rock layers. The groundwater flow model was first re-calibrated to 2012 observed groundwater levels. Then, a transient model was built to dynamically simulate the hydraulic variation within the impoundment prior to and during the geosynthetic cap installation. A forward pathline analysis using MODPATH (Pollock, 2017) assisted in identifying the general flow patterns towards each monitoring well and surface water features. For this report, data collected during the October 22, 2018 groundwater gauging event were combined with simulated transient conditions for the corresponding time period to interpret groundwater flow patterns. The groundwater flow model also incorporates the understanding of water levels within the FAP that provides outward flow from the FAP to surrounding fractured units. Additionally, groundwater elevation contours within the Upper Connellsville sandstone and SRF were extrapolated from the modeled groundwater contours and flow directions using groundwater flow understanding based on the Appalachian conceptual site model for groundwater flow (USGS, 1981).

Vertical flow paths occur primarily within the SRF system along the ridges towards valleys, with horizontal contributions to surface water discharge and down valley groundwater flow. A multiple line of evidence approach was utilized to define the horizontal and vertical components of flow and is outlined in Section 3.2. Additional vertical flow paths also occur within the rock units, to a lesser extent.

Available groundwater elevations are summarized on **Table 1**. Simulated and extrapolated potentiometric contours for the Upper Connellsville sandstone and SRF system are depicted on **Figure 8A**. As shown, horizontal flow is outward from the pond to the Upper Connellsville sandstone in most areas except for the northwest where MW-10 currently appears to be up gradient. At lower elevations where the Upper Connellsville is absent, groundwater flow within the SRF then generally follows topography, ultimately reaching the nearest valley. Additional simulated potentiometric surfaces for deeper and hydraulically-connected secondary groundwater-bearing zones of the Clarksburg disconformity and Morgantown sandstone are provided on **Figures 8B** and **8C**, respectively. Flow contributions from shallow systems and potentially from the FAP are horizontal (radial flow from the pond) and vertical to the Clarksburg shale disconformity and vertical to the Morgantown sandstone.

3.1.3 Hydraulic Conductivity

The following subsections describe field implementation and data analysis of hydraulic testing conducted at the FAP (e.g., borehole packer tests, rock core permeability, slug tests, well yield tests). Historical hydraulic tests are briefly described and referenced. However, hydraulic conductivity estimates derived from historical test data were not generally consistent with more recent testing. Therefore, this report and evaluation products use current hydraulic conductivity estimates obtained during the 2017 and 2018 investigation.

3.1.3.1 Historical Aquifer Tests

The first six bedrock monitoring wells at the FAP (MW-1 through MW-6) were installed in 1995. Slug tests were performed at these wells and analysed to provide hydraulic conductivity estimates. Either a solid slug or a volume of water was used to induce the near instantaneous head change, depending on initial static water level. Packer tests were performed on open boreholes at three of these six wells prior to well installation (MW-2, MW-4, and MW-5). The objective of packer testing was to assess relative productivity of bedrock units. Hydraulic conductivity estimates were not generated as a result of packer tests, but packer test results were considered when selecting monitoring well screen intervals at these locations. Further details of slug test and packer test methodology and results are provided in *Groundwater Quality at the John E. Amos Power Plant* (EPRI, 1999).

3.1.3.2 Yield Testing

Well yield testing was conducted by Arcadis from March through July 2018 at select new and existing monitoring wells. Yield tests were completed by pumping each well at variable and steady state extraction rates and measuring the water level response in each well during and after pumping (recovery). Extraction rates were maintained using a submersible pump. High-resolution water level data were collected during both pumping and recovery phases via data-logging pressure transducers installed in each test well. Representative portions of drawdown and recovery data were selected for analysis and analyzed using AQTESOLV® for Windows® Version 4.50 (Duffield, 2007). The hydraulic parameter values were determined using applicable analytical solutions based on the observed response for a single (partially-penetrating) well under confined or unconfined conditions, as appropriate. Additional details on field methodology are provided in **Appendix A**.

Yield tests were completed at wells representing the uppermost aquifer (i.e., SRF and Upper Connellsville sandstone), as well as other secondary groundwater-bearing zones that are not aquifers (i.e., Clarksburg shale, Clarksburg disconformity, and Morgantown sandstone). The highest hydraulic conductivity was observed in the SRF system at MW-6 (37 ft/day). Wells MW-5, MW-8, MW-1801B, and MW-1801C did not maintain a flow rate and testing analysis was not completed. Hydraulic conductivity estimates derived from yield tests in the stress relief fracture system ranged from 0.1 to 37 ft/day. In the Upper Connellsville sandstone, hydraulic conductivity estimates ranged from 0.02 to 0.1 ft/day (the lower end of the SRF system range). A summary of yield testing results is provided on **Table 2** and solution reports with individual curve matches are provided in **Appendix F**.

3.1.3.3 Rock Core Permeability Testing

In addition to testing the hydraulic properties of all groundwater-bearing units, ex-situ permeability testing was performed to determine hydraulic properties of the lower-transmissivity units. Representative rock cores were selected from the non-fractured portions of the Morgantown sandstone, shale units underlying the Upper Connellsville sandstone and Clarksburg disconformity. Laboratory analysis included both horizontal and vertical steady-state permeability measurements via flexible wall permeameter consistent with ASTM D5084.

Average horizontal hydraulic conductivity estimates ranged from 4.08×10^{-5} ft/day to 1.36×10^{-4} ft/day. Average vertical hydraulic conductivity estimates were approximately ten times greater, ranging from 3.23

x 10^{-4} ft/day to 9.07 x 10^{-4} ft/day. These values are approximately two to four orders of magnitude lower than hydraulic conductivity estimates within the fractured units. The test results confirm that flow within the Morgantown sandstone is attributable to secondary porosity within the fracture system and not from the primary (sandstone matrix) porosity. These low values were used to help refine the numerical groundwater flow model. A summary of rock core permeability testing is included on **Table 3**.

3.1.3.4 Packer Testing

Packer testing was conducted during installation of all monitoring wells installed in 2017 and 2018 except MW-1804 and MW-1807. The intent of injection packer testing is to estimate relative bedrock permeability for various borehole depth intervals to assist with water-bearing unit identification and monitoring well installation. Upon completion of each borehole, rock cuttings were flushed from the borehole with water in preparation for packer testing. Inflatable upper and lower rubber packers were then inserted to a specified 10-ft depth interval and inflated to create a seal. A riser pipe was attached to the top of the upper packer to provide a rigid, sealed standpipe with a pressure gauge at a known distance above the ground surface. Through this riser pipe, water was injected into the packer interval while measuring the gauge injection pressure, as well as injection volumes via a totalizing flowmeter.

During the packer tests, flow rates and borehole pressure were monitored at regular intervals. Test data was analyzed using the method described in the U.S. Department of the Interior Ground Water Manual (1977).

Packer tests were designed to target the Upper Connellsville sandstone, Clarksburg shale and associated sandstone interbeds, Morgantown sandstone, Birmingham Reds, and Graffton sandstone, in order of decreasing elevation. Most of the tested intervals did not accept the injected water, indicating that those intervals have very low transmissivity. There were no transmissive zones tested at borings MW-1802 and MW-1809. However, some lithologic intervals representing the SRF, Upper Connellsville sandstone, Clarksburg weathered shale, and Morgantown sandstone were determined targets due to the lateral extent and relative fracturing. Estimated hydraulic conductivities at borings MW-1801, MW-1803, and MW-1805, representing the Clarksburg weathered shale, Upper Connellsville sandstone, and Morgantown sandstone, respectively, were relatively low, ranging from 0.015 ft/day to 0.4 ft/day. Estimated hydraulic conductivities at borings MW-1806, MW-1808, and MW-1810 were generally higher, ranging from 0.4 ft/day to 1.9 ft/day. Packer test results are summarized on **Table 2** and packer testing logs are included in **Appendix F**.

3.1.4 Stress Relief Fracture System and Upper Connellsville

As described in Section 3.1.3, several different methods were used to quantify hydraulic conductivity at the Site. Estimated hydraulic conductivity values across all methodologies within the SRF system, which constitutes part of the uppermost aquifer, ranged from 0.1 to 37 ft/day. The geometric mean hydraulic conductivity for the SRF system was 2 ft/day (**Table 2**). Estimated hydraulic conductivity values across all methodologies within the Upper Connellsville sandstone, which constitutes the rest of the uppermost aquifer, ranged from 0.015 to 0.4 ft/day. The geometric mean hydraulic conductivity for the Upper Connellsville sandstone was 0.1 ft/day (**Table 2**).

3.1.5 Borehole Geophysics

Vertical geophysical logging, including temperature, temperature gradient, fluid resistivity, natural gamma, density, neutron, lateral resistivity, spontaneous potential, calliper, and single point resistance instrumentation, was completed during well installations at MW-2, MW-4, MW-5, MW-9, and MW-10 during installation activities in 1995 and 2002. Geophysical logging was also performed at boring 2008-17 when it was installed in 2007, and at borings B-1401 and B-1402 when they were installed in 2014 including natural gamma, density, resistivity, and calliper instrumentation. Similarly, vertical geophysical logging was conducted at wells MW-1801, MW-1802, MW-1805, MW-1806, and MW-1808. The purpose of borehole geophysics was to assist with the identification of probable water-bearing units and well screen design, as well as to provide data for stratigraphic correlation of bedrock units across the site. Geophysical logs are included in **Appendix G**.

In general, the geophysical logging results were consistent with a sedimentary package of alternating shale and sandstone. **Figure 6** illustrates natural gamma logs that were critical to stratigraphic identification projected onto cross sections A-A’, B-B’, and C-C’. The Upper Connellsville sandstone was identified at wells MW-1801, MW-1802, MW-1805, MW-1806, and MW-1808 by a distinct left gamma shift at elevations between 800 ft amsl and 850 ft amsl. The Morgantown sandstone was identified using gamma logs at MW-6, MW-1801, MW-1802, MW-1806, and MW-1808. The gamma logs generally indicated that the Morgantown sandstone had a higher proportion of shale compared to the Upper Connellsville Sandstone.

In addition to gamma logs, the calliper logs were particularly useful for identifying and correlating the fissile, weathered shale unit within the Clarksburg shale. Wider borehole apertures were observed at wells MW-1801, MW-1802, MW-1805, MW-1806, and MW-1808 at an elevation near 700 ft amsl, which was interpreted to be caused by a high degree of weathering (**Appendix G**). Acoustic televiewer imaging systems emit an ultrasonic pulse and records the reflected acoustic signal. The transit time and amplitude of the reflected signal is recorded as a photographic-like image and allows for 360º borehole imaging. Acoustic televiewer logs at the Site were used to identify depth, orientation (i.e. dip direction and angle), aperture, and description (e.g., major open joint, filled fracture, etc) of potential groundwater-bearing fractures of planar features along the entire length of each borehole. Acoustic televiewer data confirmed the high degree of weathering associated with the Clarksburg shale at wells MW-1801, MW-1802, MW-1806, MW-1808. In addition, they contributed to identification of the SRF and upper and lower surfaces of the Morgantown sandstone. Acoustic televiewer logs are included in **Appendix G**.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

Per 40 CFR 257.60(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (5 ft) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high conditions).

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS, 2015; Fetter, 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Units

The identified shallowest Site hydrostratigraphic unit is the Upper Connellsville sandstone combined with the saturated portion of the SRF system, which are considered the uppermost aquifer at the Site. Regionally, the Upper Connellsville sandstone is not known to be the uppermost aquifer because its occurrence is variable based on elevation relative to the water table. The SRF is known to be regionally prevalent and is considered the regional uppermost aquifer system outside of primary unconsolidated fluvial valleys. The uppermost aquifer is not known to be used locally for groundwater supply or industrial water use.

Deeper secondary groundwater bearing zones are included for hydraulic water level monitoring only. While providing information about vertical hydraulic gradients and general groundwater conditions, these deeper units are not included as part of the monitoring well network and are not aquifers. The two deeper secondary groundwater-bearing zones identified during the investigation are the Clarksburg weathered shale/disconformity and the Morgantown sandstone (**Figure 6**). The Clarksburg shale is in contact with the FAP, receives outward flow, and is connected with the SRF system where the unit truncates into ridges or valleys (**Figure 8B**). The Morgantown sandstone is the first encountered secondary groundwater-bearing zone below the FAP that also extends laterally towards the main Teays and Kanawha valleys (**Figure 8C**). Both the deeper units are low in permeability. The recommended monitoring network is further explained in Section 4.

3.2.3 Hydraulic Connection – Multiple Lines of Physical Evidence Approach

A multiple lines of evidence approach was used to understand the hydraulics related to horizontal and vertical groundwater flow at the Site. The main purpose for this demonstration was to help understand the relative dynamics of the unlined FAP with respect to the surrounding water-bearing bedrock units and the SRF system. As stated above, most of the water-bearing units are low in permeability and some likely act as aquitards. The lines of evidence were explored to see if there are any indications that the low permeable units impede downward flow in relation to stratigraphic position and in relation to hydraulic connections with the SRF system.

At the Site, the Upper Connellsville sandstone and SRF system are determined to be the uppermost aquifer based on spatial occurrence and relative yield. However, the occurrence and elevation of the

Upper Connellsville sandstone relative to the groundwater table in surrounding areas is not known. The following lines of physical evidence support the understanding that the SRF system is connected from the ridgetops down to the valleys and is considered hydraulically connected with lateral units.

The physical lines of evidence that verify SRF hydraulics are:

- SRF and seeps observed at dam edges
- SRF and seeps observed in new spill way bedrock cut (near MW-1802A)
- SRF occurring independent of bedrock units at depths greater than 50 feet (MW-1809A and MW-1810A
- Fractures and seeps observed in abandoned decant tower tunnel
- Shallow shales are fractured on ridges and respond to injection packer testing completed in 2018
- Yield testing at SRF wells indicate sustainable flow rates of over 1 gpm at MW-2/MW-6 and over 0.5 gpm at MW-1809A

Based on this information and the positive correlation of these lines of evidence with the Appalachian conceptual site model for groundwater flow (USGS, 1981), the SRF system is hydraulically connected from ridges to valleys. A generalized cross section illustrating the features of an Appalachian SRF system is provided on **Figure 9**.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by Arcadis and AEP personnel on April 19, 2017 to review existing well network conditions and locations. The well network that existed at the time of that site visit was deficient, lacking both the quantity (i.e. 3 down gradient, 1 up gradient) and distribution to accurately represent background water quality and the quality of groundwater passing the waste boundary of the CCR Unit, per 40 CFR 257.91. Subsequently, installation of additional monitoring wells was completed from November 2017 through July 2018. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 4**. As presented in **Table 4**, wells included in the monitoring network have been designated as up gradient, down gradient, or background. Additionally, some monitoring wells are designated for hydraulic monitoring only. Further details are provided in Section 4.1.

Spatially, the monitoring well network as illustrated on **Figure 10** is distributed across the entire Site and sufficiently monitors up gradient, down gradient, and background locations as specified in 40 CFR 257.91. The well screen intervals are located in either the SRF system and Upper Connellsville sandstone (i.e., uppermost aquifer), Clarksburg shale, or Morgantown sandstone. In general, monitoring wells are clustered so that multiple hydrostratigraphic units are screened at one location.

3.3.2 Gaps in Monitoring Network

As discussed in Section 3.3.1 of this report, gaps in the monitoring network were identified upon initial Arcadis review in April 2017. Following monitoring well installation described in this report and detailed in **Appendix A**, there are no gaps in the monitoring network. The recommended monitoring well network is described in Section 4.

4 RECOMMENDED MONITORING NETWORK

The network meets specifications stated in 40 CFR 257.91. Recommended groundwater monitoring objectives utilizing existing wells are further discussed and will provide an adequate understanding of seasonal and temporal fluctuations in groundwater quality, hydraulics, and groundwater flow at the Site.

4.1 Monitoring Well Network Distribution

The groundwater quality monitoring network at the Site consists of 16 wells as represented on **Table 4** and **Figure 10**. Additionally, all other available monitoring wells and piezometers listed on **Table 4** will be gauged, along with the 16 groundwater quality monitoring wells, for the purposes of groundwater flow analysis.

The determinations of up gradient, down gradient, and background location relative to the FAP, discussed below, is based on the most current groundwater modeling performed by Arcadis in 2018 and 2019, which is discussed in Section 3.1.2 and **Appendix E**.

4.1.1 Down Gradient Locations

Monitoring wells down gradient of the FAP in Little Scary Creek valley (MW-1, MW-2, MW-5, MW-6) and wells screened within the uppermost aquifer in the northern, eastern, and southern ridges surrounding the FAP (MW-1801A, MW-1804A, MW-1806A, MW-7, MW-8, and MW-9) constitute the down gradient groundwater quality monitoring locations (**Figure 10**).

4.1.2 Up Gradient or Background Locations

Based on recent groundwater modeling and the current understanding of groundwater flow directions, only one well (MW-10) within the uppermost aquifer immediately adjacent to the FAP is located hydraulically up gradient. Well MW-10 is not included in the groundwater quality monitoring network because it does not produce sufficient well yield for sample collection. Per 40 CFR 257.91, the owner of a CCR unit may collect background groundwater samples from wells that are not hydraulically up gradient of the CCR unit, provided that the other wells will provide an indication of background groundwater quality that is as representative or more representative than that provided by the upgradient wells.

Five wells located across Little Scary Creek valley to the southwest of the FAP constitute the background groundwater quality monitoring locations (**Figure 10**). Four of these wells are screened in the SRF portion of the uppermost aquifer (MW-1807A, MW-1808A, MW-1809A, and MW-1810A). An additional well is screened in the Clarksburg shale (MW-1807B) to provide background groundwater quality in a deeper secondary groundwater-bearing zone that is hydraulically connected to the SRF. These wells are all screened within the same hydrostratigraphic units that are present immediately surrounding the FAP and are therefore representative of background groundwater quality. Because Little Scary Creek provides a flow barrier between the background monitoring wells and the FAP, any groundwater impacts associated with the FAP are not likely to impact these five wells (**Figure 6**).

4.2 Well Construction

As discussed above in Section 3, gaps in the monitoring well network at the FAP were addressed by installation of 22 monitoring wells from November 2017 through July 2018. All monitoring wells were constructed in general accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011 by a state licensed driller.

Installation details and field methods are provided in **Appendix A**. Well construction data for the monitoring well network is summarized on **Table 4**. Boring logs and the monitoring well completion diagrams are provided in **Appendix B**.

5 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Todd A. Minehardt, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91(b), (c) and (e).

TODD A. MINEHARDT,

Printed Name of Registered Professional Engineer

Signature

23518	WV	4/17/19
Registration No.	Registration State	Date

TODD A. MINEHARDT
REGISTERED
23518
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

4/17/19

6 REFERENCES

Acres American Incorporated – Engineers. 1971. Appalachian Power Company, John E. Amos Plant, Fly Ash Retention Dam, Contact A2, Main Dam and Appurtenances, Geotechnical Data for Bidders.

Acres American Incorporated. 1974. “Draft, Preliminary Design Report, John E. Amos Plant, Fly Ash Retention Dam, Stage 2.” Prepared for Appalachian Power Company, November.

Acres American Incorporated – Engineers. 1975a. Appalachian Power Company, John E. Amos Plant, Fly Ash Retention Dam, Stage 2, Geotechnical Data for Bidders, Phase 3 Investigation, Volume 1.

Acres American Incorporated – Engineers. 1975b. Geotechnical Data for Bidders, Volume 2 (Phases 1 and 2 Investigations), John E. Amos Plant, Fly Ash Retention Dam, Stage 2.

Acres American Incorporated – Engineers. 1975c. Various Stage 2 construction drawings, John E. Amos Plant, Fly Ash Retention Dam, Stage 2.

AEP. 2008. Amos FGD Haul Road Project, AEP Civil Engineering Laboratory, Logs of Borings.

AEP. 2012. Application for Certificate of Approval, John E. Amos Plant, Fly Ash Dam WV I.D. #07911.

Arcadis. 2016a. Ash Pond – CCR Groundwater Monitoring Well Network Evaluation, Amos Plant, Winfield Road, Putnam County, Winfield, West Virginia.

Arcadis. 2016b. FGD Landfill – CCR Groundwater Monitoring Well Network Evaluation, Amos Plant, Winfield Road, Putnam County, Winfield, West Virginia.

Banks Environmental Data, Inc. 2017. Water Well Report, AEP Water Well Inventory, Amos Plant, ES-124909.

Cross, A.T and M.P. Shemel. 1956. Geology and Economic Resources of the Ohio River Valley in West Virginia, Part I Geology. West Virginia Geological Survey Volume XXII.

CTech Development Corporation. 2017. Earth Volumetric Studio. https://www.ctech.com/

Duffield, Glenn. 2007. AQTESOLV® for Windows® Version 4.50.

EPRI. 1999. Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia, Prepared for American Electric Power Service Corp.

Fetter, Charles Willard, and C. W. Fetter. 2001. Applied hydrogeology. Vol. 3. No. 3. Upper Saddle River: Prentice hall.

GAI Consultants, Inc. 2006. Class F Industrial Landfill Facility Application, John E. Amos Landfill, John E. Amos Plant, Winfield, West Virginia, GAI Project Number: C040384.40.

H.C. Nutting, A Terracon Company. 2008. Geotechnical Data Collection Report, Amos U3 Fly Ash Dam Raising Study, Saint Albans, Putnam County, West Virginia, HCN/Terracon Project No. N2075307.

Latimer, W.J., et al. 1911. Jackson, Mason and Putnam Counties, Volume 1, County Reports and Maps. Wheeling News Litho. Company.

Orsborn, N.P. 2008. Deposition and Structural Features of the Basal Morgantown Sandstone of the Casselman Formation (Pennsylvanian) of the Greater Pittsburgh Region. MS Thesis.

Pollock, D.W. 2017. MODPATH v7.2.01: A particle-tracking model for MODFLOW: U.S. Geological Survey Software Release, 15 December 2017, http://dx.doi.org/10.5066/F70P0X5X.

Reger, D.B., et al. 1918. Barbour and Upshur Counties and Western Portion of Randolph, Volume 1, County Reports and Maps. Wheeling News Litho. Company.

Southeast Regional Climate Center. 2017. Historical Climate Summaries, Winfield Locks, West Virginia, http://www.sercc.com, Query conducted by Mr. Josh Roberts of Arcadis on May 10, 2017.

Stantec Consulting Services Inc. 2011. Dam and Dike Inspection Report, John Amos Power Station, St. Albans, West Virginia.

Stantec Consulting Services Inc. 2012. Design Basis Report, John E. Amos Plant, Fly Ash Pond Closure, Appalachian Power Company, Putnam County, West Virginia.

Terracon. 2016. Construction Certification Report, Amos Plant Fly Ash Pond Closure, 2015 Phase I Construction, Putnam County, West Virginia, Terracon Project Number: N4159048, DRAFT.

Terracon. 2017a. Construction Certification Report, Amos Plant Fly Ash Pond Closure, 2016 Phase II Construction, Putnam County, West Virginia, Terracon Project Number: N4159048, DRAFT.

Terracon. 2017b. Construction Certification Report, Amos Plant Fly Ash Pond Closure, 2017 Phase III Construction, Putnam County, West Virginia, Terracon Project Number: N4159048.

UGSS. 1981. Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. Water-Supply Paper 2177.

USGS. 2001. Aquifer-Characteristics Data for West Virginia. Water-Resources Investigations Report 01-4036

USGS. 2015. Aquifers and Groundwater. Available online at www.usgs.gov.

TABLES

Table 1
Water Level Data
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

ARCADIS

Monitoring Well ID	Location Description to CCR Unit	Hydro-stratigraphic Unit Target	Northing [a]	Easting [a]	Ground Surface Elevation [a] (ft amsl)	Top of Casing Elevation [a] (ft amsl)	Ground Surface Elevation (Installation)	Top of Casing Elevation (Installation)	Ground Surface Elevation (07/28/14)	Top of Casing Elevation (07/28/14)	Top of Casing Elevation (9/29/15)	Top of Casing Elevation (11/2/15)
Downgradient												
MW-1801A	South	U/SRF	531398.627	1726314.531	901.12	904.17	--	--	--	--	--	--
MW-1801B	South	C	531401.126	1726316.987	901.06	903.86	--	--	--	--	--	--
MW-1801C	South	M	531413.037	1726329.094	900.39	903.19	--	--	--	--	--	--
MW-1802A	West	U/SRF	533246.455	1724119.981	887.75	890.87	--	--	--	--	--	--
MW-1802B	West	C	533242.023	1724120.003	887.87	890.76	--	--	--	--	--	--
MW-1803B	Northwest	C	534006.697	1723941.610	904.25	907.06	--	--	--	--	--	--
MW-1804A	North	U/SRF	533349.763	1725662.499	858.53	861.85	--	--	--	--	--	--
MW-1804B	North	C	533352.364	1725659.003	859.17	860.89	--	--	--	--	--	--
MW-1805B	Northeast	C	533272.299	1727730.142	883.25	885.59	--	--	--	--	--	--
MW-1805C	Northeast	M	533273.891	1727725.724	882.32	885.91	--	--	--	--	--	--
MW-1806A	East	U/SRF	532750.917	1728577.239	889.63	893.13	--	--	--	--	--	--
MW-1806B	East	C	532748.326	1728573.233	889.48	892.05	--	--	--	--	--	--
MW-1806C	East	M	532745.975	1728569.060	888.96	891.74	--	--	--	--	--	--
MW-1	Southwest	SRF	531275.00	1724355.00	647.57	649.77	647.57	649.77	--	--	--	--
MW-2	Southwest	SRF	529941.00	1724235.00	645.20	647.10	645.20	647.10	--	--	--	--
MW-3	Southeast	M	530928.00	1728546.00	952.99	955.29	952.99	955.29	--	--	--	--
MW-4	Southeast	C	530922.00	1728552.00	953.20	955.10	953.20	955.10	--	--	--	--
MW-5	Southwest	SRF	531282.00	1724360.00	648.03	649.93	647.50	649.93	--	--	--	--
MW-6	Southwest	SRF	531266.00	1724352.00	647.50	649.45	648.03	649.45	--	--	--	--
MW-7	Southeast	U/SRF	530938.00	1788533.00	953.00	955.30	953.00	955.29	--	--	--	--
MW-8	Northeast	U/SRF	533742.00	1727871.70	963.01	965.43	963.01	965.43	--	--	--	--
MW-9	North	U/SRF	533589.20	1726988.10	944.66	946.81	944.66	946.81	--	--	--	--
Upgradient/Background												
MW-1802C	West	M	533237.344	1724120.267	888.11	890.92	--	--	--	--	--	--
MW-1803C	Northwest	M	534010.613	1723944.640	904.04	906.95	--	--	--	--	--	--
MW-1807A	Southwest	SRF	530862.801	1722479.851	861.99	864.95	--	--	--	--	--	--
MW-1807B	Southwest	C	530865.269	1722475.145	861.14	865.19	--	--	--	--	--	--
MW-1808A	Southwest	SRF	530578.048	1723313.873	857.55	860.53	--	--	--	--	--	--
MW-1808B	Southwest	C	530575.968	1723317.305	857.58	860.05	--	--	--	--	--	--
MW-1808C	Southwest	M	530573.810	1723321.874	857.52	860.51	--	--	--	--	--	--
MW-1809A	Southwest	SRF	530459.418	1722189.267	738.09	741.12	--	--	--	--	--	--
MW-1810A	Southwest	SRF	530152.248	1723192.379	735.26	738.33	--	--	--	--	--	--
MW-10	Northwest	U/SRF	534085.80	1724114.60	903.68	905.85	903.68	905.85	--	--	--	--
Fly Ash Pond Pool												
FAP Pool Stage	--	--	--	--	--	--	--	--	--	--	--	--
Piezometers												
STN-12-4 (Multi-port)	Central	Ash	531882.3	1726127.2	861.83	865.39	861.83	863.49	--	--	--	865.39
Port 1	--	Ash	--	--	--	--	--	--	--	--	--	865.39
Port 2	--	Ash	--	--	--	--	--	--	--	--	--	865.39
Port 3	--	Ash	--	--	--	--	--	--	--	--	--	865.39
Port 4	--	Ash	--	--	--	--	--	--	--	--	--	865.39
Port 5	--	Ash	--	--	--	--	--	--	--	--	--	865.39
Port 6	--	Ash	--	--	--	--	--	--	--	--	--	865.39
Port 7	--	Ash	--	--	--	--	--	--	--	--	--	865.39
STN-12-8	East	SRF	532214.2	1728169.3	874.26	880.49	872.66	874.51	874.26	880.76	--	880.49
STN-12-9	Northeast	SRF	532150.5	1728713.8	883.16	887.08	875.30	877.03	883.16	887.16	--	887.08
PZ-1701	--	Ash	533047.5	1724588.0	--	838.58	--	838.58	--	--	--	--
PZ-1702	--	Ash	533805.9	1724556.0	--	848.12	--	848.12	--	--	--	--

Monitoring Well ID	11/29/17		1/2/18		1/26/18		2/28/18		4/3/18		7/18/18		8/27/18		10/1/18		10/22/18		12/17/18	
	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl	DTW bTOC	GW Elev ft amsl
Downgradient																				
MW-1801A	--	--	--	--	--	--	--	--	--	--	51.00	853.17	53.49	850.68	51.36	852.81	52.50	851.67	50.22	853.95
MW-1801B	--	--	--	--	--	--	--	--	--	--	221.50	682.36	219.12	684.74	216.72	687.14	215.72	688.14	212.90	690.96
MW-1801C	--	--	--	--	--	--	--	--	--	--	155.51	747.68	163.25	739.94	192.98	710.21	195.74	707.45	198.57	704.62
MW-1802A	--	--	--	--	--	--	--	--	--	--	61.43	829.44	56.36	834.51	55.35	835.52	55.65	835.22	55.97	834.90
MW-1802B	--	--	--	--	--	--	--	--	--	--	196.60	694.16	195.94	694.82	195.41	695.35	195.30	695.46	194.51	696.25
MW-1803B	--	--	--	--	--	--	--	--	--	--	196.91	710.15	196.51	710.55	193.55	713.51	192.25	714.81	191.60	715.46
MW-1804A	--	--	--	--	--	--	--	--	--	--	17.91	843.94	19.84	842.01	18.23	843.62	19.34	842.51	17.26	844.59
MW-1804B	--	--	--	--	--	--	--	--	--	--	179.06	681.83	178.71	682.18	178.46	682.43	178.54	682.35	178.31	682.58
MW-1805B	--	--	--	--	--	--	--	--	--	--	211.75	673.84	210.00	675.59	209.99	675.60	208.72	676.87	205.06	680.53
MW-1805C	--	--	--	--	--	--	--	--	--	--	262.48	623.43	260.07	625.84	257.12	628.79	255.47	630.44	249.93	635.98
MW-1806A	--	--	--	--	--	--	--	--	--	--	25.59	867.54	27.01	866.12	25.57	867.56	25.82	867.31	25.12	868.01
MW-1806B	--	--	--	--	--	--	--	--	--	--	210.39	681.66	208.92	683.13	206.76	685.29	206.02	686.03	203.58	688.47
MW-1806C	--	--	--	--	--	--	--	--	--	--	257.40	634.34	255.06	636.68	253.05	638.69	252.05	639.69	249.38	642.36
MW-1	13.12	636.65	13.13	636.64	13.11	636.66	13.21	636.56	12.24	637.53	12.20	637.57	12.33	637.44	12.23	637.54	12.15	637.62	12.00	637.77
MW-2	55.95	591.15	55.79	591.31	55.61	591.49	55.47	591.63	54.38	592.72	55.36	591.74	56.02	591.08	55.58	591.52	55.61	591.49	54.40	592.70
MW-3	274.21	681.08	274.28	681.01	274.35	680.94	274.18	681.11	274.01	681.28	307.05	648.24	305.22	650.07	--	--	300.40	654.89	301.60	653.69
MW-4	230.87	724.23	230.85	724.25	230.82	724.28	230.75	724.35	229.21	725.89	248.66	706.44	248.25	706.85	248.29	706.81	247.98	707.12	247.67	707.43
MW-5	33.25	616.68	33.09	616.84	33.21	616.72	33.22	616.71	32.81	617.12	32.83	617.10	33.14	616.79	33.13	616.80	33.05	616.88	32.85	617.08
MW-6	12.83	636.62	12.83	636.62	12.69	636.76	12.51	636.94	11.90	637.55	11.92	637.53	12.06	637.39	11.95	637.50	11.86	637.59	11.75	637.70
MW-7	104.75	850.54	104.71	850.58	104.35	850.94	104.35	850.94	102.89	852.40	100.42	854.88	100.72	854.58	100.79	854.51	100.23	855.07	99.85	855.45
MW-8	111.85	853.58	111.57	853.86	120.81	844.62	111.74	853.69	109.41	856.02	107.39	858.04	108.00	857.43	108.08	857.35	108.14	857.29	107.48	857.95
MW-9	95.41	851.40	95.42	851.39	100.03	846.78	95.45	851.36	91.93	854.88	90.56	856.25	91.20	855.61	91.84	854.97	90.63	856.18	90.44	856.37
Upgradient/Background																				
MW-1802C	--	--	--	--	--	--	--	--	--	--	274.60	616.32	264.32	626.60	266.24	624.68	262.03	628.89	247.17	643.75
MW-1803C	--	--	--	--	--	--	--	--	--	--	273.68	633.27	266.27	640.68	267.41	639.54	265.53	641.42	261.88	645.07
MW-1807A	--	--	--	--	--	--	--	--	--	--	106.64	758.31	107.38	757.57	107.06	757.89	107.69	757.26	105.85	759.10
MW-1807B	--	--	--	--	--	--	--	--	--	--	123.42	741.77	123.82	741.37	123.62	741.57	123.45	741.74	122.88	742.31
MW-1808A	--	--	--	--	--	--	--	--	--	--	82.34	778.19	83.71	776.82	83.75	776.78	83.58	776.95	82.72	777.81
MW-1808B	--	--	--	--	--	--	--	--	--	--	154.36	705.69	155.72	704.33	153.59	706.46	153.16	706.89	152.40	707.65
MW-1808C	--	--	--	--	--	--	--	--	--	--	168.94	691.57	165.83	694.68	167.00	693.51	167.18	693.33	162.97	697.54
MW-1809A	--	--	--	--	--	--	--	--	--	--	47.88	693.24	48.10	693.02	47.40	693.72	47.08	694.04	46.91	694.21
MW-1810A	--	--	--	--	--	--	--	--	--	--	68.36	669.97	69.40	668.93	63.23	675.10	67.94	670.39	67.71	670.62
MW-10	59.51	846.34	58.05	847.80	57.39	848.46	59.19	846.66	55.12	850.73	57.02	848.83	59.02	846.83	57.07	848.78	57.33	848.52	56.57	849.28
Fly Ash Pond Pool																				
FAP Pool Stage	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Piezometers																				
STN-12-4 (Multi-port)																				
Port 1	16.61	848.78	16.75	848.64	16.91	848.48	16.41	848.98	16.38	849.01	20.36	845.03	13.17	852.22	11.77	853.62	11.80	853.59	11.48	853.91
Port 2	17.16	848.23	17.18	848.21	16.7	848.69	17.15	848.24	16.76	848.63	38.40	826.99	11.83	853.56	8.19	857.20	11.21	854.18	11.44	853.95
Port 3	17.07	848.32	17.12	848.27	17.22	848.17	16.75	848.64	16.23	849.16	56.42	808.97	11.10	854.29	9.90	855.49	9.30	856.09	11.69	853.70
Port 4	17.13	848.26	17.19	848.20	17.31	848.08	16.72	848.67	16.18	849.21	74.42	790.97	10.72	854.67	11.88	853.51	11.61	853.78	11.73	853.66
Port 5	17.25	848.14	17.32	848.07	17.43	847.96	16.94	848.45	16.28	849.11	92.30	773.09	13.93	851.46	12.12	853.27	11.55	853.84	11.85	853.54
Port 6	17.35	848.04	17.41	847.98	17.51	847.88	17.10	848.29	16.82	848.57	Dry	Dry	12.13	853.26	12.28	853.11	11.68	853.71	11.78	853.61
Port 7	17.45	847.94	17.55	847.84	17.62	847.77	17.25	848.14	17.01	848.38	--	--	12.38	853.01	12.17	853.22	12.41	852.98	12.01	853.38
STN-12-8	21.29	859.20	21.34	859.15	21.41	859.08	19.62	860.87	11.51	868.98	13.93	866.56	16.05	864.44	14.00	866.49	15.26	865.23	--	--
STN-12-9	26.02	861.06	25.95	861.13	25.66	861.42	22.81	864.27	21.87	865.21	19.22	867.86	20.52	866.56	19.89	867.19	19.22	867.86	18.85	868.23
PZ-1701	8.61	829.97	9.65	828.93	8.64	829.94	8.17	830.41	7.82	830.76	5.63	832.95	6.34	832.24	6.20	832.38	6.22	832.36	6.08	832.50
PZ-1702	12.39	835.73	12.51	835.61	11.98	836.14	12.16	835.96	10.06	838.06	8.73	839.39	9.45	838.67	7.49	840.63	8.57	839.55	8.04	840.08

NOTES:

Monitoring wells are arranged by bedrock unit in order of increasing depth

Elevation in NAVD 88, feet above mean sea level (ft amsl)

bls = Below land surface

bTOC = Below top of casing

GW Elev = groundwater level elevation

NA = not available

-- = not measured

a = 1983 West Virginia State Planar Coordinates NAD83/NAVD88. Surveyed in July 2018

b = Source: GAI Consultants. March 2006. Class F Industrial Landfill Facility Application, John E. Amos Landfill, Volume 1, Appendix K - Monitor Well Construction Diagrams. TOC elevation was 883.0 before 10/20/94.

c = Survey data and boring log not available, coordinates estimated based on AEP DWG. No. 13-30500-11-E. TOC elevation was 882.1 before 10/20/94.

d = The April 2018 water level at DW-2 was measured on 4/6/2018, not 4/3/2018

Table 2
Summary of Hydraulic Testing Results
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Test Borehole/Well Identification	Ground Surface Elevation (ft amsl)	Hydrogeologic Unit	Test Date	Boring Diameter (inches)	Casing Diameter (inches)	Top of Interval (ft-bgs)	Top of Interval (ft-amsl)	Bottom of Interval (ft-bgs)	Bottom of Interval (ft-amsl)	Interval Length (ft)	Slot Size (slot)	b (ft)	Test Pressure (psi)	Flow Rate[4] (gpm)	T (ft^2/day)	K (ft/day)	K (cm/sec)
Borehole Packer Testing[1]																	
MW-1801	900.39	Clarksburg Shale	2/2/2018	3	--	150	750.39	160	740.39	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Clarksburg Shale	2/1/2018	3	--	160	740.39	170	730.39	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Clarksburg Shale (sandstone interbed)	2/1/2018	3	--	175	725.39	185	715.39	10	--	10	30	0.4	0.6	5.7E-02	2.0E-05
												10	60	1.3	1.0	0.1	3.7E-05
		Clarksburg Shale	2/1/2018	3	--	185	715.39	195	705.39	10	--	10	30	1.3	1.7	0.2	6.1E-05
		Morgantown Sandstone	2/1/2018	3	--	247	653.39	257	643.39	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/31/2018	3	--	265	635.39	275	625.39	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/31/2018	3	--	280	620.39	290	610.39	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
MW-1802	888.11	Morgantown Sandstone	1/23/2018	3	--	253	635.11	263	625.11	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/23/2018	3	--	269	619.11	279	609.11	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/23/2018	3	--	279	609.11	289	599.11	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/23/2018	3	--	289	599.11	299	589.11	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
MW-1803	904.04	Upper Connellsville Sandstone	1/29/2018	3	--	60	844.04	70	834.04	10	--	10	30	0.2	0.3	2.8E-02	9.8E-06
		Upper Connellsville Sandstone	1/29/2018	3	--	70	834.04	80	824.04	10	--	10	30	2.7	3.7	0.4	1.3E-04
		Clarksburg Shale (sandstone interbed)	1/29/2018	3	--	128	776.04	138	766.04	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Morgantown Sandstone	1/29/2018	3	--	270	634.04	280	624.04	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/29/2018	3	--	280	624.04	290	614.04	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/29/2018	3	--	290	614.04	300	604.04	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/29/2018	3	--	300	604.04	310	594.04	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--

Table 2
Summary of Hydraulic Testing Results
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Test Borehole/Well Identification	Ground Surface Elevation (ft amsl)	Hydrogeologic Unit	Test Date	Boring Diameter (inches)	Casing Diameter (inches)	Top of Interval (ft-bgs)	Top of Interval (ft-amsl)	Bottom of Interval (ft-bgs)	Bottom of Interval (ft-amsl)	Interval Length (ft)	Slot Size (slot)	b (ft)	Test Pressure (psi)	Flow Rate[4] (gpm)	T (ft^2/day)	K (ft/day)	K (cm/sec)
MW-1805	882.32	Clarksburg Shale (sandstone interbed)	2/14/2018	3	--	180	702.32	190	692.32	10	--	--	100	0.0	--	--	--
		Clarksburg Shale (sandstone interbed)	2/14/2018	3	--	190	692.32	200	682.32	10	--	--	100	0.0	--	--	--
		Morgantown Sandstone	2/14/2018	3	--	237	645.32	247	635.32	10	--	--	100	0.0	--	--	--
		Morgantown Sandstone	2/14/2018	3	--	247	635.32	257	625.32	10	--	--	60	0.0	--	--	--
												10	100	0.3	0.1	1.5E-02	5.2E-06
		Birmingham Reds	1/23/2018	3	--	275	607.32	285	597.32	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Birmingham Reds	1/23/2018	3	--	285	597.32	295	587.32	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Graffton Sandstone	1/23/2018	3	--	295	587.32	305	577.32	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Graffton Sandstone	1/23/2018	3	--	305	577.32	315	567.32	10	--	--	60	0.0	--	--	--
												--	90	0.0	--	--	--
MW-1806	888.96	Clarksburg Shale	4/4/2018	3	--	185	703.96	195	693.96	10	--	--	30	0.0	--	--	--
		Clarksburg Shale	4/4/2018	3	--	200	688.96	210	678.96	10	--	10	30	10	19	1.9	6.7E-04
												10	60	14	14	1.4	5.0E-04
		Clarksburg Shale	4/4/2018	3	--	215	673.96	225	663.96	10	--	10	60	11	11	1.1	3.8E-04
												10	100	15	8.8	0.9	3.1E-04
		Morgantown Sandstone	4/4/2018	3	--	225	663.96	235	653.96	10	--	10	60	9.4	9.4	0.9	3.3E-04
												10	100	15	9.1	0.9	3.2E-04
		Morgantown Sandstone	4/3/2018	3	--	265	623.96	275	613.96	10	--	--	30	0.0	--	--	--
												--	100	0.0	--	--	--
MW-1808	857.52	Morgantown Sandstone	4/23/2018	3	--	215	642.52	225	632.52	10	--	10	60	5.6	3.7	0.4	1.3E-04
		Morgantown Sandstone	4/23/2018	3	--	235	622.52	245	612.52	10	--	10	60	9.4	6.0	0.6	2.1E-04
MW-1809	738.09	Clarksburg Shale (sandstone interbed) / SRF	3/2/2018	3	--	90	648.09	100	638.09	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
MW-1810	735.26	SRF	2/28/2018	3	--	70	665.26	80	655.26	10	--	10	30	4.0	6.52	0.7	2.3E-04
		Clarksburg Shale (sandstone interbed)	2/28/2018	3	--	80	655.26	90	645.26	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Clarksburg Shale (sandstone interbed)	2/28/2018	3	--	90	645.26	100	635.26	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Clarksburg Shale (sandstone interbed)	2/28/2018	3	--	98	637.26	108	627.26	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--
		Clarksburg Shale (sandstone interbed)	2/28/2018	3	--	108	627.26	118	617.26	10	--	--	60	0.0	--	--	--
												--	100	0.0	--	--	--

Table 2
Summary of Hydraulic Testing Results
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

ARCADIS Design & Consultancy for natural and built assets

Test Borehole/Well Identification	Ground Surface Elevation (ft amsl)	Hydrogeologic Unit	Test Date	Boring Diameter (inches)	Casing Diameter (inches)	Top of Interval (ft-bgs)	Top of Interval (ft-amsl)	Bottom of Interval (ft-bgs)	Bottom of Interval (ft-amsl)	Interval Length (ft)	Slot Size (slot)	b (ft)	Test Pressure (psi)	Flow Rate[4] (gpm)	T (ft^2/day)	K (ft/day)	K (cm/sec)
Yield Testing Recovery[2]																	
MW-1	647.57	SRF	4/5/2018	6	2	41.10	606.47	50.00	597.57	9	10	8.9	--	0.8	2.8	0.3	1.1E-04
MW-5	648.03	SRF	3/26/2018	6	2	101.60	546.43	111.00	537.03	9	10	Insufficient Yield					
MW-6	647.50	SRF	4/6/2018	6	2	28.50	619.00	33.50	614.00	5	10	5.0	--	3.8	183	37	1.3E-02
MW-1801A	901.12	Upper Connellsville Sandstone	7/4/2018	6	2	55.00	846.12	75.00	826.12	20	20	20	--	0.4	1.7	0.1	3.0E-05
MW-1806A	889.63	Upper Connellsville Sandstone	7/19/2018	6	2	60.40	829.23	80.40	809.23	20	20	20.00	--	0.1	0.3	0.02	5.3E-06
MW-1810A	735.26	SRF	6/18/2018	6	2	60.00	675.26	80.00	655.26	20	20	15.22	--	0.3	1.5	0.10	3.5E-05
Yield Testing Drawdown[3]																	
MW-2	645.20	SRF	3/23/2018	6	2	96.10	549.10	105.00	540.20	9	10	8.9	--	0.8	52	5.8	2.1E-03
MW-6	647.50	SRF	4/6/2018	6	2	28.50	619.00	33.50	614.00	5	10	5.0	--	3.8	181	36	1.3E-02
MW-8	963.01	Upper Connellsville Sandstone	4/10/2018	6	2	144.00	819.01	163.00	800.01	19	--	Insufficient Yield					
MW-1801A	901.12	Upper Connellsville Sandstone	7/4/2018	6	2	55.00	846.12	75.00	826.12	20	20	20	--	0.4	2.2	0.1	3.9E-05
MW-1801B	901.06	Clarksburg Shale (sandstone interbed)	7/18/2018	6	2	198.40	702.66	223.00	678.06	25	20	Insufficient Yield					
MW-1801C	900.39	Morgantown Sandstone	7/18/2018	6	2	237.00	663.39	262.00	638.39	25	20	Insufficient Yield					
MW-1806A	889.63	Upper Connellsville Sandstone	7/19/2018	6	2	60.40	829.23	80.40	809.23	20	20	20.00	--	0.1	0.5	2.3E-02	8.1E-06
MW-1808A	857.55	SRF	7/20/2018	6	2	84.20	773.35	109.20	748.35	25	20	25.00	--	0.5	42	1.7	5.9E-04
MW-1809A	738.09	SRF	6/28/2018	6	2	57.00	681.09	72.00	666.09	15	20	15.00	--	1.1	28	1.9	6.6E-04
MW-1810A	735.26	SRF	6/18/2018	6	2	60.00	675.26	80.00	655.26	20	20	15.22	--	0.3	1.7	0.1	3.9E-05

Table 2
Summary of Hydraulic Testing Results
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Test Borehole/Well Identification	Ground Surface Elevation (ft amsl)	Hydrogeologic Unit	Test Date	Boring Diameter (inches)	Casing Diameter (inches)	Top of Interval (ft-bgs)	Top of Interval (ft-amsl)	Bottom of Interval (ft-bgs)	Bottom of Interval (ft-amsl)	Interval Length (ft)	Slot Size (slot)	b (ft)	Test Pressure (psi)	Flow Rate[4] (gpm)	T (ft^2/day)	K (ft/day)	K (cm/sec)
Results Summary																	
	Unit	**Hydrogeologic Unit**	**Minimum K (ft/day)**		**Maximum K (ft/day)**		**Geomean K (ft/day)**		**Minimum K (cm/sec)**		**Maximum K (cm/sec)**		**Geomean K (cm/sec)**				
	A	SRF	0.1		37		2		3.5E-05		1.3E-02		5.5E-04				
	A	Upper Connellsville Sandstone	1.5E-02		0.4		0.1		5.3E-06		1.3E-04		2.0E-05				
	B	Clarksburg Shale	0.2		2		0.8		6.1E-05		6.7E-04		3.0E-04				
	B	Clarksburg Shale (sandstone interbed)	5.7E-02		0.1		7.7E-02		2.0E-05		3.7E-05		2.7E-05				
	C	Morgantown Sandstone	1.5E-02		0.9		0.3		5.2E-06		3.3E-04		1.1E-04				

NOTES:

[1] Packer testing analysis analyzed using U.S. Department of the Interior, Bureau of Reclamation, 1977. Ground Water Manual, A Water Resources Technical Publication, pp. 258-264

[2] Recovery results analyzed by the Theis solution; correction of drawdown data applied for unconfined conditions ($s'=s-s^2/2b$; where s is drawdown and b is aquifer thickness)

Kruseman, G.P. and Ridder, N.A., 1990. Analysis and evaluation of pumping test data. Analysis and evaluation of pumping test data., (47)

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524

Birsoy, Y.K. and W.K. Summers, 1980. Determination of aquifer parameters from step tests and intermittent pumping, Ground Water, vol. 18, no. 2, pp. 137-146.

[3] Drawdown results analyzed by the Cooper-Jacob solution; storage result not reliable due to test duration

Cooper, H.H. and C.E. Jacob, 1946. A generalized graphical method for evaluating formation constants and summarizing well field history, Am. Geophys. Union Trans., vol. 27, pp. 526-534

[4] Flow rate is average flow rate for borehole packer tests and maximum sustain flow rate (yield) for yield tests

amsl = above mean sea level (NAVD88)

b = thickness of packed interval or thickness of tested zone

SS = sandstone

SRF = stress relief fracture system

N/A = not available

-- = not applicable

T = transmissivity

K = hydraulic conductivity

ft = feet

gpm - gallons per minute

psi = pounds per square inch

cm/sec = centimeters per second

bgs = below ground surface

Table 3
Summary of Rock Core Permeability Testing Results
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Sample ID	Sample Depth (ft)	Unit	Average Effective Permeability to Water (millidarcy)	Average Hydraulic Conductivity (ft/day)	Average Hydraulic Conductivity (cm/s)
Horizontal					
MW-1802 (68.0-69.9)	68.30 - 68.45	Shale below Upper Connellsville	0.0473	1.36E-04	4.80E-08
MW-1802 (218.5-220.5)	219.18 - 219.30	Shale Aquitard below Clarskburg Disconformity	0.0246	6.97E-05	2.46E-08
MW-1802 (262.0-264.5)	263.90 - 264.05	Morgantown Sandstone	0.0144	4.08E-05	1.44E-08
Vertical					
MW-1802 (68.0-69.9)	68.70 - 68.81	Shale below Upper Connellsville	0.1127	3.23E-04	1.14E-07
MW-1802 (218.5-220.5)	218.8 - 218.95	Shale Aquitard below Clarskburg Disconformity	0.3070	9.07E-04	3.20E-07
MW-1802 (262.0-264.5)	264.1 - 264.3	Morgantown Sandstone	0.1990	5.84E-04	2.06E-07

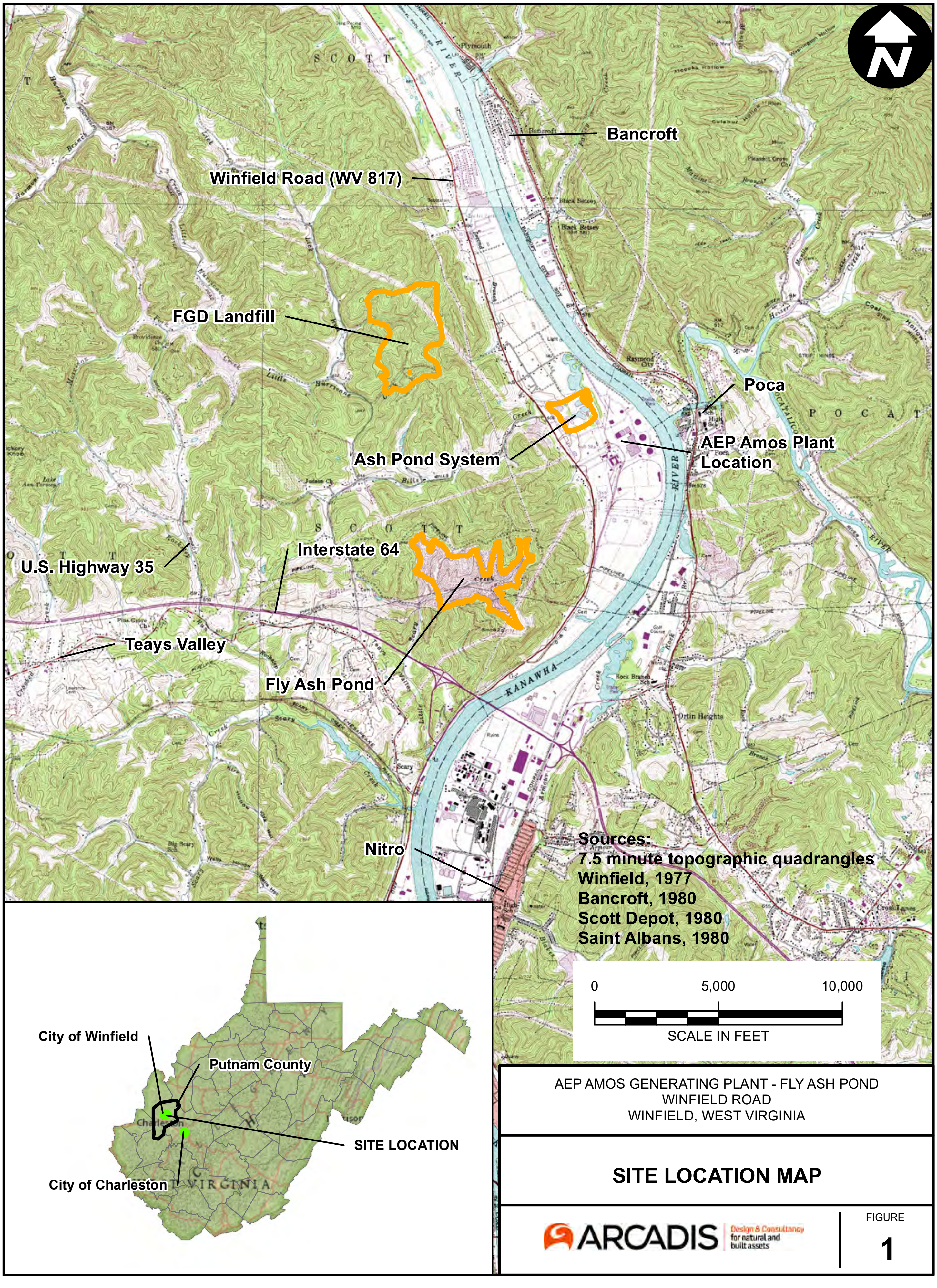
NOTES:
Horizontal and vertical permeability and hydraulic conductivity measured following ASTM D5084
Confining pressure during all tests was 25 pounds per square inch (psi)
Effective is with as-received pore fluids in place
Permeability to water and hydraulic conductivity measured ast saturated conditions
ft = feet
cm = centimeter
s = second

Table 4
Well Construction Details
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Monitoring Well ID	Hydraulic Monitoring Only	Location Description to CCR Unit	Hydro-stratigraphic Unit Target	Northing [a]	Easting [a]	Ground Surface Elevation [a] (ft amsl)	Top of Casing Elevation [a] (ft amsl)	Total Borehole Depth (ft bgs)	Date Installed	Screen Material	Well Diameter (inches)	Top of Bentonite Seal		Bottom of Bentonite Seal		Top of Secondary Sand Pack		Bottom of Secondary Sand Pack		Top of Primary Sand Pack		Bottom of Primary Sand Pack		Top of Screen		Bottom of screen		Screen Length (ft)
												Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	Depth (ft bgs)	Elevation (ft amsl)	
Downgradient																												
MW-1801A		South	U/SRF	531398.627	1726314.531	901.12	904.17	77.00	3/14/2018	Slotted PVC (20-slot)	2.00	45.00	856.12	50.90	850.22	50.90	850.22	52.00	849.12	52.00	849.12	77.00	824.12	55.00	846.12	75.00	826.12	20.00
MW-1801B	X	South	C	531401.126	1726316.987	901.06	903.86	225.00	3/20/2018	Slotted PVC (20-slot)	2.00	43.00	858.06	192.80	708.26	192.80	708.26	194.00	707.06	194.00	707.06	225.00	676.06	198.40	702.66	223.00	678.06	24.60
MW-1801C	X	South	M	531413.037	1726329.094	900.39	903.19	305.80	4/13/2018	Slotted PVC (20-slot)	2.00	194.00	706.39	233.00	667.39	233.00	667.39	234.00	666.39	234.00	666.39	264.00	636.39	237.00	663.39	262.00	638.39	25.00
MW-1802A	X	West	U/SRF	533246.455	1724119.981	887.75	890.87	67.00	5/1/2018	Slotted PVC (20-slot)	2.00	30.00	857.75	41.00	846.75	41.00	846.75	42.00	845.75	42.00	845.75	67.00	820.75	46.60	841.15	66.60	821.15	20.00
MW-1802B	X	West	C	533242.023	1724120.003	887.87	890.76	198.00	5/1/2018	Slotted PVC (20-slot)	2.00	159.20	728.67	170.90	716.97	170.90	716.97	172.10	715.77	172.10	715.77	198.00	689.87	176.00	711.87	196.00	691.87	20.00
MW-1803B	X	Northwest	C	534006.697	1723941.610	904.25	907.06	197.00	5/9/2018	Slotted PVC (20-slot)	2.00	164.00	740.25	167.00	737.25	167.00	737.25	168.00	736.25	168.00	736.25	198.00	706.25	171.00	733.25	196.00	708.25	25.00
MW-1804A		North	U/SRF	533349.763	1725662.499	858.53	861.85	49.00	5/31/2018	Slotted PVC (20-slot)	2.00	7.00	851.53	18.90	839.63	18.90	839.63	19.90	838.63	19.90	838.63	49.00	809.53	27.50	831.03	47.50	811.03	20.00
MW-1804B	X	North	C	533352.364	1725659.003	859.17	860.89	184.30	5/24/2018	Slotted PVC (20-slot)	2.00	134.00	725.17	147.50	711.67	147.50	711.67	148.70	710.47	148.70	710.47	180.40	678.77	152.00	707.17	177.00	682.17	25.00
MW-1805B	X	Northeast	C	533272.299	1727730.142	883.25	885.59	214.00	5/18/2018	Slotted PVC (20-slot)	2.00	174.00	709.25	188.00	695.25	188.00	695.25	189.00	694.25	189.00	694.25	214.00	669.25	192.00	691.25	212.00	671.25	20.00
MW-1805C	X	Northeast	M	533273.891	1727725.724	882.32	885.91	324.30	4/20/2018	Slotted PVC (20-slot)	2.00	225.00	657.32	228.00	654.32	228.00	654.32	229.00	653.32	229.00	653.32	264.00	618.32	232.00	650.32	262.00	620.32	30.00
MW-1806A		East	U/SRF	532750.917	1728577.239	889.63	893.13	81.00	5/16/2018	Slotted PVC (20-slot)	2.00	45.00	844.63	56.00	833.63	56.00	833.63	57.00	832.63	57.00	832.63	81.00	808.63	60.40	829.23	80.40	809.23	20.00
MW-1806B	X	East	C	532748.326	1728573.233	889.48	892.05	211.00	5/15/2018	Slotted PVC (20-slot)	2.00	178.10	711.38	190.60	698.88	190.60	698.88	191.80	697.68	191.80	697.68	211.00	678.48	195.00	694.48	210.00	679.48	15.00
MW-1806C	X	East	M	532745.975	1728569.060	888.96	891.74	290.70	4/12/2018	Slotted PVC (20-slot)	2.00	183.00	705.96	220.00	668.96	220.00	668.96	221.00	667.96	221.00	667.96	255.00	633.96	225.00	663.96	255.00	633.96	30.00
MW-1		Southwest	SRF	531275.00	1724355.00	647.57	649.77	114.80	7/27/1995	Slotted PVC (10-slot)	2.00	33.00	614.57	38.00	609.57	--	--	--	--	38.00	609.57	78.10	569.47	41.10	606.47	50.00	597.57	8.90
MW-2		Southwest	SRF	529941.00	1724235.00	645.20	647.10	129.80	7/27/1995	Slotted PVC (10-slot)	2.00	77.70	567.50	84.70	560.50	--	--	--	--	84.70	560.50	111.00	534.20	96.10	549.10	105.00	540.20	8.90
MW-3	X	Southeast	M	530928.00	1728546.00	952.99	955.29	313.80	8/10/1995	Slotted PVC (10-slot)	2.00	262.70	690.29	267.80	685.19	--	--	--	--	267.80	685.19	312.20	640.79	280.20	672.79	309.10	643.89	28.90
MW-4	X	Southeast	C	530922.00	1728552.00	953.20	955.10	310.50	7/20/1995	Slotted PVC (10-slot)	2.00	191.10	762.10	197.30	755.90	--	--	--	--	197.30	755.90	249.10	704.10	239.10	714.10	248.00	705.20	8.90
MW-5		Southwest	SRF	531282.00	1724360.00	648.03	649.93	114.80	7/26/1995	Slotted PVC (10-slot)	2.00	86.00	562.03	91.00	557.03	--	--	--	--	91.00	557.03	112.10	535.93	101.60	546.43	111.00	537.03	9.40
MW-6		Southwest	SRF	531266.00	1724352.00	647.50	649.45	114.80	8/21/1995	Slotted PVC (10-slot)	2.00	22.50	625.00	27.20	620.30	--	--	--	--	27.20	620.30	34.20	613.30	28.50	619.00	33.50	614.00	5.00
MW-7		Southeast	U/SRF	530938.00	1788533.00	953.00	955.30	132.50	3/26/1996	Slotted PVC (20-slot)	2.00	102.50	850.50	108.00	845.00	--	--	--	--	108.00	845.00	132.50	820.50	110.00	843.00	130.00	823.00	20.00
MW-8		Northeast	U/SRF	533742.00	1727871.70	963.01	965.43	168.60	1/30/2002	Slotted PVC	2.00	136.10	826.91	141.80	821.21	--	--	--	--	141.80	821.21	166.00	797.01	144.00	819.01	163.00	800.01	19.00
MW-9		North	U/SRF	533589.20	1726988.10	944.66	946.81	144.90	1/16/2002	Slotted PVC	2.00	111.20	833.46	120.10	824.56	--	--	--	--	120.10	824.56	140.10	804.56	120.10	824.56	139.10	805.56	19.00
Upgradient/Background																												
MW-1802C	X	West	M	533237.344	1724120.267	888.11	890.92	315.70	4/27/2018	Slotted PVC (20-slot)	2.00	201.00	687.11	248.00	640.11	248.00	640.11	249.00	639.11	249.00	639.11	274.50	613.61	253.00	635.11	273.00	615.11	20.00
MW-1803C	X	Northwest	M	534010.613	1723944.640	904.04	906.95	338.50	5/7/2018	Slotted PVC (20-slot)	2.00	157.00	747.04	248.90	655.14	248.90	655.14	250.00	654.04	250.00	654.04	275.00	629.04	253.00	651.04	273.40	630.64	20.40
MW-1807A		Southwest	SRF	530862.801	1722479.851	861.99	864.95	116.00	5/29/2018	Slotted PVC (20-slot)	2.00	88.00	773.99	91.00	770.99	91.00	770.99	92.00	769.99	92.00	769.99	116.00	745.99	95.00	766.99	115.00	746.99	20.00
MW-1807B		Southwest	C	530865.269	1722475.145	861.14	865.19	204.00	5/21/2018	Slotted PVC (20-slot)	2.00	126.00	735.14	129.00	732.14	129.00	732.14	130.00	731.14	130.00	731.14	155.00	706.14	133.00	728.14	153.00	708.14	20.00
MW-1808A		Southwest	SRF	530578.048	1723313.873	857.55	860.53	112.00	5/11/2018	Slotted PVC (20-slot)	2.00	70.00	787.55	80.00	777.55	80.00	777.55	81.00	776.55	81.00	776.55	111.00	746.55	84.20	773.35	109.20	748.35	25.00
MW-1808B	X	Southwest	C	530575.968	1723317.305	857.58	860.05	165.00	5/7/2018	Slotted PVC (20-slot)	2.00	131.00	726.58	134.00	723.58	134.00	723.58	135.00	722.58	135.00	722.58	165.00	692.58	138.50	719.08	158.50	699.08	20.00
MW-1808C	X	Southwest	M	530573.810	1723321.874	857.52	860.51	289.00	5/8/2018	Slotted PVC (20-slot)	2.00	208.00	649.52	211.00	646.52	211.00	646.52	212.00	645.52	212.00	645.52	242.00	615.52	215.00	642.52	240.00	617.52	25.00
MW-1809A		Southwest	SRF	530459.418	1722189.267	738.09	741.12	125.80	3/7/2018	Slotted PVC (20-slot)	2.00	48.60	689.49	52.60	685.49	52.60	685.49	54.40	683.69	54.40	683.69	74.00	664.09	57.00	681.09	72.00	666.09	15.00
MW-1810A		Southwest	SRF	530152.248	1723192.379	735.26	738.33	124.00	3/13/2018	Slotted PVC (20-slot)	2.00	50.00	685.26	53.00	682.26	53.00	682.26	54.00	681.26	54.00	681.26	82.00	653.26	60.00	675.26	80.00	655.26	20.00
MW-10	X	Northwest	U/SRF	534085.80	1724114.60	903.68	905.85	165.00	1/22/2002	Slotted PVC	2.00	53.10	850.58	58.60	845.08	--	--	--	--	58.60	845.08	82.60	821.08	60.90	842.78	78.90	824.78	18.00
Piezometers																												
STN-12-4 (Multi-port)	X																											
Port 1	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	0.33	861.50	16.73	845.10	--	--	--	--	16.73	845.10	22.73	839.10	18.83	843.00	20.83	841.00	2.00
Port 2	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	22.73	839.10	34.83	827.00	--	--	--	--	34.83	827.00	40.83	821.00	36.83	825.00	38.83	823.00	2.00
Port 3	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	40.83	821.00	52.73	809.10	--	--	--	--	152.73	709.10	58.83	803.00	54.83	807.00	56.83	805.00	2.00
Port 4	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	58.83	803.00	70.63	791.20	--	--	--	--	70.63	791.20	76.83	785.00	72.83	789.00	74.83	787.00	2.00
Port 5	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	76.83	785.00	88.63	773.20	--	--	--	--	88.63	773.20	94.63	767.20	90.83	771.00	92.83	769.00	2.00
Port 6	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	94.63	767.20	105.33	756.50	--	--	--	--	105.33	756.50	112.83	749.00	108.83	753.00	110.83	751.00	2.00
Port 7	X	Central	Ash	531882.3	1726127.2	861.83	865.39	127.83	3/8/2012	Solinst Multilevel System	0.25	112.43	749.40	124.33	737.50	--	--	--	--	124.33	737.50	127.83	734.00	126.83	735.00	127.33	734.50	0.50
STN-12-8	X	East	SRF	532214.2	1728169.3	872.66	880.49	59.46	2/24/2012	Slotted PVC (8-slot)	2.00	42.66	830.00	44.66	828.00	--	--	--	--	44.66	828.00	42.66	830.00	46.66	826.00	56.66	816.00	10.00
STN-12-9	X	Northeast	SRF	532150.5	1728713.8	875.30	887.08	41.00	2/21/2012	Slotted PVC (8-slot)	2.00	24.00	851.30	27.00	848.30	--	--	--	--	27.00	848.30	41.00	834.30	25.00	850.30	35.00	840.30	10.00
PZ-1701	X	West	Ash	533047.5	1724588.0	833.59	838.58	66.00	3/23/2017	Slotted PVC (8-slot)	2.00	51.00	782.59	53.00	780.59	--	--	--	--	53.00	780.59	66.00	767.59	55.00	778.59	65.00	768.59	10.00
PZ-1702	X	Northwest	Ash	533805.9	1724556.0	843.19	848.12	33.00	3/24/2017	Slotted PVC (8-slot)	2.00	18.00	825.19	20.00	823.19	--	--	--	--	20.00	823.19	33.00	810.19	22.00	821.19	32.00	811.19	10.00

NOTES:
a = 1983 West Virginia State Planar Coordinates NAD83/NAVD88. Surveyed in July 2018.
Piezometers pre-cap surface elevations provided.
ft = feet
bgs = below ground surface
amsl = above mean sea level
-- = not applicable
SRF = Stress Relief Fracture System
U = Upper Connellsville sandstone
C = Clarksburg
M = Morgantown sandstone and adjacent shale

FIGURES



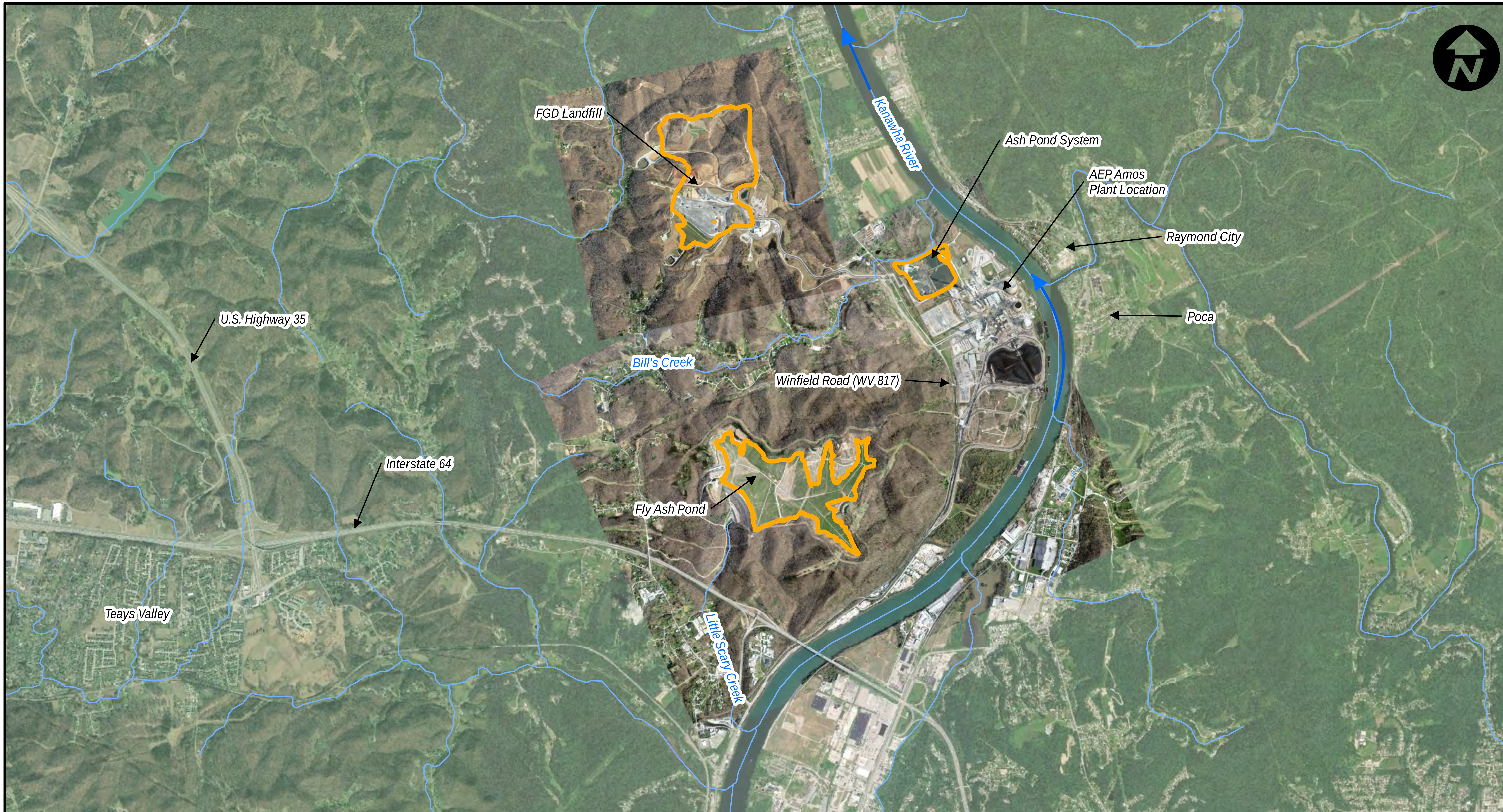
AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

Document Path: Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F1_ site map.mxd



LEGEND:

Coal Combustion Residual (CCR) Unit

Rivers and Streams

Streamflow Direction

NOTES:
1. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. WEST VIRGINIA 1983 STATE PLANAR COORDINATES

0 3,000 6,000 Feet
GRAPHIC SCALE

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F2_AmosRegionalMap.mxd 1/14/2019 9:27:48 AM

LEGEND:

- CCR Unit Boundary
- 2014 Soil and Rock Boring Location
- Oil & Gas Well
- 2008 Soil Boring and/or Rock Core
- Dewatering Well Converted to Piezometer
- Dewatering Well - Abandoned
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- 2012 Direct Push Boring with Cone Penetration Test (SCPTU)
- 2012 Direct Push Boring
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- 2012 Soil Boring with Standard Penetration Tests and Rock Core
- Rivers and Streams
- Stream Flow Direction
- Access Road

NOTES:
1. 2018 aerial imagery obtained from AEP.
2. FAP monitor well, STN boring, B-1401, and B-1402 coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer and 2008 soil boring coordinate source: AEP-provided boring logs
4. Oil and gas well coordinate source: WVDEP Oil and Gas Well Database
5. West Virginia 1983 State Planar Coordinates

0 600 1,200 Feet

GRAPHIC SCALE

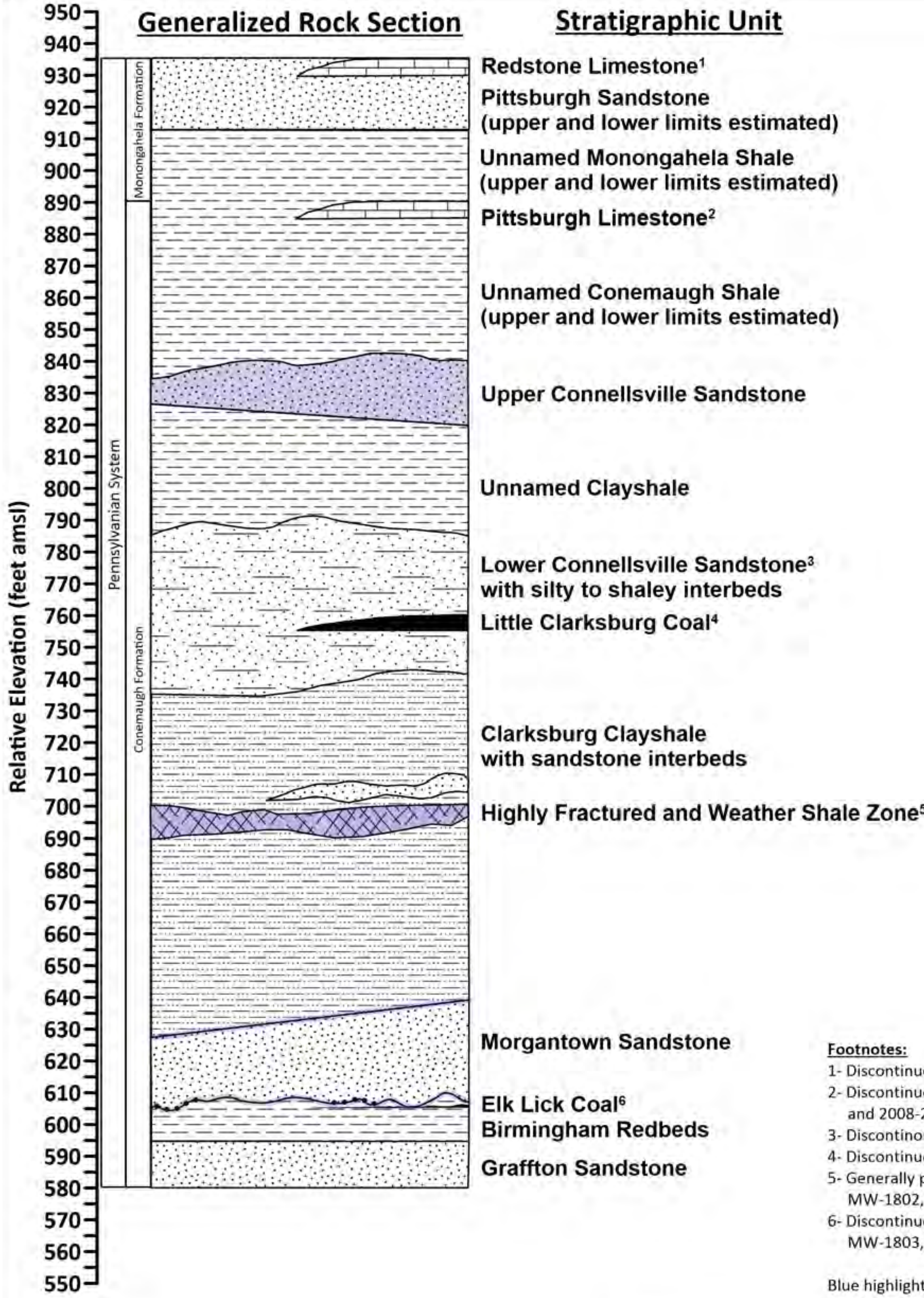
AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

FLY ASH POND LAYOUT AND WELL LOCATIONS MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 3

City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F3_Layout_WellLocations_v4.mxd 4/11/2019 10:36:50 AM



Footnotes:

1- Discontinuous - only present at boring MW-3
2- Discontinuous - only present at borings MW-3 and 2008-26
3- Discontinous - interbeds of sandstone
4- Discontinuous - only present at boring B-0608
5- Generally present at borings MW-1801, MW-1802, MW-1803, and MW-1805
6- Discontinuous and thin - present at MW-1802, MW-1803, MW-1805

Blue highlighted areas designate groundwater-bearing fracture zones

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

GENERALIZED STRATIGRAPHIC COLUMN

ARCADIS Design & Consultancy for natural and built assets

FIGURE 4

References:

- Site stratigraphic and geophysics from current data collection and historical reports.
- Cross, A.T and M.P. Shemel. 1956. *Geology and Economic Resources of the Ohio River Valley in West Virginia, Part I Geology.* West Virginia Geological Survey Volume XXII.
- Latimer, W.J., et al. 1911. *Jackson, Mason and Putnam Counties, Volume 1, County Reports and Maps.* Wheeling News Litho. Company.
- Orsborn, N.P. 2008. *Deposition and Structural Features of the Basal Morgantown Sandstone of the Casselman Formation (Pennsylvanian) of the Greater Pittsburgh Region.* MS Thesis.
- Reger, D.B., et al. 1918. *Barbour and Upshur Counties and Western Portion of Randolph, Volume 1, County Reports and Maps.* Wheeling News Litho. Company.

LEGEND:

- CCR Unit Boundary
- Stormwater Pond
- 2014 Soil and Rock Boring Location
- Oil & Gas Well
- 2008 Soil Boring and/or Rock Core
- Dewatering Well Converted to Piezometer
- Dewatering Well - Abandoned
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Monitoring wells for the Ash Pond CCR Unit
- 2012 Direct Push Boring with Cone Penetration Test (SCPTU)
- 2012 Direct Push Boring
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- 2012 Soil Boring with Standard Penetration Tests and Rock Core
- Rivers and Streams
- Stream Flow Direction
- Access Road
- Cross Section Location

NOTES:

1. Topography from AEP dwg no. 13-30705-0 and 3dAMtopo_FAP11_aerial05.dgn. Contour Interval: 10 feet (2 feet within CCR unit boundary)
2. FAP monitor well, STN boring, B-1401, and B-1402 coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer and 2008 soil boring coordinate source: AEP-provided boring logs
4. Oil and gas well coordinate source: WVDEP Oil and Gas Well Database
5. Amos Generating Plant monitor well, piezometer, and soil boring coordinate source: June 2016 AEP survey and EPRI, April 1999, Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia
6. West Virginia 1983 State Planar Coordinates
7. CSM = Conceptual Site Model

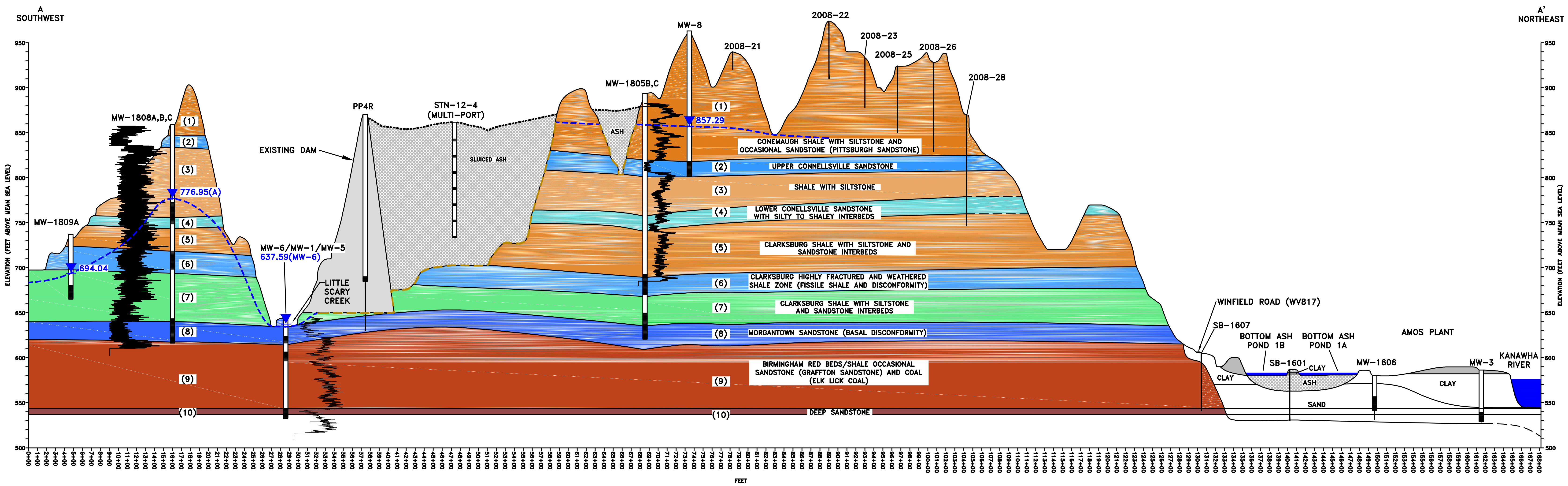
AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

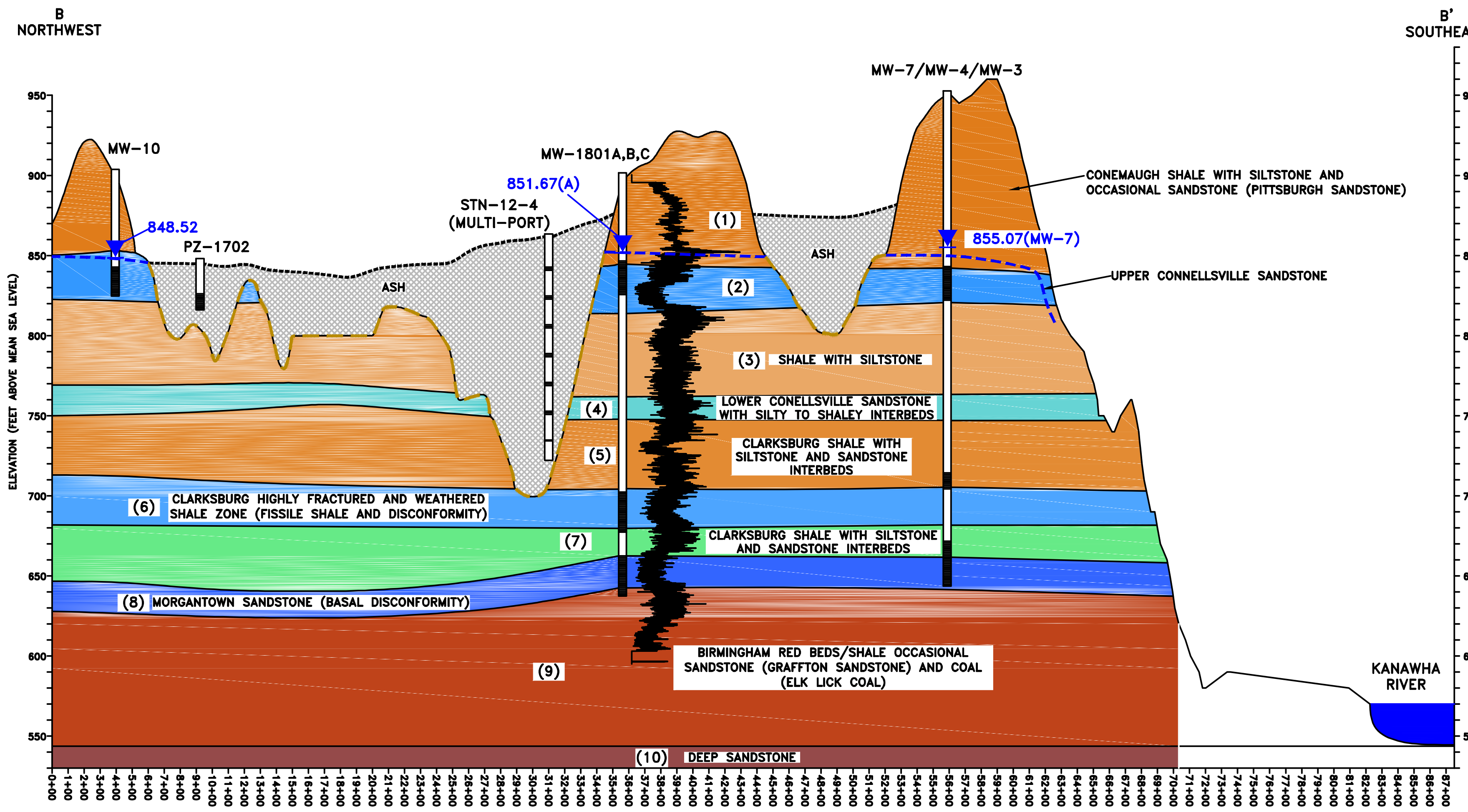
CROSS SECTION LOCATION MAP

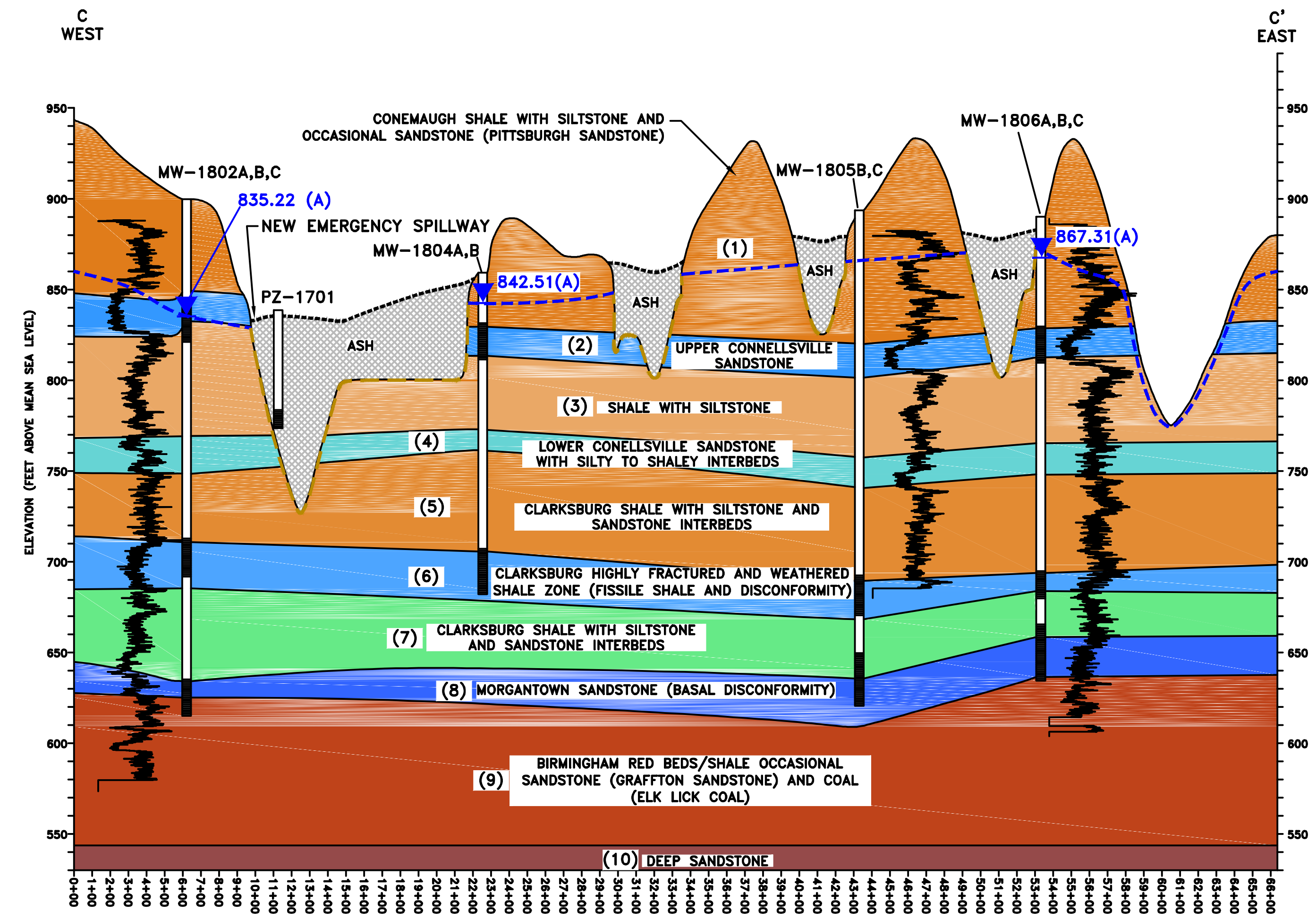
ARCADIS Design & Consultancy for natural and built assets

FIGURE
5

City: Div/Group: Created By: Last Saved By: akens
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F5_Layout_CrossSectionLocationRevJan2019.mxd 3/29/2019 7:44:22 AM







LEGEND

MW-9 — WELL OR BORING IDENTIFICATION
— WELL
— WELL SCREEN
— BORING

CAP CONSTRUCTION (BOTTOM TO TOP):
- SUBGRADE PREPARATION (IN-PLACE FLY ASH AND ONSITE BORROW MATERIAL DEWATERING, EXCAVATING, GRADING)
- 40-MIL LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) FLEXIBLE MEMBRANE LINER
- 8oz. GEOTEXTILE CUSHION LAYER
- 18 INCHES OF PROTECTIVE SOIL COVER LAYER
- 6 INCHES OF VEGETATIVE COVER LAYER
- DRAINAGE STRUCTURES
- SEEDING AND MULCHING

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) MONITORING WELL WATER LEVEL OCTOBER 22, 2018

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) POTENTIOMETRIC SURFACE

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) TOP BELOW SATURATED ASH

NATURAL GAMMA LOG

0 100 200 300 COUNTS PER SECOND

(1) CONEMAUGH SHALE WITH SILTSTONE AND OCCASIONAL SANDSTONE (PITTSBURGH SANDSTONE)
(2) UPPER CONNELLSVILLE SANDSTONE
(3) SHALE WITH SILTSTONE
(4) LOWER CONELLSVILLE SANDSTONE WITH SILTY TO SHALEY INTERBEDS
(5) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS
(6) CLARKSBURG HIGHLY FRACTURED AND WEATHERED SHALE ZONE (FISSILE SHALE AND DISCONFORMITY)
(7) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS
(8) MORGANTOWN SANDSTONE (BASAL DISCONFORMITY)
(9) BIRMINGHAM RED BEDS/SHALE OCCASIONAL SANDSTONE (GRAFFTON SANDSTONE) AND COAL (ELK LICK COAL)
(10) DEEP SANDSTONE

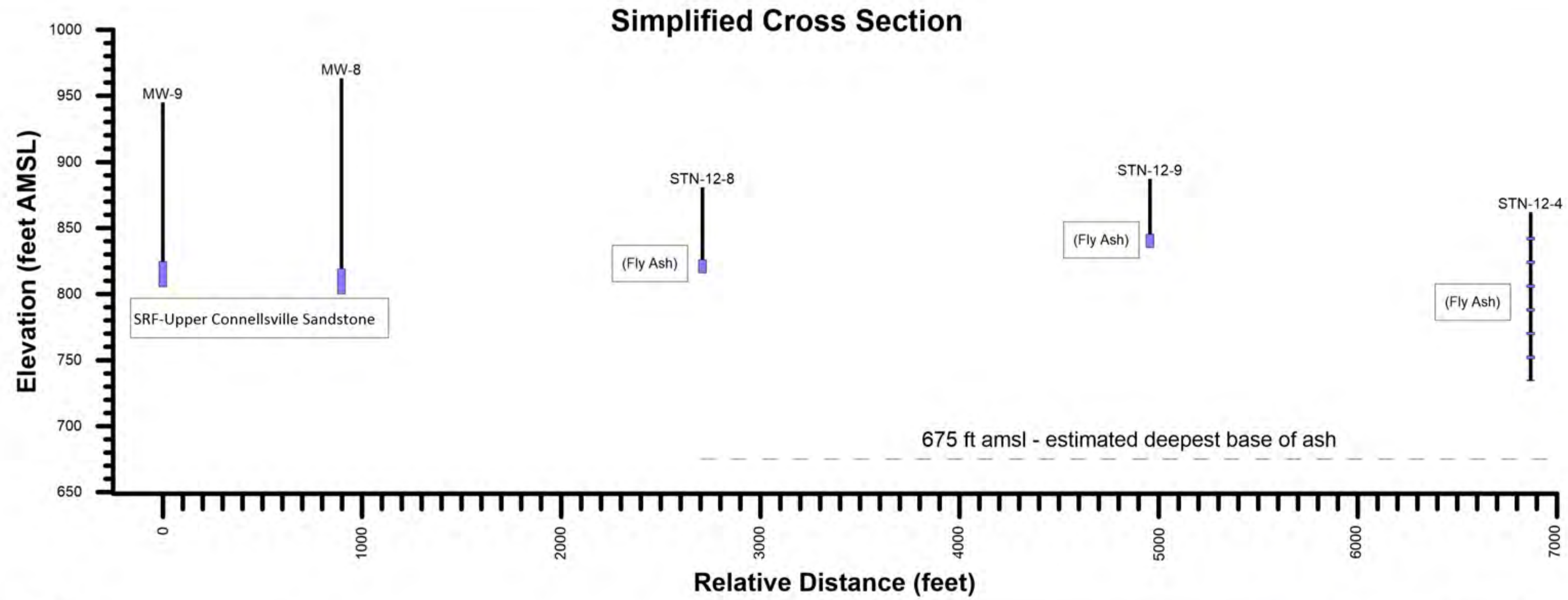
VERTICAL SCALE: 1" = 100'
HORIZONTAL SCALE: 1" = 1000'

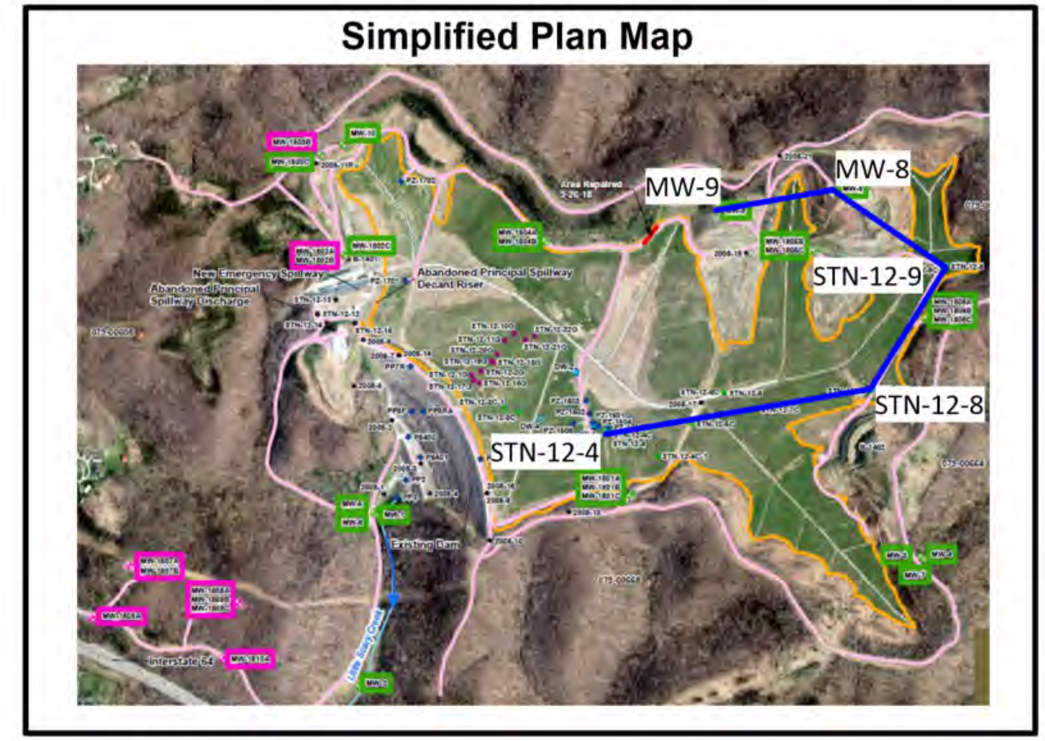
AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

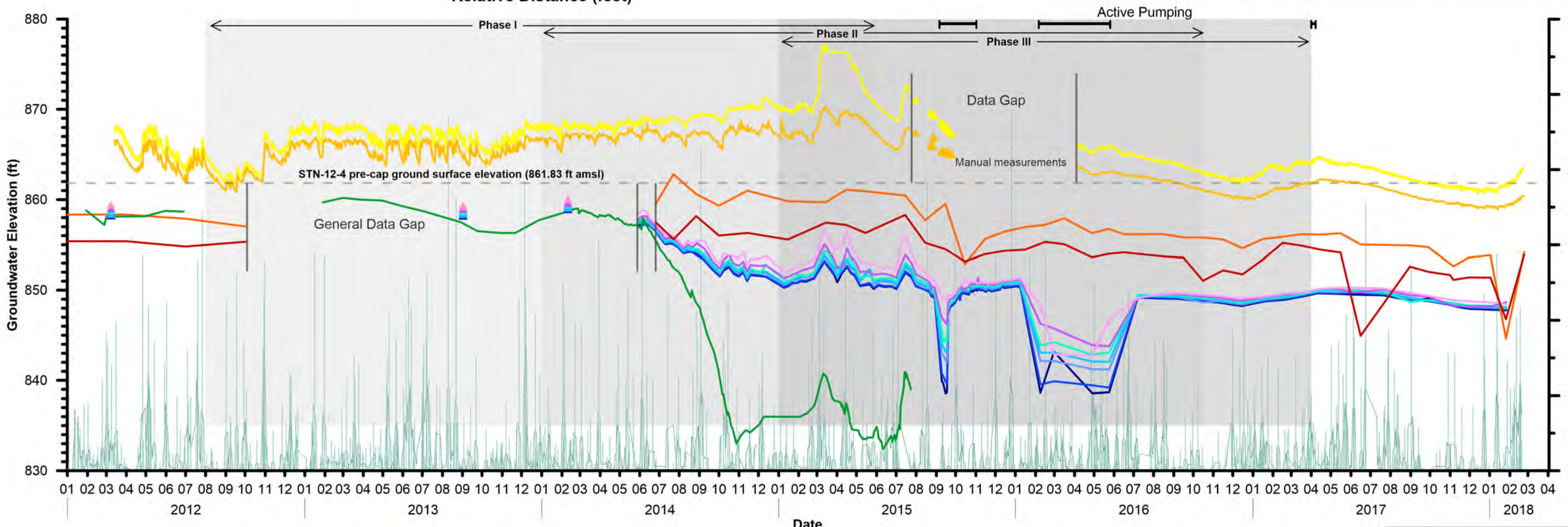
CROSS SECTIONS A-A', B-B' AND C-C'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6







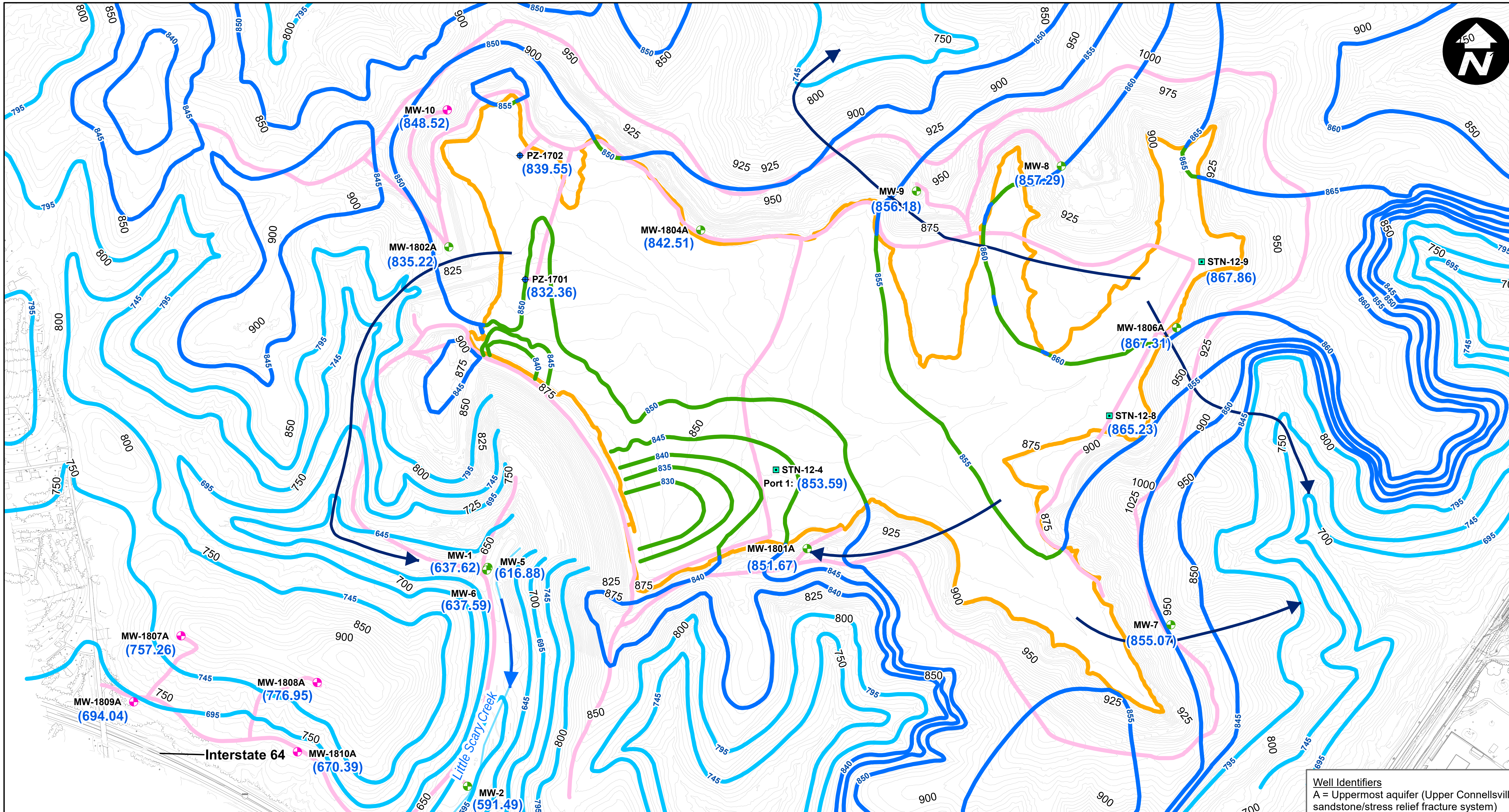
Note: 1) Barometric efficiency (BE) applied to STN-12-8 and STN-12-9 after initiation of Phase I capping
2) Precipitation are daily summaries from the Saint Albans, WV NOAA weather station: USC00467852
3) ft = feet (vertical datum is NAVD 88)
4) amsl = above mean sea level

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

Fly Ash Pond
Comprehensive Hydrograph

ARCADIS Design & Consultancy for natural and built assets

FIGURE
7



LEGEND:

- CCR Unit Boundary
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- Rivers and Streams
- Stream Flow Direction
- Access Road
- Potentiometric Surface Contour Lines (ft amsl) 5-ft Interval
- Simulated Potentiometric Surface Contour Lines (ft amsl) 50-ft Interval
- (848.52) Observed Groundwater Elevation* - 10/22/18
- Fly Ash Pond Water Contour Lines (ft amsl) 5-ft Interval
- Groundwater Flow Direction

* Water levels in Upper Connellsville sandstone and SRF monitoring wells are displayed and designated by the A well modifier and previous installed wells (MW-1, 2, 5, 6, 7, 8, 9, 10). Simulated groundwater flow from the calibrated numerical groundwater flow model for the Upper Connellsville sandstone and SRF system for October 2018 steady state conditions was used to guide understanding of and extrapolation of overall conditions based on the complexity and interaction with the water level in the fly ash pond, recharge and utilizing the regional groundwater flow Appalachian SRF conceptual site model (USGS, 1981). The simulated conditions closely match the monitoring well network; however, actual water levels may be slightly displaced relative to the contour interval.

NOTES:
1. Topography from AEP dwg no. 13-30705-0 and 3dAMtopo_FAP11_aerial05.dgn. Contour Interval: 10 feet (2 feet within CCR unit boundary)
2. FAP monitor well coodinate source: AEP Drawing No. 13-30702-1
3. West Virginia 1983 State Planar Coordinates

REFERENCES:

United States Geological Survey (USGS), 1981. Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. Water-Supply Paper 2177.

0 600 1,200 Feet
GRAPHIC SCALE

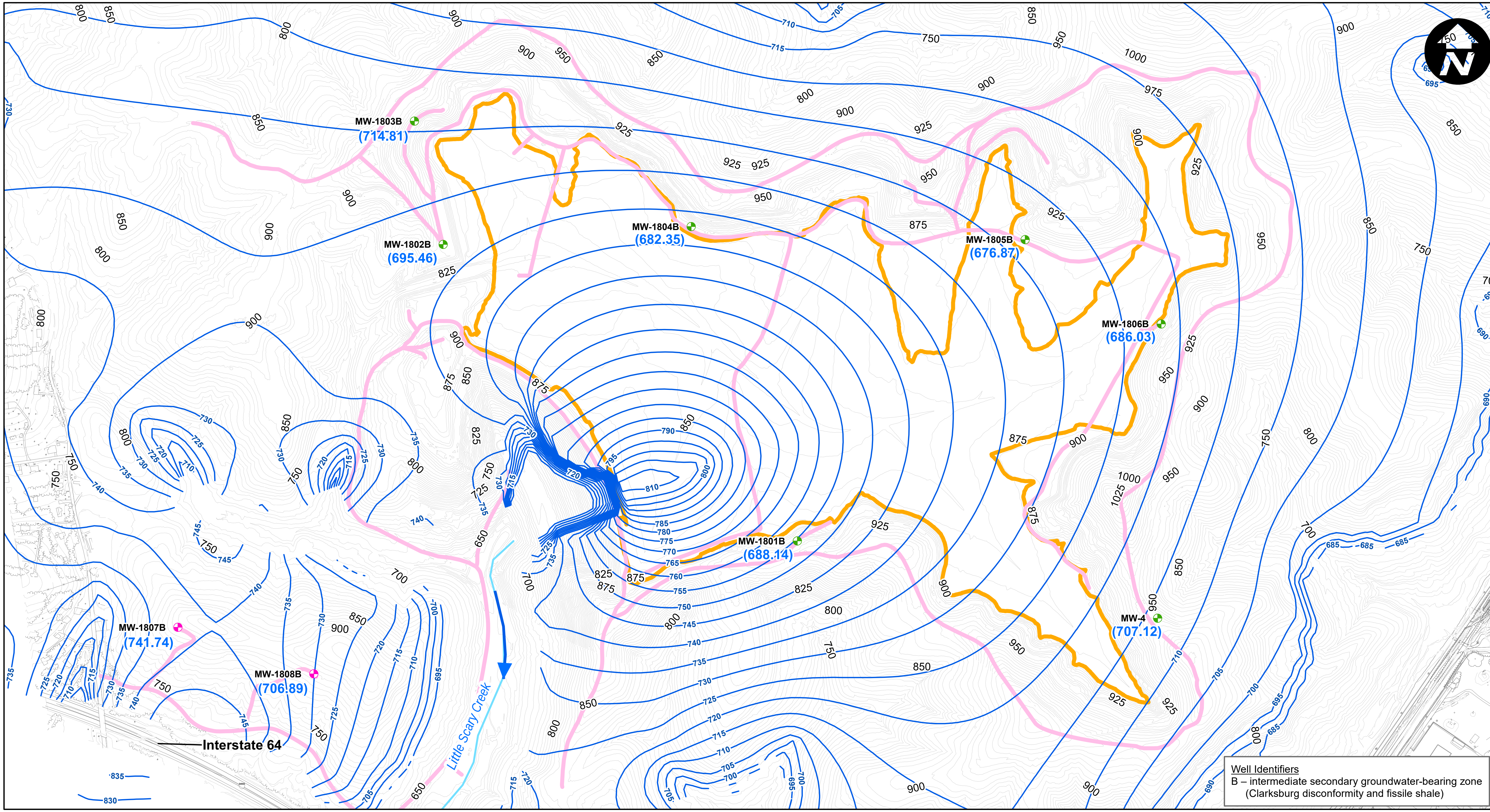
AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

POTENTIOMETRIC SURFACE MAP
UPPERMOST AQUIFER
(UPPER CONNELLSVILLE SANDSTONE AND SRF)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8A

City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F8A_POT_ShallowGWZone_SRF_Connellsville.mxd 4/11/2019 12:38:59 PM



City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F8B_POT_IntermediateGWZone_Clarksburg.mxd 4/11/2019 12:50:37 PM

LEGEND:

- CCR Unit Boundary
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Rivers and Streams
- Stream Flow Direction
- Access Road
- Simulated Potentiometric Surface Contour Lines (ft amsl)
- (848.52) Observed Groundwater Elevation* - 10/22/18

* Groundwater levels at monitoring wells are still recovering from well installation and development activities and do not reflect equilibrium conditions. The simulated groundwater contours are estimated based on a calibrated transient groundwater flow model (MODFLOW).

NOTES:
1. Topography from AEP dwg no. 13-30705-0 and 3dAMtopo_FAP11_aerial05.dgn. Contour Interval: 10 feet (2 feet within CCR unit boundary)
2. FAP monitor well coodinate source: AEP Drawing No. 13-30702-1
3. West Virginia 1983 State Planar Coordinates

REFERENCES:
United States Geological Survey (USGS), 1981.
Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. Water-Supply Paper 2177.

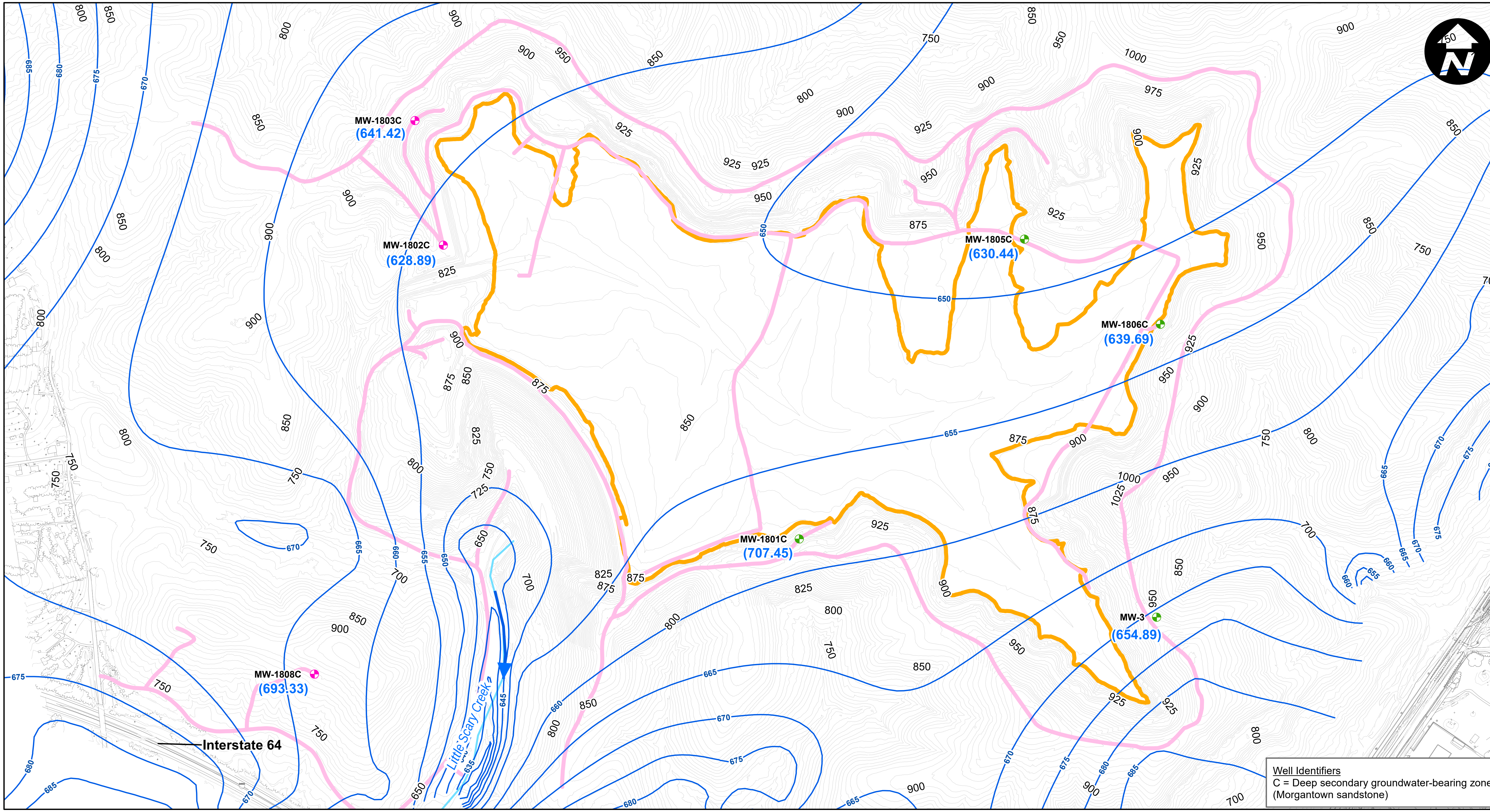
0 600 1,200 Feet
GRAPHIC SCALE

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

SIMULATED POTENTIOMETRIC SURFACE MAP INTERMEDIATE SECONDARY GROUNDWATER-BEARING ZONE (CLARKSBURG DISCONFORMITY AND FISSILE SHALE)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8B



LEGEND:

- CCR Unit Boundary
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Rivers and Streams
- Stream Flow Direction
- Access Road
- Simulated Potentiometric Surface Contour Lines (ft amsl)
- (848.52) Observed Groundwater Elevation* - 10/22/18

* Groundwater levels at monitoring wells are still recovering from well installation and development activities and do not reflect equilibrium conditions. The simulated groundwater contours are estimated based on a calibrated transient groundwater flow model (MODFLOW)

NOTES:
1. Topography from AEP dwg no. 13-30705-0 and 3dAMtopo_FAP11_aerial05.dgn. Contour Interval: 10 feet (2 feet within CCR unit boundary)
2. FAP monitor well coodinate source: AEP Drawing No. 13-30702-1
3. West Virginia 1983 State Planar Coordinates

REFERENCES:
United States Geological Survey (USGS), 1981.
Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. Water-Supply Paper 2177.

0 600 1,200 Feet
GRAPHIC SCALE

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

SIMULATED POTENTIOMETRIC SURFACE MAP
DEEP SECONDARY GROUNDWATER-BEARING ZONE
(MORGANTOWN SANDSTONE)

ARCADIS Design & Consultancy for natural and built assets

FIGURE
8C

City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F8C_POT_DeepGWZone_Morgantown.mxd 3/29/2019 1:39:45 PM

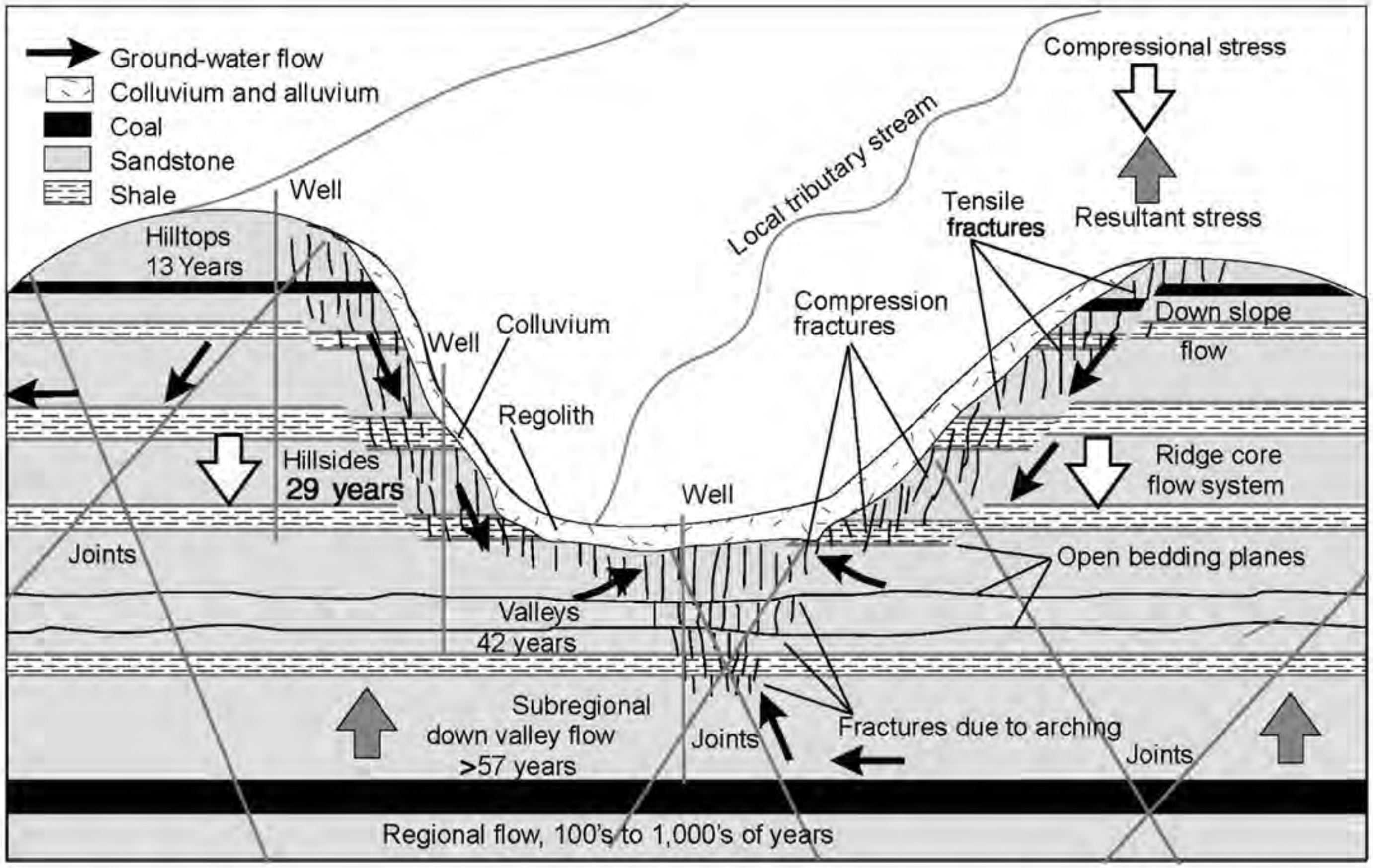


Figure 3. Revised conceptual model of ground-water flow in an Appalachian Plateaus fractured-bedrock aquifer including apparent age of ground water (Modified from Wyrick and Borchers, fig. 3.2-1, 1981 and Kozar, 1998).

References:

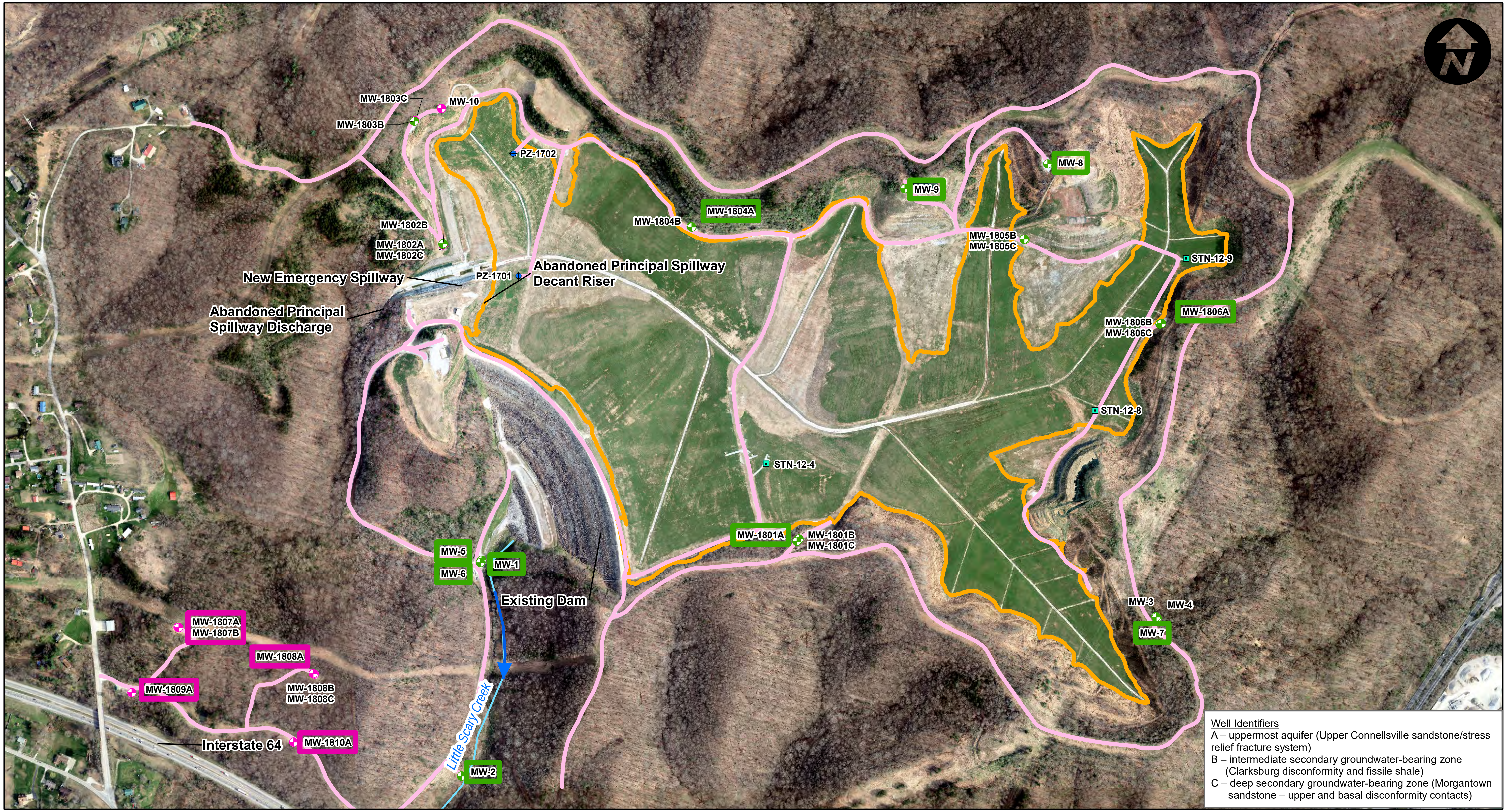
- United States Geological Survey (USGS), Wyrick, G.D. and J.W. Borchers, 1981. Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. Water-Supply Paper 2177.

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

STRESS RELIEF FRACTURE SYSTEM CONCEPTUAL SITE MODEL

ARCADIS Design & Consultancy for natural and built assets

FIGURE 9



Well Identifiers
A – uppermost aquifer (Upper Connellsville sandstone/stress relief fracture system)
B – intermediate secondary groundwater-bearing zone (Clarksburg disconformity and fissile shale)
C – deep secondary groundwater-bearing zone (Morgantown sandstone – upper and basal disconformity contacts)

LEGEND:

- CCR Unit Boundary
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Downgradient Monitoring Well - Hydraulic Monitoring Only
- Upgradient or Background Monitoring Well - Hydraulic Monitoring Only
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- Rivers and Streams
- Stream Flow Direction
- Access Road

NOTES:
1. 2018 aerial imagery obtained from AEP.
2. FAP monitor well and STN boring coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer coordinate source: AEP-provided boring logs.
4. West Virginia 1983 State Planar Coordinates

0 600 1,200 Feet
GRAPHIC SCALE

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

MONITORING WELL NETWORK MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
10

City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\ImpoundmentReport\F10_MonitoringWell_Network_v2.mxd 4/11/2019 1:07:30 PM

APPENDIX A

Field Methodology

APPENDIX A

FIELD METHODOLOGY

Based on the recommended well network modifications, the following generalized tasks were completed:

- Installation of 22 bedrock borings
- Installation and development of 22 new monitoring wells
- The redevelopment of 9 existing monitoring wells

Arcadis provided oversight for drilling of 22 bedrock borings that resulted in installation of 22 monitoring wells by an AEP-licensed drilling crew. Implementation of the field activities began with the initial utility clearance activities beginning November 2017. Additional utility location was completed in 2018. Drilling operations began on December 4, 2017 and ended on May 31, 2018. Well development and yield testing began in April 2018 and continued to July 2018.

Staking, Surveying, and Utilities Clearance

AEP oversaw the installation of approximately 20 feet by 20 feet gravel well pads to provide a stable area and working room for the drill rig to drill and install the new monitoring wells. AEP also repaired and added access roads to allow access to each of the new well locations. All proposed new monitoring well locations were staked by an AEP subcontractor, DLZ, prior to utility clearance and commencement of drilling. DLZ surveyed the spatial northing and easting coordinates as well as the ground surface elevation of each staked monitoring well location prior to drilling. The accuracy of elevation measurements was at least to the nearest 0.01 foot. An Arcadis representative contacted 8-1-1 to assess the presence of underground utilities near the new monitoring well and boring locations prior to drilling activities. AEP completed a plant dig permit, which identified private plant utilities near the new monitoring well and borings locations. Arcadis retained the services of a utility locating subcontractor (The Underground Detective) to perform a geophysical survey (e.g. ground penetrating radar, electromagnetic survey, etc.) over an area of 25 feet by 25 to locate utilities at each new monitoring well location. The private utility locator also used an air knife/soil vacuum extraction system to pre-dig the proposed borehole locations to a diameter at least 10 percent larger than the largest diameter tooling to be used during drilling and to a depth of 8 feet below the ground surface (bgs) or to bedrock, whichever was encountered first.

Decontamination

All down-hole tools or equipment were decontaminated in accordance with ASTM D5088 prior to the start of drilling and between each borehole location. At a minimum, the tooling was washed with detergent solution followed by a potable water rinse. The use of a pressure washer was used when possible. Containerization was not required for decontamination water because all work was completed outside of the Fly Ash Pond area and not considered contaminated. Water for decontamination or drilling was potable and obtained from the AEP Amos Plant.

Borehole Advancement and Stratigraphy/Lithology

Bedrock boreholes began by using standard hollow-stem auger methods with a minimum 8.25" inner diameter auger in accordance with ASTM D5784 until the soil-rock interface was encountered. Continuous spit-spoon sampling and standard penetration testing was performed in accordance with ASTM D1586 until bedrock was encountered. A minimum 6-inch diameter PVC surface casing was temporarily set 2 feet into the competent bedrock prior to beginning rock coring. Bentonite chips were placed in the annulus between the borehole and the surface casing to ground surface, serving as a temporary seal around the surface casing during drilling operations. The chips were placed in a controlled manner to prevent contamination of the well. Chips were hydrated periodically during placement. The bentonite annulus seal was allowed to set for approximately 12 hours (overnight) before continuing with rock coring. The 6-inch PVC casing was removed upon installation of the permanent well casing.

Rock core samples were completed with NQ sized wireline system in accordance with ASTM D 2113-93. Upon completion of coring, the bore holes were enlarged to 6" diameter using rotary drilling methods in accordance with ASTM D 5783-95.

Arcadis logged all geologic samples collected during the drilling process for bedrock monitoring wells. Field logging of the soil and rock samples were performed in accordance with ASTM D5434-12. Unconsolidated soils were classified under the Unified Soil Classification System (USCS), while rock core logging was classified in accordance with the *Midwest Geosciences Group; Field Guide for Rock Core Logging and Fracture Analysis*. Boring logs and well construction details for all installations completed during this scope of work are provided in **Appendix B**. No unconsolidated soil samples were collected. Rock coring was completed continuously using a NQ wireline system that retrieved a 2-inch diameter core to the termination depth. The borehole was flushed to remove any remaining drilling debris.

Packer Testing and Downhole Geophysics

To assist in locating the discrete water-bearing units, a combination of packer testing and downhole geophysical surveys was conducted.

Prior to geophysical logging, single-straddle packer tests were conducted on select intervals of the open core holes. Final determination of intervals for packer testing was determined based on review of lithologic boring logs, and consultation between Arcadis and AEP. At a minimum, straddle packer testing was completed at the anticipated depth interval corresponding to monitoring well screen depths. Upper and lower inflatable rubber packers attached to a rigid riser pipe were inserted to the specified test interval. Once at the test interval, the rubber packers were inflated to create a seal. The riser pipe was fitted with a pressure gauge at a known and documented distance above the ground surface, as well as a totalizing flow meter. Water was injected through the riser pipe at a constant pressure, while the Arcadis representative measured and recorded totalizing flow volume and gauge pressure at specified time intervals for a total of up to 30 minutes per each pressure. At the completion of the straddle packer test, water injection ceased and gauge pressure was monitored until it returned to pre-test conditions. Once gauge pressure stabilized, the packers were deflated and either removed from the borehole or to the next specified depth interval to repeat the straddle packer test procedure. Straddle packer test data was analyzed according to the method described in U.S. Department of the Interior, Bureau of Reclamation, 1977. Ground Water Manual, A Water Resources Technical Publication, pp. 258-264. After packer testing, the core hole was reamed to 8-inch diameter using air rotary drilling methods and water injections to remove cuttings in accordance with ASTM D 5782-95-Use of Direct Air Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices. The bedrock boreholes were flushed of cuttings at the completion of reaming using potable water. The final borehole depth was confirmed via tagline measurement following borehole flushing.

Geophysical logging occurred upon completion of packer testing, after the borehole was reamed to 8" diameter. These activities would typically be completed in the reverse order. However, this sequencing was necessary due to a highly weathered bedrock unit that continuously collapsed at many of the boreholes around a depth of approximately 200' bgs. Geophysical logging was performed by an AEP-selected contractor, Marshall Miller & Associates. Five boreholes were selected to undergo downhole geophysical logging. The purpose was to assist with well design and obtain more detailed information on transmissive groundwater zones of the saturated units (e.g., bedrock type, fractures, permeability and porosity). The locations were selected based on lithology, packer testing results, saturated unit and location. The following suite of instrumentation was included during geophysical logging:

- Acoustical Televiewer
- Natural gamma, density, guard resistivity, caliper
- Natural gamma, temperature, delta temperature, fluid conductivity, 16-64 normal resistivity, lateral resistivity, spontaneous potential, single point resistance.
- Natural gamma, neutron porosity, single point resistance, deviation.

Data from the geophysical testing was analyzed by Marshall Miller and Arcadis and is presented in **Appendix G**.

Monitoring Well Installation and Construction

Monitoring well installation and construction was completed in accordance with the AEP- approved work plan prepared by Arcadis following an initial review of the Site monitoring well network. The work plan was prepared using West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011 and American Society of Testing Material (ASTM) standards, where referenced, as guidance. Arcadis directed the drilling and installation of the identified up and down gradient monitoring wells. AEP installed the wells with some late support from DLZ who was directly contracted through AEP. Drilling activities began on December 4, 2018. Prior to beginning work, daily health and safety meetings were held each morning, including a thorough discussion of the day's scope of work, identified hazards, hazard mitigation, and completion of the AEP Job Safety Analysis documentation in the presence of AEP staff. Health and safety documentation was retained by both Arcadis and AEP.

Based on the field conditions, Arcadis directed AEP regarding the total drilling and well completion depths, well construction configuration, and well materials to be used. Screened intervals for bedrock monitoring wells targeted the Upper Connellsville sandstone, stress relief fracture system, Clarksburg shale disconformity, and Morgantown sandstone. Final well depths and screened intervals are included in **Table 4**.

All monitoring wells were constructed in general accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011.

Bedrock monitoring wells were constructed of 2-inch Schedule 40 PVC risers and screens. The well was double-cased, with a 6-inch PVC surface casing installed into the upper two feet of bedrock. The surface casing was grouted in place using a bentonite grout. Well screens were constructed of 20 slot (0.020 ft screen openings) PVC. A primary filter pack of Global® #5 sand was placed across the screened interval to approximately 2 feet above the screen, followed by approximately 1 foot of secondary (finer gradation) filter pack composed of Global® #6 sand.

Boring logs and well construction diagrams are provided in **Appendix B**. **Table 4** provides a summary of the well construction details of all wells in the current monitoring well network.

Monitoring Well Development

Well development was completed at all newly-installed wells, as well as existing wells to be retained in the monitoring well network. At existing wells, the wells were purged with a bladder pump to remove dislodged material from the well. Well development at new wells was performed a minimum of 48 hours after the completion of well construction. The static water level was measured in the well prior to initiation of development. All wells were developed through a pump and surge method in accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011. The well was initially purged with a pump to remove loose material and fines from the well. Due to poor water production and quality in the new wells, all of the wells had to be developed multiple times over multiple days. Wells where visual clarity remained poor during pumping were flushed using potable water in an attempt to remove the sediment in the sand pack and well.

New wells that did achieve good visual clarity (i.e., were clear) from development and flushing underwent a final pumping cycle to meet the following criteria: 1) a minimum of 10 casing volumes were purged from the well, and 2) field water quality parameters including temperature, pH, conductivity, oxidation-reduction potential, and turbidity were stable within applicable criteria (temperature stabilizes within ±0.50C, pH stabilizes within ±0.2 units, conductivity stabilizes within ±3 percent, and turbidity is less than 100 nephelometric turbidity units). Well development data are included as **Appendix D**.

APPENDIX B

Boring/Well Construction Logs

ARCADIS

Electric Power Research Institute, 1999

Boring Logs

MW-1 to MW-10

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER		BORING NO.	D=MW-01 DATE 8/27/07 SHEET 1 OF 5
COMPANY		BORING START	BORING FINISH 7/27/95
PROJECT	EPRI GROUND WATER STUDY - AMOS	PIEZOMETER TYPE	WELL TYPE OW
COORDINATES	N 531,275.0 E 1,724,355.0	HGT. RISER ABOVE GROUND	2.2 DIA 2.0
GROUND ELEVATION	647.6 SYSTEM STATE PLANE	DEPTH TO TOP OF WELL SCREEN	41.1 BOTTOM 50.0
		WELL DEVELOPMENT	YES BACKFILL QUICK GROUT
		FIELD PARTY	TJH=REB RIG CME-75

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										AUGERED TO 2'		
									GM	**GRAY ROCK FRAGMENTS, GRAVEL, SILT,** DRY, (FILL).		
									ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 3\4), Moist.		
										AUGERED TO 7.0'		
							5					
									ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 4\8) LIGHT BROWN (5YR 5\6 AND MODERATE BROWN (5YR 3\4), TRACE FELDSPAR, MOIST.		
										AUGERED TO 12.0'		
							10					
									ML	**SAME AS ABOVE**		
									CL	**SILTY CLAY**, PALE YELLOWISH BROWN (12YR 6\2) AND LIGHT OLIVE GRAY (5YR 5\2), LOW TO MEDIUM PLASTICITY, MOIST.		
										AUGERED TO 17.0'		
							15					
									SC	**CLAYEY-SILTY FINE SAND**, DUSKY YELLOWISH BROWN (10 YR 2\2),MOIST TO WET.		
										AUGERED TO 22.0'		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
X	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **D.BENNETT**

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-01** DATE **8/27/07** SHEET **2** OF **5**

BORING START BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
								SC	**SAME AS SAMPLE No. 4**	
								SW	**MEDIUM TO COARSE SAND**, LIGHT BLUISH GRAY (5B 7\1), MOIST. AUGERED TO 23.9' - AUGERED THROUGH OBSTRUCTION (ROCK?) **MORGANTOWN SANDSTONE?**, GRAY. 24.0 - 25.0' Solid, light gray, (N-7) 25.0 - 26.0' Fractured, brown clay lined fractures, light gray (N-7). 26.0 - 27.0' Minimal fractures 27.0 - 27.7' Fractured, weathered, very fine dark gray (N-3) bedding. 27.7 - 29.8' Light gray (N-7) sandstone	
							25			
							30		29.8 - 33.8' Light gray (N-7) sandstone	
										33.0 Top of bentonite seal
									CLAY SHALE, MEDIUM GRAY (N4) MOIST, VERY SOFT.	
							35		**CLAY SHALE**, GRAYISH BROWN (5YR 3\2), MOIST, VERY SOFT.	
									CLAY SHALE, LIGHT OLIVE GRAY (5Y 5\2) MEDIUM LIGHT GRAY (N6), SOFT, MODERATE WEATHERING.	
									SHALE, MEDIUM BLUISH GRAY (5B 5\1), TRACE IRREGULAR BEDDING PLANES, SOFT.	38.0 Top of sand pack.
							40		**SAME AS ABOVE**	
										41.1 Top of screen.
									SAME, WITH MODERATE BROWN (5YR 3\4) BEDDING PLANES, MEDIUM TO HIGHLY FRACTURED, MODERATE WEATHERING.	
									SHALE, MEDIUM BLUISH GRAY 5Y 5\2), SLIGHT TO MODERATE WEATHERED	
							45		**CLAY SHALE**, PALE BROWN (5YR 5/2), TO DARK YELLOWISH BROWN (10YR 4/2) AND	

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-01** DATE **8/27/07** SHEET **3** OF **5**

BORING START BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										LIGHT OLIVE GRAY (5YR 4/2), SOFT, SOME IRREGULAR BEDDING PLANES		
							50					50.0 Bottom of screen.
												51.1 Bottom of sand.
							55					
										SAME EXCEPT VERY SOFT		
							60			**CLAYEY SILT**, DARK YELLOWISH BROWN (10yr 4\2), MOIST - WET		
										SAME, VERY WEATHERED, SOFT		
										CLAY SHALE, PALE BROWN (5YR 5\2), SLIGHTLY WEATHERED		
							65					
										SAME, SOME MODERATELY WEATHERED, SOFT		
										SAME, VERY WEATHERED, VERY SOFT		
										SAME, MODERATELY WEATHERED, SOFT		
										SHALE, MEDIUM GRAY (N5), SOFT.		
							70			**SAME**		
										CLAY SHALE, PALE BROWN (YR 5\2) AND		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-01** DATE **8/27/07**

BORING START BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM GRAY (N5), MODERATELY WEATHERED, SOFT.		
							75					
										SHALE, PALE BROWN (5YR 5\2) AND LIGHT OLIVE GRAY (5Y 5\2), IRREGULAR BEDDING, WEATHERED, SOFT.		
							80			**SAME**, SOME SEDIMENT FILLED FRACTURES		
							85					
										SHALE, GRAYISH OLIVE (10 YR 4\2) AND MODERATE BROWN (5YR 3\4), INTERBEDDED LAYERS, SOFT, SLIGHTLY WEATHERED.		
							90			**SAME**, EXCEPT WEATHERED		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), WITH SOME INTERBEDDED BROWNISH GRAY (5YR 4\1) COLOR, SLIGHTLY WEATHERED, SOFT		
							95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-01** DATE **8/27/07** SHEET **5** OF **5**

BORING START BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							100			**SAME**, EXCEPT WEATHERED		
										SHALE, MEDIUM BLUISH GRAY 5B 5\1), SLIGHTLY WEATHERED, SOFT		
							105			**SANDSTONE**, MEDIUM BLUISH GRAY (5B 5\1), SLIGHTLY WEATHERED AT 104', SOFT.		
							110			**SAME**, SOFT		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), SOFT.		
										SHALE, MEDIUM DARK GRAY, SOFT, WEATHERED, VERY FRACTURED.		
										CLAY SHALE, GRAYISH BROWN (5YB 3\2), WEATHERED, SOFT TO VERY SOFT, FRACTURED.		
										114.8 BOTTOM OF HOLE		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 529,941.0 E 1,724,235.0**

GROUND ELEVATION **645.2** SYSTEM **STATE PLANE**

BORING NO. **D=MW-02** DATE **8/27/07** SHEET **1** OF **6**

BORING START **7/12/95** BORING FINISH **7/27/95**

PIEZOMETER TYPE WELL TYPE **OW**

HGT. RISER ABOVE GROUND **1.9** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **96.1** BOTTOM **105.0**

WELL DEVELOPMENT **YES** BACKFILL **QUICK GROUT**

FIELD PARTY **MCR=REY=TJH-REB** RIG **BK-81**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										AUGERED TO 1.8'		
1	SS	1.8	3.3	7-6-6	12"				SW	**SILT, FINE SAND AND GRAVEL**, Moderate brown (5yr 4\4), gray rock fragments to 2.3'		
									GP	**ROCK FRAGMENTS**, Light olive gray (5y 5\2), feldspar present, dry		
										AUGERED TO 6.3'		
							5					
2	SS	6.3	7.8	2-2-3	4"				ML	**CLAYEY SILT AND GRAVEL**, Moderate brown (5yr 4\4), with light olive gray (5y 5\2) rock fragments, moist-dry.		
										AUGERED TO 11.3'		
							10					
3	SS	11.3	12.8	3-3-4	12"				ML	**Same as sample no. 2**		
										AUGERED TO 16.3'		
							15					
4	SS	16.3	17.8	2-2-3	11"				CL	**SILTY CLAY AND GRAVEL**, moderate brown (5yr 4/4), with light olive gray (5y 5/2) rock fragments, moist		
										AUGERED TO 21.3'		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **D. BENNETT**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER ____________

COMPANY ____________

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-02** DATE **8/27/07** SHEET **2** OF **6**

BORING START **7/12/95** BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
5	SS	21.3	22.8	5-7-5	10"			CL	**Same except moist wet.**	
								SM	**SILTY MEDIUM TO COARSE SAND**, Greenish olive (10 y 4\2), feldspar, rock fragments at bottom, moist to wet AUGERED TO 26.3'	
							25			
6	SS	26.3	27.8	5-6-5	15"			CL	**SILTY CLAY**, Moderate brown (5yr 4\4) and greenish olive (10y 4\2), gravel, feldspar, rock fragments, moist. AUGERED TO 31.3'	
							30			
7	SS	31.3	32.8	5-5-5	18"			SM	**CLAYEY SILT AND FINE SAND**, Moderate brown (5yr 4\4) and medium gray (n5), moist to wet.	
								SM	**CLAYEY SILT AND FINE SAND**, Medium bluish gray (5b 5\1), feldspar, rock fragments, moist to wet AUGERED TO 36.3	
							35			
8	SS	36.3	37.8	11-8-10	18"			SM	**Same as sample no 7 except wet.**	WIL'S at 36.3
								SW	**MEDIUM TO COARSE SAND**, Medium bluish gray (5b 5\1), feldspar, rock fragments, moist. AUGERED TO 41.3'	
							40			
9	SS	41.3	42.4	26-47-50/.1	12"				**CLAYEY SHALE**, Moderate brown (5yr 4\4), moist to dry, medium bluish gray (5b 1\1) clayey shale rock piece at bottom. AUGERED TO 44.1'	
10	SS	44.1	44.3		1"				**CLAY SHALE**, Bluish gray (5B 5\1),rock pieces.	Drill notes entire overburden was fill.
1	NQ	44.3	49.8		5.5	55	45		**CLAYEY SHALE**, DARK YELLOWISH BROWN (10YR 4\2),very soft, weathered.	

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-02** DATE **8/27/07** SHEET **3** OF **6**

BORING START **7/12/95** BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	NQ	49.8	54.8		4.85	76	50			**CLAYEY SHALE**, GRAYISH RED (5R 4\2) AND TRACE LIGHT OLIVE BROWN (5Y 5\6), very soft to soft, very weathered.		49.8 Getting alternating water return of brown and red.
3	NQ	54.8	59.8		2.9	48	55			**Same, except very weathered**		54.8 Red water return.
4	NQ	59.8	64.8		4.0	44	60			**Same**		
5	NQ	64.8	74.8		8.75	67	65			**Same except, except soft, fairly weathered.**		
							70					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-02** DATE **8/27/07** SHEET **4** OF **6**

BORING START **7/12/95** BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
								CLAY SHALE, GRAYISH RED (10 R 4\2), very soft, weathered.	
6	NQ	74.8	80.8		5.9	51	75	**Same, numerous sediment filled fractures.**	
									77.7 Top of seal.
							80		
7	NQ	82.2	84.8		2.6	33		**CLAY SHALE**, GRAYISH RED (1O R 4\2), soft, weathered.	
8	NQ	84.8	94.3		9.5	86	85		84.7 Top of sand.
									Brown water return 86.5.
								SHALE, MEDIUM BLUISH GRAY (5B 5\1), Some laminations, slightly weathered with exception to fractures.	
							90		Fracture at 90.5' to 91' and 92'.
9	NQ	94.3	99.8		5.5	45		**SHALE**, MEDIUM BLUISH GRAY (B 5\1), some laminations, some calcite pockets, slightly weathered.	
							95		
									96.1 Top of screen. 96.2 Lost water return.
								Same except weathered\fracture zone (97.0 to 98.0)	

Continued Next Page

JOB NUMBER ______

COMPANY ______

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-02** DATE **8/27/07** SHEET **5** OF **6**

BORING START **7/12/95** BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
10	NQ	99.8	109.8		10.0	58	100			**SHALE**, MEDIUM BLUISH GRAY (5B 5\1), little laminations, soft.		
							105					105.0 Bottom of screen.
										CLAY SHALE, OLIVE GRAY (5YR 4\1) AND BROWNISH GRAY (5YR 4\1) sediment filled fractures, weathered, very soft.		
										CLAY SHALE, MODERATE BROWN (5YR 4\4), weathered, soft.		
11	NQ	109.8	115.8		5.5	30	110			**Same except very soft to soft, sediment filled fractures.**		
												111.0 Bottom of sand.
												113.4 Bottom of seal.
							115					
12	NQ	115.8	124.8		8.9	94				**SHALE**, MEDIUM BLUISH GRAY (5YR 5\1), laminated, soft. **Same except slightly weathered.** **Same as 115.8 to 116.5**		
							120					
										120.9' - 121.0' LIGHT BLUISH GRAY SILTY CLAY FILLED FRACTURE (5b 7\1). **Same as 115.8 to 120.9**		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-02** DATE **8/27/07** SHEET **6** OF **6**

BORING START **7/12/95** BORING FINISH **7/27/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	NQ	124.8	129.8		?		125			**SHALE**, MEDIUM BLUISH GRAY (5B 5\1), Laminated, soft.		Never got back water.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER			
COMPANY		BORING NO. D=MW-03	DATE 8/27/07 SHEET 1 OF 13
PROJECT	EPRI GROUND WATER STUDY - AMOS	BORING START	BORING FINISH 8/10/95
COORDINATES	N 530,928.0 E 1,728,546.0	PIEZOMETER TYPE	WELL TYPE OW
GROUND ELEVATION	953.0 SYSTEM STATE PLANE	HGT. RISER ABOVE GROUND 2.3	DIA 2.0
		DEPTH TO TOP OF WELL SCREEN 280.2	BOTTOM 309.1
		WELL DEVELOPMENT YES	BACKFILL QUICK GROUT
		FIELD PARTY TJH-REB	RIG CME-75

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										LIGHT OLIVE-BROWN (5Y,5/6) SILTY FINE SAND, ROCK FRAGMENTS, FELDSPAR, DRY		
							5					
										SAME, SHALE-LIKE, TRACE BLACK COAL SEAMS, DRY		
							10					
										SAME		
										LIGHT OLIVE BROWN (5Y 5/6) CLAY SHALE, WEATHERED, NUMEROUS FRACTURES, ABUNDANT FILLED FRACTURES.		
							15					
										MEDIUM LIGHT GRAY (N6) LIMESTONE, LAMINATED, SLIGHTLY WEATHERED		

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER D. BENNETT

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **2** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										SAME EXCEPT WEATHERED AND FRACTURED		
							25			**MODERATE BROWN (5YR4/4) CLAY SHALE**, VERY WEATHERED, FRACTURED		
							30			**MEDIUM LIGHT GRAY (N6) SANDSTONE**, MEDIUM GRAINED, SLIGHTLY WEATHERED		
							35 40			**MEDIUM LIGHT GRAY (N6) SANDSTONE**, MEDIUM TO COARSE GRAINED, LAMINATED, SLIGHTLY WEATHERED		
							45			**MEDIUM GRAY (N5) COARSE SANDSTONE**, BLACK LAMINATIONS, SLIGHTLY WEATHERED		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **3** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							50					
										MEDIUM GRAY (N5) CLAYSHALE, WEATHERED, FRACTURED		
										GRAYISH-RED (5R4/2) CLAY SHALE, WEATHERED, FRACTURED		
							55					
										MEDIUM GRAY (N5) CLAY SHALE, WEATHERED, FRACTURED		
										MEDIUM GRAY (N5) LIMESTONE		
							60			WEATHERED ZONE 60.5'-60.6 SHALEY 60.6'- 60.8'		
										MEDIUM GRAY (N5) SHALE, SOME LAMINATIONS, SLIGHTLY WEATHERED		
							65					
										GRAYISH RED (5R4/2) CLAY SHALE, WEATHERED, SEDIMENT FILLED FRACTURES		
							70					
										INTERBEDDED MEDIUM GRAY (N5) AND GRAYISH RED (5R4/2) SHALE, SLIGHT TO		

Continued Next Page

JOB NUMBER
COMPANY
PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **4** OF **13**
BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MODERATELY FRACTURED AND WEATHERED		
							75					
										MEDIUM GRAY (N5) SHALE, SLIGHTLY WEATHERED		
							80					
										MEDIUM GRAY (N5) SANDSTONE, MEDIUM TO COARSE GRAIN, SOME INTERBEDDED CALCITE, SLIGHTLY WEATHERED		
							85					
										MEDIUM GRAY (N5) SHALE, LAMINATED, SOFT, SLIGHT TO MODERATELY WEATHERED, FRACTURED		
							90					
										MEDIUM GRAY (N5) SHALE, SOME LAMINATIONS, SLIGHTLY WEATHERED		
							95					

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **5** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										GRAYISH RED (5Y4/2) SHALE, MODERATELY FRACTURED AND WEATHERED, SOFT		
							100			SAME EXCEPT GRAYISH RED (5R5/2) AND MEDIUM GRAY (N5) SHALE, WEATHERED FROM 100.8 TO 101.2'		
										MEDIUM GRAY (N5) SHALE AND MEDIUM SANDSTONE, INTERBEDDED, LAMINATED, SLIGHTLY WEATHERED, SOME FRACTURES		
							105					
							110			**MEDIUM GRAY (N5) SANDSTONE**, MEDIUM TO COARSE GRAIN WITH INTERBEDDED SHALE, LAMINATED, SLIGHTLY WEATHERED		
							115					
							120			120.8 - 120.9 CLAY FILLED FRACTURE, YELLOWISH GRAY (5R7/2) 120.9 - 121.8' LIGHT OLIVE GRAY (5Y6/1) MEDIUM TO COARSE SANDSTONE, SLIGHTLY WEATHERED 121.8 - 122.2' MEDIUM DARK GRAY (N4) SHALE		

Continued Next Page

JOB NUMBER ______

COMPANY ______

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **6** OF **13**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING START ______ BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							125			122.2 - 122.5' MEDIUM GRAY (N5) CLAY FILLED FRACTURE 122.5 - 124.7' MEDIUM DARK GRAY (N4) CLAY AND MEDIUM SANDSTONE INTERBEDDED, SLIGHT TO MEDIUM WEATHERED 124.7 - 125.8 MEDIUM GRAY (N5) MEDIUM TO COARSE SANDSTONE, LAMINATIONS PRESENT 125.8 - 131.8 MEDIUM GRAY (N5) MEDIUM TO COARSE SANDSTONE, SOME LAMINATIONS, SLIGHTLY WEATHERED		
							130					
										MEDIUM DARK GRAY (N4) SHALE, LAMINATED, SLIGHTLY WEATHERED 134.2 - 134.8' FRACTURED, WEATHERED		
							135					
										MEDIUM DARK GRAY (N4) TO DARK GRAY (N3) SHALE, SLIGHT TO MODERATELY WEATHERED, LAMINATIONS PRESENT. 137.5 - 137.6' FRACTURED		
							140			140.5 - 142.2' FRACTURED		
							145					
										DARK GRAY (N3) TO DARK REDDISH BROWN (10R3/4) CLAY SHALE, VERY WEATHERED, VERY SOFT		
										DARK GRAY (N3) TO DARK REDDISH BROWN (10R3/4) CLAY SHALE, LAMINATIONS, SLIGHT TO MODERATELY WEATHERED.		

Continued Next Page

JOB NUMBER
COMPANY
PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **7** OF **13**
BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										DARK REDDISH BROWN 10R3/4) AND GRAYISH GREEN (10Y4/2) CLAY SHALE, VERY SOFT, SLIGHTLY WEATHERED, SOME CALCITE PRESENT		
							155					
										DARK REDDISH BROWN 10R3/4 AND GRAYISH GREEN (10Y4/2) CLAY SHALE, TRACE CALCITE, SOFT, MODERATELY FRACTURED AND WEATHERED		
							160					
										MEDIUM DARK GRAY (N4) SHALE, SOME CALCITE NODULES, SOME LAMINATIONS, SLIGHTLY WEATHERED		
							165					
										MEDIUM DARK GRAY (N4), DARK GRAY (N3) AND TRACE GRAYISH RED (10R4/2) SHALE AND FINE TO MEDIUM SANDSTONE, INTERBEDDED, SLIGHTLY WEATHERED		
										GRAYISH BROWN (10R4/2) CLAY SHALE, MODERATELY FRACTURED AND WEATHERED.		
							170					
							175					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **8** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										DARK GRAY (N3) SHALE, MODERATELY WEATHERED		
										GRAYISH RED (10R4/2) AND MODERATE OLIVE BROWN (5Y4/4) CLAY SHALE, SOME CALCITE VEINS, MODERATE WEATHERED AND FRACTURED.		
							180			**MEDIUM GRAY (N5) SHALE**, WITH INTERBEDDED FINE SANDSTONE, LITTLE WEATHERING 180.5 - 190.8 SAME EXCEPT SOME CALCITE VEINS, SLIGHTLY WEATHERED		
							185					
							190					
										MEDIUM GRAY (N5) SHALE		
							195					
										MEDIUM GRAY (N5) WITH DARK GRAY (N3) SEAMS OF SHALE AND CLAY SHALE, MODERATELY WEATHERED AND FRACTURED		
							200			200.1 - 200.4 MODERATELY BROWN (5YR 3/4)		
										MEDIUM BLUISH GRAY (5B5/1) SHALE, CALCITE NODULES, SOME LAMINATIONS,		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **9** OF **13**

BORING START

BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										SLIGHT TO MODERATELY WEATHERED		
							205					
										MODERATE BROWN (5YR 3/4) CLAY SHALE, FRACTURES, SOFT		
							210					
										MEDIUM DARK GRAY (N4) AND MODERATE BROWN (5YR 3/4) INTERBEDDED SHALE, SLIGHTLY WEATHERED, FRACTURED		
							215					
										MEDIUM GRAY (N5) FINE SANDSTONE, TRACE CALCITE PRESENT, SLIGHTLY WEATHERED		
							220					
										MODERATE BROWN (5YR 3/4) CLAYEY SHALE, SLIGHTLY WEATHERED		
							225					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **10** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							230			228.8 - 230.8 SAME EXCEPT WITH GRAYISH OLIVE (10Y 4/2), LAMINATIONS MODERATELY WEATHERED, FRACTURED		
							235			**LIGHT BLUISH GRAY (5B 7/1) SHALE AND MEDIUM GRAIN SANDSTONE**, INTERBEDDED, SLIGHTLY WEATHERED		
							240			**MEDIUM LIGHT GRAY (N6) SANDSTONE**, MEDIUM TO COARSE GRAIN, LAMINATED, CALCITE PRESENT, SLIGHTLY WEATHERED 241.8 - 242.7 SLIGHT TO MODERATE WEATHERING, FRACTURES		
							245					
							250			**DARK GREENISH GRAY (5GY 4/1) AND MODERATE BROWN (5YR 3/4) CLAY SHALE**, SOFT, MODERATELY WEATHERED, FRACTURED 250.8 - 259.8 SAME, EXCEPT SOFT TO VERY SOFT, WEATHERED, SEDIMENT FILLED FRACTURES 259.8 - 265.8 SAME, HIGHLY FRACTURED		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **11** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							255					
							260					
												262.7 Top of bentonite seal.
							265			265.8 - 269.0 SAME, HIGHLY FRACTURED, GRAYISH RED (10R 4/2) AND LIGHT OLIVE BROWN (5Y 5/6)		
												267.8 Top of sand.
										269.0 - 269.2 NO RECOVERY 269.2 - 271.3 DARK YELLOWISH BROWN (10YR 4/2), WEATHERED		
							270					
										<u>GRAYISH RED (10R 4/2) AND MODERATE OLIVE BROWN (5Y 5/6) CLAY SHALE</u>, SLIGHT TO MODERATELY WEATHERED, FRACTURED.		
							275					
										<u>BROWNISH GRAY (5YR 4/1) INTERBEDDED WITH MEDIUM GRAY (N5) CLAY SHALE/SHALE</u>, TRACE CALCITE, MODERATELY WEATHERED, FRACTURED		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **12** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												280.2 Top of screen.
										MEDIUM GRAY (N5) SHALE, LAMINATED		
										MEDIUM GRAY (N5) AND GRAYISH BROWN (5YR 2/2) SHALE, INTERBEDDED WITH CLAYEY SHALE, TRACE CALCITE, LAMINATIONS, SLIGHTLY WEATHERED		
							285					
							290					
										MEDIUM GRAY (N5) FINE TO COARSE SANDSTONE, INTERBEDDED WITH SHALE, LAMINATED, SLIGHT WEATHERING		
							295					
										298.2 - 300.5 SAME EXCEPT SHALE WITH MODERATE BROWN (5YR 4/4) AND GRAYISH BROWN (5YR 3/2), LAMINATIONS, SLIGHT WEATHERING		
							300					
							305					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-03** DATE **8/27/07** SHEET **13** OF **13**

BORING START BORING FINISH **8/10/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							310					309.1 Bottom of screen.
												312.2 Bottom of sand.
												313.8 Bottom of bottom seal.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 530,922.0 E 1,728,552.0**

GROUND ELEVATION **953.2** SYSTEM **STATE PLANE**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **1** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

PIEZOMETER TYPE WELL TYPE **OW**

HGT. RISER ABOVE GROUND **1.9** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **239.1** BOTTOM **248.0**

WELL DEVELOPMENT **YES** BACKFILL **QUICK GROUT**

FIELD PARTY **MCR-REL-TJH-REB** RIG **BK-81 CME-75**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												AUGERED TO 2.0'
1	SPT	2.0	3.5	22-9-6	1.0					**LIGHT OLIVE-BROWN (5Y,5/6) SILTY FINE SAND**, ROCK FRAGMENTS, FELDSPAR, DRY		
							5					
2	SPT	7.0	7.8	28-50/4	.83					SAME, SHALE-LIKE, TRACE BLACK COAL SEAMS, DRY		
							10					
3	SPT	12.0	13.3	30-45-50/4	1.33					SAME		
1	NQ	14.2	20.8		6.5	56	15			**LIGHT OLIVE BROWN (5Y 5/6) CLAY SHALE**, WEATHERED, NUMEROUS FRACTURES, ABUNDANT FILLED FRACTURES.		RETURN WATER WENT FROM GREEN TO GRAY IN RUN #1.
										MEDIUM LIGHT GRAY (N6) LIMESTONE, LAMINATED, SLIGHTLY WEATHERED		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **D. BENNETT**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **2** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	NQ	20.8	30.8		8.4	30				SAME EXCEPT WEATHERED AND FRACTURED		
							25			**MODERATE BROWN (5YR4/4) CLAY SHALE**, VERY WEATHERED, FRACTURED		
										MEDIUM LIGHT GRAY (N6) SANDSTONE, MEDIUM GRAINED, SLIGHTLY WEATHERED		
							30					
3	NQ	30.8	40.8		9.0	90	35			**MEDIUM LIGHT GRAY (N6) SANDSTONE**, MEDIUM TO COARSE GRAINED, LAMINATED, SLIGHTLY WEATHERED		
							40					
4	NQ	40.8	50.8		9.6	96	45			**MEDIUM GRAY (N5) COARSE SANDSTONE**, BLACK LAMINATIONS, SLIGHTLY WEATHERED		LOST WATER

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **3** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							50					
5	NQ	50.8	60.8		10.0	64						STILL NO WATER RETURN
										MEDIUM GRAY (N5) CLAYSHALE, WEATHERED, FRACTURED		
										GRAYISH-RED (5R4/2) CLAY SHALE, WEATHERED, FRACTURED		
							55					
										MEDIUM GRAY (N5) CLAY SHALE, WEATHERED, FRACTURED		
										MEDIUM GRAY (N5) LIMESTONE		
							60			WEATHERED ZONE 60.5'-60.6 SHALEY 60.6'- 60.8'		
6	NQ	60.8	70.8		9.5	72				**MEDIUM GRAY (N5) SHALE**, SOME LAMINATIONS, SLIGHTLY WEATHERED		
							65			**GRAYISH RED (5R4/2) CLAY SHALE**, WEATHERED, SEDIMENT FILLED FRACTURES		SPORADIC GRAY WATER RETURN
							70					
7	NQ	70.8	80.8		10.0	91				**INTERBEDDED MEDIUM GRAY (N5) AND GRAYISH RED (5R4/2) SHALE**, SLIGHT TO		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **4** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MODERATELY FRACTURED AND WEATHERED		
							75					
										MEDIUM GRAY (N5) SHALE, SLIGHTLY WEATHERED		
							80					
8	NQ	80.8	90.8		10.0	89						SPORADIC GRAY WATER RETURN
										MEDIUM GRAY (N5) SANDSTONE, MEDIUM TO COARSE GRAIN, SOME INTERBEDDED CALCITE, SLIGHTLY WEATHERED		
							85					
										MEDIUM GRAY (N5) SHALE, LAMINATED, SOFT, SLIGHT TO MODERATELY WEATHERED, FRACTURED		
							90					
9	NQ	90.8	100.8		10.0	80				**MEDIUM GRAY (N5) SHALE**, SOME LAMINATIONS, SLIGHTLY WEATHERED		SPORADIC WATER RETURN
							95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **5** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										GRAYISH RED (5Y4/2) SHALE, MODERATELY FRACTURED AND WEATHERED, SOFT		
10	NQ	100.8	110.8		9.9	89	100			SAME EXCEPT GRAYISH RED (5R5/2) AND MEDIUM GRAY (N5) SHALE, WEATHERED FROM 100.8 TO 101.2'		
										MEDIUM GRAY (N5) SHALE AND MEDIUM SANDSTONE, INTERBEDDED, LAMINATED, SLIGHTLY WEATHERED, SOME FRACTURES		
							105					SPORADIC WATER RETURN
11	NQ	110.8	120.8		10.0	95	110			**MEDIUM GRAY (N5) SANDSTONE**, MEDIUM TO COARSE GRAIN WITH INTERBEDDED SHALE, LAMINATED, SLIGHTLY WEATHERED		SPORADIC WATER RETURN
							115					
12	NQ	120.8	125.8		5.0	80	120			120.8 - 120.9 CLAY FILLED FRACTURE, YELLOWISH GRAY (5R7/2) 120.9 - 121.8' LIGHT OLIVE GRAY (5Y6/1) MEDIUM TO COARSE SANDSTONE, SLIGHTLY WEATHERED 121.8 - 122.2' MEDIUM DARK GRAY (N4) SHALE		RESUMED DRILLING 7-19-95 SPORADIC WATER RETURN

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **6** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										122.2 - 122.5' MEDIUM GRAY (N5) CLAY FILLED FRACTURE 122.5 - 124.7' MEDIUM DARK GRAY (N4) CLAY AND MEDIUM SANDSTONE INTERBEDDED, SLIGHT TO MEDIUM WEATHERED		
13	NQ	125.8	135.8		9.8	87	125			124.7 - 125.8 MEDIUM GRAY (N5) MEDIUM TO COARSE SANDSTONE, LAMINATIONS PRESENT 125.8 - 131.8 MEDIUM GRAY (N5) MEDIUM TO COARSE SANDSTONE, SOME LAMINATIONS, SLIGHTLY WEATHERED		SLIGHT WATER RETURN
							130			**<u>MEDIUM DARK GRAY (N4) SHALE</u>**, LAMINATED, SLIGHTLY WEATHERED 134.2 - 134.8' FRACTURED, WEATHERED		
14	NQ	135.8	145.8		9.9	90	135			**<u>MEDIUM DARK GRAY (N4) TO DARK GRAY (N3) SHALE</u>**, SLIGHT TO MODERATELY WEATHERED, LAMINATIONS PRESENT. 137.5 - 137.6' FRACTURED		
							140			140.5 - 142.2' FRACTURED		GOT GRAY WATER RETURN
15	NQ	145.8	155.8		9.7	76	145			**<u>DARK GRAY (N3) TO DARK REDDISH BROWN (10R3/4) CLAY SHALE</u>**, VERY WEATHERED, VERY SOFT **<u>DARK GRAY (N3) TO DARK REDDISH BROWN (10R3/4) CLAY SHALE</u>**, LAMINATIONS, SLIGHT TO MODERATELY WEATHERED.		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **7** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										DARK REDDISH BROWN 10R3/4) AND GRAYISH GREEN (10Y4/2) CLAY SHALE, VERY SOFT, SLIGHTLY WEATHERED, SOME CALCITE PRESENT		
							155					
16	NQ	155.8	165.8		10.0	85				**DARK REDDISH BROWN 10R3/4 AND GRAYISH GREEN (10Y4/2) CLAY SHALE**, TRACE CALCITE, SOFT, MODERATELY FRACTURED AND WEATHERED		
							160			**MEDIUM DARK GRAY (N4) SHALE**, SOME CALCITE NODULES, SOME LAMINATIONS, SLIGHTLY WEATHERED		
							165					
17	NQ	165.8	170.8		5.0	80				**MEDIUM DARK GRAY (N4), DARK GRAY (N3) AND TRACE GRAYISH RED (10R4/2) SHALE AND FINE TO MEDIUM SANDSTONE**, INTERBEDDED, SLIGHTLY WEATHERED		
							170			**GRAYISH BROWN (10R4/2) CLAY SHALE**, MODERATELY FRACTURED AND WEATHERED.		
18	NQ	170.8	180.8		9.8	83						
							175					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **8** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										DARK GRAY (N3) SHALE, MODERATELY WEATHERED		
										GRAYISH RED (10R4/2) AND MODERATE OLIVE BROWN (5Y4/4) CLAY SHALE, SOME CALCITE VEINS, MODERATE WEATHERED AND FRACTURED.		
							180			**MEDIUM GRAY (N5) SHALE**, WITH INTERBEDDED FINE SANDSTONE, LITTLE WEATHERING		
19	NQ	180.8	190.8		10.0	91				180.5 - 190.8 SAME EXCEPT SOME CALCITE VEINS, SLIGHTLY WEATHERED		
							185					
							190					
20	NQ	190.8	200.8		9.9	82				**MEDIUM GRAY (N5) SHALE**		191.1 Top of seal.
							195					
										MEDIUM GRAY (N5) WITH DARK GRAY (N3) SEAMS OF SHALE AND CLAY SHALE, MODERATELY WEATHERED AND FRACTURED		197.3 Top of sand.
							200			200.1 - 200.4 MODERATELY BROWN (5YR 3/4)		
21	NQ	200.8	210.8		10.0	98				**MEDIUM BLUISH GRAY (5B5/1) SHALE**, CALCITE NODULES, SOME LAMINATIONS,		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **9** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										SLIGHT TO MODERATELY WEATHERED		
							205					
										MODERATE BROWN (5YR 3/4) CLAY SHALE, FRACTURES, SOFT		209.1 Top of screen.
							210					
22	NQ	210.8	220.8		9.95	94				**MEDIUM DARK GRAY (N4) AND MODERATE BROWN (5YR 3/4) INTERBEDDED SHALE**, SLIGHTLY WEATHERED, FRACTURED		
							215					
										MEDIUM GRAY (N5) FINE SANDSTONE, TRACE CALCITE PRESENT, SLIGHTLY WEATHERED		
							220					
23	NQ	220.8	230.8		10.0	95						
										MODERATE BROWN (5YR 3/4) CLAYEY SHALE, SLIGHTLY WEATHERED		
							225					

Continued Next Page

JOB NUMBER ____

COMPANY ____

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **10** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										228.8 - 230.8 SAME EXCEPT WITH GRAYISH OLIVE (10Y 4/2), LAMINATIONS MODERATELY WEATHERED, FRACTURED		
24	NQ	230.8	240.8		10.0	91	230					
							235			**LIGHT BLUISH GRAY (5B 7/1) SHALE AND MEDIUM GRAIN SANDSTONE**, INTERBEDDED, SLIGHTLY WEATHERED		
25	NQ	240.8	250.8		10.0	80	240			**MEDIUM LIGHT GRAY (N6) SANDSTONE**, MEDIUM TO COARSE GRAIN, LAMINATED, CALCITE PRESENT, SLIGHTLY WEATHERED 241.8 - 242.7 SLIGHT TO MODERATE WEATHERING, FRACTURES		
							245			**DARK GREENISH GRAY (5GY 4/1) AND MODERATE BROWN (5YR 3/4) CLAY SHALE**, SOFT, MODERATELY WEATHERED, FRACTURED		248.0 Bottom of screen. 249.1 Bottom of sand.
26	NQ	250.8	259.8		9.0	38	250			250.8 - 259.8 SAME, EXCEPT SOFT TO VERY SOFT, WEATHERED, SEDIMENT FILLED FRACTURES 259.8 - 265.8 SAME, HIGHLY FRACTURED		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **11** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							255					257.0 Bottom of seal.
27	NQ	259.8	265.8		3.6	25	260					
28	NQ	265.8	269.0		1.45	11	265			265.8 - 269.0 SAME, HIGHLY FRACTURED, GRAYISH RED (10R 4/2) AND LIGHT OLIVE BROWN (5Y 5/6)		WATER LEVEL PRIOR TO START 7.1'
29	NQ	269.0	269.2		0	0				269.0 - 269.2 NO RECOVERY		PULLED RODS AND CORE BARREL OUT OF HOLE - BIT MISSING. RETREIVED BIT FULL INTACT.
30	NQ	269.2	271.3		.2	0	270			269.2 - 271.3 DARK YELLOWISH BROWN (10YR 4/2), WEATHERED		
31	NQ	271.3	275.5		4.2	60				**GRAYISH RED (10R 4/2) AND MODERATE OLIVE BROWN (5Y 5/6) CLAY SHALE**, SLIGHT TO MODERATELY WEATHERED, FRACTURED.		
32	NQ	275.5	282.8		7.3	96	275			**BROWNISH GRAY (5YR 4/1) INTERBEDDED WITH MEDIUM GRAY (N5) CLAY SHALE/SHALE**, TRACE CALCITE, MODERATELY WEATHERED, FRACTURED		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **12** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM GRAY (N5) SHALE, LAMINATED		
33	NQ	282.8	290.5		7.6	99				**MEDIUM GRAY (N5) AND GRAYISH BROWN (5YR 2/2) SHALE**, INTERBEDDED WITH CLAYEY SHALE, TRACE CALCITE, LAMINATIONS, SLIGHTLY WEATHERED		
							285					
							290					
34	NQ	290.5	300.5		9.9	99				**MEDIUM GRAY (N5) FINE TO COARSE SANDSTONE**, INTERBEDDED WITH SHALE, LAMINATED, SLIGHT WEATHERING		
							295					
										298.2 - 300.5 SAME EXCEPT SHALE WITH MODERATE BROWN (5YR 4/4) AND GRAYISH BROWN (5YR 3/2), LAMINATIONS, SLIGHT WEATHERING		
							300					
35	NQ	300.5	310.5		9.45	90				**MEDIUM DARK GRAY (N4) SHALE**, SLIGHTLY WEATHERED		
										MEDIUM GRAY (N5) SANDSTONE, MEDIUM TO COARSE GRAIN, SLIGHTLY WEATHERED, TRACE CALCITE		
							305					
										305.6 - 305.7 WEATHERED, FRACTURED		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-04** DATE **8/27/07** SHEET **13** OF **13**

BORING START **7/18/95** BORING FINISH **7/20/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							310			**MEDIUM DARK GRAY (N4) SHALE**, SLIGHTLY WEATHERED		
										BOTTOM OF BORING 310.5'		

AEP EPRI_AMOS.GPJ AEP.GDT 8/27/07

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER		BORING NO.	D=MW-05
		DATE	8/27/07
		SHEET	1 OF 5
COMPANY		BORING START	7/11/95
PROJECT	EPRI GROUND WATER STUDY - AMOS	BORING FINISH	7/26/95
COORDINATES	N 531,282.0 E 1,724,360.0	PIEZOMETER TYPE	
GROUND ELEVATION	648.0	WELL TYPE	OW
SYSTEM	STATE PLANE	HGT. RISER ABOVE GROUND	1.9
		DIA	2.0
		DEPTH TO TOP OF WELL SCREEN	101.6
		BOTTOM	111.0
		WELL DEVELOPMENT	YES
		BACKFILL	QUICK GROUT
		FIELD PARTY	MCR-RLY=TJH-REB
		RIG	BK-81 CME-75

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
									AUGERED TO 2'	
1	SS	2.0	3.5	??-28-19	15"			GM	**GRAY ROCK FRAGMENTS, GRAVEL, SILT,** DRY, (FILL).	
								ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 3\4), Moist.	
									AUGERED TO 7.0'	
							5			
2	SS	7.0	22.0	10-9-9	7.5"			ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 4\8) LIGHT BROWN (5YR 5\6 AND MODERATE BROWN (5YR 3\4), TRACE FELDSPAR, MOIST.	
									AUGERED TO 12.0'	
							10			
3	SS	12.0	13.5	13-8-5	17"			ML	**SAME AS ABOVE**	
								CL	**SILTY CLAY**, PALE YELLOWISH BROWN (12YR 6\2) AND LIGHT OLIVE GRAY (5YR 5\2), LOW TO MEDIUM PLASTICITY, MOIST.	
									AUGERED TO 17.0'	
							15			
4	SS	17.0	18.5	3-3-3	18"			SC	**CLAYEY-SILTY FINE SAND**, DUSKY YELLOWISH BROWN (10 YR 2\2),MOIST TO WET.	
									AUGERED TO 22.0'	

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
X	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **D.BENNETT**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **2** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	SS	22.0	23.2	7-7-50/3"	13"				SC	**SAME AS SAMPLE No. 4**		
									SW	**MEDIUM TO COARSE SAND**, LIGHT BLUISH GRAY (5B 7\1), MOIST.		
1	NQ	24.0	29.8		5.0	60	25			AUGERED TO 23.9' - AUGERED THROUGH OBSTRUCTION (ROCK?) **MORGANTOWN SANDSTONE?**, GRAY. 24.0 - 25.0' Solid, light gray, (N-7) 25.0 - 26.0' Fractured, brown clay lined fractures, light gray (N-7). 26.0 - 27.0' Minimal fractures 27.0 - 27.7' Fractured, weathered, very fine dark gray (N-3) bedding. 27.7 - 29.8' Light gray (N-7) sandstone		25.0 Fracture = 8 26.0 Fracture = 3 26.5 Lost water 27.0 Fracture = 5
2	NQ	29.8	39.8		10.0	93	30			29.8 - 33.8' Light gray (N-7) sandstone		
										CLAY SHALE, MEDIUM GRAY (N4) MOIST, VERY SOFT.		
							35			**CLAY SHALE**, GRAYISH BROWN (5YR 3\2), MOIST, VERY SOFT.		35.2 Fracture = 3
										CLAY SHALE, LIGHT OLIVE GRAY (5Y 5\2) MEDIUM LIGHT GRAY (N6), SOFT, MODERATE WEATHERING.		36.3 Fracture = 3
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), TRACE IRREGULAR BEDDING PLANES, SOFT.		37.3 Fracture = 2
3	NQ	39.8	49.8		9.8	67	40			**SAME AS ABOVE**		39.8 Fracture = 6
										SAME, WITH MODERATE BROWN (5YR 3\4) BEDDING PLANES, MEDIUM TO HIGHLY FRACTURED, MODERATE WEATHERING.		42.5 Fracture = 8
										SHALE, MEDIUM BLUISH GRAY 5Y 5\2), SLIGHT TO MODERATE WEATHERED		
							45			**CLAY SHALE**, PALE BROWN (5YR 5/2), TO DARK YELLOWISH BROWN (10YR 4/2) AND		44.6 numerous fractures.

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER ______

COMPANY ______

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **3** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										LIGHT OLIVE GRAY (5YR 4/2), SOFT, SOME IRREGULAR BEDDING PLANES		
4	NQ	49.8	56.5		4.7	54	50					
												51.0 Regained drill water
							55					
5	NQ	56.5	59.8		2.55	50				**SAME EXCEPT VERY SOFT**		56.5 Fracture = 7
6	NQ	59.8	67.3		7.5	96	60			**CLAYEY SILT**, DARK YELLOWISH BROWN (10yr 4\2), MOIST - WET		
										SAME, VERY WEATHERED, SOFT		
										CLAY SHALE, PALE BROWN (5YR 5\2), SLIGHTLY WEATHERED		
							65					
										SAME, SOME MODERATELY WEATHERED, SOFT		
7	NQ	67.3	69.8		2.5	40				**SAME**, VERY WEATHERED, VERY SOFT		
										SAME, MODERATELY WEATHERED, SOFT		68.0 Fracture = 5
										SHALE, MEDIUM GRAY (N5), SOFT.		
8	NQ	69.8	78.8		6.8	64	70			**SAME**		
										CLAY SHALE, PALE BROWN (YR 5\2) AND		71.6 Fracture = 12

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **4** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM GRAY (N5), MODERATELY WEATHERED, SOFT.		
							75					
9	NQ	78.8	79.8		1.0	40				**SHALE**, PALE BROWN (5YR 5\2) AND LIGHT OLIVE GRAY (5Y 5\2), IRREGULAR BEDDING, WEATHERED, SOFT.		78.8 numerous fracture.
10	NQ	79.8	87.8		6.3	48	80			**SAME**, SOME SEDIMENT FILLED FRACTURES		
							85					86.0 Top of seal.
11	NQ	87.8	89.8		2.0	75				**SHALE**, GRAYISH OLIVE (10 YR 4\2) AND MODERATE BROWN (5YR 3\4), INTERBEDDED LAYERS, SOFT, SLIGHTLY WEATHERED.		
12	NQ	89.8	90.8		.75	0	90			**SAME**, EXCEPT WEATHERED		
13	NQ	90.8	99.8		9.0	100				**SHALE**, MEDIUM BLUISH GRAY (5B 5\1), WITH SOME INTERBEDDED BROWNISH GRAY (5YR 4\1) COLOR, SLIGHTLY WEATHERED, SOFT		91.0 Top sand.
							95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **5** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
14	NQ	99.8	100.3		.25	0	100			**SAME**, EXCEPT WEATHERED		Lost water return on run #14.
15	NQ	100.3	109.8		9.5	95				**SHALE**, MEDIUM BLUISH GRAY 5B 5\1), SLIGHTLY WEATHERED, SOFT		101.6 Top of screen.
										SANDSTONE, MEDIUM BLUISH GRAY (5B 5\1), SLIGHTLY WEATHERED AT 104', SOFT.		
							105					
16	NQ	109.8	114.8		4.4	40	110			**SAME**, SOFT		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), SOFT.		111.0 Bottom of screen.
										SHALE, MEDIUM DARK GRAY, SOFT, WEATHERED, VERY FRACTURED.		112.0 Fracture = 7 112.1 Bottom of sand.
										CLAY SHALE, GRAYISH BROWN (5YB 3\2), WEATHERED, SOFT TO VERY SOFT, FRACTURED.		
										114.8 BOTTOM OF HOLE		114.7 Bottom of seal.

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER

COMPANY

PROJECT EPRI GROUND WATER STUDY - AMOS

COORDINATES N 531,266.0 E 1,724,352.0

GROUND ELEVATION 647.5 SYSTEM STATE PLANE

BORING NO. D=MW-06 DATE 8/27/07 SHEET 1 OF 5

BORING START 8/20/95 BORING FINISH 8/21/95

PIEZOMETER TYPE WELL TYPE OW

HGT. RISER ABOVE GROUND 1.95 DIA 2.0

DEPTH TO TOP OF WELL SCREEN 28.5 BOTTOM 33.5

WELL DEVELOPMENT YES BACKFILL QUICK GROUT

FIELD PARTY TJH-REB RIG CME-75

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
									AUGERED TO 2'	
								GM	**GRAY ROCK FRAGMENTS, GRAVEL, SILT,** DRY, (FILL).	
								ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 3\4), Moist. AUGERED TO 7.0'	
							5			
								ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 4\8) LIGHT BROWN (5YR 5\6 AND MODERATE BROWN (5YR 3\4), TRACE FELDSPAR, MOIST. AUGERED TO 12.0'	
							10			
								ML	**SAME AS ABOVE**	
								CL	**SILTY CLAY**, PALE YELLOWISH BROWN (12YR 6\2) AND LIGHT OLIVE GRAY (5YR 5\2), LOW TO MEDIUM PLASTICITY, MOIST. AUGERED TO 17.0'	
							15			
								SC	**CLAYEY-SILTY FINE SAND**, DUSKY YELLOWISH BROWN (10 YR 2\2),MOIST TO WET.	
									AUGERED TO 22.0'	

Continued Next Page

TYPE OF CASING USED

	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER D. BEMMETT

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-06** DATE **8/27/07** SHEET **2** OF **5**

BORING START **8/20/95** BORING FINISH **8/21/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									SC	**SAME AS SAMPLE No. 4**		22.5 Top of seal.
									SW	**MEDIUM TO COARSE SAND**, LIGHT BLUISH GRAY (5B 7\1), MOIST.		
							25			AUGERED TO 23.9' - AUGERED THROUGH OBSTRUCTION (ROCK?) **MORGANTOWN SANDSTONE?**, GRAY. 24.0 - 25.0' Solid, light gray, (N-7) 25.0 - 26.0' Fractured, brown clay lined fractures, light gray (N-7). 26.0 - 27.0' Minimal fractures 27.0 - 27.7' Fractured, weathered, very fine dark gray (N-3) bedding. 27.7 - 29.8' Light gray (N-7) sandstone		27.2 Top of sand. 28.5 Top of screen.
							30			29.8 - 33.8' Light gray (N-7) sandstone		
							35			**CLAY SHALE**, MEDIUM GRAY (N4) MOIST, VERY SOFT.		33.5 Bottom of screen. 34.2 Bottom of sand.
										CLAY SHALE, GRAYISH BROWN (5YR 3\2), MOIST, VERY SOFT.		
										CLAY SHALE, LIGHT OLIVE GRAY (5Y 5\2) MEDIUM LIGHT GRAY (N6), SOFT, MODERATE WEATHERING.		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), TRACE IRREGULAR BEDDING PLANES, SOFT.		
							40			**SAME AS ABOVE**		
										SAME, WITH MODERATE BROWN (5YR 3\4) BEDDING PLANES, MEDIUM TO HIGHLY FRACTURED, MODERATE WEATHERING.		
										SHALE, MEDIUM BLUISH GRAY 5Y 5\2), SLIGHT TO MODERATE WEATHERED		
							45			**CLAY SHALE**, PALE BROWN (5YR 5/2), TO DARK YELLOWISH BROWN (10YR 4/2) AND		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-06** DATE **8/27/07** SHEET **3** OF **5**

BORING START **8/20/95** BORING FINISH **8/21/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										LIGHT OLIVE GRAY (5YR 4/2), SOFT, SOME IRREGULAR BEDDING PLANES		
							50					
							55					
										SAME EXCEPT VERY SOFT		
							60			**CLAYEY SILT**, DARK YELLOWISH BROWN (10yr 4\2), MOIST - WET		
										SAME, VERY WEATHERED, SOFT		
										CLAY SHALE, PALE BROWN (5YR 5\2), SLIGHTLY WEATHERED		
							65					
										SAME, SOME MODERATELY WEATHERED, SOFT		
										SAME, VERY WEATHERED, VERY SOFT		
										SAME, MODERATELY WEATHERED, SOFT		
										SHALE, MEDIUM GRAY (N5), SOFT.		
							70			**SAME**		
										CLAY SHALE, PALE BROWN (YR 5\2) AND		

Continued Next Page

JOB NUMBER ______

COMPANY ______

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-06** DATE **8/27/07** SHEET **4** OF **5**

BORING START **8/20/95** BORING FINISH **8/21/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM GRAY (N5), MODERATELY WEATHERED, SOFT.		
							75					
										SHALE, PALE BROWN (5YR 5\2) AND LIGHT OLIVE GRAY (5Y 5\2), IRREGULAR BEDDING, WEATHERED, SOFT.		
							80			**SAME**, SOME SEDIMENT FILLED FRACTURES		
							85					
										SHALE, GRAYISH OLIVE (10 YR 4\2) AND MODERATE BROWN (5YR 3\4), INTERBEDDED LAYERS, SOFT, SLIGHTLY WEATHERED.		
							90			**SAME**, EXCEPT WEATHERED		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), WITH SOME INTERBEDDED BROWNISH GRAY (5YR 4\1) COLOR, SLIGHTLY WEATHERED, SOFT		
							95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-06** DATE **8/27/07** SHEET **5** OF **5**

BORING START **8/20/95** BORING FINISH **8/21/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							100			**SAME**, EXCEPT WEATHERED		
										SHALE, MEDIUM BLUISH GRAY 5B 5\1), SLIGHTLY WEATHERED, SOFT		
										SANDSTONE, MEDIUM BLUISH GRAY (5B 5\1), SLIGHTLY WEATHERED AT 104', SOFT.		
							105					
							110			**SAME**, SOFT		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), SOFT.		
										SHALE, MEDIUM DARK GRAY, SOFT, WEATHERED, VERY FRACTURED.		
										CLAY SHALE, GRAYISH BROWN (5YB 3\2), WEATHERED, SOFT TO VERY SOFT, FRACTURED.		
										114.8 BOTTOM OF HOLE		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 533,742.0 E 1,727,871.7**

GROUND ELEVATION **963.0** SYSTEM **State Plane using NAD 83**

BORING NO. **D=MW-08** DATE **8/27/07** SHEET **1** OF **7**

BORING START **1/23/02** BORING FINISH **1/30/02**

PIEZOMETER TYPE WELL TYPE

HGT. RISER ABOVE GROUND **2.421** DIA

DEPTH TO TOP OF WELL SCREEN **144.0** BOTTOM **163.0**

WELL DEVELOPMENT BACKFILL

FIELD PARTY **MCR / REB** RIG **BK-81**

Water Level, ft	▽ 23.5	▼ 19.6	▼
TIME		16 hrs	
DATE	1/30/02	1/31/02	

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												Grounding procedures not in use on this boring. Drill water used - river water from fire header at Amos Plant. Drilled 4" roller bit to 9.0' and inserted 3" PVC to bedrock.
							5					
1	NQ-2	9.0	15.1		5.4	48				**5R 4/2 GRAYISH RED CLAYSTONE** Broken up		Started coring at 9.0'.
							10					
2	NQ-2	15.1	25.1		4.7	0	15			**5R 4/2 GRAYISH RED SHALE** (5.3' lost)		
											▼	SWL @ 19.6' 16 hrs

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **REB**

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-08** DATE **8/27/07** SHEET **2** OF **7**

BORING START **1/23/02** BORING FINISH **1/30/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												after completion of boring.
											∇	SWL @ 23.5' on 1/30/02 with NQ hole to 125.1'
3	NQ-2	25.1	32.1		6.2	85	25					SWL - Dry on 1/29/02 with NQ hole to 25.1'
										N5 MEDIUM GRAY SHALE		
										N5 MEDIUM GRAY SILTY SANDSTONE		
							30			**5GY 6/1 GREENISH GRAY SANDSTONE** Medium grain		
4	NQ-2	32.1	40.1		8.0	79				**N5 MEDIUM GRAY SILTY SANDSTONE** Fine grain		
							35					
5	NQ-2	40.1	50.1		10.0	78	40			**N5 MEDIUM GRAY SANDSTONE** Medium grain		
										N5 MEDIUM GRAY SHALE		
										5R 4/2 GRAYISH RED SHALE		
										N5 MEDIUM GRAY SHALE		
							45			**N5 MEDIUM GRAY SILTY SANDSTONE** Fine grain, hard		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-08** DATE **8/27/07** SHEET **3** OF **7**

BORING START **1/23/02** BORING FINISH **1/30/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	NQ-2	50.1	57.1		5.5	76	50			**N5 MEDIUM GRAY SHALE**		
										5R 4/2 GRAYISH RED SHALE		
										RED & GRAY SHALE		
							55			**N5 MEDIUM GRAY SHALE** vertical crack & iron stain @ 64.3'; iron stain @ 67.4'		
7	NQ-2	57.1	65.1		7.8	76	60					
8	NQ-2	65.1	75.1		10.0	65	65					
										N5 MEDIUM GRAY SANDSTONE Medium grain, fractured @ 68.7' - 69.1', shale streaks		
							70			**N5 MEDIUM GRAY SHALE**		

Continued Next Page

JOB NUMBER ______

COMPANY ______

BORING NO. **D=MW-08** DATE **8/27/07**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING START **1/23/02** BORING FINISH **1/30/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										5R 4/2 GRAYISH RED SHALE With greenish mixed in		
9	NQ-2	75.1	85.1		10.0	58	75			**N5 MEDIUM GRAY SHALE**		
										5R 4/2 GRAYISH RED SHALE		
							80					
										N5 MEDIUM GRAY SILTY SANDSTONE Fine grain, hard, calcite 83.7'-85.1'		
10	NQ-2	85.1	95.1		9.4	83	85					
							90					
										5R 4/2 GRAYISH RED SHALE Some calcite		
11	NQ-2	95.1	105.1		10.0	86	95					
										N5 MEDIUM GRAY SHALE Some calcite		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-08** DATE **8/27/07** SHEET **5** OF **7**

BORING START **1/23/02** BORING FINISH **1/30/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							100					
										N5 MEDIUM GRAY SILTY SANDSTONE Fine to Medium grain		
										N5 MEDIUM GRAY SHALE		
12	NQ-2	105.1	115.1		10.0	100	105			**N4 MEDIUM DARK GRAY SHALE** Fractured @ 110.8'		
							110					
										N4 MEDIUM DARK GRAY SANDSTONE Medium grain, with shale streaks		
13	NQ-2	115.1	125.1		8.4	79	115			**N4 MEDIUM DARK GRAY SHALE**		
										N5 MEDIUM GRAY SANDSTONE Medium grain, shale streaks		
							120					
										N5 MEDIUM GRAY SHALE		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-08** DATE **8/27/07** SHEET **6** OF **7**

BORING START **1/23/02** BORING FINISH **1/30/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
14	NQ-2	125.1	133.6		9.4	83	125			**5R 4/2 GRAYISH RED SHALE** Note: 0.9 pickup from last run		
							130			**5R 4/2 GRAYISH RED CLAYSTONE**		
15	NQ-2	133.6	143.6		10.0	97				**N5 MEDIUM GRAY SILTY SANDSTONE** Fine to Medium grain		
							135			**N4 MEDIUM DARK GRAY SHALE**		
										N5 MEDIUM GRAY SANDSTONE Medium grain, shale streaks		
										N4 MEDIUM DARK GRAY SHALE		
							140					
16	NQ-2	143.6	153.6		10.0	100						
							145			**N5 MEDIUM GRAY SANDSTONE** Medium to coarse grain, shale streaks		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-08** DATE **8/27/07** SHEET **7** OF **7**

BORING START **1/23/02** BORING FINISH **1/30/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
17	NQ-2	153.6	163.6		9.3	97	155					
							160			**N4 MEDIUM DARK GRAY SHALE**		
18	NQ-2	163.6	168.6		5.7	95	165					Stopped boring @ 168.6' on 1/30/02. Monitoring well to be installed at a later date.

AEP EPRI_AMOS.GPJ AEP.GDT 8/27/07

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 533,589.2 E 1,726,988.1**

GROUND ELEVATION **944.7** SYSTEM **State Plane using NAD 83**

BORING NO. **D=MW-09** DATE **8/27/07** SHEET **1** OF **6**

BORING START **1/15/02** BORING FINISH **1/16/02**

PIEZOMETER TYPE WELL TYPE

HGT. RISER ABOVE GROUND **2.15** DIA

DEPTH TO TOP OF WELL SCREEN **120.1** BOTTOM **139.1**

WELL DEVELOPMENT BACKFILL

FIELD PARTY **MCR / REB** RIG **BK-81**

Water Level, ft	▽ 23.3	▼ 60.0	▼ 61.6
TIME		18 hrs	144 hrs
DATE	1/16/02	1/17/02	1/22/02

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												Grounding procedures not in use on this boring. Drilled 4" roller bit to 9.0' and inserted 3" PVC into overburden. Used condensate water from 0-124.9' and river water from 124.9'-144.9'
							5					
1	NQ-2	9.0	14.9		6.0	62				**5GY 6/1 GREENISH GRAY SILTSTONE**		Started NQ-2 coring at 9.0'.
							10					
2	NQ-2	14.9	24.9		10.0	67	15			**10YR 6/6 DARK YELLOWISH ORANGE SILTSTONE**		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **REB**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-09** DATE **8/27/07** SHEET **2** OF **6**

BORING START **1/15/02** BORING FINISH **1/16/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
											▽	SWL @ 23.3' on 1/16/02 with NQ hole @ 94.9'
										10YR 6/6 DARK YELLOWISH ORANGE SANDSTONE Medium grain		
3	NQ-2	24.9	34.9		10.0	45	25					
										10YR 7/4 GRAYISH ORANGE SANDSTONE Medium grain		
										N5 MEDIUM GRAY SANDSTONE		
										N5 MEDIUM GRAY CLAY SHALE		
										RED & GRAY WEATHERED CLAY SHALE		
							30					
4	NQ-2	34.9	44.9		10.0	72	35			**5R 4/2 GRAYISH RED CLAY SHALE**		
										N5 MEDIUM GRAY CLAY SHALE		
							40					
5	NQ-2	44.9	54.9		9.8	42	45			**N5 MEDIUM GRAY SANDY CLAY SHALE**		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-09** DATE **8/27/07** SHEET **3** OF **6**

BORING START **1/15/02** BORING FINISH **1/16/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										N5 MEDIUM GRAY CLAY SHALE		
							50					
										RED & GRAY CLAY SHALE		
6	NQ-2	54.9	64.9		10.0	61	55					
							60			**N5 MEDIUM GRAY SANDSTONE** With limestone nodules		SWL @ 60.0' on 1/17/02 18 hrs after completion of boring SWL @ 61.6' on 1/22/02 144 hrs after completion of boring
										N5 MEDIUM GRAY CLAY SHALE		
7	NQ-2	64.9	74.9		10.0	93	65			**N5 MEDIUM GRAY SANDY CLAY SHALE**		
							70					
										5R 4/2 GRAYISH RED CLAYSTONE With calcite		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER ____

COMPANY ____

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-09** DATE **8/27/07** SHEET **4** OF **6**

BORING START **1/15/02** BORING FINISH **1/16/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										5R 4/2 GRAYISH RED CLAY SHALE		
										5R 4/2 GRAYISH RED CLAYSTONE With calcite		
8	NQ-2	74.9	84.9		10.0	90	75			**N5 MEDIUM GRAY SANDY CLAY SHALE** With calcite		
							80					
										N5 MEDIUM GRAY CLAY SHALE With calcite		
										N5 MEDIUM GRAY SANDY CLAY SHALE With calcite @ 85.6', fractured @ 91.5'-92.5'		
9	NQ-2	84.9	94.9		10.0	100	85					
							90					
10	NQ-2	94.9	104.9		10.0	97	95			**N4 MEDIUM DARK GRAY CLAY SHALE**		
										N5 MEDIUM GRAY SANDSTONE Medium grain		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-09** DATE **8/27/07** SHEET **5** OF **6**

BORING START **1/15/02** BORING FINISH **1/16/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										N5 MEDIUM GRAY CLAY SHALE		
							100					
										5R 4/2 GRAYISH RED CLAY SHALE		
11	NQ-2	104.9	114.9		9.8	82	105					
										N5 MEDIUM GRAY CLAY SHALE		
							110					
										N5 MEDIUM GRAY CLAYEY SANDSTONE		
12	NQ-2	114.9	124.9		10.0	89	115					
										N5 MEDIUM GRAY CLAY SHALE Clay lense from 116.9'-118.2', some fractures		
							120					
										N5 MEDIUM GRAY SANDSTONE Medium grain		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-09** DATE **8/27/07** SHEET **6** OF **6**

BORING START **1/15/02** BORING FINISH **1/16/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	NQ-2	124.9	134.9		10.0	100	125			**N5 MEDIUM GRAY SANDSTONE** Medium grain, with shale streaks throughout		2000 gallons of drill water used to 124.9'
							130					
14	NQ-2	134.9	144.9		9.9	95	135					
							140			**N4 MEDIUM DARK GRAY SHALE**		Stopped boring at 144.9' on 1/16/02. Flushed boring with approx. 1000 gallons of water. Bailed boring completely dry using 20' of NQ rods and dart bailer Set well per JTM-N 120'-140' on 2/11/02

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 534,085.8 E 1,724,114.6**

GROUND ELEVATION **903.7** SYSTEM **State Plane using NAD 83**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **1** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

PIEZOMETER TYPE WELL TYPE

HGT. RISER ABOVE GROUND **2.176** DIA

DEPTH TO TOP OF WELL SCREEN **60.9** BOTTOM **78.9**

WELL DEVELOPMENT BACKFILL

FIELD PARTY **MCR / REB** RIG **BK-81**

Water Level, ft	39.2	28.1	33.5
TIME		16 hrs	120 hrs
DATE	1/22/02	1/23/02	1/28/02

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												Grounding procedures not in use on this boring. Drilled 4" roller bit to 9.0' and inserted 3" PVC to bedrock. Used river water from fire header at Amos Plant for drill water.
							5					
1	NQ-2	9.0	15.0		5.2	46				**5R 3/4 DUSKY RED CLAY SHALE**		Started NQ-2 coring at 9.0'.
							10					
										10YR 6/6 DARK YELLOWISH ORANGE CLAY SHALE		
2	NQ-2	15.0	25.0		10.0	48	15					
										10YR 6/6 DARK YELLOWISH ORANGE SILTSTONE		
										10YR 6/6 DARK YELLOWISH ORANGE CLAY		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **REB**

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **2** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										SHALE		
										5R 3/4 DUSKY RED CLAY SHALE		
										10YR 6/6 DARK YELLOWISH ORANGE SILTSTONE		
3	NQ-2	25.0	35.0		9.8	23	25			**5GY 6/1 GREENISH GRAY CLAY SHALE** Fractured throughout		SWL @ 28.1' on 1/23/02 16 hrs after completion of boring.
							30					
										5GY 6/1 GREENISH GRAY SILTSTONE Fractured throughout		
										5GY 6/1 GREENISH GRAY CLAY SHALE		SWL @ 33.5' on 1/28/02 120 hrs after completion of boring.
4	NQ-2	35.0	45.0		10.0	51	35			**5GY 6/1 GREENISH GRAY SILTSTONE**		
										5R 4/2 GRAYISH RED SHALE		
										5GY 6/1 GREENISH GRAY CLAY SHALE		
										N5 MEDIUM GRAY SHALEY SANDSTONE Fractured @ 39.0', iron stain		SWL @ 39.2' on 1/22/02 with NQ hole @ 75.0' - 96 hour reading.
							40			**N5 MEDIUM GRAY SHALE**		
										5R 4/2 GRAYISH RED SHALE Fractured from 44.0'-45.0'		
5	NQ-2	45.0	55.0		10.0	92	45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **3** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										N5 MEDIUM GRAY SHALE		
							50			**N5 MEDIUM GRAY SHALEY SANDSTONE** Medium grain		
6	NQ-2	55.0	65.0		10.0	100	55			**N5 MEDIUM GRAY SANDSTONE** Medium grain, shale streaks throughout		
							60			**N5 MEDIUM GRAY SANDSTONE** Medium to Coarse grain, shale streaks throughout Note: Fractured from 69.3'-71.4'		
7	NQ-2	65.0	75.0		10.0	100	65					
							70					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **4** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	NQ-2	75.0	85.0		10.0	96	75			**N5 MEDIUM GRAY SANDSTONE** Medium to Coarse grain		
							80			**N5 MEDIUM GRAY SHALE**		
9	NQ-2	85.0	95.0		10.0	86	85			**N5 MEDIUM GRAY to N4 MEDIUM DARK GRAY SHALE**		
							90					
										5R 4/2 GRAYISH RED SHALE		
10	NQ-2	95.0	105.0		10.0	82	95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **5** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										N5 MEDIUM GRAY SHALE		
							100			**N5 MEDIUM GRAY FINE GRAIN SANDY SHALE**		
11	NQ-2	105.0	115.0		10.0	100	105			**N5 MEDIUM GRAY SHALEY SANDSTONE** Fine to Medium grain, limestone nodules		
							110					
12	NQ-2	115.0	125.0		9.6	86	115			**N5 MEDIUM GRAY SHALEY SANDSTONE** Fine to Medium grain		
										N5 MEDIUM GRAY SANDSTONE Coarse grain		
							120					
										5R 4/2 GRAYISH RED SHALE		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **6** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	NQ-2	125.0	135.0		9.8	63	125			**N5 MEDIUM GRAY SHALE**		
										RED, GRAY & BROWNISH SHALE		
										N5 MEDIUM GRAY SHALEY SANDSTONE Fine grain		
							130					
14	NQ-2	135.0	145.0		10.0	100	135			**N5 MEDIUM GRAY SHALE**		
							140					
										N5 MEDIUM GRAY SHALEY SANDSTONE		
										N5 MEDIUM GRAY SHALE		
15	NQ-2	145.0	155.0		9.8	61	145					
										N4 MEDIUM DARK GRAY WEATHERED SHALE		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-10** DATE **8/27/07** SHEET **7** OF **7**

BORING START **1/17/02** BORING FINISH **1/22/02**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										N5 MEDIUM GRAY SILTY SANDSTONE Fine grain		
										N5 MEDIUM GRAY SHALE Reddish tint		
16	NQ-2	155.0	165.0		10.0	90	155			**N5 MEDIUM GRAY SILTY SANDSTONE** Fine grain		
							160			**N5 MEDIUM GRAY SHALE**		
										5R 4/2 GRAYISH RED SHALE		
							165					Stopped boring at 165.0' on 1/22/02.

AEP EPRI_AMOS.GPJ AEP.GDT 8/27/07

ARCADIS

Electric Power Research Institute, 1999

Well Construction Diagrams

MW-1 to MW-10

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

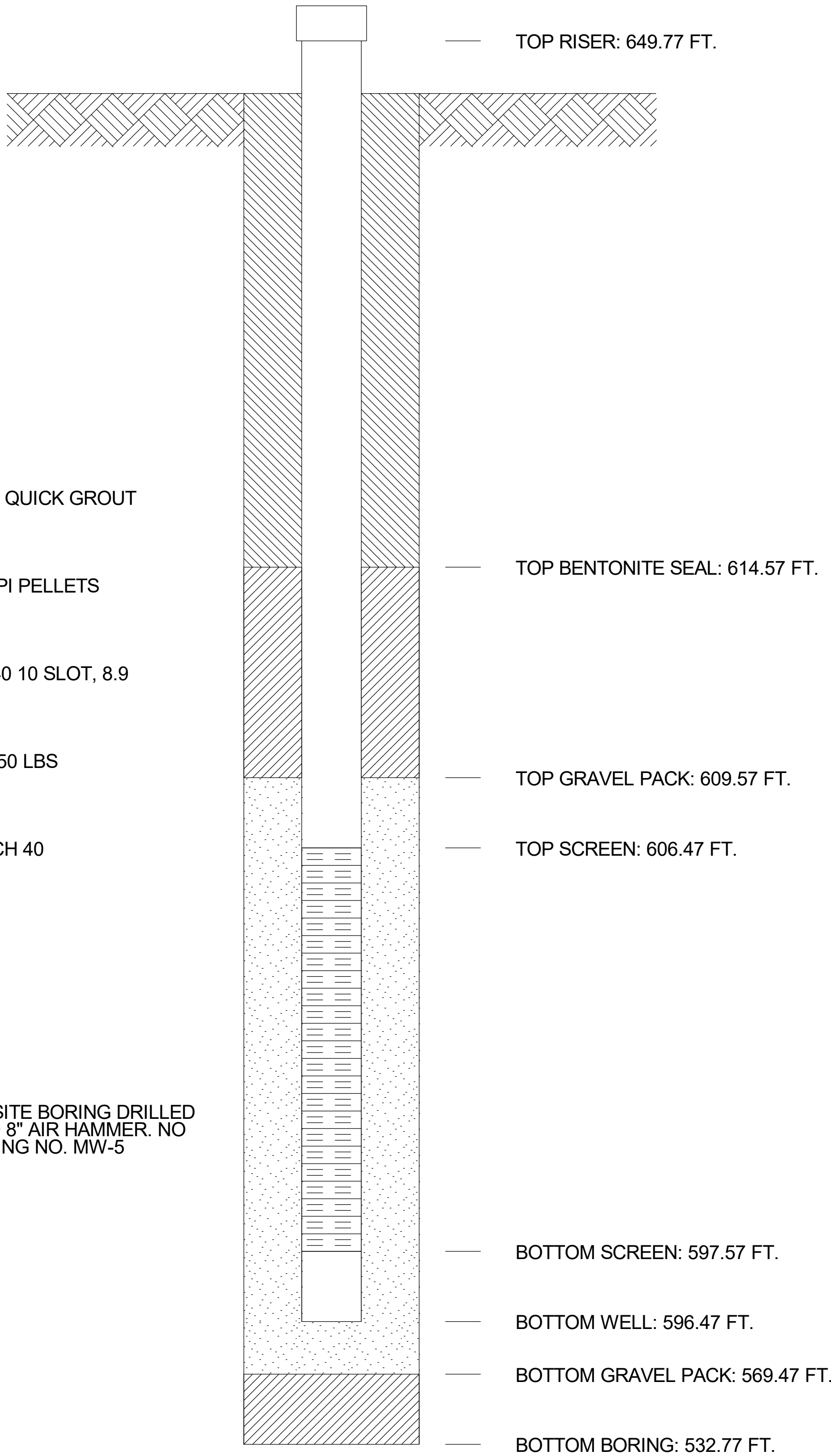
WELL No. **MW-1** BORING No. **D=MW-01** INSTALLED **7/27/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 531,275.0 E 1,724,355.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 647.57 FT.



GROUT SEAL: 450 GALLONS QUICK GROUT

BENTONITE SEAL: 100 LBS. PI PELLETS

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 8.9

GRAVEL PACK: #5 & SHOT 850 LBS

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

FLY ASH DAM CLUSTERED SITE BORING DRILLED USING 10" CASING AND 8" AIR HAMMER. NO CORE TAKEN SEE BORING NO. MW-5

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

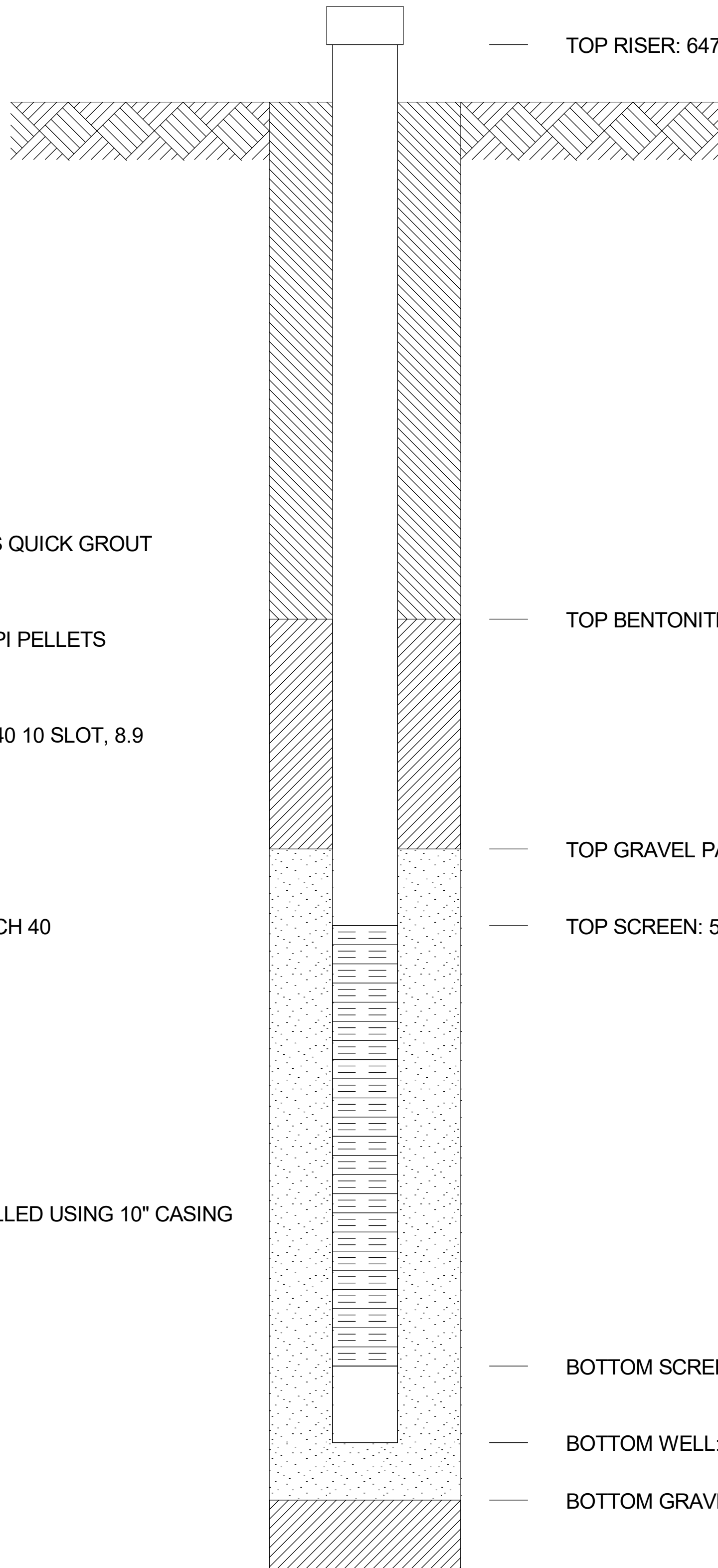
WELL No. **MW-2** BORING No. **D=MW-02** INSTALLED **7/27/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 529,941.0 E 1,724,235.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 645.20 FT.



GROUT SEAL: 250 GALLONS QUICK GROUT

BENTONITE SEAL: 100 BLS PI PELLETS

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 8.9

GRAVEL PACK: #5 & SHOT

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

FLY ASH DAM BORING DRILLED USING 10" CASING AND 8" AIR HAMMER.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

AEP

JOB NUMBER

COMPANY

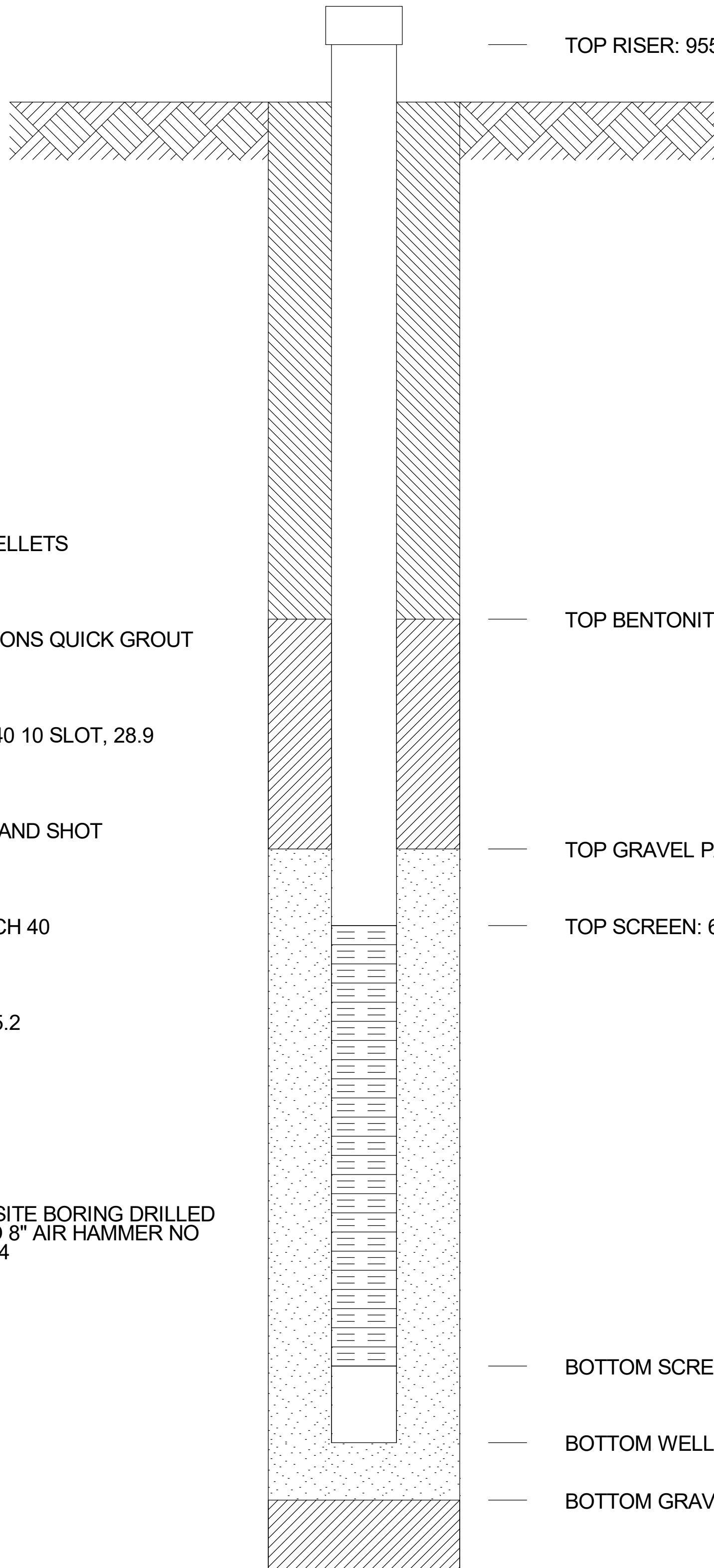
WELL No. **MW-3** BORING No. **D=MW-03** INSTALLED **8/10/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 530,928.0 E 1,728,546.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 952.99 FT.



TOP RISER: 955.29 FT.

TOP BENTONITE SEAL: 690.29 FT.

TOP GRAVEL PACK: 685.19 FT.

TOP SCREEN: 672.79 FT.

BOTTOM SCREEN: 643.89 FT.

BOTTOM WELL: 642.79 FT.

BOTTOM GRAVEL PACK: 640.79 FT.

BOTTOM BORING: 639.19 FT.

GROUT SEAL: 150 LBS. PI PELLETS

BENTONITE SEAL: 750 GALLONS QUICK GROUT

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 28.9

GRAVEL PACK: 1150,250 #5 AND SHOT

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH: 305.2-295.2

FLY ASH DAM CLUSTERED SITE BORING DRILLED USING 10" CASING AND 8" AIR HAMMER NO CORE TAKEN SEE MW-4

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

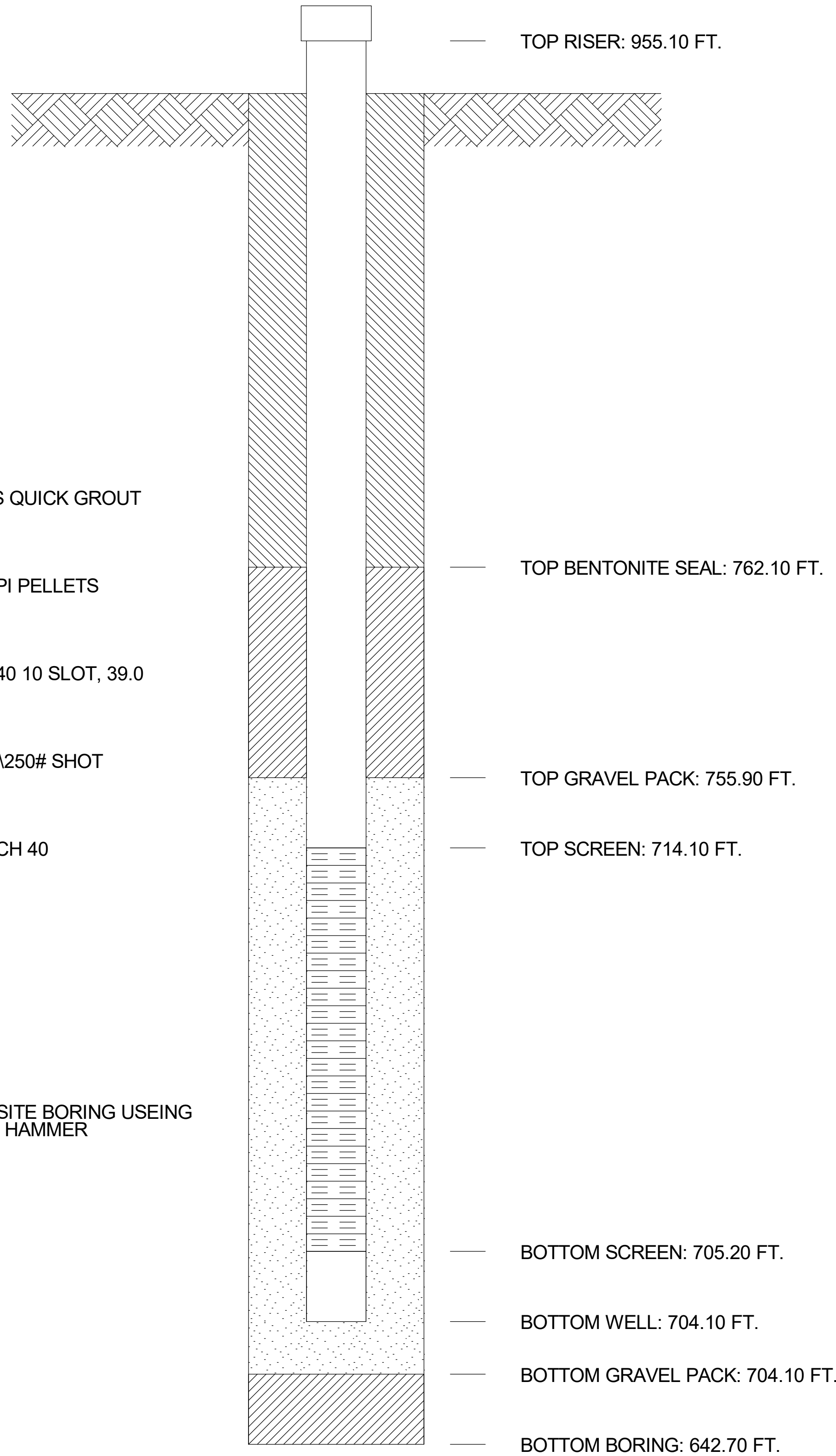
WELL No. **MW-4** BORING No. **D=MW-04** INSTALLED **7/20/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 530,922.0 E 1,728,552.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 953.20 FT.



GROUT SEAL: 750 GALLONS QUICK GROUT

BENTONITE SEAL: 150 LBS PI PELLETS

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 39.0

GRAVEL PACK: 1550 LBS #5\250# SHOT

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

FLY ASH DAM CLUSTERED SITE BORING USEING
10" CASING AND 8" AIR HAMMER

GEOMCNST EPRI_AMOS.GPJ AEP.GDT 6/14/13

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

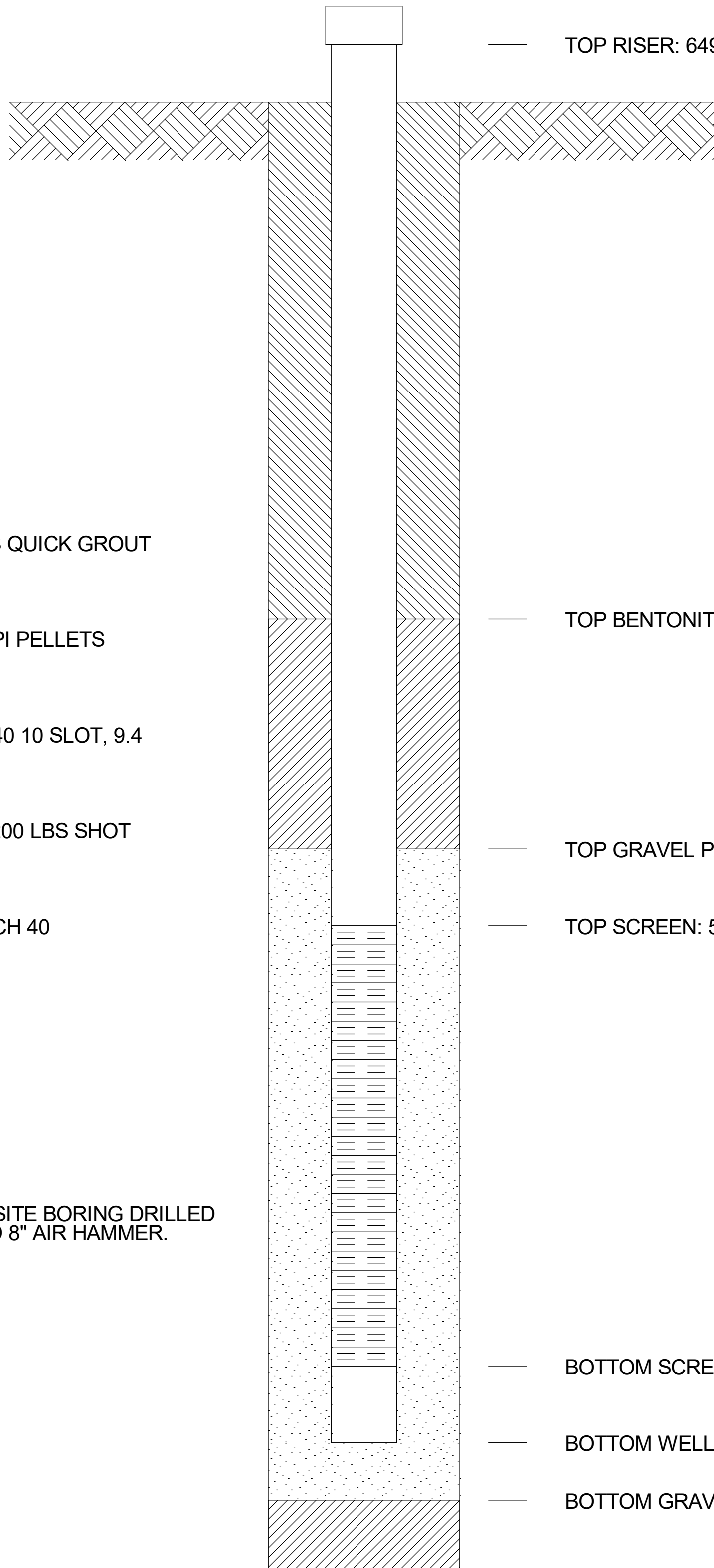
WELL No. **MW-5** BORING No. **D=MW-05** INSTALLED **7/26/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 531,282.0 E 1,724,360.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 648.03 FT.



GROUT SEAL: 600 GALLONS QUICK GROUT

BENTONITE SEAL: 100 LBS PI PELLETS

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 9.4

GRAVEL PACK: 500 LBS #5 200 LBS SHOT

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

FLY ASH DAM CLUSTERED SITE BORING DRILLED USING 10" CASING AND 8" AIR HAMMER.

GEOMCNST EPRI_AMOS.GPJ AEP.GDT 6/14/13

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

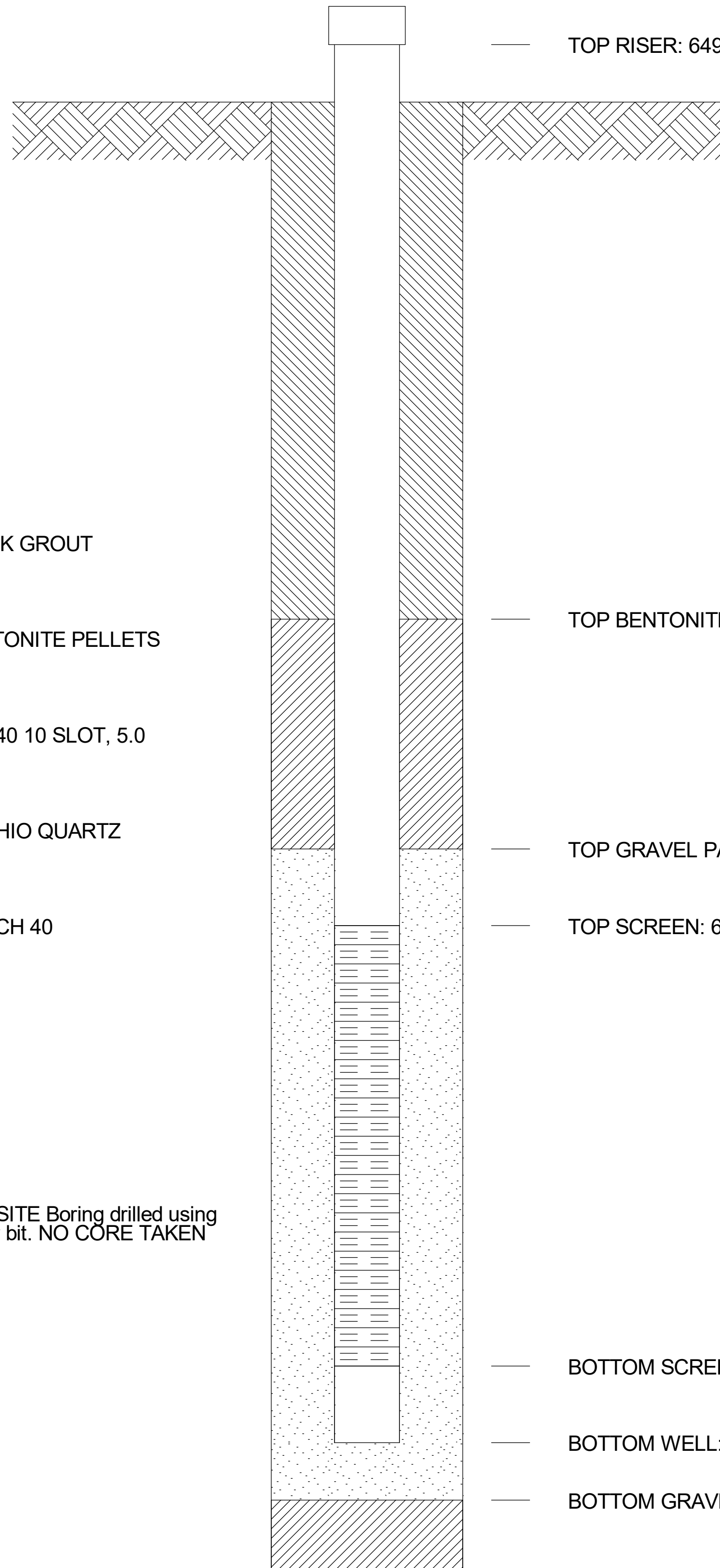
WELL No. **MW-6** BORING No. **D=MW-06** INSTALLED **8/21/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 531,266.0 E 1,724,352.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 647.50 FT.



GROUT SEAL: 75 GAL. QUICK GROUT

BENTONITE SEAL: 75# BENTONITE PELLETS

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 5.0

GRAVEL PACK: 75# NO. 5 OHIO QUARTZ

RISER PIPE: 2.0, dia., PVC SCH 40

SPACERS, DEPTH:

FLY ASH DAM CLUSTERED SITE Boring drilled using 6.25 hsa and 5 7/8" roller bit. NO CORE TAKEN SEE MW-5

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

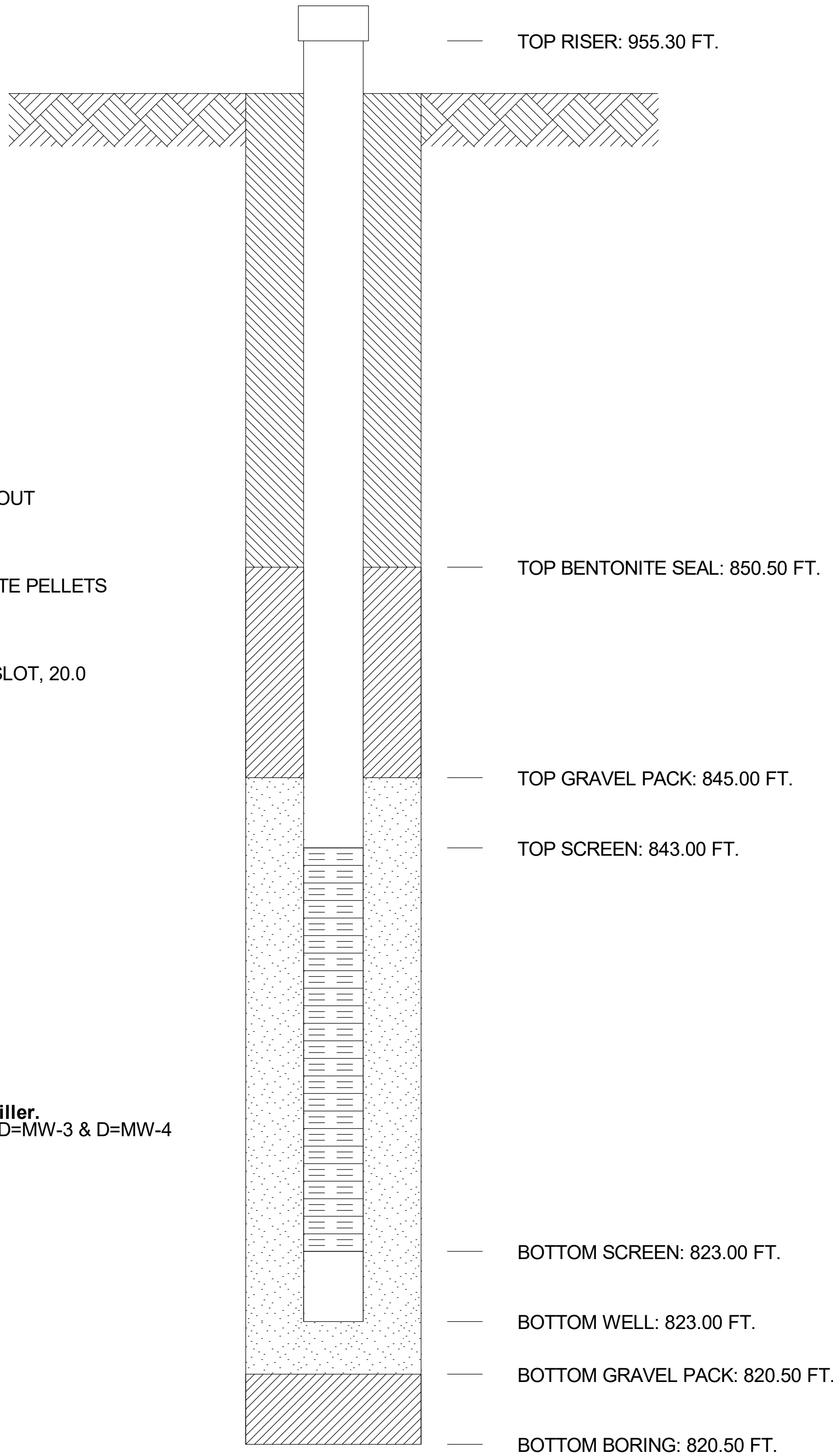
WELL No. **MW-7** BORING No. **D=MW-07** INSTALLED **3/26/96**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 530,938.0 E 1,788,533.0**

SYSTEM

GROUND ELEVATION 953.00 FT.



GROUT SEAL: VOLCLAY GROUT

BENTONITE SEAL: BENTONITE PELLETS

SCREEN: 2.0 dia., PVC .020 SLOT, 20.0

GRAVEL PACK: SAND

RISER PIPE: 2.0, dia., PVC

SPACERS, DEPTH:

Well installed by contract driller.
WELL IS CLUSTERED WITH D=MW-3 & D=MW-4

Used 4 centralizers
Top 3' - Sakcrete

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

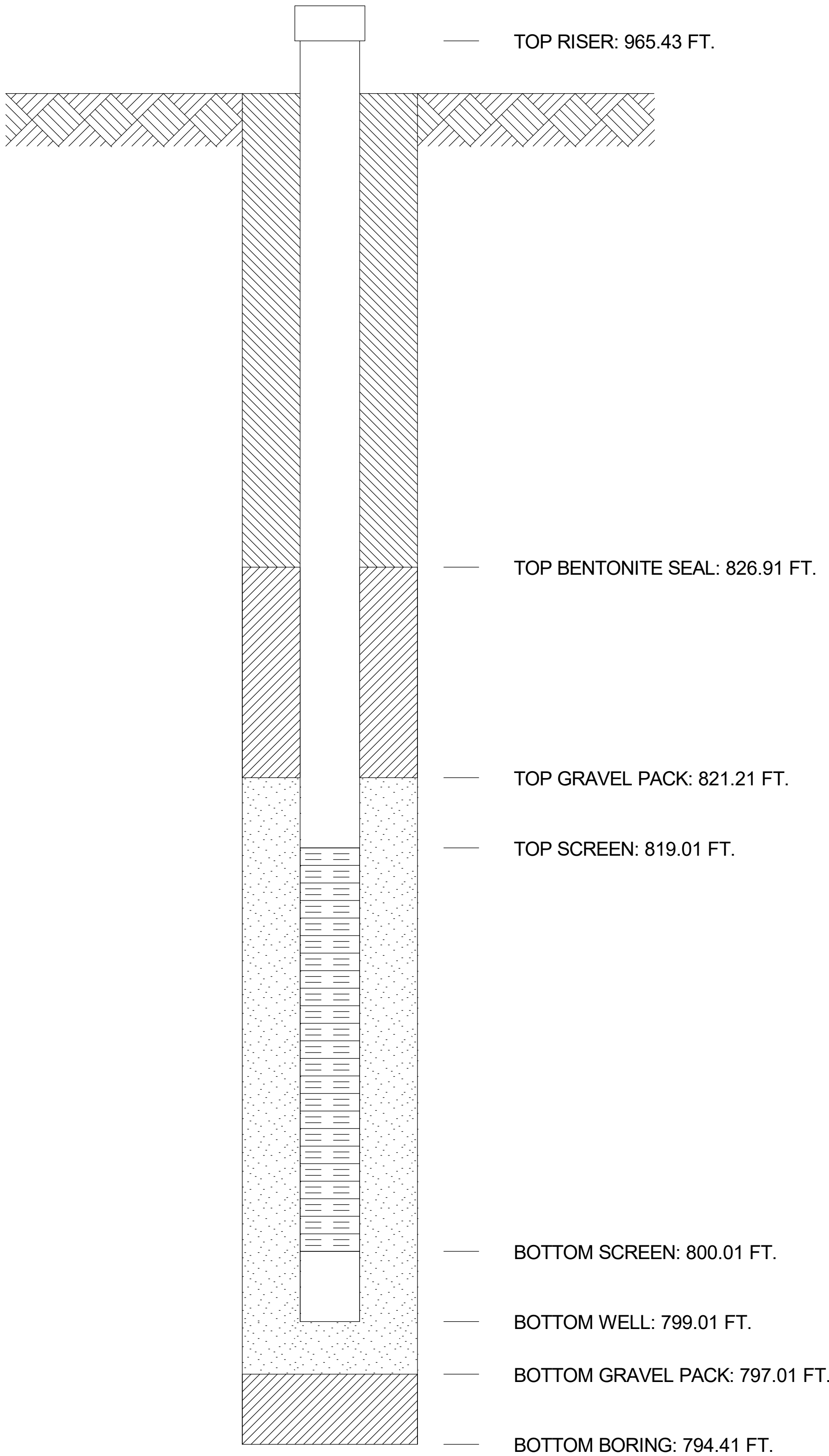
WELL No. **MW-8/001** BORING No. **D=MW-08** INSTALLED **1/30/02**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 533,742.0 E 1,727,871.7**

SYSTEM **State Plane using NAD 83**

GROUND ELEVATION 963.01 FT.



GROUT SEAL:

BENTONITE SEAL:

SCREEN: dia., , 19.0

GRAVEL PACK:

RISER PIPE: , dia.,

SPACERS, DEPTH:

GEOMCNST EPRI_AMOS.GPJ AEP.GDT 6/14/13

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

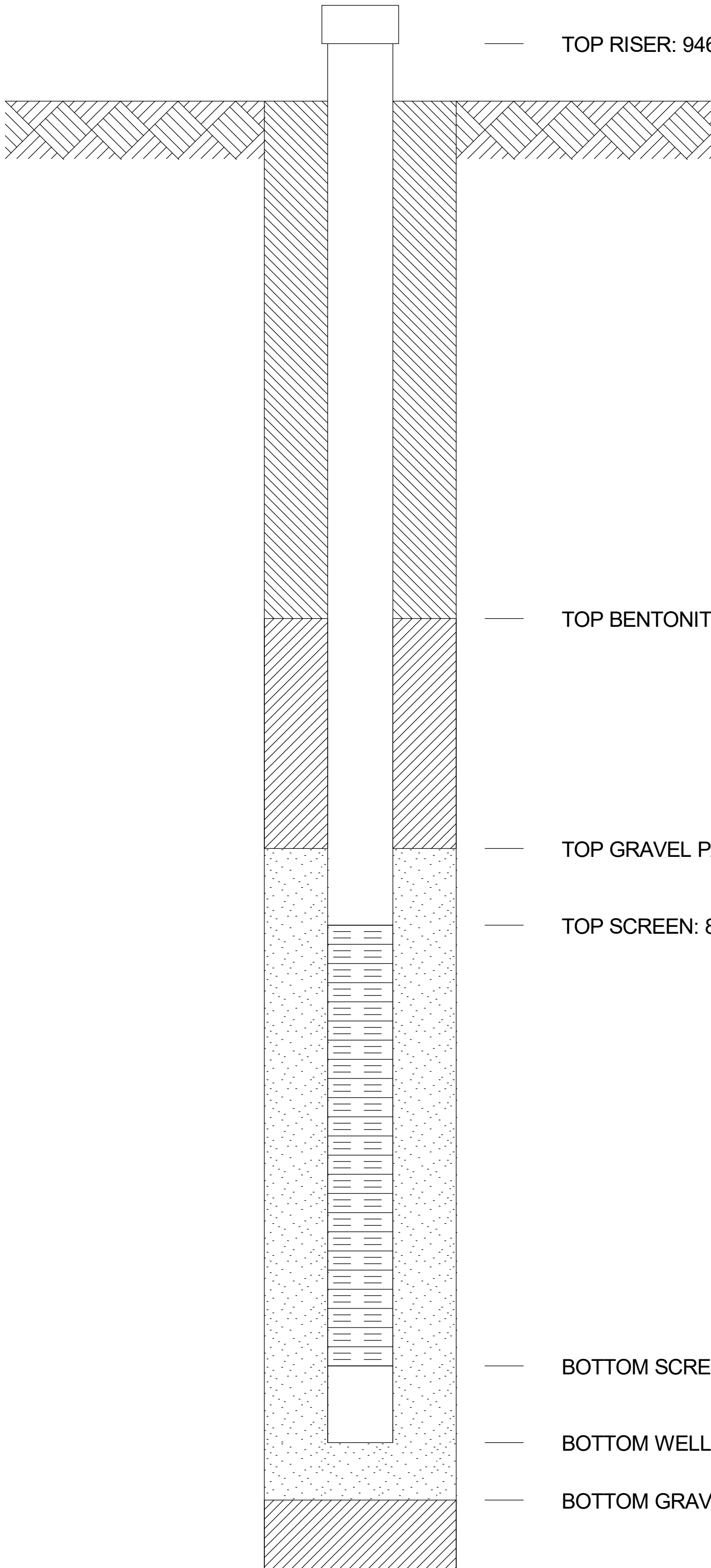
WELL No. **MW-9/001** BORING No. **D=MW-09** INSTALLED **1/16/02**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 533,589.2 E 1,726,988.1**

SYSTEM **State Plane using NAD 83**

GROUND ELEVATION 944.66 FT.



GROUT SEAL:

BENTONITE SEAL:

SCREEN: dia., , 19.0

GRAVEL PACK:

RISER PIPE: , dia.,

SPACERS, DEPTH:

GEOMCNST EPRI_AMOS.GPJ AEP.GDT 6/14/13

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

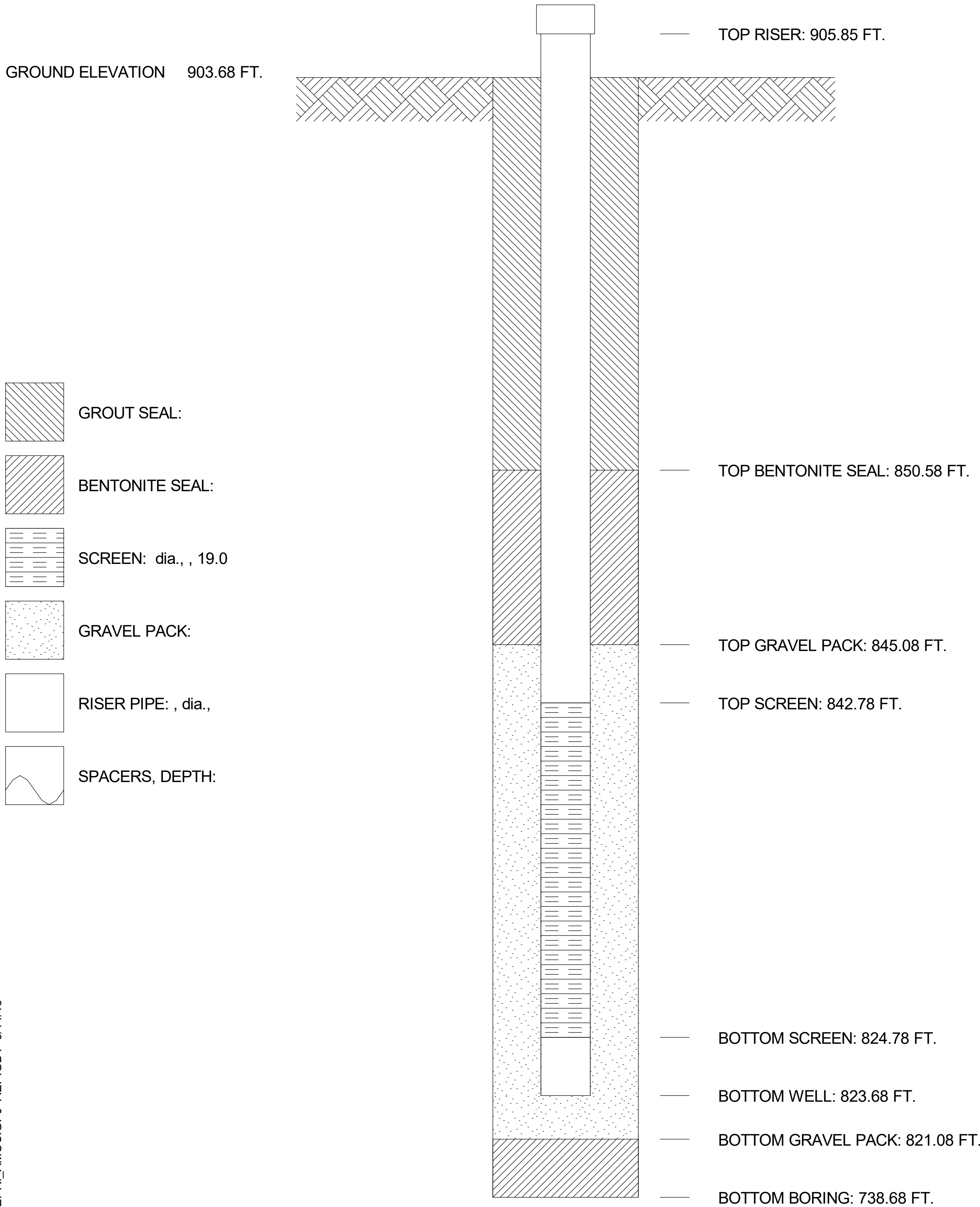
COMPANY

WELL No. **MW-10/002** BORING No. **D=MW-10** INSTALLED **1/22/02**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 534,085.8 E 1,724,114.6**

SYSTEM **State Plane using NAD 83**

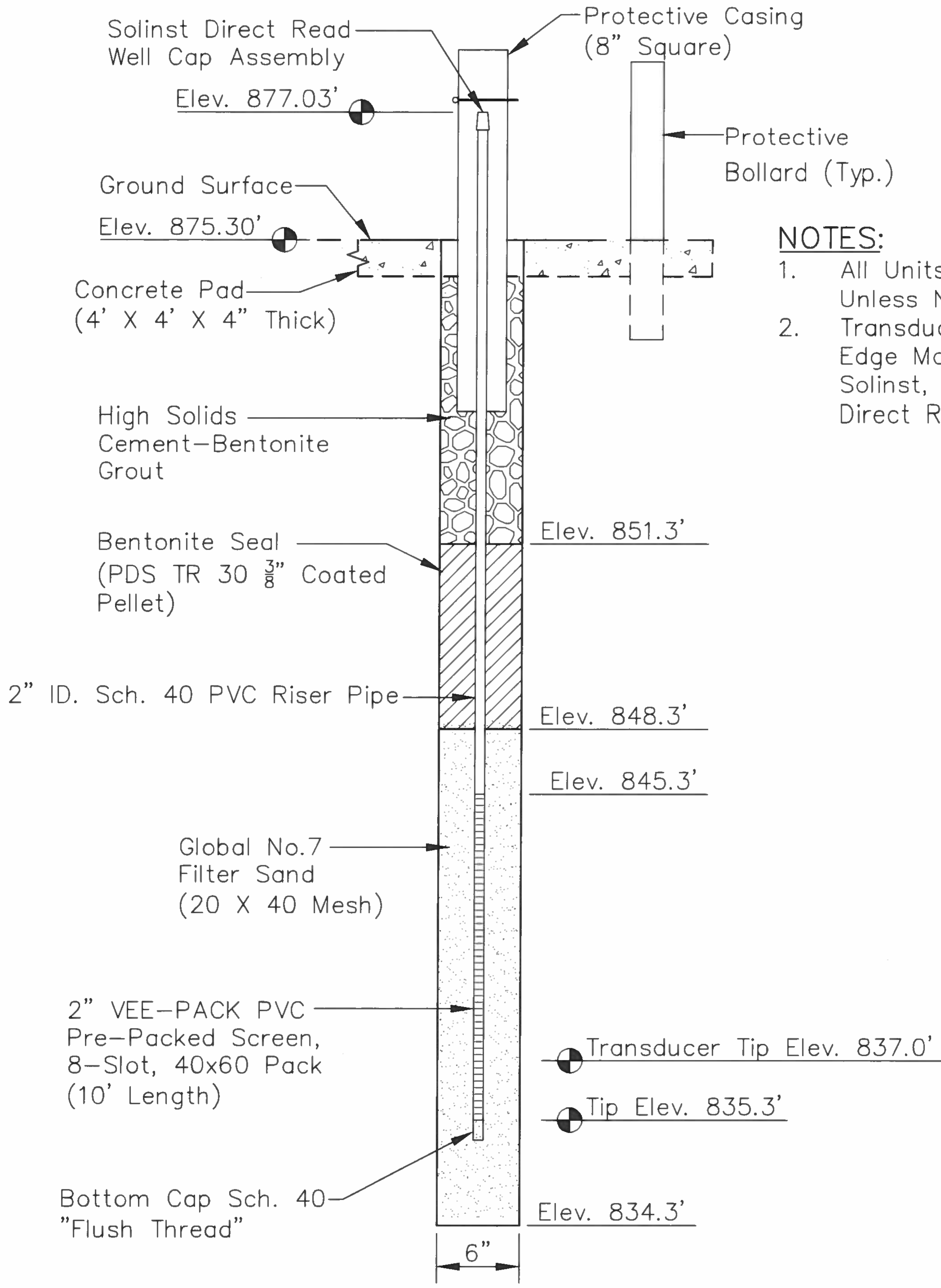


GEOMCNST EPRI_AMOS.GPJ AEP.GDT 6/14/13

Stantec Consulting Services Inc., 2012

Well Construction Diagrams

STN-12-4, STN-12-8, STN-12-9



NOTES:

1. All Units Are in Feet Unless Noted Otherwise.
2. Transducer is Levelogger Edge Model 3001 by Solinst, Attached to a Direct Read Cable.

PLOT DATE: 04/27/2012 USER: JENNINGS, MATTHEW
U:\1756\175661014\ENVIRONMENTAL\DRAWING\SHEET_FILES\MONITORING WELLS\STN-12-9-WELL-LOG.DWG

LOCATION:

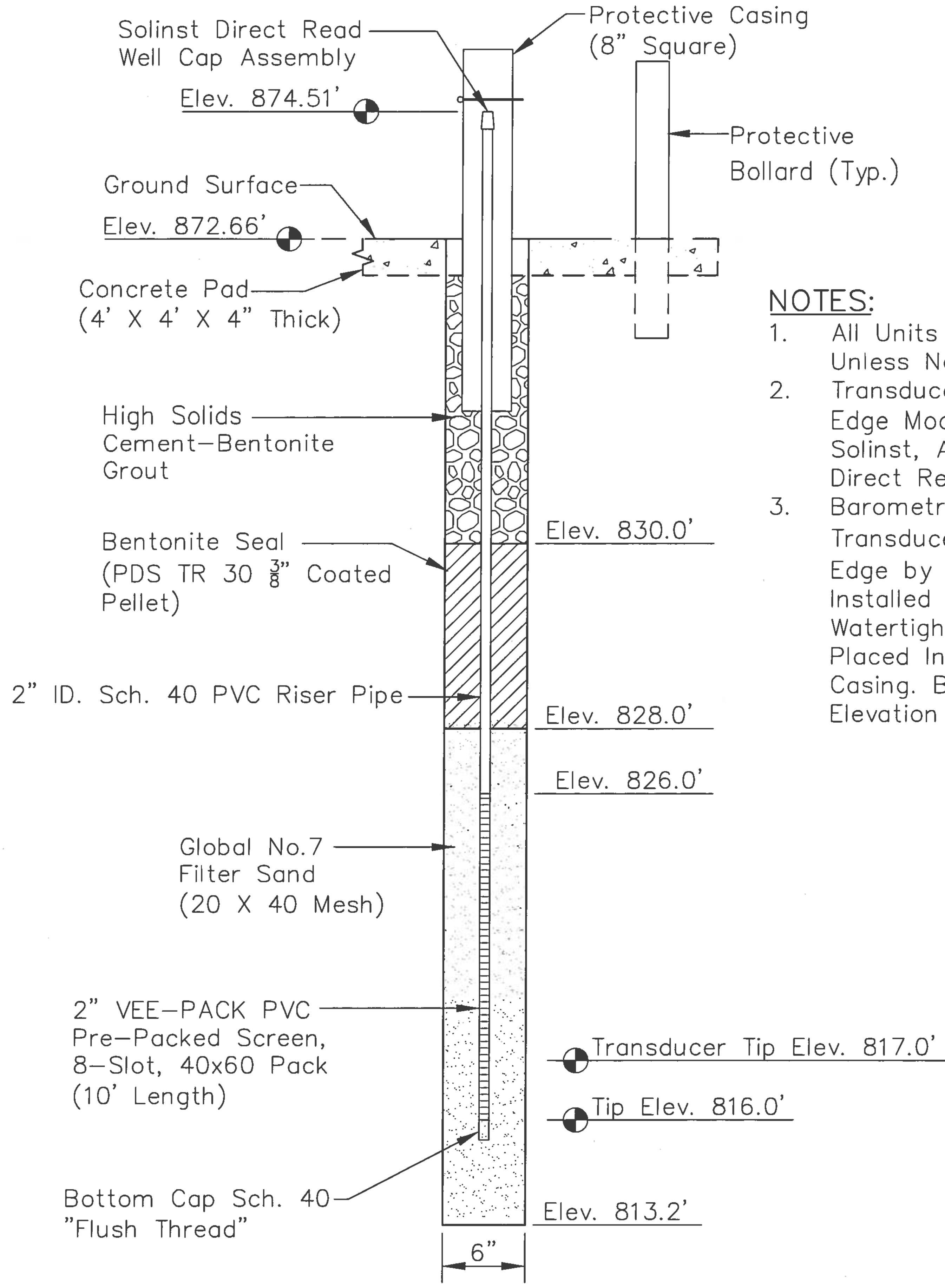
Northing: 532,150.52
Easting: 1,728,713.76
Ground Elevation: 875.30'
Installation Date: 2/21/12
Horizontal Datum: NAD83
WV. South
Vertical Datum: NAVD 88

PIEZOMETER DETAIL
AEP AMOS POWER PLANT, FLY ASH DAM COMPLEX
STN-12-9, WEST VIRGINIA WELL ID WV00054-0001-12

Stantec

Stantec Consulting Services Inc.
11687 Lebanon Rd.
Cincinnati, Ohio
45241-2012
513-842-8200
www.stantec.com

				REVISED		SHEET
DRAWN BY	MSJ	DATE	4/25/12			
CHECKED BY	JMM	PROJ. NO.	175661014	1.	3.	1 OF 1
CHECKED BY	JSD	SCALE	NTS	2.	4.	



NOTES:

1. All Units Are in Feet Unless Noted Otherwise.
2. Transducer is Levelogger Edge Model 3001 by Solinst, Attached to a Direct Read Cable.
3. Barometric Pressure Transducer (Baralogger Edge by Solinst) Installed in Seperate Watertight PVC Riser Placed Inside Protective Casing. Barometric Elevation = 868.00 Feet.

PLOT DATE: 04/26/2012 USER: JENNINGS, MATTHEW
U:\1756\175661014\ENVIRONMENTAL\DRAWING\SHEET_FILES\MONITORING WELLS\STN-12-8-WELL-LOG.DWG

LOCATION:

Northing: 532,214.20
Easting: 1,728,169.25
Ground Elevation: 872.66'
Installation Date: 2/24/12
Horizontal Datum: NAD83
WV. South
Vertical Datum: NAVD 88

PIEZOMETER DETAIL
AEP AMOS POWER PLANT, FLY ASH DAM COMPLEX
STN-12-8, WEST VIRGINIA WELL ID WV00054-0002-12

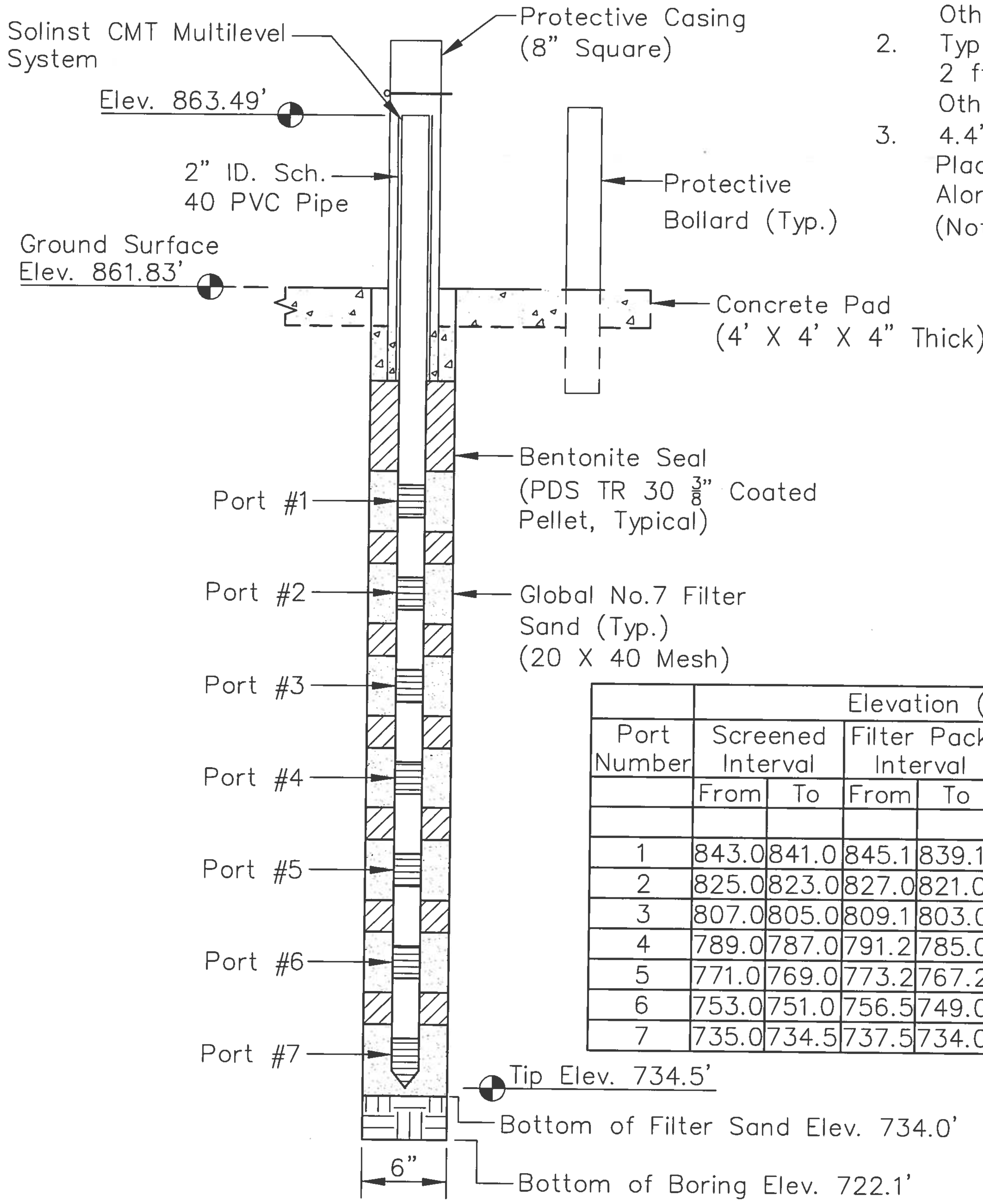
Stantec

Stantec Consulting Services Inc.
11687 Lebanon Rd.
Cincinnati, Ohio
45241-2012
513-842-8200
www.stantec.com

				REVISED		SHEET
DRAWN BY	MSJ	DATE	4/25/12			
CHECKED BY	JMM	PROJ. NO.	175661014	1.	3.	1 OF 1
CHECKED BY	JSD	SCALE	NTS	2.	4.	

NOTES:

1. All Units Are in Feet Unless Noted Otherwise.
2. Typical Port Length is 2 ft. Unless Noted Otherwise.
3. 4.4" Dia. Centralizers Placed at 10ft. Spacing Along Well Tubing (Not Shown).



Port Number	Elevation (ft.) Screened Interval		Filter Pack Interval		Bentonite Seal Interval	
	From	To	From	To	From	To
					861.5	845.1
1	843.0	841.0	845.1	839.1	839.1	827.0
2	825.0	823.0	827.0	821.0	821.0	809.1
3	807.0	805.0	809.1	803.0	803.0	791.2
4	789.0	787.0	791.2	785.0	785.0	773.2
5	771.0	769.0	773.2	767.2	767.2	756.5
6	753.0	751.0	756.5	749.0	749.4	737.5
7	735.0	734.5	737.5	734.0		

PLOT DATE: 04/27/2012 USER: JENNINGS, MATTHEW
U:\1756\175661014\ENVIRONMENTAL\DRAWING\SHEET_FILES\MONITORING WELLS\STN-12-4-WELL-LOG.DWG

LOCATION:

Northing: 531,882.29
Easting: 1,726,127.18
Ground Elevation: 861.83'
Installation Date: 3/8/12
Horizontal Datum: NAD 83
WV. South
Vertical Datum: NAVD 88

PIEZOMETER DETAIL
AEP AMOS POWER PLANT, FLY ASH DAM COMPLEX
STN-12-4, WEST VIRGINIA WELL ID WV00054-0003-12

Stantec

Stantec Consulting Services Inc.
11687 Lebanon Rd.
Cincinnati, Ohio
45241-2012
513-842-8200
www.stantec.com

				REVISED		SHEET
DRAWN BY	MSJ	DATE	4/25/12			
CHECKED BY	JMM	PROJ. NO.	175661014	1.	3.	1 OF 1
CHECKED BY	JSD	SCALE	NTS	2.	4.	

American Electric Power, 1975-1984

Piezometer Construction Information

PP2, PP3, PP4R, PP7R, PP8F, PP8RA, P8400, P8401

AMOS	PIEZOMETER PP2

FLY ASH DAM
INSTALLED - MAR76

NORTH : 531523.4
EAST : 1724596.6

TOP OF RISER ELEVATION :	679.0
TIP ELEVATION :	631.6
GROUND ELEVATION :	677.5
SCREENED INT :	631.6-636

NOTES : SCREENED IN BLANKET DRAIN

DATE	READING (FT.)	ELEVATION (FT.)
Feb-84	41.83	637.17
Sep-84	41.92	637.08
Oct-84	41.92	637.08
Dec-84	42.08	636.92
Jan-85	42.00	637.00
Mar-85	42.00	637.00
Apr-85	42.08	636.92
May-85	42.17	636.83
Jun-85	42.08	636.92
Jul-85	42.00	637.00
Oct-85	46.50	632.50
Nov-85	42.50	636.50
Dec-85	42.33	636.67
Jan-86	42.42	636.58
Feb-86	42.17	636.83
Mar-86	42.33	636.67
Apr-86	42.17	636.83
May-86	42.33	636.67
Jun-86	42.00	637.00
Jul-86	42.08	636.92
Aug-86	42.42	636.58
Sep-86	42.00	637.00
Oct-86	42.25	636.75
Nov-86	42.00	637.00
Dec-86	42.17	636.83
Jan-87	42.17	636.83
Feb-87	42.00	637.00
Mar-87	42.42	636.58
Apr-87	42.17	636.83
May-87	42.50	636.50
Jun-87	42.17	636.83
Jul-87	42.08	636.92
Aug-87	42.08	636.92
Sep-87	42.00	637.00
Nov-87	42.08	636.92
Dec-87	42.50	636.50
Jan-88	42.00	637.00
Feb-88	42.33	636.67
Mar-88	42.00	637.00
Apr-88	42.00	637.00
May-88	42.00	637.00
Jun-88	42.00	637.00
Jul-88	41.75	637.25
Aug-88	42.17	636.83
Sep-88	42.08	636.92
Oct-88	42.08	636.92
Nov-88	42.08	636.92
Dec-88	41.58	637.42
Jan-89	42.75	636.25
Feb-89	42.75	636.25
Mar-89	42.58	636.42
Apr-89	44.25	634.75
May-89	44.25	634.75
Jun-89	43.75	635.25
Jul-89	43.92	635.08
Aug-89	44.00	635.00
Sep-89	44.00	635.00
Oct-89	43.83	635.17
Nov-89	44.17	634.83
Jan-90	43.92	635.08
Feb-90	43.92	635.08
Mar-90	44.00	635.00
Apr-90	43.83	635.17
May-90	44.00	635.00
Jun-90	44.25	634.75
Jul-90	42.58	636.42
Aug-90	42.50	636.50
Sep-90	43.92	635.08
Oct-90	43.58	635.42
Nov-90	44.00	635.00
Dec-90	44.50	634.50
Jan-91	44.00	635.00
Feb-91	39.92	639.08
Mar-91	44.00	635.00
Apr-91	43.83	635.17
May-91	42.92	636.08
Jun-91	43.92	635.08
Sep-91	42.67	636.33
Dec-91	42.58	636.42
Mar-92	42.50	636.50
Jun-92	42.50	636.50
Sep-92	42.42	636.58
Dec-92	42.50	636.50
Mar-93	42.83	636.17
Jun-93	42.75	636.25
Sep-93	42.66	636.34
Dec-93	43.08	635.92
Mar-94	42.75	636.25
May-94	42.75	636.25
Sep-94	42.73	636.27
Dec-94	42.66	636.34
Mar-95	42.62	636.38
Jun-95	42.91	636.09
Sep-95	42.73	636.27
Dec-95	47.00	632.00
Mar-96	42.66	636.34
Jun-96	42.66	636.34
Sep-96	42.62	636.38
Dec-96	42.66	636.34
Mar-97	42.68	636.32
Jun-97	42.67	636.33
Sep-97	42.67	636.33
Dec-97	48.67	630.33
Mar-98	42.42	636.58
Jun-98	41.71	637.29
Sep-98	42.67	636.33
Dec-98	42.62	636.38
Mar-99	42.60	636.40
Jun-99	42.62	636.38
Sep-99	42.67	636.33
Dec-99	42.62	636.38
Mar-00	42.58	636.42
Jun-00	42.62	636.38
Sep-00	42.58	636.42
Dec-00	42.65	636.35
Mar-01	42.54	636.46
Jun-01	42.58	636.42
Sep-01	42.50	636.50
Dec-01	42.50	636.50
Mar-02	42.42	636.58
Jun-02	42.50	636.50
Sep-02	42.46	636.54
Dec-02	42.54	636.46
Mar-03	42.54	636.46
Jun-03	42.50	636.50
Sep-03	42.60	636.40
Dec-03	42.58	636.42
Mar-04	42.54	636.46
Jun-04	42.58	636.42
Sep-04	42.50	636.50
Dec-04	42.50	636.50
Mar-05	42.50	636.50
Jun-05	42.52	636.48
Sep-05	42.50	636.50
Dec-05	42.54	636.46
Mar-06	42.46	636.54
Jun-06	42.46	636.54
Sep-06	42.50	636.50
Dec-06	42.46	636.54
Mar-07	42.44	636.56
Jun-07	42.33	636.67
Sep-07	42.37	636.63
Dec-07	42.52	636.48
Mar-08	42.58	636.42
Jun-08	42.54	636.46
Sep-08	42.58	636.42
Dec-08	42.67	636.33
Mar-09	42.62	636.38
Jun-09	42.53	636.47
Sep-09	42.71	636.29
Dec-09	42.63	636.37
Mar-10	42.65	636.35
Jun-10	42.65	636.35
Sep-10	42.63	636.37
Dec-10	42.68	636.32
Mar-11	42.59	636.41
Jun-11	43.32	635.68
Sep-11	42.58	636.42
Dec-11	42.93	636.07
Mar-12	42.89	636.11
Jun-12	43.05	635.95
Sep-12	43.15	635.85
Dec-12	43.29	635.71
Mar-13	43.01	635.99
Jun-13	43.11	635.89

AMOS

PIEZOMETER PP3

FLY ASH DAM
INSTALLED - DEC75

NORTH : 531390.4
EAST : 1724532.6

TOP OF RISER ELEVATION :	653.3
TIP ELEVATION :	610.2
GROUND ELEVATION :	646.0
SCREENED INT :	610-615
NOTES : AT TOE OF DAM	

DATE	READING (FT.)	ELEVATION (FT.)
Feb-84	15.92	637.38
Sep-84	16.00	637.30
Oct-84	15.92	637.38
Dec-84	16.17	637.13
Jan-85	16.00	637.30
Mar-85	16.00	637.30
Apr-85	16.00	637.30
May-85	16.08	637.22
Jun-85	16.00	637.30
Jul-85	16.00	637.30
Oct-85	23.50	629.80
Nov-85	16.33	636.97
Dec-85	16.50	636.80
Jan-86	16.42	636.88
Feb-86	16.25	637.05
Mar-86	15.83	637.47
Apr-86	16.00	637.30
May-86	16.17	637.13
Jun-86	16.00	637.30
Jul-86	15.08	638.22
Aug-86	16.67	636.63
Sep-86	16.00	637.30
Oct-86	16.00	637.30
Nov-86	16.00	637.30
Dec-86	16.08	637.22
Jan-87	16.25	637.05
Feb-87	16.08	637.22
Mar-87	16.08	637.22
Apr-87	16.00	637.30
May-87	16.00	637.30
Jun-87	16.25	637.05
Jul-87	16.17	637.13
Aug-87	16.00	637.30
Sep-87	15.92	637.38
Nov-87	15.00	638.30
Dec-87	16.17	637.13
Jan-88	15.92	637.38
Feb-88	15.58	637.72
Mar-88	15.92	637.38
Apr-88	16.08	637.22
May-88	16.17	637.13
Jun-88	16.17	637.13
Jul-88	15.67	637.63
Aug-88	15.92	637.38
Sep-88	15.92	637.38
Oct-88	16.08	637.22
Nov-88	13.92	639.38
Dec-88	15.83	637.47
Jan-89	16.92	636.38
Feb-89	16.92	636.38
Mar-89	16.92	636.38
Apr-89	17.83	635.47
May-89	17.83	635.47
Jun-89	17.83	635.47
Jul-89	18.00	635.30
Aug-89	17.92	635.38
Sep-89	18.00	635.30
Oct-89	17.67	635.63
Nov-89	18.00	635.30
Jan-90	17.75	635.55
Feb-90	17.67	635.63
Mar-90	17.92	635.38
Apr-90	17.83	635.47
May-90	17.83	635.47
Jun-90	18.00	635.30
Jul-90	16.42	636.88
Aug-90	16.25	637.05
Sep-90	18.33	634.97
Oct-90	17.75	635.55
Nov-90	18.00	635.30
Dec-90	18.25	635.05
Jan-91	17.83	635.47
Feb-91	17.75	635.55
Mar-91	17.75	635.55
Apr-91	17.92	635.38
May-91	18.25	635.05
Jun-91	18.08	635.22
Sep-91	16.75	636.55
Dec-91	16.58	636.72
Mar-92	16.42	636.88
Jun-92	16.67	636.63
Sep-92	16.42	636.88
Dec-92	16.50	636.80
Mar-93	16.50	636.80
Jun-93	16.33	636.97
Sep-93	16.58	636.72
Dec-93	16.17	637.13
Mar-94	16.66	636.64
May-94	16.69	636.61
Sep-94	15.96	637.34
Dec-94	16.63	636.67
Mar-95	16.62	636.68
Jun-95	16.79	636.51
Sep-95	15.96	637.34
Dec-95	16.34	636.96
Mar-96	16.79	636.51
Jun-96	16.88	636.42
Sep-96	16.84	636.46
Dec-96	16.25	637.05
Mar-97	16.79	636.51
Jun-97	16.67	636.63
Sep-97	16.81	636.49
Dec-97	16.75	636.55
Mar-98	16.58	636.72
Jun-98	15.79	637.51
Sep-98	16.87	636.43
Dec-98	16.83	636.47
Mar-99	16.83	636.47
Jun-99	16.83	636.47
Sep-99	16.83	636.47
Dec-99	16.75	636.55
Mar-00	16.79	636.51
Jun-00	16.67	636.63
Sep-00	16.75	636.55
Dec-00	16.67	636.63
Mar-01	16.63	636.67
Jun-01	16.67	636.63
Sep-01	16.67	636.63
Dec-01	16.65	636.65
Mar-02	16.58	636.72
Jun-02	16.67	636.63
Sep-02	16.63	636.67
Dec-02	16.58	636.72
Mar-03	16.62	636.68
Jun-03	16.67	636.63
Sep-03	16.73	636.57
Dec-03	16.71	636.59
Mar-04	16.75	636.55
Jun-04	16.79	636.51
Sep-04	16.42	636.88
Dec-04	16.71	636.59
Mar-05	16.58	636.72
Jun-05	17.19	636.11
Sep-05	16.60	636.70
Dec-05	16.83	636.47
Mar-06	16.71	636.59
Jun-06	17.25	636.05
Sep-06	16.79	636.51
Dec-06	16.67	636.63
Jan-07	16.67	636.63
Feb-07	17.25	636.05
Mar-07	16.58	636.72
Apr-07	16.54	636.76
Jun-07	16.75	636.55
Sep-07	16.64	636.66
Dec-07	16.71	636.59
Mar-08	16.73	636.57
Jun-08	16.67	636.63
Sep-08	16.75	636.55
Dec-08	16.77	636.53
Mar-09	16.70	636.60
Jun-09	16.60	636.70
Sep-09	16.74	636.56
Dec-09	16.76	636.54
Mar-10	16.73	636.57
Jun-10	16.93	636.37
Sep-10	16.78	636.52
Dec-10	16.94	636.36
Mar-11	16.81	636.49
Jun-11	17.01	636.29
Sep-11	16.74	636.56
Dec-11	16.87	636.43
Mar-12	16.52	636.78
Jun-12	16.90	636.40
Sep-12	16.71	636.59
Dec-12	16.79	636.51
Mar-13	16.92	636.38
Jun-13	16.96	636.34

AMOS

PIEZOMETER PP4R

FLY ASH DAM
INSTALLED - FEB76

NORTH : 531683.3
EAST : 1725169.6

TOP OF RISER ELEVATION : 883.0*
*ELEV. AFTER 20OCT94 : 881.2
TIP ELEVATION : 685.0
GROUND ELEVATION : 880.0
SCREENED INT : 685-690
NOTES : SCREENED IN DAM FILL

DATE	READING (FT.)	ELEVATION (FT.)
Feb-84	223.83	659.17
Sep-84	223.83	659.17
Oct-84	223.75	659.25
Jan-85	224.17	658.83
Mar-85	224.25	658.75
Apr-85	224.33	658.67
May-85	224.25	658.75
Jun-85	224.00	659.00
Jul-85	224.92	658.08
Oct-85	224.58	658.42
Nov-85	224.50	658.50
Dec-85	224.17	658.83
Jan-86	223.83	659.17
Feb-86	224.33	658.67
Mar-86	224.33	658.67
Apr-86	224.83	658.17
May-86	224.42	658.58
Jun-86	223.50	659.50
Jul-86	223.58	659.42
Aug-86	223.83	659.17
Sep-86	224.00	659.00
Oct-86	223.67	659.33
Nov-86	223.92	659.08
Dec-86	223.50	659.50
Jan-87	224.00	659.00
Feb-87	223.92	659.08
Mar-87	224.08	658.92
Apr-87	223.67	659.33
May-87	223.83	659.17
Jun-87	223.83	659.17
Jul-87	223.42	659.58
Aug-87	223.42	659.58
Sep-87	223.25	659.75
Nov-87	223.50	659.50
Dec-87	225.00	658.00
Jan-88	233.25	649.75
Feb-88	222.50	660.50
Mar-88	223.92	659.08
Apr-88	223.50	659.50
May-88	223.33	659.67
Jun-88	223.42	659.58
Jul-88	222.92	660.08
Aug-88	223.42	659.58
Sep-88	223.17	659.83
Oct-88	223.08	659.92
Nov-88	222.58	660.42
Dec-88	225.00	658.00
Jan-89	223.08	659.92
Feb-89	223.25	659.75
Mar-89	223.67	659.33
Apr-89	223.75	659.25
May-89	224.17	658.83
Jun-89	224.00	659.00
Jul-89	223.67	659.33
Aug-89	223.50	659.50
Sep-89	223.92	659.08
Oct-89	224.00	659.00
Nov-89	224.00	659.00
Jan-90	223.42	659.58
Feb-90	223.25	659.75
Mar-90	222.33	660.67
Apr-90	223.50	659.50
May-90	223.42	659.58
Jun-90	224.00	659.00
Jul-90	221.75	661.25
Aug-90	221.83	661.17

DATE	READING (FT.)	ELEVATION (FT.)
Sep-90	222.17	660.83
Oct-90	223.92	659.08
Nov-90	223.50	659.50
Dec-90	224.08	658.92
Jan-91	223.00	660.00
Feb-91	222.75	660.25
Mar-91	224.92	658.08
Apr-91	224.92	658.08
May-91	227.00	656.00
Jun-91	227.08	655.92
Sep-91	225.00	658.00
Dec-91	225.00	658.00
Mar-92	224.92	658.08
Jun-92	124.92	758.08
Sep-92	224.33	658.67
Dec-92	224.75	658.25
Mar-93	224.58	658.42
Jun-93	223.08	659.92
Sep-93	223.17	659.83
Mar-94	223.58	659.42
May-94	223.33	659.67
Sep-94	222.97	660.03
Dec-94	223.04	658.20
Mar-95	223.00	658.24
Jun-95	222.67	658.57
Sep-95	222.97	658.27
Dec-95	222.75	658.49
Mar-96	221.92	659.32
Jun-96	122.79	758.45
Sep-96	222.33	658.91
Dec-96	222.42	658.82
Mar-97	222.42	658.82
Jun-97	222.17	659.07
Sep-97	221.96	659.28
Dec-97	208.75	672.49
Mar-98	223.33	657.91
Jun-98	223.29	657.95
Sep-98	223.21	658.03
Dec-98	222.83	658.41
Mar-99	222.83	658.41
Jun-99	222.83	658.41
Sep-99	222.42	658.82
Dec-99	222.75	658.49
Mar-00	222.71	658.53
Jun-00	222.04	659.20
Sep-00	221.96	659.28
Dec-00	224.17	657.07
Mar-01	223.29	657.95
Jun-01	222.79	658.45
Sep-01	122.46	758.78
Dec-01	222.63	658.61
Mar-02	222.67	658.57
Jun-02	222.29	658.95
Sep-02	222.33	658.91
Dec-02	222.17	659.07
Mar-03	222.62	658.62
Jun-03	222.00	659.24
Sep-03	221.87	659.37
Dec-03	223.39	657.85
Mar-04	223.08	658.16
Jun-04	223.06	658.18
Sep-04	222.92	658.32
Dec-04	223.00	658.24
Mar-05	222.58	658.66
Jun-05	222.69	658.55
Sep-05	222.58	658.66
Dec-05	222.89	658.35
Mar-06	223.08	658.16
Jun-06	222.46	658.78
Sep-06	222.42	658.82
Dec-06	222.75	658.49
Mar-07	222.42	658.82
Jun-07	220.21	661.03
Sep-07	222.17	659.07
Dec-07	224.00	657.24
Mar-08	223.33	657.91
Jun-08	223.48	657.76
Sep-08	223.14	658.10
Dec-08	222.99	658.25

DATE	READING (FT.)	ELEVATION (FT.)
Mar-09	222.58	658.66
Jun-09	222.49	658.75
Sep-09	222.84	658.40
Dec-09	222.90	658.34
Mar-10	222.89	658.35
Jun-10	223.34	657.90
Sep-10	222.54	658.70
Dec-10	223.19	658.05
Mar-11	217.26	663.98
Jun-11	222.82	658.42
Sep-11	222.35	658.89
Dec-11	223.26	657.98
Mar-12	222.67	658.57
Jun-12	223.18	658.06
Sep-12	221.74	659.50
Dec-12	221.36	659.88
Mar-13	222.76	658.48
Jun-13	222.49	658.75

AMOS	PIEZOMETER PP7R

FLY ASH DAM
INSTALLED - OCT76

NORTH : 532388.3
EAST : 1724633.7
TOP OF RISER ELEVATION : 882.1*
*ELEV. AFTER 20OCT94 : 880.3
TIP ELEVATION : 636.4
GROUND ELEVATION : 880.0
SCREENED INT : 636-641
NOTES : SCREENED IN BEDROCK BELOW DAM FILL

DATE	READING (FT.)	ELEVATION (FT.)
Feb-84	198.00	684.10
Sep-84	198.00	684.10
Oct-84	197.83	684.27
Dec-84	198.33	683.77
Jan-85	198.00	684.10
Mar-85	197.92	684.18
Apr-85	197.58	684.52
May-85	197.83	684.27
Jun-85	198.67	683.43
Jul-85	197.50	684.60
Oct-85	201.00	681.10
Nov-85	198.42	683.68
Dec-85	198.08	684.02
Jan-86	198.08	684.02
Feb-86	197.83	684.27
Mar-86	197.83	684.27
Apr-86	198.00	684.10
May-86	198.82	683.28
Jun-86	197.50	684.60
Jul-86	197.83	684.27
Aug-86	198.75	683.35
Sep-86	198.08	684.02
Oct-86	198.50	683.60
Nov-86	198.00	684.10
Dec-86	197.83	684.27
Jan-87	197.83	684.27
Feb-87	197.92	684.18
Mar-87	197.08	685.02
Apr-87	197.83	684.27
May-87	197.83	684.27
Jun-87	198.17	683.93
Jul-87	197.75	684.35
Aug-87	197.67	684.43
Sep-87	197.33	684.77
Nov-87	197.67	684.43
Dec-87	197.67	684.43
Jan-88	197.75	684.35
Feb-88	194.42	687.68
Mar-88	197.75	684.35
Apr-88	197.50	684.60
May-88	197.67	684.43
Jun-88	197.50	684.60
Jul-88	197.67	684.43
Aug-88	197.75	684.35
Sep-88	197.83	684.27
Oct-88	197.83	684.27
Nov-88	198.00	684.10
Dec-88	198.83	683.27
Jan-89	198.83	683.27
Feb-89	198.25	683.85
Mar-89	198.92	683.18
Apr-89	199.33	682.77
May-89	199.67	682.43
Jun-89	199.17	682.93
Jul-89	199.25	682.85
Aug-89	199.25	682.85
Sep-89	193.25	688.85
Oct-89	195.83	686.27
Nov-89	195.58	686.52
Jan-90	196.00	686.10
Feb-90	196.00	686.10
Mar-90	194.33	687.77
Apr-90	199.33	682.77
May-90	199.00	683.10
Jun-90	199.42	682.68
Jul-90	199.00	683.10

DATE	READING (FT.)	ELEVATION (FT.)
Aug-90	199.00	683.10
Sep-90	199.00	683.10
Oct-90	199.25	682.85
Nov-90	199.17	682.93
Dec-90	200.50	681.60
Jan-91	198.83	683.27
Feb-91	198.92	683.18
Mar-91	199.00	683.10
Apr-91	199.00	683.10
May-91	198.50	683.60
Jun-91	199.00	683.10
Jul-91	199.92	682.18
Aug-91	199.25	682.85
Jun-93	196.08	686.02
Jul-93	196.50	685.60
Aug-93	195.42	686.68
Sep-93	196.33	685.77
Oct-93	196.58	685.52
Nov-93	196.50	685.60
Jan-94	196.17	685.93
Feb-94	196.25	685.85
Mar-94	196.25	685.85
Apr-94	196.42	685.68
May-94	196.17	685.93
Jun-94	196.17	685.93
Jul-94	196.00	686.10
Aug-94	196.02	686.08
Sep-94	195.96	686.14
Oct-94	195.83	684.49
Nov-94	195.46	684.86
Dec-94	196.00	684.32
Jan-95	196.19	684.13
Feb-95	196.04	684.28
Mar-95	196.16	684.16
Apr-95	196.08	684.24
May-95	196.12	684.20
Jun-95	196.02	684.30
Jul-95	196.00	684.32
Aug-95	196.02	684.30
Sep-95	195.96	684.36
Oct-95	196.92	683.40
Nov-95	195.92	684.40
Dec-95	195.92	684.40
Jan-96	195.92	684.40
Feb-96	195.92	684.40
Mar-96	195.92	684.40
Apr-96	196.00	684.32
May-96	195.83	684.49
Jun-96	195.92	684.40
Jul-96	196.17	684.15
Aug-96	196.08	684.24
Sep-96	196.12	684.20
Oct-96	196.12	684.20
Nov-96	196.08	684.24
Dec-96	196.17	684.15
Jan-97	196.21	684.11
Feb-97	196.21	684.11
Mar-97	196.08	684.24
Apr-97	196.04	684.28
May-97	196.17	684.15
Jun-97	196.17	684.15
Jul-97	196.12	684.20
Aug-97	196.17	684.15
Sep-97	196.33	683.99
Oct-97	196.58	683.74
Nov-97	196.29	684.03
Dec-97	196.25	684.07
Jan-98	196.37	683.95
Feb-98	196.17	684.15
Mar-98	196.17	684.15
Apr-98	243.08	637.24
May-98	196.17	684.15
Jun-98	196.08	684.24
Jul-98	196.12	684.20
Aug-98	196.12	684.20
Sep-98	196.08	684.24
Oct-98	196.08	684.24
Nov-98	196.25	684.07
Dec-98	196.12	684.20

DATE	READING (FT.)	ELEVATION (FT.)
Jan-99	196.00	684.32
Feb-99	196.08	684.24
Mar-99	196.08	684.24
Apr-99	196.29	684.03
May-99	196.12	684.20
Jun-99	196.17	684.15
Jul-99	196.17	684.15
Aug-99	196.17	684.15
Sep-99	196.21	684.11
Oct-99	196.21	684.11
Nov-99	196.25	684.07
Dec-99	196.25	684.07
Jan-00	196.29	684.03
Feb-00	196.17	684.15
Mar-00	196.29	684.03
Apr-00	196.29	684.03
May-00	196.17	684.15
Jun-00	196.25	684.07
Jul-00	196.12	684.20
Aug-00	196.17	684.15
Sep-00	196.17	684.15
Oct-00	196.17	684.15
Nov-00	196.12	684.20
Dec-00	196.08	684.24
Jan-01	196.12	684.20
Feb-01	196.12	684.20
Mar-01	196.21	684.11
Apr-01	196.17	684.15
May-01	196.12	684.20
Jun-01	196.12	684.20
Jul-01	196.17	684.15
Aug-01	196.08	684.24
Sep-01	196.12	684.20
Oct-01	196.08	684.24
Nov-01	196.04	684.28
Dec-01	196.92	683.40
Jan-02	196.00	684.32
Feb-02	196.00	684.32
Mar-02	196.08	684.24
Apr-02	196.04	684.28
May-02	196.04	684.28
Jun-02	196.04	684.28
Jul-02	196.00	684.32
Aug-02	196.08	684.24
Sep-02	196.04	684.28
Oct-02	196.04	684.28
Nov-02	196.04	684.28
Dec-02	196.25	684.07
Jan-03	195.94	684.38
Feb-03	195.92	684.40
Mar-03	195.94	684.38
Apr-03	195.92	684.40
May-03	195.83	684.49
Jun-03	195.96	684.36
Jul-03	195.83	684.49
Aug-03	195.77	684.55
Sep-03	195.89	684.43
Oct-03	195.79	684.53
Nov-03	195.71	684.61
Dec-03	195.71	684.61
Jan-04	195.75	684.57
Feb-04	195.79	684.53
Mar-04	195.83	684.49
Apr-04	195.64	684.68
May-04	195.62	684.70
Jun-04	195.79	684.53
Jul-04	195.67	684.65
Aug-04	195.79	684.53
Sep-04	195.81	684.51
Oct-04	195.71	684.61
Nov-04	195.58	684.74
Dec-04	195.62	684.70
Jan-05	195.58	684.74
Feb-05	195.54	684.78
Mar-05	195.54	684.78
Apr-05	195.58	684.74
May-05	195.54	684.78
Jun-05	195.52	684.80
Jul-05	195.67	684.65

DATE	READING (FT.)	ELEVATION (FT.)
Aug-05	195.50	684.82
Sep-05	195.48	684.84
Oct-05	195.50	684.82
Nov-05	195.50	684.82
Dec-05	195.46	684.86
Jan-06	195.56	684.76
Feb-06	195.67	684.65
Mar-06	195.46	684.86
Apr-06	195.54	684.78
May-06	195.58	684.74
Jun-06	195.42	684.90
Jul-06	195.54	684.78
Aug-06	195.67	684.65
Sep-06	195.67	684.65
Oct-06	195.46	684.86
Nov-06	195.50	684.82
Dec-06	195.46	684.86
Jan-07	195.46	684.86
Feb-07	195.46	684.86
Mar-07	195.33	684.99
Apr-07	195.33	684.99
May-07	195.33	684.99
Jun-07	195.33	684.99
Jul-07	195.27	685.05
Aug-07	195.37	684.95
Sep-07	195.37	684.95
Oct-07	195.54	684.78
Nov-07	195.44	684.88
Dec-07	195.46	684.86
Jan-08	195.67	684.65
Feb-08	195.75	684.57
Mar-08	195.48	684.84
Apr-08	195.85	684.47
May-08	195.67	684.65
Jun-08	195.70	684.62
Jul-08	195.73	684.59
Aug-08	195.73	684.59
Sep-08	195.71	684.61
Oct-08	195.68	684.64
Nov-08	195.73	684.59
Dec-08	195.82	684.50
Jan-09	195.77	684.55
Feb-09	195.52	684.80
Mar-09	195.64	684.68
Apr-09	195.67	684.65
May-09	195.68	684.64
Jun-09	195.62	684.70
Jul-09	195.79	684.53
Aug-09	195.67	684.65
Sep-09	195.76	684.56
Oct-09	195.64	684.68
Nov-09	195.03	685.29
Dec-09	195.58	684.74
Jan-10	195.73	684.59
Feb-10	195.68	684.64
Mar-10	195.60	684.72
Apr-10	195.67	684.65
May-10	195.78	684.54
Jun-10	195.45	684.87
Jul-10	195.93	684.39
Aug-10	195.82	684.50
Sep-10	195.69	684.63
Oct-10	195.56	684.76
Nov-10	195.55	684.77
Dec-10	195.66	684.66
Jan-11	195.63	684.69
Feb-11	195.63	684.69
Mar-11	195.93	684.39
Apr-11	195.68	684.64
May-11	195.61	684.71
Jun-11	195.41	684.91
Jul-11	196.01	684.31
Aug-11	196.01	684.31
Sep-11	195.69	684.63
Oct-11	195.61	684.71
Nov-11	195.00	685.32
Dec-11	195.42	684.90
Jan-12	195.21	685.11
Feb-12	195.36	684.96

AMOS	PIEZOMETER PP8F

FLY ASH DAM
INSTALLED - AUG76

NORTH : 532048.3
EAST : 1724644.7

TOP OF RISER ELEVATION : 752.8
TIP ELEVATION : 666.2
GROUND ELEVATION : 750.0
SCREENED INT : 666-671
NOTES : SCREENED IN BLANKET DRAIN

DATE	READING (FT.)	ELEVATION (FT.)
Feb-84	86.08	666.67
Sep-84	86.00	666.75
Oct-84	86.08	666.67
Dec-84	86.08	666.67
Jan-85	86.17	666.58
Mar-85	86.00	666.75
Apr-85	86.00	666.75
May-85	86.17	666.58
Jun-85	86.08	666.67
Jul-85	86.00	666.75
Oct-85	86.00	666.75
Nov-85	86.33	666.42
Dec-85	86.50	666.25
Jan-86	86.50	666.25
Feb-86	86.50	666.25
Mar-86	86.42	666.33
Apr-86	86.42	666.33
May-86	85.92	666.83
Jun-86	86.33	666.42
Jul-86	86.50	666.25
Aug-86	86.75	666.00
Sep-86	86.33	666.42
Oct-86	86.83	665.92
Nov-86	86.25	666.50
Dec-86	86.42	666.33
Jan-87	85.25	667.50
Feb-87	86.50	666.25
Mar-87	86.50	666.25
Apr-87	86.42	666.33
May-87	86.08	666.67
Jun-87	86.42	666.33
Jul-87	86.33	666.42
Aug-87	86.42	666.33
Sep-87	86.50	666.25
Nov-87	86.42	666.33
Dec-87	86.25	666.50
Jan-88	86.33	666.42
Feb-88	86.67	666.08
Mar-88	85.83	666.92
Apr-88	86.08	666.67
May-88	85.00	667.75
Jun-88	86.17	666.58
Jul-88	86.00	666.75
Aug-88	86.50	666.25
Sep-88	85.83	666.92
Oct-88	86.08	666.67
Nov-88	86.42	666.33
Dec-88	86.33	666.42
Jan-89	87.17	665.58
Feb-89	87.50	665.25
Mar-89	86.75	666.00
Apr-89	87.92	664.83
May-89	88.08	664.67
Jun-89	88.17	664.58
Jul-89	88.50	664.25
Aug-89	88.50	664.25
Sep-89	88.42	664.33
Oct-89	88.25	664.50
Nov-89	88.00	664.75
Jan-90	88.17	664.58
Feb-90	88.00	664.75
Mar-90	88.17	664.58
Apr-90	88.00	664.75
May-90	88.00	664.75
Jun-90	88.25	664.50
Jul-90	86.83	665.92

DATE	READING (FT.)	ELEVATION (FT.)
Aug-90	87.00	665.75
Sep-90	88.25	664.50
Oct-90	88.83	663.92
Nov-90	88.00	664.75
Dec-90	88.50	664.25
Jan-91	88.50	664.25
Feb-91	88.25	664.50
Mar-91	85.75	667.00
Apr-91	88.25	664.50
May-91	88.08	664.67
Jun-91	88.17	664.58
Aug-91	88.00	664.75
Nov-91	86.75	666.00
Dec-91	86.83	665.92
Jan-92	88.33	664.42
Feb-92	86.25	666.50
Mar-92	86.67	666.08
Apr-92	86.67	666.08
May-92	86.00	666.75
Jun-92	86.92	665.83
Jul-92	86.75	666.00
Aug-92	86.50	666.25
Sep-92	86.67	666.08
Oct-92	90.00	662.75
Nov-92	86.75	666.00
Dec-92	86.58	666.17
Jan-93	86.33	666.42
Feb-93	86.58	666.17
Mar-93	86.67	666.08
Apr-93	86.33	666.42
May-93	86.42	666.33
Jun-93	87.75	665.00
Jul-93	87.00	665.75
Aug-93	86.92	665.83
Sep-93	87.00	665.75
Oct-93	86.92	665.83
Nov-93	87.25	665.50
Dec-93	88.66	664.09
Jan-94	87.42	665.33
Feb-94	87.75	665.00
Mar-94	87.08	665.67
Apr-94	87.00	665.75
May-94	86.96	665.79
Jun-94	86.91	665.84
Jul-94	87.00	665.75
Aug-94	86.98	665.77
Sep-94	86.91	665.84
Oct-94	87.08	665.67
Nov-94	86.84	665.91
Dec-94	86.91	665.84
Jan-95	87.04	665.71
Feb-95	87.08	665.67
Mar-95	86.83	665.92
Apr-95	87.00	665.75
May-95	86.08	666.67
Jun-95	86.96	665.79
Jul-95	87.00	665.75
Aug-95	86.98	665.77
Sep-95	86.91	665.84
Oct-95	87.50	665.25
Nov-95	86.75	666.00
Dec-95	86.50	666.25
Jan-96	86.92	665.83
Feb-96	86.96	665.79
Mar-96	86.92	665.83
Apr-96	87.50	665.25
May-96	87.63	665.12
Jun-96	86.92	665.83
Jul-96	86.88	665.87
Aug-96	87.50	665.25
Sep-96	87.00	665.75
Oct-96	87.00	665.75
Nov-96	87.00	665.75
Dec-96	87.00	665.75
Jan-97	86.92	665.83
Feb-97	86.96	665.79
Mar-97	86.96	665.79
Apr-97	86.43	666.32
May-97	87.00	665.75

DATE	READING (FT.)	ELEVATION (FT.)
Jun-97	87.00	665.75
Jul-97	86.96	665.79
Aug-97	86.96	665.79
Sep-97	86.94	665.81
Oct-97	86.92	665.83
Nov-97	86.95	665.80
Dec-97	86.95	665.80
Jan-98	86.96	665.79
Feb-98	86.96	665.79
Mar-98	86.92	665.83
Apr-98	86.96	665.79
May-98	86.92	665.83
Jun-98	86.92	665.83
Jul-98	87.00	665.75
Aug-98	86.96	665.79
Sep-98	86.96	665.79
Oct-98	87.00	665.75
Nov-98	86.92	665.83
Dec-98	86.96	665.79
Jan-99	86.92	665.83
Feb-99	86.94	665.81
Mar-99	87.00	665.75
Apr-99	87.06	665.69
May-99	87.00	665.75
Jun-99	86.96	665.79
Jul-99	86.96	665.79
Aug-99	86.96	665.79
Sep-99	86.96	665.79
Oct-99	98.96	653.79
Nov-99	86.92	665.83
Dec-99	86.92	665.83
Jan-00	86.96	665.79
Feb-00	86.92	665.83
Mar-00	86.92	665.83
Apr-00	86.92	665.83
May-00	86.96	665.79
Jun-00	86.83	665.92
Jul-00	86.83	665.92
Aug-00	86.83	665.92
Sep-00	86.83	665.92
Oct-00	86.83	665.92
Nov-00	86.83	665.92
Dec-00	86.79	665.96
Jan-01	86.83	665.92
Feb-01	86.79	665.96
Mar-01	86.83	665.92
Apr-01	86.83	665.92
May-01	86.79	665.96
Jun-01	86.79	665.96
Jul-01	86.79	665.96
Aug-01	85.75	667.00
Sep-01	86.71	666.04
Oct-01	86.71	666.04
Nov-01	86.73	666.02
Dec-01	86.71	666.04
Jan-02	86.71	666.04
Feb-02	86.71	666.04
Mar-02	86.71	666.04
Apr-02	96.75	656.00
May-02	86.69	666.06
Jun-02	96.67	656.08
Jul-02	86.71	666.04
Aug-02	86.67	666.08
Sep-02	86.71	666.04
Oct-02	86.67	666.08
Nov-02	86.63	666.12
Dec-02	86.63	666.12
Jan-03	86.71	666.04
Feb-03	86.62	666.13
Mar-03	86.62	666.13
Apr-03	86.58	666.17
May-03	86.58	666.17
Jun-03	86.54	666.21
Jul-03	86.58	666.17
Aug-03	86.56	666.19
Sep-03	86.52	666.23
Oct-03	86.48	666.27
Nov-03	86.46	666.29
Dec-03	86.46	666.29

DATE	READING (FT.)	ELEVATION (FT.)
Jan-04	96.50	656.25
Feb-04	86.42	666.33
Mar-04	86.42	666.33
Apr-04	86.12	666.63
May-04	86.42	666.33
Jun-04	86.46	666.29
Jul-04	86.37	666.38
Aug-04	86.37	666.38
Sep-04	86.33	666.42
Oct-04	86.37	666.38
Nov-04	86.37	666.38
Dec-04	86.37	666.38
Jan-05	86.33	666.42
Feb-05	86.33	666.42
Mar-05	86.33	666.42
Apr-05	86.27	666.48
May-05	86.31	666.44
Jun-05	86.27	666.48
Jul-05	86.25	666.50
Aug-05	86.12	666.63
Sep-05	86.12	666.63
Oct-05	86.17	666.58
Nov-05	86.10	666.65
Dec-05	86.21	666.54
Jan-06	86.17	666.58
Feb-06	86.10	666.65
Mar-06	86.04	666.71
Apr-06	86.08	666.67
May-06	86.00	666.75
Jun-06	86.00	666.75
Jul-06	96.00	656.75
Aug-06	86.00	666.75
Sep-06	85.92	666.83
Oct-06	85.83	666.92
Nov-06	86.67	666.08
Dec-06	85.79	666.96
Jan-07	85.79	666.96
Feb-07	85.71	667.04
Mar-07	85.58	667.17
Apr-07	85.50	667.25
May-07	85.44	667.31
Jun-07	85.40	667.35
Jul-07	85.42	667.33
Aug-07	85.31	667.44
Sep-07	85.31	667.44
Oct-07	86.96	665.79
Nov-07	86.92	665.83
Dec-07	86.96	665.79
Jan-08	87.00	665.75
Feb-08	87.00	665.75
Mar-08	86.96	665.79
Apr-08	86.96	665.79
May-08	86.83	665.92
Jun-08	86.98	665.77
Jul-08	87.03	665.72
Aug-08	86.96	665.79
Sep-08	86.92	665.83
Oct-08	86.94	665.81
Nov-08	86.92	665.83
Dec-08	86.98	665.77
Jan-09	86.98	665.77
Feb-09	86.94	665.81
Mar-09	86.87	665.88
Apr-09	86.84	665.91
May-09	86.94	665.81
Jun-09	86.92	665.83
Jul-09	86.92	665.83
Aug-09	87.02	665.73
Sep-09	87.04	665.71
Oct-09	87.00	665.75
Nov-09	86.72	666.03
Dec-09	86.91	665.84
Jan-10	97.41	655.34
Feb-10	86.98	665.77
Mar-10	87.12	665.63
Apr-10	87.00	665.75
May-10	86.79	665.96
Jun-10	86.88	665.87
Jul-10	87.03	665.72

AMOS	PIEZOMETER PP8RA

FLY ASH DAM
INSTALLED - APR77

NORTH : 532048.3
EAST : 1724724.7

TOP OF RISER ELEVATION : 779.2
TIP ELEVATION : 635.7
GROUND ELEVATION : 777.0
SCREENED INT : 635.7-660
NOTES : IN BEDROCK

DATE	READING (FT.)	ELEVATION (FT.)
Feb-84	100.50	678.70
Sep-84	100.50	678.70
Oct-84	100.33	678.87
Dec-84	100.08	679.12
Jan-85	100.25	678.95
Mar-85	100.17	679.03
Apr-85	100.00	679.20
May-85	100.00	679.20
Jun-85	100.25	678.95
Jul-85	100.08	679.12
Oct-85	101.17	678.03
Nov-85	101.25	677.95
Dec-85	100.42	678.78
Jan-86	100.25	678.95
Feb-86	100.00	679.20
Mar-86	100.00	679.20
Apr-86	99.83	679.37
May-86	100.00	679.20
Jun-86	99.83	679.37
Jul-86	99.67	679.53
Aug-86	99.83	679.37
Sep-86	99.75	679.45
Oct-86	99.75	679.45
Nov-86	99.67	679.53
Dec-86	99.75	679.45
Jan-87	99.58	679.62
Feb-87	99.67	679.53
Mar-87	99.50	679.70
Apr-87	99.33	679.87
May-87	99.50	679.70
Jun-87	99.25	679.95
Jul-87	99.17	680.03
Aug-87	99.17	680.03
Sep-87	99.25	679.95
Nov-87	99.17	680.03
Dec-87	99.33	679.87
Jan-88	98.92	680.28
Feb-88	99.33	679.87
Mar-88	99.00	680.20
Apr-88	98.58	680.62
May-88	97.50	681.70
Jun-88	98.00	681.20
Jul-88	99.25	679.95
Aug-88	99.08	680.12
Sep-88	99.25	679.95
Oct-88	99.58	679.62
Nov-88	99.33	679.87
Dec-88	99.33	679.87
Jan-89	99.67	679.53
Feb-89	99.67	679.53
Mar-89	99.42	679.78
Apr-89	100.67	678.53
May-89	100.67	678.53
Jun-89	100.58	678.62
Jul-89	101.00	678.20
Aug-89	100.67	678.53
Sep-89	100.67	678.53
Oct-89	100.58	678.62
Nov-89	100.50	678.70
Jan-90	100.67	678.53
Feb-90	100.67	678.53
Mar-90	100.50	678.70
Apr-90	100.42	678.78
May-90	100.50	678.70
Jun-90	100.50	678.70
Jul-90	99.08	680.12

DATE	READING (FT.)	ELEVATION (FT.)	DATE	READING (FT.)	ELEVATION (FT.)	DATE	READING (FT.)	ELEVATION (FT.)
Aug-90	98.92	680.28	Jul-97	98.92	680.28	Feb-04	98.29	680.91
Sep-90	100.42	678.78	Aug-97	99.00	680.20	Mar-04	98.25	680.95
Oct-90	100.42	678.78	Sep-97	98.96	680.24	Apr-04	98.17	681.03
Nov-90	100.42	678.78	Oct-97	99.08	680.12	May-04	98.12	681.08
Dec-90	100.83	678.37	Nov-97	99.00	680.20	Jun-04	98.12	681.08
Jan-91	100.17	679.03	Dec-97	99.04	680.16	Jul-04	98.12	681.08
Feb-91	99.92	679.28	Jan-98	99.08	680.12	Aug-04	98.12	681.08
Mar-91	100.17	679.03	Feb-98	98.96	680.24	Sep-04	98.12	681.08
Apr-91	100.25	678.95	Mar-98	99.00	680.20	Oct-04	98.00	681.20
May-91	100.00	679.20	Apr-98	99.00	680.20	Nov-04	98.25	680.95
Jun-91	100.33	678.87	May-98	99.00	680.20	Dec-04	98.00	681.20
Jul-91	100.42	678.78	Jun-98	98.87	680.33	Jan-05	98.92	680.28
Aug-91	100.67	678.53	Jul-98	98.83	680.37	Feb-05	97.83	681.37
Nov-91	99.25	679.95	Aug-98	98.92	680.28	Mar-05	97.83	681.37
Dec-91	99.33	679.87	Sep-98	98.83	680.37	Apr-05	97.92	681.28
Jan-92	99.08	680.12	Oct-98	98.96	680.24	May-05	97.79	681.41
Feb-92	99.33	679.87	Nov-98	98.83	680.37	Jun-05	97.83	681.37
Mar-92	117.50	661.70	Dec-98	99.00	680.20	Jul-05	97.83	681.37
Jun-92	99.42	679.78	Jan-99	98.87	680.33	Aug-05	97.71	681.49
Jul-92	99.58	679.62	Feb-99	98.87	680.33	Sep-05	97.57	681.63
Aug-92	99.17	680.03	Mar-99	98.87	680.33	Oct-05	97.77	681.43
Sep-92	99.92	679.28	Apr-99	99.00	680.20	Nov-05	97.75	681.45
Oct-92	99.58	679.62	May-99	98.96	680.24	Dec-05	97.75	681.45
Nov-92	99.92	679.28	Jun-99	98.96	680.24	Jan-06	97.75	681.45
Dec-92	98.83	680.37	Jul-99	98.87	680.33	Feb-06	97.67	681.53
Jan-93	98.50	680.70	Aug-99	99.00	680.20	Mar-06	97.75	681.45
Feb-93	98.92	680.28	Sep-99	98.96	680.24	Apr-06	97.67	681.53
Mar-93	99.00	680.20	Oct-99	86.92	692.28	May-06	97.79	681.41
Apr-93	98.92	680.28	Nov-99	99.00	680.20	Jun-06	97.62	681.58
May-93	99.17	680.03	Dec-99	98.92	680.28	Jul-06	97.58	681.62
Jun-93	98.92	680.28	Jan-00	99.08	680.12	Aug-06	97.62	681.58
Jul-93	99.00	680.20	Feb-00	98.92	680.28	Sep-06	98.38	680.82
Aug-93	99.08	680.12	Mar-00	99.00	680.20	Oct-06	98.50	680.70
Sep-93	99.00	680.20	Apr-00	98.92	680.28	Nov-06	91.02	688.18
Oct-93	99.00	680.20	May-00	98.87	680.33	Dec-06	97.46	681.74
Nov-93	99.08	680.12	Jun-00	98.83	680.37	Jan-07	97.52	681.68
Dec-93	99.66	679.54	Jul-00	98.79	680.41	Feb-07	97.50	681.70
Jan-94	99.75	679.45	Aug-00	98.83	680.37	Mar-07	97.54	681.66
Feb-94	99.92	679.28	Sep-00	98.79	680.41	Apr-07	97.46	681.74
Mar-94	99.08	680.12	Oct-00	98.83	680.37	May-07	97.46	681.74
Apr-94	99.17	680.03	Nov-00	98.79	680.41	Jun-07	97.46	681.74
May-94	98.79	680.41	Dec-00	98.75	680.45	Jul-07	97.46	681.74
Jun-94	98.74	680.46	Jan-01	98.75	680.45	Aug-07	97.46	681.74
Jul-94	98.70	680.50	Feb-01	98.79	680.41	Sep-07	97.21	681.99
Aug-94	98.74	680.46	Mar-01	98.81	680.39	Oct-07	97.54	681.66
Sep-94	98.70	680.50	Apr-01	98.83	680.37	Nov-07	97.54	681.66
Oct-94	98.75	680.45	May-01	98.75	680.45	Dec-07	97.54	681.66
Nov-94	98.52	680.68	Jun-01	98.83	680.37	Jan-08	97.96	681.24
Dec-94	98.70	680.50	Jul-01	98.75	680.45	Feb-08	97.92	681.28
Jan-95	99.28	679.92	Aug-01	98.71	680.49	Mar-08	97.87	681.33
Feb-95	98.53	680.67	Sep-01	98.62	680.58	Apr-08	95.83	683.37
Mar-95	99.07	680.13	Oct-01	98.67	680.53	May-08	97.75	681.45
Apr-95	98.65	680.55	Nov-01	98.67	680.53	Jun-08	97.81	681.39
May-95	99.50	679.70	Dec-01	98.69	680.51	Jul-08	97.71	681.49
Jun-95	98.61	680.59	Jan-02	98.62	680.58	Aug-08	97.62	681.58
Jul-95	98.70	680.50	Feb-02	98.58	680.62	Sep-08	97.68	681.52
Aug-95	98.74	680.46	Mar-02	98.62	680.58	Oct-08	97.65	681.55
Sep-95	98.70	680.50	Apr-02	98.62	680.58	Nov-08	97.58	681.62
Oct-95	99.50	679.70	May-02	98.67	680.53	Dec-08	97.67	681.53
Nov-95	98.45	680.75	Jun-02	98.58	680.62	Jan-09	97.64	681.56
Dec-95	97.89	681.31	Jul-02	98.54	680.66	Feb-09	97.59	681.61
Jan-96	98.59	680.61	Aug-02	98.58	680.62	Mar-09	97.50	681.70
Feb-96	98.33	680.87	Sep-02	98.67	680.53	Apr-09	97.48	681.72
Mar-96	98.57	680.63	Oct-02	98.58	680.62	May-09	97.58	681.62
Apr-96	99.75	679.45	Nov-02	98.63	680.57	Jun-09	97.50	681.70
May-96	100.20	679.00	Dec-02	98.79	680.41	Jul-09	97.43	681.77
Jun-96	98.62	680.58	Jan-03	98.62	680.58	Aug-09	97.39	681.81
Jul-96	98.66	680.54	Feb-03	98.62	680.58	Sep-09	97.39	681.81
Aug-96	99.50	679.70	Mar-03	98.60	680.60	Oct-09	97.40	681.80
Sep-96	98.84	680.36	Apr-03	98.50	680.70	Nov-09	97.41	681.79
Oct-96	98.96	680.24	May-03	98.58	680.62	Dec-09	97.38	681.82
Nov-96	99.00	680.20	Jun-03	98.54	680.66	Jan-10	98.09	681.11
Dec-96	99.08	680.12	Jul-03	98.44	680.76	Feb-10	97.42	681.78
Jan-97	99.08	680.12	Aug-03	98.42	680.78	Mar-10	97.39	681.81
Feb-97	99.04	680.16	Sep-03	98.46	680.74	Apr-10	97.30	681.90
Mar-97	98.95	680.25	Oct-03	98.44	680.76	May-10	97.19	682.01
Apr-97	98.90	680.30	Nov-03	98.37	680.83	Jun-10	97.28	681.92
May-97	98.96	680.24	Dec-03	98.37	680.83	Jul-10	97.20	682.00
Jun-97	98.96	680.24	Jan-04	98.29	680.91	Aug-10	97.26	681.94

AMOS	PIEZOMETER P8400

FLY ASH DAM
INSTALLED - DEC84

NORTH : 531854.8
EAST : 1724615.9

TOP OF RISER ELEVATION : 717.2
TIP ELEVATION : 660.9
GROUND ELEVATION : 715.5
SCREENED INT : 659.3-702
NOTES : 40 FT PVC SLOTTED SCREEN

DATE	READING (FT.)	ELEVATION (FT.)
Dec-84	44.00	673.22
Apr-85	40.50	676.72
May-85	40.50	676.72
Jun-85	41.17	676.05
Jul-85	41.00	676.22
Oct-85	46.83	670.39
Nov-85	40.92	676.30
Dec-85	40.92	676.30
Jan-86	39.17	678.05
Feb-86	40.75	676.47
Mar-86	34.83	682.39
Apr-86	40.67	676.55
May-86	40.58	676.64
Jun-86	40.25	676.97
Jul-86	40.00	677.22
Aug-86	40.00	677.22
Sep-86	39.83	677.39
Oct-86	39.83	677.39
Nov-86	39.50	677.72
Dec-86	39.83	677.39
Jan-87	32.33	684.89
Feb-87	41.00	676.22
Mar-87	23.75	693.47
Apr-87	23.17	694.05
Jun-87	23.75	693.47
Sep-87	26.17	691.05
Nov-87	28.42	688.80
Dec-87	40.83	676.39
Jan-88	40.75	676.47
Feb-88	41.92	675.30
Mar-88	40.50	676.72
Apr-88	40.75	676.47
May-88	40.75	676.47
Jun-88	24.00	693.22
Jul-88	40.33	676.89
Aug-88	57.00	660.22
Sep-88	40.58	676.64
Oct-88	40.67	676.55
Nov-88	40.58	676.64
Dec-88	40.50	676.72
Jan-89	41.50	675.72
Feb-89	41.00	676.22
Mar-89	40.00	677.22
Apr-89	29.00	688.22
May-89	29.50	687.72
Jun-89	33.25	683.97
Jul-89	33.08	684.14
Aug-89	40.33	676.89
Sep-89	40.67	676.55
Oct-89	40.08	677.14
Nov-89	40.50	676.72
Jan-90	40.00	677.22
Feb-90	40.00	677.22
Mar-90	40.50	676.72
Apr-90	39.92	677.30
May-90	39.42	677.80
Jun-90	31.50	685.72
Jul-90	37.50	679.72
Aug-90	37.50	679.72
Sep-90	40.92	676.30
Oct-90	40.58	676.64
Nov-90	34.08	683.14
Dec-90	34.50	682.72
Jan-91	34.83	682.39
Feb-91	39.92	677.30
Mar-91	39.50	677.72

DATE	READING (FT.)	ELEVATION (FT.)	DATE	READING (FT.)	ELEVATION (FT.)	DATE	READING (FT.)	ELEVATION (FT.)
Apr-91	26.67	690.55	Feb-98	37.79	679.43	Sep-04	30.75	686.47
Jun-91	30.75	686.47	Mar-98	37.83	679.39	Oct-04	34.79	682.43
Jul-91	30.83	686.39	Apr-98	37.58	679.64	Nov-04	35.00	682.22
Aug-91	33.00	684.22	May-98	37.79	679.43	Dec-04	34.87	682.35
Nov-91	55.50	661.72	Jun-98	37.21	680.01	Jan-05	34.50	682.72
Dec-91	56.08	661.14	Jul-98	37.00	680.22	Feb-05	35.00	682.22
Jan-92	56.08	661.14	Aug-98	37.00	680.22	Mar-05	33.96	683.26
Feb-92	56.08	661.14	Sep-98	36.54	680.68	Apr-05	33.25	683.97
Mar-92	25.00	692.22	Oct-98	38.37	678.85	May-05	34.00	683.22
Apr-92	56.00	661.22	Nov-98	38.42	678.80	Jun-05	34.81	682.41
May-92	56.00	661.22	Dec-98	38.67	678.55	Jul-05	33.83	683.39
Jun-92	26.17	691.05	Jan-99	37.92	679.30	Aug-05	33.75	683.47
Jul-92	52.17	665.05	Feb-99	37.46	679.76	Sep-05	24.19	693.03
Aug-92	55.50	661.72	Mar-99	36.92	680.30	Oct-05	33.42	683.80
Sep-92	26.00	691.22	Apr-99	37.50	679.72	Nov-05	33.69	683.53
Oct-92	25.75	691.47	May-99	36.96	680.26	Dec-05	34.58	682.64
Nov-92	56.00	661.22	Jun-99	37.25	679.97	Jan-06	34.12	683.10
Dec-92	29.17	688.05	Jul-99	25.58	691.64	Feb-06	33.46	683.76
Jan-93	29.75	687.47	Aug-99	36.29	680.93	Mar-06	34.92	682.30
Feb-93	30.33	686.89	Sep-99	36.21	681.01	Apr-06	33.71	683.51
Mar-93	30.00	687.22	Oct-99	36.00	681.22	May-06	26.96	690.26
Apr-93	25.50	691.72	Nov-99	36.83	680.39	Jun-06	33.00	684.22
May-93	31.00	686.22	Dec-99	37.08	680.14	Jul-06	32.83	684.39
Jun-93	31.08	686.14	Jan-00	37.42	679.80	Aug-06	33.79	683.43
Jul-93	25.00	692.22	Feb-00	37.50	679.72	Sep-06	33.06	684.16
Aug-93	26.00	691.22	Mar-00	37.79	679.43	Oct-06	32.67	684.55
Sep-93	23.58	693.64	Apr-00	38.00	679.22	Nov-06		
Oct-93	37.66	679.56	May-00	37.29	679.93	Dec-06	33.46	683.76
Nov-93	35.17	682.05	Jun-00	36.83	680.39	Jan-07	33.25	683.97
Dec-93	23.66	693.56	Jul-00	35.92	681.30	Feb-07	33.33	683.89
Jan-94	36.84	680.38	Aug-00	35.92	681.30	Mar-07	33.08	684.14
Feb-94	37.92	679.30	Sep-00	35.33	681.89	Apr-07	32.58	684.64
Mar-94	24.25	692.97	Oct-00	36.19	681.03	May-07	32.83	684.39
Apr-94	24.92	692.30	Nov-00	36.46	680.76	Jun-07	32.96	684.26
May-94	25.10	692.12	Dec-00	36.42	680.80	Jul-07	32.33	684.89
Jun-94	25.58	691.64	Jan-01	37.02	680.20	Aug-07	25.42	691.80
Jul-94	36.50	680.72	Feb-01	36.33	680.89	Sep-07	32.00	685.22
Aug-94	23.63	693.59	Mar-01	37.46	679.76	Oct-07	33.00	684.22
Sep-94	23.63	693.59	Apr-01	37.29	679.93	Nov-07	33.50	683.72
Oct-94	27.58	689.64	May-01	37.25	679.97	Dec-07	34.23	682.99
Nov-94	28.20	689.02	Jun-01	37.29	679.93	Jan-08	33.92	683.30
Dec-94	26.79	690.43	Jul-01	36.46	680.76	Feb-08	33.83	683.39
Jan-95	26.71	690.51	Aug-01	36.00	681.22	Mar-08	33.25	683.97
Feb-95	24.96	692.26	Sep-01	36.58	680.64	Apr-08	32.63	684.59
Mar-95	25.00	692.22	Oct-01	36.42	680.80	May-08	31.00	686.22
Apr-95	37.17	680.05	Nov-01	36.50	680.72	Jun-08	31.04	686.18
May-95	37.08	680.14	Dec-01	37.17	680.05	Jul-08	30.46	686.76
Jun-95	24.65	692.57	Jan-02	37.21	680.01	Aug-08	30.81	686.41
Jul-95	36.50	680.72	Feb-02	36.62	680.60	Sep-08	31.50	685.72
Aug-95	23.63	693.59	Mar-02	37.08	680.14	Oct-08	33.21	684.01
Sep-95	23.63	693.59	Apr-02	36.87	680.35	Nov-08	33.67	683.55
Oct-95	25.16	692.06	May-02	36.04	681.18	Dec-08	33.42	683.80
Nov-95	24.17	693.05	Jun-02	33.67	683.55	Jan-09	33.71	683.51
Dec-95	37.00	680.22	Jul-02	35.75	681.47	Feb-09	32.48	684.74
Jan-96	36.84	680.38	Aug-02	35.25	681.97	Jun-09	30.57	686.65
Feb-96	36.84	680.38	Sep-02	35.29	681.93	Jul-09	30.18	687.04
Mar-96	34.00	683.22	Oct-02	35.25	681.97	Aug-09	30.47	686.75
Apr-96	35.75	681.47	Nov-02	35.67	681.55	Sep-09	30.60	686.62
May-96	36.58	680.64	Dec-02	36.08	681.14	Oct-09	31.65	685.57
Jun-96	34.08	683.14	Jan-03	36.12	681.10	Nov-09	33.62	683.60
Jul-96	35.50	681.72	Feb-03	36.50	680.72	Dec-09	34.38	682.84
Aug-96	35.42	681.80	Mar-03	35.75	681.47	Jan-10	33.91	683.31
Sep-96	35.42	681.80	Apr-03	35.88	681.34	Feb-10	32.80	684.42
Oct-96	36.04	681.18	May-03	35.67	681.55	Mar-10	32.35	684.87
Nov-96	35.84	681.38	Jun-03	35.37	681.85	Apr-10	31.94	685.28
Dec-96	36.75	680.47	Jul-03	36.00	681.22	May-10	30.60	686.62
Jan-97	36.83	680.39	Aug-03	35.46	681.76	Jun-10	30.78	686.44
Feb-97	37.08	680.14	Sep-03	34.87	682.35	Jul-10	29.71	687.51
Mar-97	36.83	680.39	Oct-03	35.14	682.08	Aug-10	29.73	687.49
Apr-97	32.62	684.60	Nov-03	35.00	682.22	Sep-10	33.14	684.08
May-97	36.62	680.60	Dec-03	34.94	682.28	Oct-10	24.47	692.75
Jun-97	37.00	680.22	Jan-04	35.08	682.14	Nov-10	35.13	682.09
Jul-97	36.67	680.55	Feb-04	34.29	682.93	Dec-10	32.68	684.54
Aug-97	35.92	681.30	Mar-04	34.92	682.30	Jan-11	24.14	693.08
Sep-97	36.17	681.05	Apr-04	34.83	682.39	Feb-11	33.19	684.03
Oct-97	38.37	678.85	May-04	35.00	682.22	Mar-11	32.66	684.56
Nov-97	38.83	678.39	Jun-04	34.83	682.39	Apr-11	31.51	685.71
Dec-97	39.08	678.14	Jul-04	35.21	682.01	May-11	33.20	684.02
Jan-98	38.58	678.64	Aug-04	35.08	682.14	Jun-11	32.64	684.58

AMOS	PIEZOMETER P8401

FLY ASH DAM
INSTALLED - DEC84

NORTH : 531699.7
EAST : 1724707.7

TOP OF RISER ELEVATION : 718.1
TIP ELEVATION : 658.4
GROUND ELEVATION : 716.4
SCREENED INT : 658.4-700
NOTES : 40 FT. SLOTTED PVC SCREEN

DATE	READING (FT.)	ELEVATION (FT.)
Dec-84	57.60	660.50
Jan-85	54.75	663.35
Apr-85	50.58	667.52
May-85	49.50	668.60
Jun-85	52.42	665.68
Jul-85	56.25	661.85
Oct-85	58.00	660.10
Nov-85	57.83	660.27
Dec-85	58.00	660.10
Jan-86	58.08	660.02
Feb-86	58.00	660.10
Mar-86	58.17	659.93
Apr-86	58.25	659.85
May-86	58.25	659.85
Jun-86	57.67	660.43
Jul-86	57.50	660.60
Aug-86	52.25	665.85
Sep-86	51.83	666.27
Oct-86	52.00	666.10
Nov-86	51.83	666.27
Dec-86	51.75	666.35
Jan-87	51.83	666.27
Feb-87	51.67	666.43
Mar-87	52.00	666.10
Apr-87	52.00	666.10
May-87	51.92	666.18
Jun-87	52.33	665.77
Jul-87	52.00	666.10
Aug-87	51.92	666.18
Sep-87	51.92	666.18
Nov-87	52.08	666.02
Dec-87	51.67	666.43
Jan-88	51.50	666.60
Feb-88	52.33	665.77
Mar-88	51.92	666.18
Apr-88	52.08	666.02
May-88	51.83	666.27
Jun-88	51.17	666.93
Jul-88	52.08	666.02
Aug-88	52.67	665.43
Sep-88	52.08	666.02
Oct-88	52.08	666.02
Nov-88	52.17	665.93
Dec-88	52.17	665.93
Jan-89	53.08	665.02
Feb-89	52.75	665.35
Mar-89	52.42	665.68
Apr-89	53.75	664.35
May-89	53.67	664.43
Jun-89	53.67	664.43
Jul-89	53.58	664.52
Aug-89	53.67	664.43
Sep-89	53.58	664.52
Oct-89	53.92	664.18
Nov-89	54.17	663.93
Jan-90	53.25	664.85
Feb-90	53.08	665.02
Mar-90	53.75	664.35
Apr-90	53.75	664.35
May-90	53.75	664.35
Jun-90	53.83	664.27
Jul-90	52.33	665.77
Aug-90	52.17	665.93
Sep-90	53.83	664.27
Oct-90	53.25	664.85
Nov-90	53.67	664.43

DATE	READING (FT.)	ELEVATION (FT.)	DATE	READING (FT.)	ELEVATION (FT.)	DATE	READING (FT.)	ELEVATION (FT.)
Dec-90	53.92	664.18	Aug-97	47.83	670.27	Mar-04	47.50	670.60
Jan-91	53.50	664.60	Sep-97	47.85	670.25	Apr-04	47.62	670.48
Feb-91	52.17	665.93	Oct-97	47.83	670.27	May-04	47.46	670.64
Mar-91	53.75	664.35	Nov-97	48.08	670.02	Jun-04	47.46	670.64
Apr-91	53.67	664.43	Dec-97	48.08	670.02	Jul-04	47.42	670.68
May-91	47.17	670.93	Jan-98	48.17	669.93	Aug-04	47.50	670.60
Jun-91	53.75	664.35	Feb-98	48.08	670.02	Sep-04	47.42	670.68
Jul-91	54.00	664.10	Mar-98	48.00	670.10	Oct-04	47.46	670.64
Aug-91	43.25	674.85	Apr-98	48.21	669.89	Nov-04	47.71	670.39
Sep-91	52.00	666.10	May-98	48.21	669.89	Dec-04	47.58	670.52
Nov-91	58.67	659.43	Jun-98	48.08	670.02	Jan-05	47.37	670.73
Dec-91	52.08	666.02	Jul-98	48.04	670.06	Feb-05	47.58	670.52
Jan-92	51.75	666.35	Aug-98	48.10	670.00	Mar-05	47.54	670.56
Feb-92	51.67	666.43	Sep-98	48.00	670.10	Apr-05	47.50	670.60
Mar-92	52.17	665.93	Oct-98	48.00	670.10	May-05	47.73	670.37
Apr-92	51.67	666.43	Nov-98	47.79	670.31	Jun-05	47.44	670.66
May-92	51.50	666.60	Dec-98	48.17	669.93	Jul-05	47.46	670.64
Jun-92	51.17	666.93	Jan-99	48.08	670.02	Aug-05	47.17	670.93
Jul-92	51.58	666.52	Feb-99	37.96	680.14	Sep-05		
Aug-92	52.17	665.93	Mar-99	47.87	670.23	Oct-05	47.04	671.06
Sep-92	50.00	668.10	Apr-99	48.21	669.89	Nov-05	47.14	670.96
Oct-92	50.00	668.10	May-99	45.79	672.31	Dec-05	47.52	670.58
Nov-92	49.92	668.18	Jun-99	48.04	670.06	Jan-06	47.62	670.48
Dec-92	49.92	668.18	Jul-99	48.08	670.02	Feb-06	47.75	670.35
Jan-93	50.33	667.77	Aug-99	48.12	669.98	Mar-06	47.50	670.60
Feb-93	49.83	668.27	Sep-99	47.92	670.18	Apr-06	47.67	670.43
Mar-93	49.67	668.43	Oct-99	48.00	670.10	May-06	47.58	670.52
Apr-93	49.33	668.77	Nov-99	48.00	670.10	Jun-06	47.58	670.52
May-93	50.08	668.02	Dec-99	48.00	670.10	Jul-06	47.42	670.68
Jun-93	49.33	668.77	Jan-00	48.12	669.98	Aug-06	47.25	670.85
Jul-93	49.00	669.10	Feb-00	48.17	669.93	Sep-06	47.21	670.89
Aug-93	30.66	687.44	Mar-00	48.08	670.02	Oct-06	47.17	670.93
Sep-93	49.50	668.60	Apr-00	48.00	670.10	Nov-06	25.67	692.43
Oct-93	49.42	668.68	May-00	48.04	670.06	Dec-06	47.25	670.85
Nov-93	49.33	668.77	Jun-00	48.00	670.10	Jan-07	47.62	670.48
Dec-93	49.66	668.44	Jul-00	48.00	670.10	Feb-07	47.37	670.73
Jan-94	48.84	669.26	Aug-00	47.92	670.18	Mar-07	47.50	670.60
Feb-94	49.00	669.10	Sep-00	47.79	670.31	Apr-07	47.46	670.64
Mar-94	48.42	669.68	Oct-00	47.88	670.22	May-07	47.42	670.68
Apr-94	48.42	669.68	Nov-00	47.83	670.27	Jun-07	47.33	670.77
May-94	48.35	669.75	Dec-00	47.88	670.22	Jul-07	47.21	670.89
Jun-94	47.00	671.10	Jan-01	47.88	670.22	Aug-07	47.00	671.10
Jul-94	48.00	670.10	Feb-01	48.00	670.10	Sep-07	47.08	671.02
Aug-94	48.23	669.87	Mar-01	47.88	670.22	Oct-07	47.27	670.83
Sep-94	48.13	669.97	Apr-01	48.00	670.10	Nov-07	47.37	670.73
Oct-94	48.25	669.85	May-01	48.04	670.06	Dec-07	47.39	670.71
Nov-94	44.00	674.10	Jun-01	47.58	670.52	Jan-08	47.42	670.68
Dec-94	48.21	669.89	Jul-01	47.79	670.31	Feb-08	47.37	670.73
Jan-95	48.23	669.87	Aug-01	47.67	670.43	Mar-08	47.52	670.58
Feb-95	48.00	670.10	Sep-01	47.58	670.52	Apr-08	47.53	670.57
Mar-95	48.08	670.02	Oct-01	47.69	670.41	May-08	47.46	670.64
Apr-95	48.33	669.77	Nov-01	47.62	670.48	Jun-08	47.56	670.54
May-95	53.25	664.85	Dec-01	47.42	670.68	Jul-08	47.46	670.64
Jun-95	48.17	669.93	Jan-02	47.75	670.35	Aug-08	47.42	670.68
Jul-95	48.00	670.10	Feb-02	47.87	670.23	Sep-08	47.48	670.62
Aug-95	48.23	669.87	Mar-02	47.96	670.14	Oct-08	47.37	670.73
Sep-95	48.13	669.97	Apr-02	47.96	670.14	Nov-08	47.27	670.83
Oct-95	48.08	670.02	May-02	47.92	670.18	Dec-08	47.24	670.86
Nov-95	48.17	669.93	Jun-02	47.83	670.27	Jan-09	47.27	670.83
Dec-95	48.17	669.93	Jul-02	47.79	670.31	6-Feb-09	47.45	670.65
Jan-96	48.33	669.77	Aug-02	47.79	670.31	11-Feb-09	47.17	670.93
Feb-96	48.33	669.77	Sep-02	47.75	670.35	17-Feb-09	47.27	670.83
Mar-96	48.00	670.10	Oct-02	47.58	670.52	25-Feb-09	47.42	670.68
Apr-96	48.25	669.85	Nov-02	47.67	670.43	5-Mar-09	47.29	670.81
May-96	48.17	669.93	Dec-02	47.83	670.27	12-Mar-09	47.28	670.82
Jun-96	48.25	669.85	Jan-03	47.75	670.35	19-Mar-09	47.44	670.66
Jul-96	48.17	669.93	Feb-03	47.92	670.18	25-Mar-09	47.17	670.93
Aug-96	48.25	669.85	Mar-03	47.67	670.43	31-Mar-09	47.17	670.93
Sep-96	48.08	670.02	Apr-03	47.75	670.35	24-Apr-09	47.28	670.82
Oct-96	48.08	670.02	May-03	47.92	670.18	26-May-09	47.22	670.88
Nov-96	48.12	669.98	Jun-03	47.75	670.35	25-Jun-09	47.33	670.77
Dec-96	48.12	669.98	Jul-03	47.75	670.35	30-Jul-09	47.32	670.78
Jan-97	48.00	670.10	Aug-03	47.67	670.43	24-Aug-09	47.00	671.10
Feb-97	48.12	669.98	Sep-03	47.58	670.52	18-Sep-09	46.98	671.12
Mar-97	48.21	669.89	Oct-03	47.54	670.56	21-Oct-09	47.20	670.90
Apr-97	48.04	670.06	Nov-03	47.29	670.81	23-Nov-09	47.23	670.87
May-97	47.83	670.27	Dec-03	47.37	670.73	4-Dec-09	47.19	670.91
Jun-97	48.04	670.06	Jan-04	47.58	670.52	28-Jan-10	47.20	670.90
Jul-97	47.92	670.18	Feb-04	47.58	670.52	22-Feb-10	47.26	670.84

ARCADIS

H.C. Nutting Company, 2008

Boring Logs

2008-1 to 2008-17

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-1**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	N 531,413.5 E 1,724,431.9	Date Completed	1/16/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
648.10	0.0												
647.60	0.5	0.5 Gray, FILL: silty gravel, road bed, wet, medium dense	1	SS	0.0-1.5	9-6-4 (10)	100						
		Reddish brown, GRAVELLY LEAN CLAY with SAND, residual soil structure, moist, stiff - very stiff											
		8.0	2	SS	5.0-6.5	17-9-14 (23)	100						
639.60	8.5	Gray with light brown, SANDSTONE, fine to medium grained, slightly micaeous with few lamminations, slightly weathered, medium hard - hard	3	SS	10.0-10.4	50/4	100						
			1	NQ2	11.5-13.5		100	100					
			2	NQ2	13.5-18.5		96	96					
			3	NQ2	18.5-23.5		100	100					
		31.5 2" tool drop at 24.5' Lost water return at 24.5' Slighly fractured zone from 24.5' to 26'	4	NQ2	23.5-28.5		100	92					
			5	NQ2	28.5-33.5		100	100					

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. 10 ft. ▼
Water used in drilling	11.5 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-6 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-1**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	**N** 531,413.5 **E** 1,724,431.9	Date Completed	1/16/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray with light brown, SANDSTONE, fine to medium grained, slightly micaeous with few lamminations, slightly weathered, medium hard - hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	6	NQ2	33.5-38.5		100	96					
608.10	40.0		7	NQ2	38.5-40.0		100	100					
		BORING COMPLETED @ 40.0'											

General Notes		Water Level Observations	
Driller	Mathis	Immediate	NW ft.
Rig No.		At Completion	ft.
Rig Type	Truck	After	24 Hrs. 10 ft. ▼
Method	NQ2/SS	Water used in drilling	11.5 ft.
Inspector	TAG		

Remarks

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-2**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/2/2008
Boring Location	N 531,979.5 E 1,724,491.4	Date Completed	1/5/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	Stratum thickness	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
714.80	0.0	Gray to brown, FILL: clayey gravel with sand, many cobbles and boulders, moist, medium dense	15.0	1	SS	0.0-0.8	32-50/3	88						
				2	SS	5.0-6.5	10-10-7 (17)	100						
				3	SS	10.0-11.5	18-10-8 (18)	100						
699.80	15.0	Reddish brown mottled with gray and brown, LEAN CLAY, residual soil structure, moist - dry, very stiff	6.0	4	SS	15.0-16.5	6-10-12 (22)	67						
693.80	21.0	Reddish brown mottled with gray and brown, CLAYSTONE, highly weathered - moderately weathered, extremely soft - soft	7.8	5	SS	20.0-21.4	15-32-50/5	100						
				6	SS	25.0-25.4	50/5	100						
686.00	28.8	Gray, SILTSTONE with few thin red claystone interbeds, slightly weathered, medium hard	2.2	1	NQ2	27.0-30.0		100	80					
683.80	31.0	Gray, SANDSTONE, fine to medium grained, few micaceous laminations, slightly weathered, medium hard - hard		2	NQ2	30.0-35.0		98	92					

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2/SS
Inspector	TAG

Remarks

Pneumatic piezometer installed at a depth of 42 feet in the middle of a 10 ft. screening section.

Water Level Observations

Immediate	NW	ft.
At Completion	1.0	ft. ∇
After 24 Hrs.	40	ft. ▼
Water used in drilling	27.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

TEST BORING FLY ASH DAM RAISING.GPJ HC NUTTING.GDT 2/8/08

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-2**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/2/2008
Boring Location	**N** 531,979.5 **E** 1,724,491.4	Date Completed	1/5/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
675.60	39.2	8.2 Gray, SANDSTONE, fine to medium grained, few micaceous laminations, slightly weathered, medium hard - hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	3	NQ2	35.0-40.0		100	94					
657.40	57.4	Reddish brown, SILTY CLAYSTONE, few gray interbeds, moderately weathered - slightly weathered, soft 18.2	4	NQ2	40.0-45.0		100	56					
			5	NQ2	45.0-50.0		100	34					
			6	NQ2	50.0-55.0		100	30					
			7	NQ2	55.0-60.0		100	92					
		Gray, SILTSTONE, few clayey seams, moderately weathered - slightly weathered, soft - medium hard	8	NQ2	60.0-65.0		100	86					
			9	NQ2	65.0-70.0		100	92					

General Notes		Remarks	Water Level Observations	
Driller	Mathis	Pneumatic piezometer installed at a depth of 42 feet in the middle of a 10 ft. screening section.	Immediate	NW ft.
Rig No.			At Completion	1.0 ft. ▽
Rig Type	Truck		After	24 Hrs. 40 ft. ▼
Method	NQ2/SS		Water used in drilling	27.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-2**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/2/2008
Boring Location	N 531,979.5 E 1,724,491.4	Date Completed	1/5/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, SILTSTONE, few clayey seams, moderately weathered - slightly weathered, soft - medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	10	NQ2	70.0-75.0		100	100					
		34.1											
		Sandstone interbeds at 75' to 77'	11	NQ2	75.0-80.0		100	90					
			12	NQ2	80.0-85.0		100	90					
			13	NQ2	85.0-90.0		100	90					
623.30	91.5												
		Gray to reddish brown, CLAYSTONE, few silty or sandy seams, slightly weathered, soft	14	NQ2	90.0-95.0		94	68					
		8.5	15	NQ2	95.0-100.0		100	42					
614.80	100.0												
		BORING COMPLETED @ 100.0'											

General Notes		Remarks	Water Level Observations	
Driller	Mathis	Pneumatic piezometer installed at a depth of 42 feet in the middle of a 10 ft. screening section.	Immediate	NW ft.
Rig No.			At Completion	1.0 ft. ▽
Rig Type	Truck		After	24 Hrs. 40 ft. ▼
Method	NQ2/SS		Water used in drilling	27.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-3**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/7/2008
Boring Location	N 531,649.4 E 1,724,711.2	Date Completed	1/9/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
715.40	0.0												
		Brown, CLAY FILL: sandy lean clay with gravel, few cobbles, moist, very stiff	1	SS	0.0-1.5	4-12-8 (20)	100						
	5.0	5.0											
710.40	5.0												
		Brown and gray, FILL: clayey gravel with sand, many boulders and cobbles throughout, moist - very moist, medium dense - dense	2	SS	5.0-6.5	12-26-14 (40)	100						
			3	SS	10.0-11.5	19-20-26 (46)	100						
			4	SS	15.0-16.5	10-18-17 (35)	100						
			5	SS	20.0-21.5	6-9-17 (26)	100						
			6	SS	25.0-26.5	12-12-17 (29)	100						
			7	SS	30.0-30.2	50/2	100						

General Notes		Remarks	Water Level Observations	
Driller	Mathis	Pneumatic piezometer installed at a depth of 82 feet in the middle of a 8 ft. screening section.	Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs.	NA ft.
Method	NQ2/SS		Water used in drilling	60.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-3**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/7/2008
Boring Location	N 531,649.4 E 1,724,711.2	Date Completed	1/9/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Brown and gray, FILL: clayey gravel with sand, many boulders and cobbles throughout, moist - very moist, medium dense - dense ***(LAYER CONTINUED DESCRIPTION REPEATED)***	8	SS	35.0-36.5	10-18-25 (43)	100						
70.0			9	SS	40.0-41.5	9-13-15 (28)	100						
			10	SS	45.0-46.5	9-14-15 (29)	100						
			11	SS	50.0-51.5	32-26-15 (41)	100						
			12	SS	55.0-56.5	6-11-19 (30)	100						
			13	SS	60.0-61.5	12-16-15 (31)	100						
			14	SS	65.0-66.5	10-15-16 (31)	100						

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2/SS
Inspector	TAG

Remarks

Pneumatic piezometer installed at a depth of 82 feet in the middle of a 8 ft. screening section.

Water Level Observations

Immediate	NW	ft.
At Completion		ft.
After 24 Hrs.	NA	ft.
Water used in drilling	60.0	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-3**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/7/2008
Boring Location	N 531,649.4 E 1,724,711.2	Date Completed	1/9/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Brown and gray, FILL: clayey gravel with sand, many boulders and cobbles throughout, moist - very moist, medium dense - dense ***(LAYER CONTINUED DESCRIPTION REPEATED)***	15	SS	70.0-71.5	8-11-13 (24)	100						
640.40	75.0												
		Brown, SILTY GRAVEL with SAND, apparent former stream bed, wet, very dense	16	SS	75.0-76.5	10-11-9 (20)	100						
		8.0	17	SS	80.0-81.5	11-25-47 (72)	100						
632.40	83.0												
		Gray, SANDSTONE, medium to fine grained, micaceous laminations, slightly uncemented, slightly weathered - moderately weathered, medium hard - hard	18	SS	84.5-84.8	50/3	100						
			1	NQ2	85.0-90.0		96	88				3	
		17.0	2	NQ2	90.0-95.0		100	98				3-4	
			3	NQ2	95.0-100.0		100	100				3-4	
615.40	100.0												
		BORING COMPLETED @ 100.0'											

General Notes		Remarks	Water Level Observations	
Driller	Mathis	Pneumatic piezometer installed at a depth of 82 feet in the middle of a 8 ft. screening section.	Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After	24 Hrs. NA ft.
Method	NQ2/SS		Water used in drilling	60.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 883-3113, FAX (614) 883-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-4**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 531,417.7 E 1,724,782.3	Date Completed	1/12/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
714.10	0.0	Reddish brown to gray, FILL: clayey gravel with sand, many boulders and cobbles, predominantly shale and claystone fragments, moist, medium dense (20.0)	1	SS	0.0-1.5	2-6-8 (14)	100						
			2	SS	5.0-6.5	7-17-21 (38)	100						
			3	SS	10.0-11.5	9-13-15 (28)	100						
			4	SS	15.0-16.5	4-6-9 (15)	100						
694.10	20.0	Reddish brown mottled with yellow and gray, LEAN CLAY, little sand, residual soil to completely weathered claystone bedrock, moist - dry, hard (5.5)	5	SS	20.0-21.5	14-24-34 (58)	100						
688.60	25.5	Reddish brown to gray, CLAYSTONE, many slickensided surfaces and few thin sandstone seams, highly weathered - moderately weathered, very soft - soft	6	SS	25.0-26.3	23-49-50/3	100						
			1	NQ2	26.5-29.0		100	0				1	
			2	NQ2	29.0-34.0		86	0				1	

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2/SS
Inspector	TAG

Remarks

Pneumatic piezometer installed at a depth of 73 feet in the middle of a 10 ft. screening section.

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. 34 ft. ▼
Water used in drilling	27.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-4**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 531,417.7 E 1,724,782.3	Date Completed	1/12/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		22.0	Reddish brown to gray, CLAYSTONE, many slickensided surfaces and few thin sandstone seams, highly weathered - moderately weathered, very soft - soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	3	NQ2	34.0-39.0		100	18				1-2	
				4	NQ2	39.0-44.0		80	0				1-2	
666.60	47.5			5	NQ2	44.0-49.0		96	26				1-3	
663.60	50.5	3.0	Gray with olive gray, SANDSTONE, fine to very fine grained, few thin claystone and siltstone seams, slightly weathered, medium hard - hard											
			Gray layered with reddish brown, SILTSTONE, many claystone and sandstone seams, slightly weathered, medium hard	6	NQ2	49.0-54.0		96	76				4-3	
655.10	59.0	8.5		7	NQ2	54.0-59.0		100	42				3	
			Gray, SANDSTONE, fine grained with many siltstone layers, slightly weathered, medium hard - hard	8	NQ2	59.0-64.0		98	90				3-4	
		15.0		9	NQ2	64.0-69.0		100	88				3-4	

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2/SS
Inspector	TAG

Remarks

Pneumatic piezometer installed at a depth of 73 feet in the middle of a 10 ft. screening section.

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. 34 ft. ▼
Water used in drilling	27.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-4**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 531,417.7 E 1,724,782.3	Date Completed	1/12/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, SANDSTONE, fine grained with many siltstone layers, slightly weathered, medium hard - hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	10	NQ2	69.0-74.0		100	88				3-4	
640.10	74.0												
		Gray to reddish brown, SILTSTONE, many sandy layers and claystone seams, slightly weathered - moderately weathered, soft - medium hard (20.5)	11	NQ2	74.0-79.0		96	68				2-3	
			12	NQ2	79.0-84.0		96	40				2-3	
			13	NQ2	84.0-89.0		100	84				2-3	
			14	NQ2	89.0-94.0		100	0				2-3	
619.60	94.5												
		Gray, SANDSTONE, fine grained, slightly weathered, medium hard - hard (5.5)	15	NQ2	94.0-99.0		100	88				3-4	
614.10	100.0		16	NQ2	99.0-100.0		100	100				3-4	
		BORING COMPLETED @ 100.0'											

General Notes		Remarks	Water Level Observations	
Driller	Mathis	Pneumatic piezometer installed at a depth of 73 feet in the middle of a 10 ft. screening section.	Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs.	34 ft. ▼
Method	NQ2/SS		Water used in drilling	27.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-5**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/22/2008
Boring Location	N 532,241.5 E 1,724,200.3	Date Completed	1/25/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
864.60	0.0												
864.10	0.5	0.5 Brown to dark brown, TOPSOIL: silty clay with sand, moist, stiff	1	SS	0.0-0.9	18-50/5	100						
		12.1 Olive brown to gray, SANDSTONE, fine grained, abundant shale laminations, some micaceous laminations, slightly weathered, medium hard - hard	1	NQ2	5.0-15.0		100	48					
852.00	12.6	14.4 Gray, SILTSTONE with many shale seams, few thin sandstone interbeds, moderately weathered, soft - medium hard	2	NQ2	15.0-25.0		100	73					
837.60	27.0	7.0 Olive brown to gray, SANDSTONE, fine grained, micaceous, slightly wavy bedded, slightly weathered, medium hard - hard	3	NQ2	25.0-35.0		100	91					
830.60	34.0												

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. 131 ft. ▼
Water used in drilling	5.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-5**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/22/2008
Boring Location	**N** 532,241.5 **E** 1,724,200.3	Date Completed	1/25/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray to brownish gray, CLAYSTONE, few thin siltstone interbeds, moderately weathered, very soft - soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	4	NQ2	35.0-40.0		100	0					
		19.0	5	NQ2	40.0-50.0		100	46					
811.60	53.0												
		Gray to olive brown, SANDSTONE, fine grained, abundant siltstone interbeds, moderately weathered - slightly weathered, medium hard	6	NQ2	50.0-60.0		100	26					
		6.3											
805.30	59.3												
		Olive brown to gray, SANDSTONE, fine to medium grained, slightly micaceous, slightly weathered, medium hard - hard											
		Near vertical fracture from 63.2' to 64.5'	7	NQ2	60.0-70.0		100	87					
		17.7											

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Track		After	24 Hrs. 131 ft. ▼
Method	NQ2/SS		Water used in drilling	5.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-5**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/22/2008
Boring Location	N 532,241.5 E 1,724,200.3	Date Completed	1/25/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Olive brown to gray, SANDSTONE, fine to medium grained, slightly micaceous, slightly weathered, medium hard - hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	8	NQ2	70.0-80.0		70	57					
787.60	77.0												
		Gray, SILTSTONE, few thin sandstone and claystone interbeds, slightly weathered, medium hard	9	NQ2	80.0-90.0		100	89					
		30.0	10	NQ2	90.0-100.0		95	77					

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Track		After	24 Hrs. 131 ft. ▼
Method	NQ2/SS		Water used in drilling	5.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-5**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/22/2008
Boring Location	N 532,241.5 E 1,724,200.3	Date Completed	1/25/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)		SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
757.60	107.0	Gray, SILTSTONE, few thin sandstone and claystone interbeds, slightly weathered, medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***		11	NQ2	100.0-110.0		100	57					
752.50	112.1	Gray, SANDSTONE, fine grained, silty seams, moderately weathered - slightly weathered, medium hard - hard	5.1											
744.60	120.0	Reddish brown, CLAYSTONE, slickensided surfaces, moderately weathered, soft - very soft	7.9	12	NQ2	110.0-120.0		100	55					
739.80	124.8	Gray to brown, SANDSTONE, fine grained, many thin claystone laminations, micaceous, slightly weathered - moderately weathered, medium hard	4.8											
734.30	130.3	Gray to reddish brown, SILTSTONE, some fissile shale interbeds, slightly weathered, medium hard	5.5	13	NQ2	120.0-130.0		97	96					
728.40	136.2	Brown, SANDSTONE, fine to medium grained, some fractures, slightly weathered - moderately weathered, medium hard - hard	5.9	14	NQ2	130.0-140.0		100	47					
		Gray to reddish brown, CLAYSTONE, few slickensided surfaces, moderately weathered, soft												

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Track		After 24 Hrs.	131 ft. ▼
Method	NQ2/SS		Water used in drilling	5.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-5**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/22/2008
Boring Location	N 532,241.5 E 1,724,200.3	Date Completed	1/25/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
718.30	146.3	10.1 Gray to reddish brown, CLAYSTONE, few slickensided surfaces, moderately weathered, soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	15	NQ2	140.0-150.0		100	47					
713.60	151.0	4.7 Gray, SILTSTONE, many sandstone laminations, slightly weathered, medium hard											
694.60	170.0	19.0 Gray to reddish brown, CLAYSTONE, few slickensided surfaces, completely weathered - moderately weathered, extremely soft - soft. Soil-like from 151' to 155'	16	NQ2	150.0-155.0		44	18					
			17	NQ2	155.0-165.0		90	66					
			18	NQ2	165.0-170.0		92	72					
		BORING COMPLETED @ 170.0'											

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Track		After 24 Hrs.	131 ft.
Method	NQ2/SS		Water used in drilling	5.0 ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-6 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-6**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/21/2008
Boring Location	**N** 532,591.6 **E** 1,724,269.2	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted))	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
874.60	0.0												
		2.5 Reddish brown to brown, FILL: sandy lean clay with gravel, some organics, moist, soft	1	SS	0.0-1.5	2-2-2 (4)	100						
872.10	2.5	Reddish brown with yellow, CLAY FILL: gravelly lean clay with sand, clay core of dam, moist, stiff - very stiff											
			2	SS	5.0-6.5	8-10-11 (21)	100						
		11.0											
			3	SS	10.0-11.5	7-8-11 (19)	100						
861.10	13.5	Brown to olive brown, SANDSTONE, very fine to fine grained with many silty/shaley laminations, moderately weathered, medium hard											
			4	SS	15.0-15.1	50/1	0						
		- fracture zone 17.3 to 18.3'											
			1	NQ2	17.0-25.4		100	75					
		20.6											
		- vertical fracture from 26.4 to 27.4'											
			2	NQ2	25.4-35.4		100	82					
840.50	34.1												

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Track		After 24 Hrs.	70 ft. ▼
Method	NQ2/SS		Water used in drilling	NA ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-6**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/21/2008
Boring Location	**N** 532,591.6 E 1,724,269.2	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
830.10	44.5	Gray to brown, SANDSTONE, medium to fine grained, micaceous, slightly weathered - faintly weathered, medium hard - hard ***(LAYER CONTINUED DESCRIPTION REPEATED)*** 10.4	3	NQ2	35.4-45.4		95	87					
812.10	62.5	Gray to red, CLAYSTONE, some silty seams, becomes red at 54.5', slightly weathered, soft 18.0	4	NQ2	45.4-55.4		100	41					
			5	NQ2	55.4-65.4		100	25					
		Gray to olive brown, SANDSTONE, fine grained with many silty laminations, wavy bedded, slightly weathered, medium hard - hard											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. 70 ft. ▼
Water used in drilling	NA ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-6**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/21/2008
Boring Location	N 532,591.6 E 1,724,269.2	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS (color, material description, moisture, stiffness/density/hardness; visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		17.5 Gray to olive brown, SANDSTONE, fine grained with many silty laminations, wavy bedded, slightly weathered, medium hard - hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	6	NQ2	65.4-75.4		100	96					
794.60	80.0												
		8.3 Olive brown, SANDSTONE, medium grained, slightly weak cementation, slightly weathered, medium hard	7	NQ2	75.4-85.4		100	98					
786.30	88.3												
		4.8 Reddish brown, CLAYSTONE, moderately weathered, very soft - soft	8	NQ2	85.4-95.4		96	48					
781.50	93.1												
		6.9 Gray, SILTSTONE, slightly weathered - faintly weathered, medium hard - hard	9	NQ2	95.4-100.0		100	100					
774.60	100.0												
		BORING COMPLETED @ 100.0'											

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Track		After	24 Hrs. 70 ft. ▼
Method	NQ2/SS		Water used in drilling	NA ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-7**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 532,470.2 E 1,724,543.6	Date Completed	1/15/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
878.70	0.0												
		2.5 Gray with reddish brown, FILL: clayey sand with gravel, moist, medium dense	1	SS	0.0-1.5	5-6-7 (13)	100						
876.20	2.5												
		17.5 Reddish brown with some light brown, CLAY FILL: gravelly lean clay, clay core of dam, moist - very moist, stiff - medium stiff	2	SS	5.0-6.5	5-10-14 (24)	100						0.5
			3	SS	10.0-11.5	6-9-12 (21)	100						1.0
			4	SS	15.0-16.5	3-3-4 (7)	100						1.25
858.70	20.0												
		10.0 Dark brown to black, FILL: silty sand, trace gravel, moist, medium dense -Composite Sample SS-5 & SS-6: LL = NP, PI = NP	5	SS	20.0-21.5	5-6-8 (14)	100						
			6	SS	25.0-26.5	9-11-12 (23)	100						
848.70	30.0												
		Reddish brown, CLAY FILL: gravelly lean clay with sand, moist - very moist, very stiff - stiff	7	SS	30.0-31.5	8-15-17 (32)	100						

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	ft.
At Completion	ft.
After	NA Hrs. NA ft.
Water used in drilling	NA ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-7**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	**N** 532,470.2 **E** 1,724,543.6	Date Completed	1/15/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		10.0 Reddish brown, CLAY FILL: gravelly lean clay with sand, moist - very moist, very stiff - stiff ***(LAYER CONTINUED DESCRIPTION REPEATED)***	8	SS	35.0-36.5	8-8-12 (20)	100						
838.70	40.0												
		Gray to brown, FILL: clayey sand with gravel, predominantly shale fragments with some sandstone, moist - very moist, medium dense - dense	9	SS	40.0-41.2	10-15-50/2	100						
		-Composite Sample SS-10 to SS-14: LL = 27, PI = 9	10	SS	45.0-46.5	8-15-20 (35)	100						
			11	SS	50.0-51.5	10-14-15 (29)	100						
		30.0	12	SS	55.0-56.5	12-50/3	53						
			13	SS	60.0-61.5	10-19-20 (39)	100						
			14	SS	65.0-66.5	8-14-14 (28)	100						
808.70	70.0												

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	ft.
At Completion	ft.
After	NA Hrs. NA ft.
Water used in drilling	NA ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-7**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 532,470.2 E 1,724,543.6	Date Completed	1/15/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray with olive brown, FILL: clayey sand with gravel, predominantly shale fragments, some boulders, very moist, dense - very dense	15	SS	70.0-71.5	36-29-29 (58)	100						
			16	SS	75.0-76.5	24-24-21 (45)	47						
			17	SS	80.0-81.5	34-30-28 (58)	13						
			18	SS	85.0-86.5	31-24-25 (49)	100						
			19	SS	90.0-91.5	23-24-50/1	73						
		-Composite Sample SS-20 to SS-24: LL = 25, PI = 8	20	SS	95.0-96.5	9-12-13 (25)	100						
			21	SS	100.0-101.5	12-16-31 (47)	100						

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Track		After NA Hrs. NA	ft.
Method	NQ2/SS		Water used in drilling NA	ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
780 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-7**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	**N** 532,470.2 **E** 1,724,543.6	Date Completed	1/15/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		70.0 Gray with olive brown, FILL: clayey sand with gravel, predominantly shale fragments, some boulders, very moist, dense - very dense ***(LAYER CONTINUED DESCRIPTION REPEATED)***	22	SS	105.0-106.5	18-18-29 (47)	100						
			23	SS	110.0-111.5	21-35-37 (72)	100						
			24	SS	115.0-116.5	16-19-25 (44)	27						
			25	SS	120.0-121.5	14-13-26 (39)	100						
			26	SS	125.0-125.8	53-50/4	100						
			27	SS	130.0-130.9	45-50/5	100						
			28	SS	135.0-136.5	18-24-32 (56)	100						
738.70	140.0												

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate ______ ft.
At Completion ______ ft.
After NA Hrs. NA ft.
Water used in drilling NA ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-7**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 532,470.2 E 1,724,543.6	Date Completed	1/15/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, FILL: clayey sand with gravel, few boulders, very moist, dense	29	SS	140.0-141.5	40-19-27 (46)	100						
			30	SS	145.0-146.5	10-14-19 (33)	100						
		15.0											
			31	SS	150.0-151.5	27-20-21 (41)	100						
723.70	155.0												
		Brown, WELL GRADED SAND with GRAVEL, subrounded to rounded gravel, medium to coarse grained sand, saturated, medium dense - loose	32	SS	155.0-156.5	7-7-6 (13)	93						
			33	SS	160.0-161.5	6-7-6 (13)	100						
		15.0											
			34	SS	165.0-166.5	4-2-5 (7)	100						
708.70	170.0												
		Gray with brown, SANDY LEAN CLAY, residual soil to completely weathered bedrock, moist, hard 2.0	35	SS	170.0-171.2	21-51-50/2	100						
706.70	172.0												
		Reddish brown with mottled olive brown, CLAYSTONE with slickensided surfaces, moderately weathered, very soft - soft	36	SS	172.0-172.2	46-50/2	350						

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Track		After NA Hrs. NA	ft.
Method	NQ2/SS		Water used in drilling NA	ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-7**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/9/2008
Boring Location	N 532,470.2 E 1,724,543.6	Date Completed	1/15/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)		SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown with mottled olive brown, CLAYSTONE with slickensided surfaces, moderately weathered, very soft - soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	20.4	1	NQ2	173.0-185.0		46	0					
				2	NQ2	185.0-195.0		89	26					
686.30	192.4													
		Gray, SANDSTONE, very fine to fine grained with many silty interbeds, micaceous, slightly weathered, medium hard - hard	7.6	3	NQ2	195.0-200.0		100	100					
678.70	200.0													
		BORING COMPLETED @ 200.0'												

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate ______ ft.
At Completion ______ ft.
After NA Hrs. NA ft.
Water used in drilling NA ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 780 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE B LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-9**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	**N** 531,423.0 **E** 1,725,216.6	Date Completed	1/19/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
878.40	0.0												
		2.5 Gray, FILL: silty gravel with sand, moist, medium dense	1	SS	0.0-1.5	4-9-10 (19)	100						
875.90	2.5	12.5 Reddish brown with some yellow, CLAY FILL: gravelly lean clay, some sand, clay core of dam, moist, stiff - very stiff											
			2	SS	5.0-6.5	6-7-8 (15)	100						
			1	ST	10.0-11.7	T-U-B-E	100			39	15		
863.40	15.0	15.0 Black to dark gray, FILL: silty sand, some cinders and coal fragments, moist, loose - medium dense	3	SS	15.0-16.5	4-4-7 (11)	100						
		-Composite Sample SS-4 & SS-5: LL = NP, PI = NP	4	SS	20.0-21.5	7-10-12 (22)	100						
			5	SS	25.0-26.5	12-12-15 (27)	100						
848.40	30.0	Reddish brown to gray, FILL: clayey sand with gravel, predominantly claystone and sandstone fragments, some boulders, moist, dense - very dense	6	SS	30.0-31.5	12-18-12 (30)	100						

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	144.2 ft. ▽
Rig Type	Track		After	NA Hrs. NA ft.
Method	NQ2/SS/ST		Water used in drilling	NA ft.
Inspector	TAG/CF		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-9**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	N 531,423.0 E 1,725,216.6	Date Completed	1/19/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown to gray, FILL: clayey sand with gravel, predominantly claystone and sandstone fragments, some boulders, moist, dense - very dense ***(LAYER CONTINUED DESCRIPTION REPEATED)*** -Composite Sample SS-7 to SS-11: LL = 28, PI = 10	7	SS	35.0-36.5	11-15-15 (30)	100						
			8	SS	40.0-41.5	12-12-18 (30)	100						
			9	SS	45.0-46.5	15-12-28 (40)	100						
			10	SS	50.0-51.5	12-16-20 (36)	100						
			11	SS	55.0-56.5	13-14-21 (35)	100						
		55.0											
			12	SS	60.0-61.5	13-18-24 (42)	100						
			13	SS	65.0-66.5	15-20-46 (66)	100						

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	144.2 ft. ▼
Rig Type	Track		After	NA Hrs. NA ft.
Method	NQ2/SS/ST		Water used in drilling	NA ft.
Inspector	TAG/CF		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-9**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	**N** 531,423.0 **E** 1,725,216.6	Date Completed	1/19/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown to gray, FILL: clayey sand with gravel, predominantly claystone and sandstone fragments, some boulders, moist, dense - very dense ***(LAYER CONTINUED DESCRIPTION REPEATED)***	14	SS	70.0-71.5	11-23-35 (58)	100						
			15	SS	75.0-76.5	11-16-13 (29)	100						
			16	SS	80.0-80.8	15-50/3	188						
793.40	85.0												
		Reddish brown to gray, FILL: silty sand with gravel, predominantly claystone and sandstone fragments, some boulders	17	SS	85.0-86.5	19-19-25 (44)	100						
		-Composite Sample SS-17 to SS-21: LL = NP, PI = NP	18	SS	90.0-91.5	14-40-38 (78)	100						
			19	SS	95.0-96.5	16-17-27 (44)	100						
			20	SS	100.0-101.5	19-19-21 (40)	100						

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	144.2 ft. ▼
Rig Type	Track		After	NA Hrs. NA ft.
Method	NQ2/SS/ST		Water used in drilling	NA ft.
Inspector	TAG/CF		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-9**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	N 531,423.0 E 1,725,216.6	Date Completed	1/19/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		45.0 Reddish brown to gray, FILL: silty sand with gravel, predominantly claystone and sandstone fragments, some boulders ***(LAYER CONTINUED DESCRIPTION REPEATED)***	21	SS	105.0-106.5	13-22-28 (50)	100						
			22	SS	110.0-111.5	7-12-26 (38)	100						
			23	SS	115.0-116.5	9-38-20 (58)	100						
			24	SS	120.0-121.5	22-17-22 (39)	100						
			25	SS	125.0-126.5	12-19-21 (40)	100						
748.40	130.0												
		10.0 Reddish brown, FILL: silty gravel with sand, moist, dense	26	SS	130.0-131.5	18-22-26 (48)	100						
			27	SS	135.0-136.5	16-19-27 (46)	0						
738.40	140.0												

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	144.2 ft. ▽
Rig Type	Track		After NA Hrs.	NA ft.
Method	NQ2/SS/ST		Water used in drilling	NA ft.
Inspector	TAG/CF		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-9**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	N 531,423.0 E 1,725,216.6	Date Completed	1/19/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown to gray, CLAY FILL: clayey sand with gravel, moist, very stiff - hard	28	SS	140.0-140.6	9-50/1	100						
		10.0 -Composite Sample SS-28 to SS-30: LL = 25, PI = 9	29	SS	145.0-146.5	4-12-39 (51)	100						
728.40	150.0	Reddish brown, CLAY FILL: lean clay with gravel, predominantly claystone and sandstone fragments, moist, hard (3.1)	30	SS	150.0-151.5	17-18-23 (41)	100						
725.30	153.1	Gray, SANDY SHALE, laminated, fine grained sand, moderately weathered - highly weathered, soft - very soft Highly weathered, extremely soft zone at 156.6' to 156.9' (10.6)	1	NQ2	153.1-160.7		88	46					
714.70	163.7	Gray to brown, CLAYSTONE, moderately weathered - highly weathered, very soft	2	NQ2	160.7-170.7		79	57					

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	144.2 ft. ▽
Rig Type	Track		After NA Hrs.	NA ft.
Method	NQ2/SS/ST		Water used in drilling	NA ft.
Inspector	TAG/CF		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-9**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/16/2008
Boring Location	**N** 531,423.0 **E** 1,725,216.6	Date Completed	1/19/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray to brown, CLAYSTONE, moderately weathered - highly weathered, very soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	3	NQ2	170.7-185.7		44	32					
		37.0											
			4	NQ2	185.7-195.7		48	32					
		Sandy zone at 195.7' to 196.8'	5	NQ2	195.7-200.7		86	42					
677.70	200.7	BORING COMPLETED @ 200.7'											

General Notes		Remarks	Water Level Observations	
Driller	Williams		Immediate	NW ft.
Rig No.			At Completion	144.2 ft. ▼
Rig Type	Track		After	NA Hrs. NA ft.
Method	NQ2/SS/ST		Water used in drilling	NA ft.
Inspector	TAG/CF		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-10**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/18/2008
Boring Location	N 531,057.3 E 1,725,242.6	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
884.20	0.0													
879.20	5.0	5.0	Brown, FILL: silty gravel with sand, some boulders, moist, very dense	1	SS	0.0-1.5	16-17-49 (66)	100						
874.00	10.2	5.2	Gray, SHALE, highly weathered, very soft	2	SS	5.0-6.5	5-6-5 (11)	100						
872.50	11.7	1.5	Gray, SANDSTONE, laminated, highly fractured, highly weathered, soft											
866.30	17.9	6.2	Gray, SANDY SHALE, laminated, abundant clay filled fractures, moderately weathered, soft - very soft	3	NQ2	10.0-15.0		96	30					
				4	NQ2	15.0-20.0		100	70					
861.20	23.0	5.1	Gray to reddish brown, CLAYSTONE, moderately weathered, very soft	5	NQ2	20.0-25.0		100	82					
858.70	25.5	2.5	Gray, SANDSTONE, fine grained, thinly laminated, micaceous, slightly weathered, soft											
853.50	30.7	5.2	Gray, SANDY SILTSTONE, thinly laminated, fine grained sand, slightly weathered, soft	6	NQ2	25.0-30.0		100	62					
		5.8	Gray, SANDSTONE, fine grained, thinly laminated, slightly weathered, soft - medium hard From 34.3 to 35.2 vertical fracture	7	NQ2	30.0-35.0		100	78					

General Notes		Remarks	Water Level Observations	
Driller	Mathis		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs.	120 ft. ▼
Method	NQ2/SS		Water used in drilling	10.0 ft.
Inspector	CJF/TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-10**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/18/2008
Boring Location	N 531,057.3 E 1,725,242.6	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
847.70	36.5	filled with calcite											
		Gray, SANDSTONE, medium grained, micaceous, thinly laminated, fresh, medium hard	8	NQ2	35.0-40.0		100	92					
		9.0	9	NQ2	40.0-45.0		100	100					
838.70	45.5	Gray, SANDSTONE, medium grained, thinly laminated, slightly weathered, soft	10	NQ2	45.0-50.0		100	94					
		9.9	11	NQ2	50.0-55.0		100	96					
828.80	55.4	Gray, SILTSTONE, pitted texure, slightly weathered, soft - very soft 4.8	12	NQ2	55.0-60.0		96	80					
824.00	60.2	Gray, SILTSTONE, fresh, soft 5.7	13	NQ2	60.0-65.0		98	90					
818.30	65.9	Gray to Brown, CLAYSTONE, pitted texure, highly fractured, slightly weathered - moderately weathered, soft - very soft	14	NQ2	65.0-70.0		100	58					

General Notes		Remarks	Water Level Observations	
Driller	Mathis		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs.	120 ft. ▼
Method	NQ2/SS		Water used in drilling	10.0 ft.
Inspector	CJF/TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 780 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-10**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/18/2008
Boring Location	N 531,057.3 E 1,725,242.6	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
810.20	74.0	8.1 Gray to Brown, CLAYSTONE, pitted texure, highly fractured, slightly weathered - moderately weathered, soft - very soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	15	NQ2	70.0-75.0		100	72					
799.00	85.2	11.2 Gray, SILTSTONE, slightly weathered, soft - very soft	16	NQ2	75.0-80.0		98	98					
		From 83.5 to 84.0' vertical fracture filled with calcite	17	NQ2	80.0-85.0		100	92					
		From 85.6 to 85.8 inclined fracture											
792.40	91.8	6.6 Gray, SILTSTONE, laminated, faintly weathered, soft From 87.7 to 88.0 highly fractured	18	NQ2	85.0-90.0		100	78					
789.50	94.7	2.9 Gray, SANDSTONE, fine to medium grained, laminated, micaceous, faintly weathered, soft - medium hard	19	NQ2	90.0-95.0		100	64					
787.20	97.0	2.3 Gray, SILTY CLAYSTONE, highly fractured, moderately weathered, soft - very soft	20	NQ2	95.0-100.0		96	48					
784.20	100.0	3.0 Gray to reddish brown, CLAYSTONE, pitted texture, moderately weathered, soft - very soft											
		Gray, SANDY SILTSTONE, fine grained sand, fresh - faintly weathered, soft - medium hard	21	NQ2	100.0-105.0		96	96					

General Notes		Remarks	Water Level Observations	
Driller	Mathis		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs.	120 ft. ▼
Method	NQ2/SS		Water used in drilling	10.0 ft.
Inspector	CJF/TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-10**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/18/2008
Boring Location	**N** 531,057.3 **E** 1,725,242.6	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
772.90	111.3	11.3	Gray, SANDY SILTSTONE, fine grained sand, fresh - faintly weathered, soft - medium hard ***(LAYER CONTINUED DESCRIPTION REPEATED)*** From 109.2 to 109.9' vertical fracture	22	NQ2	105.0-110.0		100	84					
770.30	113.9	2.6	Gray, SILTY CLAYSTONE, slightly weathered, soft	23	NQ2	110.0-115.0		100	70					
767.60	116.6	2.7	Gray, SANDSTONE, very fine grained, thinly laminated, fresh, soft - medium hard											
756.80	127.4	10.8	Gray, SILTSTONE, slightly weathered, soft From 118.5 to 120.0' highly fractured From 121.9 to 122.5 it is reddish brown From 125.4 to 127.4 it is gray and reddish brown stained	24	NQ2	115.0-120.0		100	78					
				25	NQ2	120.0-125.0		96	66					
751.90	132.3	4.9	Gray, SANDSTONE, fine grained, micaceous, fresh, soft - medium hard From 129.7 to 130.1 inclined fracture with oxidation on the surface of the fracture Lost water at 130.0' From 131.8 to 132.3 silty sandstone	26	NQ2	125.0-130.0		100	92					
747.30	136.9	4.6	Reddish brown, CLAYSTONE, highly fractured, moderately weathered - highly weathered, very soft - soft	27	NQ2	130.0-135.0		96	40					
746.20	138.0	1.1	Gray, SANDSTONE, fine grained, micaceous, slightly weathered, soft	28	NQ2	135.0-140.0		98	78					
			Gray to reddish brown, SILTSTONE, highly fractured, slightly weathered,											

General Notes		Remarks	Water Level Observations	
Driller	Mathis		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs.	120 ft. ▼
Method	NQ2/SS		Water used in drilling	10.0 ft.
Inspector	CJF/TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-10**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/18/2008
Boring Location	N 531,057.3 E 1,725,242.6	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
742.20	142.0	4.0 soft - very soft											
		Gray to reddish brown, SILTSTONE, highly fractured, slightly weathered, soft - very soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	29	NQ2	140.0-145.0		100	60					
739.20	145.0	3.0 Gray, SANDSTONE, fine grained, micaceous laminations, some silty seams, slightly weathered, medium hard - hard											
		Reddish brown to gray, SILTY CLAYSTONE, few sandy seams, moderately weathered, very soft - soft	30	NQ2	145.0-150.0		100	12					
729.00	155.2	10.2	31	NQ2	150.0-155.0		92	16					
		Gray, SILTSTONE, few sandy seams, slightly weathered - faintly weathered, medium hard Claystone interbed at 157.5' to 159.5'	32	NQ2	155.0-160.0		100	84					
		12.9	33	NQ2	160.0-165.0		100	76					
716.10	168.1		34	NQ2	165.0-170.0		100	56					
		Reddish brown, CLAYSTONE, moderately weathered - slightly weathered, soft - very soft	35	NQ2	170.0-175.0		96	0					

General Notes		Remarks	Water Level Observations
Driller	Mathis		Immediate ____ ft.
Rig No.			At Completion ____ ft.
Rig Type	Truck		After 24 Hrs. 120 ft. ▼
Method	NQ2/SS		Water used in drilling 10.0 ft.
Inspector	CJF/TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-10**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/18/2008
Boring Location	N 531,057.3 E 1,725,242.6	Date Completed	1/21/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown, CLAYSTONE, moderately weathered - slightly weathered, soft - very soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	36	NQ2	175.0-180.0		78	0					
		21.9											
			37	NQ2	180.0-185.0		96	0					
			38	NQ2	185.0-190.0		92	0					
694.20	190.0												
		BORING COMPLETED @ 190.0'											

General Notes		Remarks	Water Level Observations	
Driller	Mathis		Immediate	ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After 24 Hrs. 120 ft. ▼	
Method	NQ2/SS		Water used in drilling 10.0 ft.	
Inspector	CJF/TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8830

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-11**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/26/2008
Boring Location	N 533,944.8 E 1,723,909.5	Date Completed	1/26/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft. 904.30	DEPTH ft. 0.0	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
901.80	2.5	2.5	Gray, FILL: silty gravel with sand, existing road bed, dry, medium dense - dense											
899.30	5.0	2.5	Black to dark gray, FILL: silty sand, some fly ash, moist, medium dense											
889.30	15.0	10.0	Brown to red, CLAYEY GRAVEL with SAND, completely weathered bedrock, residual structure, moist, very dense	1	SS	5.0-5.4	50/5	100						
				2	SS	10.0-10.9	38-50/5	100						
880.40	23.9	8.9	Brown to reddish brown, CLAYSTONE, moderately weathered, very soft	3	SS	15.0-15.4	50/5	100						
				4	SS	20.0-20.1	50/1	0						
				1	NQ2	20.1-25.1		100	30					
869.20	35.1	11.2	Gray, SILSTONE, few sandstone and red claystone interbeds, slightly weathered, medium hard	2	NQ2	25.1-30.1		100	84					
				3	NQ2	30.1-35.1		100	54					

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate NW ft.
At Completion ft.
After NA Hrs. NA ft.
Water used in drilling 20.1 ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

Client	American Electric Power	Boring No.	**2008-B-11**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/26/2008
Boring Location	**N** 533,944.8 **E** 1,723,909.5	Date Completed	1/26/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		BORING COMPLETED @ 35.1'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	NA Hrs. NA ft.
Water used in drilling	20.1 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-11R**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/29/2008
Boring Location	**N** 533,944.8 E 1,723,911.5	Date Completed	1/30/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
904.30	0.0													
901.80	2.5	2.5	Gray, FILL: silty gravel with sand, existing road bed, dry, medium dense - dense											
899.30	5.0	2.5	Black to dark gray, FILL: silty sand, some fly ash, moist, medium dense											
889.30	15.0	10.0	Brown to red, CLAYEY GRAVEL with SAND, completely weathered bedrock, residual structure, moist, very dense											
885.30	19.0	4.0	Brown to reddish brown, CLAYSTONE, highly weathered, very soft											
884.50	19.8	0.8	Brownish gray, SANDSTONE, fine grained, moderately weathered, medium hard	1	NQ2	19.0-24.0		100	28					
881.40	22.9	3.1	Brownish gray, CLAYSTONE, soil-like, highly weathered, very soft. Sharp contact at 22.9'											
876.20	28.1	5.2	Gray, SILTSTONE, thinly bedded to laminated, thin to medium shale interbeds throughout, moderately weathered - slightly weathered, soft - medium hard. Claystone interbed at 24.1' to 24.4'	2	NQ2	24.0-29.0		100	78					
		8.3	Gray, SHALE, fissile, few clay seams, slightly weathered, soft. Sandstone interbed at 30.4' to 31.4'	3	NQ2	29.0-34.0		100	96					

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2
Inspector	TAG/JRB

Remarks

Boring redrilled adjacent to original 2008-B-11 location. No SPT samples obtained; boring augered to refusal and began coring to 75 ft.

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. BF ft.
Water used in drilling	19.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-6
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-11R**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/29/2008
Boring Location	**N** 533,944.8 **E** 1,723,911.5	Date Completed	1/30/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	Thickness	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
867.90	36.4		Gray, SHALE, fissile, few clay seams, slightly weathered, soft ***(LAYER CONTINUED DESCRIPTION REPEATED)***	4	NQ2	34.0-39.0		100	64					
864.60	39.7	3.3	Gray, SANDSTONE, very fine grained, thinly bedded, micaceous, slightly weathered, medium hard											
858.10	46.2	6.5	Gray to reddish brown, SILTY SHALE, weakly laminated, slightly weathered, soft Siltstone interbed at 44.5' to 45.0'	5	NQ2	39.0-44.0		100	80					
856.30	48.0	1.8	Brown, CLAYSTONE, highly weathered, very soft	6	NQ2	44.0-49.0		100	72					
855.90	48.4	0.4	Dark gray and black, CARBONACEOUS SHALE with coal streaks, moderately weathered, soft											
854.70	49.6	1.2	Gray, SILTSTONE, thinly bedded, slightly weathered, soft - medium hard											
849.70	54.6	5.0	Gray, SANDSTONE, very fine to fine grained, thinly bedded, thin shale interbeds throughout, slightly weathered, medium hard	7	NQ2	49.0-54.0		100	100					
848.00	56.3	1.7	Gray, SILTSTONE, thinly bedded, fractured, moderately weathered, soft	8	NQ2	54.0-59.0		100	78					
845.30	59.0	2.7	Gray, SANDSTONE, very fine grained, thinly bedded, few shale and clay laminations, slightly weathered, medium hard											
		16.0	Gray, SANDSTONE, fine to medium grained, medium to thickly bedded, micaceous laminations, 100% RQD, faintly weathered, hard	9	NQ2	59.0-64.0		100	100					
				10	NQ2	64.0-69.0		100	100					

General Notes		Remarks	Water Level Observations	
Driller	Mathis	Boring redrilled adjacent to original 2008-B-11 location. No SPT samples obtained; boring augered to refusal and began coring to 75 ft.	Immediate	NW ft.
Rig No.			At Completion	ft.
Rig Type	Truck		After	24 Hrs. BF ft.
Method	NQ2		Water used in drilling	19.0 ft.
Inspector	TAG/JRB		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 883-3113
FAX (614) 863-0475

INDIANA REGION
349 WALNUT STREET, STE 8
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-11R**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/29/2008
Boring Location	N 533,944.8 E 1,723,911.5	Date Completed	1/30/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Gray, SANDSTONE, fine to medium grained, medium to thickly bedded, micaceous laminations, 100% RQD, faintly weathered, hard ***(LAYER CONTINUED DESCRIPTION REPEATED)***	11	NQ2	69.0-74.0		100	100					
829.30	75.0		12	NQ2	74.0-75.0		100	100					
		BORING COMPLETED @ 75.0'											

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	NQ2
Inspector	TAG/JRB

Remarks

Boring redrilled adjacent to original 2008-B-11 location. No SPT samples obtained; boring augered to refusal and began coring to 75 ft.

Water Level Observations

Immediate	NW ft.
At Completion	ft.
After	24 Hrs. BF ft.
Water used in drilling	19.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-13**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/25/2008
Boring Location	N 531,276.2 E 1,725,843.5	Date Completed	1/25/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
906.00	0.0												
		TOPSOIL (2.0)	1	SS	0.0-1.5	2-2-3 (5)	100						
904.00	2.0	Brown to reddish brown, SANDY LEAN CLAY, residual soil structure to completely weathered bedrock, moist, very stiff - hard (13.0)											
			2	SS	5.0-6.5	46-24-34 (58)	100						
			3	SS	10.0-10.8	26-50/4	100						
891.00	15.0	Olive brown, SILTSTONE, many wavy bedded sandstone interbeds, moderately weathered, soft - medium hard (15.0)	4	SS	15.0-15.1	50/1	0						
			1	NQ2	15.1-20.0		100	82					
			2	NQ2	20.0-25.0		90	78					
			3	NQ2	25.0-30.0		100	68					
876.00	30.0	BORING COMPLETED @ 30.0'											

General Notes

Driller	Williams
Rig No.	
Rig Type	Track
Method	NQ2/SS
Inspector	TAG

Remarks

Water Level Observations

Immediate	NW ft.
At Completion	NW ft.
After	NA Hrs. NA ft.
Water used in drilling	15.0 ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER
611 LUNKEN PARK DRIVE
CINCINNATI, OH 45226
(513) 321-5816
FAX (513) 321-0294

CENTRAL OHIO REGION
790 MORRISON ROAD
COLUMBUS, OH 43230
(614) 863-3113
FAX (614) 863-0475

INDIANA REGION
340 WALNUT STREET, STE 6
LAWRENCEBURG, IN 47025
(812) 539-4300
FAX (812) 539-4301

BLUEGRASS REGION
470-B CONWAY CT., STE B-8
LEXINGTON, KY 40511
(859) 455-8530
FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	2008-B-14
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/5/2008
Boring Location	N 532,472.1 E 1,724,544.4	Date Completed	1/7/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
879.00	0.0	Gray to brown, FILL: silty gravel with sand, few cobbles, moist, dense											
877.28	3.0	3.0											
		Reddish brown mottled with gray and brown, CLAY FILL: sandy lean clay, little gravel (subangular siltstone and sandstone), very moist, stiff - very stiff	1	ST	4.5-6.5	T-U-B-E	65		19	38	16		0.2
			2	ST	14.5-16.5	T-U-B-E	90		20	37	16		0.3
			3	ST	24.5-26.5	T-U-B-E	100		19	38	16		
		61.5											

General Notes		Remarks
Driller	Williams	Boring drilled at 35° from the horizontal. Elevation values presented on boring log are corrected for angle of inclination. The depths shown are inclined distances. Pneumatic piezometer installed at an inclined distance of 88 feet in the middle of a 10 ft. screening section. Boring drilled at approximate bearing N 30° E.
Rig No.	45C	
Rig Type	Track	
Method	ST	
Inspector	TAG/JRB	

Water Level Observations		
Immediate		ft.
At Completion	20.0	ft. ▽
After	24 Hrs. NA	ft.
Water used in drilling	NW	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

LOG OF TEST BORING

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 780 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

Client	American Electric Power	Boring No.	2008-B-14
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/5/2008
Boring Location	N 532,472.1 E 1,724,544.4	Date Completed	1/7/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown mottled with gray and brown, CLAY FILL: sandy lean clay, little gravel (subangular siltstone and sandstone), very moist, stiff - very stiff (LAYER CONTINUED DESCRIPTION REPEATED)	4	ST	34.5-36.5	T-U-B-E	100						0.3
			5	ST	44.5-46.5	T-U-B-E	100		16	37	16		
			6	ST	49.5-51.5	T-U-B-E	0						
			7	ST	54.5-56.5	T-U-B-E	100		17	37	16		0.25
			8	ST	59.5-61.5	T-U-B-E	75		17	36	14		0.5
842.00	64.5	Light brown with gray, CLAY FILL: sandy lean clay with gravel, moist, stiff - very stiff	9	ST	64.5-66.5	T-U-B-E	50		17	34	14		0.5

General Notes		Remarks	Water Level Observations
Driller	Williams	Boring drilled at 35° from the horizontal. Elevation values presented on boring log are corrected for angle of inclination. The depths shown are inclined distances. Pneumatic piezometer installed at an inclined distance of 88 feet in the middle of a 10 ft. screening section. Boring drilled at approximate bearing N 30° E.	Immediate ___ ft.
Rig No.	45C		At Completion 20.0 ft. ▽
Rig Type	Track		After 24 Hrs. NA ft.
Method	ST		Water used in drilling NW ft.
Inspector	TAG/JRB		BF = BACKFILLED NW = NO WATER (Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION – 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 340 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	2008-B-14
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/5/2008
Boring Location	N 532,472.1 E 1,724,544.4	Date Completed	1/7/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Light brown with gray, CLAY FILL: sandy lean clay with gravel, moist, stiff – very stiff (LAYER CONTINUED DESCRIPTION REPEATED)	10	ST	69.5-71.5	T-U-B-E	75		19	32	10		0.5
		17.0											
			11	ST	74.5-76.5	T-U-B-E	0						
832.25	81.5		12	ST	79.5-81.5	T-U-B-E	0						
		Reddish brown, brown with gray, CLAY FILL: sandy lean clay with gravel, moist – very moist, stiff	13	ST	81.5-83.5	T-U-B-E	75		20	39	18		0.25
			14	ST	84.5-86.5	T-U-B-E	100		17	36	15		0.3
			15	ST	89.5-91.5	T-U-B-E	100		20	40	18		0.3
		20.0											
			16	ST	94.5-96.5	T-U-B-E	20						
820.78	101.5		17	ST	99.5-101.5	T-U-B-E	100		19	40	17		0.5
		BORING COMPLETED @ 101.5'											

General Notes

Driller	Williams
Rig No.	45C
Rig Type	Track
Method	ST
Inspector	TAG/JRB

Remarks

Boring drilled at 35° from the horizontal. Elevation values presented on boring log are corrected for angle of inclination. The depths shown are inclined distances. Pneumatic piezometer installed at an inclined distance of 88 feet in the middle of a 10 ft. screening section. Boring drilled at approximate bearing N 30° E.

Water Level Observations

Immediate	ft.
At Completion	20.0 ft. ▽
After	24 Hrs. NA ft.
Water used in drilling	NW ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION – 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 340 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	2008-B-16
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	12/18/2007
Boring Location	N 531,423.3 E 1,725,218.6	Date Completed	12/26/2007
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
878.80	0.0												
876.33	3.5	Gray to brown, FILL: silty gravel with sand, few cobbles, moist, dense (3.5)											
		Reddish brown mottled with gray and brown, CLAY FILL: sandy lean clay, little gravel (subangular siltstone and sandstone), moist, stiff – very stiff	1	ST	5.0–7.0	T-U-B-E	100		21	40	18		N/A
			2	ST	15.0–17.0	T-U-B-E	75		16	37	16		4.0
			3	ST	25.0–27.0	T-U-B-E	75		18	39	17		4.5
		56.5											

General Notes

Driller	Davis
Rig No.	550
Rig Type	ATV
Method	ST
Inspector	TAG/JRB

Remarks

Boring drilled at 45° from the horizontal. Elevation values presented on boring log are corrected for angle of inclination. The depths shown are inclined distances. Pneumatic piezometer installed at an inclined distance of 29 feet in the middle of a 10 ft. screening section. Boring drilled at approximate bearing N 30° E.

Water Level Observations

Immediate ________ ft.
At Completion ________ ft.
After NA Hrs. NA ft.
Water used in drilling NA ft.
BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 348 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	2008-B-16
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	12/18/2007
Boring Location	N 531,423.3 E 1,725,218.6	Date Completed	12/26/2007
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
		Reddish brown mottled with gray and brown, CLAY FILL: sandy lean clay, little gravel (subangular siltstone and sandstone), moist, stiff - very stiff (LAYER CONTINUED DESCRIPTION REPEATED)	4	ST	35.0-37.0	T-U-B-E	0						N/A
			5	ST	40.0-42.0	T-U-B-E	90			36	15		3.0
			6	ST	45.0-47.0	T-U-B-E	0						N/A
			7	ST	50.0-52.0	T-U-B-E	0						N/A
			8	ST	52.0-54.0	T-U-B-E	100		17	37	15		2.5
			9	ST	55.0-57.0	T-U-B-E	100			35	14		1.5
836.37	60.0												
		ROCK FILL (no samples obtained) 5.0	10	ST	60.0-60.0	T-U-B-E							N/A
832.84	65.0												
		BORING COMPLETED @ 65.0'	11	ST	65.0-65.0	T-U-B-E							N/A

General Notes		Remarks	Water Level Observations	
Driller	Davis	Boring drilled at 45° from the horizontal. Elevation values presented on boring log are corrected for angle of inclination. The depths shown are inclined distances. Pneumatic piezometer installed at an inclined distance of 29 feet in the middle of a 10 ft. screening section. Boring drilled at approximate bearing N 30° E.	Immediate	ft.
Rig No.	550		At Completion	ft.
Rig Type	ATV		After NA Hrs. NA	ft.
Method	ST		Water used in drilling NA	ft.
Inspector	TAG/JRB		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER 611 LUNKEN PARK DRIVE CINCINNATI, OH 45226 (513) 321-5816 FAX (513) 321-0294
CENTRAL OHIO REGION 790 MORRISON ROAD COLUMBUS, OH 43230 (614) 863-3113 FAX (614) 863-0475
INDIANA REGION 349 WALNUT STREET, STE 8 LAWRENCEBURG, IN 47025 (812) 539-4300 FAX (812) 539-4301
BLUEGRASS REGION 470-B CONWAY CT., STE B-8 LEXINGTON, KY 40511 (859) 455-8530 FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-17**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/28/2008
Boring Location	N 532,112.8 E 1,726,856.8	Date Completed	1/28/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
875.00	0.0	Gray, FILL: silty gravel, moist, dense											
		5.0											
870.00	5.0	Gray, FLY ASH (sandy silt), saturated, medium stiff											
		35.0											

General Notes

Driller	Mathis
Rig No.	
Rig Type	Truck
Method	
Inspector	TAG

Remarks

No SPT samples obtained. Augered to 40 ft and installed pneumatic piezometer at 35 ft.

Water Level Observations

Immediate	7.0	ft. ▽
At Completion	7.0	ft. ▼
After 24 Hrs.	BF	ft.
Water used in drilling	NW	ft.

BF = BACKFILLED NW = NO WATER
(Measured from ground surface)

H.C. NUTTING COMPANY
APPALACHIAN REGION - 912 MORRIS STREET
CHARLESTON, WV 25301 (304) 344-0821
FAX (304) 342-4711
EMPLOYEE OWNED
GEOTECHNICAL, ENVIRONMENTAL AND TESTING ENGINEERS SINCE 1921

CORPORATE CENTER, 611 LUNKEN PARK DRIVE, CINCINNATI, OH 45226, (513) 321-5816, FAX (513) 321-0294
CENTRAL OHIO REGION, 790 MORRISON ROAD, COLUMBUS, OH 43230, (614) 863-3113, FAX (614) 863-0475
INDIANA REGION, 349 WALNUT STREET, STE 8, LAWRENCEBURG, IN 47025, (812) 539-4300, FAX (812) 539-4301
BLUEGRASS REGION, 470-B CONWAY CT., STE B-8, LEXINGTON, KY 40511, (859) 455-8530, FAX (859) 455-8630

LOG OF TEST BORING

Client	American Electric Power	Boring No.	**2008-B-17**
Project	Amos U3 Fly Ash Dam Raising Study	Date Started	1/28/2008
Boring Location	**N** 532,112.8 **E** 1,726,856.8	Date Completed	1/28/2008
Elevation Ref.	American Electric Power	Work Order No.	N2075307

ELEV. ft.	DEPTH ft.	DESCRIPTION OF MATERIALS color, material description, moisture, stiffness/density/hardness (visual classification unless otherwise noted)	SAMPLE NO.	TYPE	DEPTH ft.	BLOWS/6" (N Value)	REC. %	RQD %	W %	LL %	PI %	HCSI	PPR tsf
835.00	40.0	Gray, FLY ASH (sandy silt), saturated, medium stiff ***(LAYER CONTINUED DESCRIPTION REPEATED)***											
		BORING COMPLETED @ 40.0'											

General Notes		Remarks	Water Level Observations	
Driller	Mathis	No SPT samples obtained. Augered to 40 ft and installed pneumatic piezometer at 35 ft.	Immediate	7.0 ft. ▽
Rig No.			At Completion	7.0 ft. ▼
Rig Type	Truck		After 24 Hrs.	BF ft.
Method			Water used in drilling	NW ft.
Inspector	TAG		BF = BACKFILLED NW = NO WATER (Measured from ground surface)	

American Electric Power, 2008

Boring Logs

2008-19 to 2008-28

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER			
COMPANY		BORING NO. 2008-19 DATE 5/13/08	SHEET 1 OF 2
PROJECT	Amos FGD Haul Road	BORING START 3/11/08	BORING FINISH 3/11/08
COORDINATES	N 533,257.1 E 1,727,206.5	PIEZOMETER TYPE NA	WELL TYPE NA
GROUND ELEVATION	SYSTEM	HGT. RISER ABOVE GROUND NA	DIA NA
		DEPTH TO TOP OF WELL SCREEN NA	BOTTOM NA
		WELL DEVELOPMENT NA	BACKFILL Quick Grout
		FIELD PARTY ZLR/RMP	RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												GROUNDING PROCEDURES NOT IN USE ON THIS BORING / DRILLED IN ROAD BED
1	SPT	1.8	3.3	3-3-6	1.1					**N5 MEDIUM GRAY BOTTOM ASH** tsf 0.25, wet		
										10R 6/6 MODERATE REDDISH ORANGE SILTY CLAY tsf 2.5, moist		
										NO RECOVERY		
							5					
2	SPT	6.8	6.8	50/0	0					**HARD 5Y 5/2 LIGHT OLIVE GRAY SILTSTONE** w/fine grain sandstone		
3	NQ	8.8	9.6		.8	0						AUGER REFUSAL @ 8.8'; BEGAN CORING @ 8.8'
4	NQ	9.6	19.6		9.9	81	10			**10Y 6/6 DARK GREENISH YELLOW SILTY FINE GRAIN SANDSTONE**		
							15					
										5Y 5/2 LIGHT OLIVE GRAY SILTY CLAYSHALE vertical fracture @ 13.1'		
5	NQ	19.6	24.6		5.0	88				**5YR 5/2 PALE BROWN SILTY CLAYSHALE**		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-19** DATE **5/13/08** SHEET **2** OF **2**

BORING START **3/11/08** BORING FINISH **3/11/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												STOPPED BORING @ 24.6'; TREMIE GROUTED FROM 24.6' TO GRADE; TOP OFF BOREHOLE W/~50 LBS OF QUICK CRETE CEMENT MIX; DISCARDED BOTTOM 24.1' - 24.6' OF CORE AS CORE BOX WAS FULL; 27 GAL OF QUICK GROUT TO TOP OF HOLE, PLACED 1 BAG OF CONCRETE IN HOLE 2' TO TOP OF GROUND

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

COORDINATES **N 533,997.2 E 1,727,462.1**

GROUND ELEVATION SYSTEM

BORING NO. **2008-21** DATE **5/13/08** SHEET **1** OF **2**

BORING START **3/10/08** BORING FINISH **3/11/08**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **Quick Grout**

FIELD PARTY **ZLR/RMP** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												GROUNDING PROCEDURES NOT IN USE ON THIS BORING; DRILLED BORING IN ROAD BED
1	SPT	2.5	4.0	32-15-34	.7					**HARD 5Y 7/6 MODERATE YELLOW BROKEN WEATHERED FINE GRAIN SANDSTONE** dry		
							5					
2	SPT	7.5	7.5	50/0	0					**NO RECOVERY**		
3	NQ	8.8	10.1		1.3	0				**HARD 10Y 6/6 DARK GREENISH YELLOW SILTY FINE GRAIN CLAYSHALE** w/high angle fracture @ 9.4'		AUGER REFUSAL @ 8.8'; REPLACED NQ BIT; STARTED CORING @ 8.8'
							10					
4	NQ	10.1	20.1		9.0	61				**HARD 10Y 6/6 DARK GREENISH YELLOW SILTY FINE GRAIN CLAYSHALE** w/vertical fracture @ 11.4' - 11.8'		
										HARD 5R 4/2 GRAYISH RED CLAYSHALE w/vertical fracture @ 14.1', high angle fracture @ 15.6' - 15.8', and soft area @ 16.6'		
							15					
										HARD 10Y 6/6 DARK GREENISH YELLOW SILTY FINE GRAIN CLAYSHALE w/soft area @ 17.3'		
										5GY 6/1 GREENISH GRAY SILTSTONE w/fine grain sandstone		
										5Y 7/2 YELOWISH GRAY SILTY CLAYSHALE		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-21** DATE **5/13/08** SHEET **2** OF **2**

BORING START **3/10/08** BORING FINISH **3/11/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										w/vertical fracture @ 18.9'		STOPPED BORING @ 20.1'; TREMIE GROUTED FROM 20.1' TO GRADE; TOP OFF BOREHOLE W/~50 LBS OF QUICK CRETE CEMENT MIX

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

COORDINATES **N 534,941.6 E 1,728,009.5**

GROUND ELEVATION SYSTEM

BORING NO. **2008-22** DATE **5/13/08** SHEET **1** OF **3**

BORING START **3/12/08** BORING FINISH **3/12/08**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **Quick Grout**

FIELD PARTY **ZLR/RMP** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												GROUNDING PROCEDURES NOT IN USE ON THIS BORING
1	SPT	1.3	2.1	48-50/2						**HARD 5Y 8/4 GRAYISH YELLOW BROKEN FINE GRAIN SANDSTONE**		
2	NQ	3.6	9.0		5.0	48				**10Y 6/2 PALE OLIVE MEDIUM COARSE SANDSTONE**		AUGER REFUSAL @ 3.6'; BEGAN CORING @ 3.6'
							5					
										10Y 6/2 PALE OLIVE SILTY CLAYSHALE w/vertical fracture @ 8.0'		
3	NQ	9.0	19.0		9.9	51				**HARD 5Y 5/2 LIGHT OLIVE GRAY SILTY LIGHT CLAYSHALE** w/some fine grain sandstone		
							10					
							15			**SOFT 10Y 6/2 PALE OLIVE CLAYSHALE**		
4	NQ	19.0	25.4		4.2	40				**5YR 5/2 PALE BROWN SILTY CLAYSHALE**		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

JOB NUMBER

COMPANY

BORING NO. **2008-22** DATE **5/13/08** SHEET **2** OF **3**

PROJECT **Amos FGD Haul Road** BORING START **3/12/08** BORING FINISH **3/12/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							25					
5	NQ	25.4	29.0		4.1	51				**5Y 5/6 DUSKY YELLOW CLAYSHALE** **MEDIUM SOFT 5YR 5/2 PALE BROWN CLAYSHALE**		SWL @ 16.3 (15 HR READING); NQ HOLE TO 25.4'
6	NQ	29.0	34.0		5.0	44	30					
7	NQ	34.0	41.9		6.0	67	35					
							40			**N5 MEDIUM GRAY FINE GRAIN SANDSTONE** broken @ 39.0' - 39.3'		
8	NQ	41.9	44.0		2.8	96				**HARD N5 MEDIUM GRAY WELL CEMENTED FINE GRAIN SANDSTONE**		
9	NQ	44.0	54.0		9.8	97	45			**HARD N5 MEDIUM GRAY WELL CEMENTED SILTSTONE**		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-22** DATE **5/13/08** SHEET **3** OF **3**

BORING START **3/12/08** BORING FINISH **3/12/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							50					
										HARD N5 MEDIUM GRAY WELL CEMENTED MEDIUM COARSE SANDSTONE		
										N6 MEDIUM LIGHT GRAY SILTSTONE		
							55					
10	NQ	59.0	64.0		10	90						
							60					
												TREMIED GROUT IN HOLE TO GROUND LEVEL USING ~35 GAL; PLACED 2' OF CONCRETE TO TOP OF GROUND

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER ______

COMPANY ______

PROJECT **Amos FGD Haul Road**

COORDINATES **N 535,340.2 E 1,728,037.6**

GROUND ELEVATION ______ SYSTEM ______

BORING NO. **2008-23** DATE **5/13/08** SHEET **1** OF **3**

BORING START **3/18/08** BORING FINISH **3/18/08**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **Quick Grout**

FIELD PARTY **ZLR/RMP** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												GROUNDING PROCEDURES NOT IN USE ON THIS BORING; UNDERCUT ORIGINAL GRADE +/-2.0' FOR DRILL PAD
1	SPT	2.0	3.5	4-5-8	1.4					**HARD 5YR 7/2 GRAYISH ORANGE PINK SILTY CLAYSHALE** tsf 2.0		
							5					
2	SPT	7.0	8.5	7-5-9	.7					**5Y 8/4 GRAYISH YELLOW WEATHERED BADLY BROKEN SANDSTONE** tsf 3.0		
										HARD RED CLAY		
										5Y 8/4 GRAYISH YELLOW WEATHERED SILTY CLAYSHALE dry		
							10					
3	SPT	12.0	13.5	28-50/3	.8							
4	NQ	14.6	20.4		5.3	70				**5YR 5/2 PALE BROWN SILTY CLAYSHALE**		
							15			**10Y 6/6 DARK GREENISH WEATHERED SANDSTONE**		
										HARD N5 MEDIUM GRAY WELL CEMENTED SILTSTONE		

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER ______

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-23** DATE **5/13/08** SHEET **2** OF **3**

BORING START **3/18/08** BORING FINISH **3/18/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	NQ	20.4	30.4		8.8	67				**HARD N5 MEDIUM GRAY FINE GRAIN WELL CEMENTED SILTSTONE** high angle fracture w/iron staining @ 25.3'		
							25					
										MEDIUM SOFT N5 PALE BROWN CLAY SILTSTONE		
							30					
6	NQ	30.4	34.9		5.7	54				**HARD N5 MEDIUM GRAY SILTSTONE** soft area badly broken @ 33.4'		SWL @ GRADE LEVEL
7	NQ	34.9	40.4		5.5	87	35			**HARD N5 MEDIUM GRAY SILTSTONE**		
										MEDIUM HARD 5YR 5/2 PALE BROWN SILTY CLAYSHALE		
							40					
8	NQ	40.4	50.4		10.1	92				**MEDIUM SOFT 5YR 5/2 PALE BROWN SILTY CLAYSHALE**		
										HARD N5 MEDIUM GRAY SILTSTONE		
							45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-23** DATE **5/13/08** SHEET **3** OF **3**

BORING START **3/18/08** BORING FINISH **3/18/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										HARD N5 MEDIUM GRAY WELL CEMENTED FINE GRAIN SANDSTONE		
9	NQ	50.4	55.4		5.0	100	50			**HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED MEDIUM COURSE SANDSTONE**		
							55					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT Amos FGD Haul Road

COORDINATES N 535,663.5 E 1,728,199.2

GROUND ELEVATION SYSTEM

BORING NO. 2008-25 DATE 5/13/08 SHEET 1 OF 4

BORING START 3/18/08 BORING FINISH 3/18/08

PIEZOMETER TYPE NA WELL TYPE NA

HGT. RISER ABOVE GROUND NA DIA NA

DEPTH TO TOP OF WELL SCREEN NA BOTTOM NA

WELL DEVELOPMENT NA BACKFILL Quick Grout

FIELD PARTY ZLR/RMP RIG D-120

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	NQ	3.8	9.9		3.85	26				**10Y 7/4 MODERATE GREENISH YELLOW WEATHERED SANDSTONE**		GROUNDING PROCEDURES NOT IN USE ON THIS BORING; CUT 3' TO 4' BELOW GRADE FOR DRILL PAD; WEATHERED SHALEY FINE GRAIN SANDSTONE; BLIND DRILLED NW CASING TO 3.8'
							5			**10YR 7/4 GRAYISH ORANGE SILTY CLAYSHALE**		
										10Y 7/4 MODERATE GREENISH YELLOW BADLY BROKEN CLAY SILTSTONE		
2	NQ	9.9	19.9		9.8	70	10			**5Y 5/2 LIGHT OLIVE GRAY CLAYSHALE**		
										10Y 6/6 DARK GREENISH YELLOW SILTSTONE		
										5Y 5/2 LIGHT OLIVE GRAY CLAYSHALE		
										HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED FINE GRAIN SANDSTONE		
							15			**10Y 6/6 DARK GREENISH YELLOW CLAY SILTSTONE**		
										5YR 5/2 PALE BROWN SILTY CLAYSHALE		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-25** DATE **5/13/08** SHEET **2** OF **4**

BORING START **3/18/08** BORING FINISH **3/18/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	NQ	19.9	29.9		10	60						
							25			**N5 MODERATE GRAY SILTY CLAYSHALE**		
										N7 LIGHT GRAY FINE GRAIN SANDSTONE		
4	NQ	29.9	39.9		10.2	96	30			**HARD 10Y 6/6 DARK GREENISH YELLOW WELL CEMENTED FINE GRAIN SANDSTONE**		
							35					
										HARD N7 LIGHT GRAY WELL CEMENTED MEDIUM COARSE SANDSTONE		
5	NQ	39.9	49.9		10.1	62	40			**HARD N7 LIGHT GRAY WELL CEMENTED MEDIUM COARSE SANDSTONE**		
							45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-25** DATE **5/13/08** SHEET **3** OF **4**

BORING START **3/18/08** BORING FINISH **3/18/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM HARD N5 MEDIUM GRAY SILTY CLAYSHALE		
										MEDIUM HARD 5YR 5/2 PALE BROWN SILTY CLAYSHALE		
6	NQ	49.9	59.9		10.0	86	50			**5RP 6/2 PALE RED PURPLE SILTY CLAYSHALE**		SWL 3.9 @ 14 HRS
										HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED SILTSTONE		
							55					
										5RP 4/2 GRAYISH RED PURPLE SILTY CLAYSHALE high angle fracture @ 55.7'		
7	NQ	59.9	69.9		10.0	85	60			**HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED CLAY SILTSTONE** high angle fractures @ 61.9' & 65.9'		
							65					
										HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED SILTSTONE		
8	NQ	69.9	74.9		5.0	100	70					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-25** DATE **5/13/08** SHEET **4** OF **4**

BORING START **3/18/08** BORING FINISH **3/18/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												TREMIED GROUT BACK TO GROUND LEVEL USING ~40 GALS; PLACED 2' OF CONCRETE TO TOP OF GROUND

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

COORDINATES **N 535,666.0 E 1,728,598.9**

GROUND ELEVATION SYSTEM

BORING NO. **2008-26** DATE **5/13/08** SHEET **1** OF **5**

BORING START **3/24/08** BORING FINISH **3/25/08**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **Quick Grout**

FIELD PARTY **ZLR/RMP** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	SPT	1.2	2.7	7-16-27	1.3					**HARD 5Y 7/2 YELLOWISH GRAY SILT** tsf 4.25; w/trace of clay; dry		GROUNDING PROCEDURES NOT IN USE ON THIS BORING; UNDERCUT +/-2' OF ORIGINAL GRADE TO MAKE DRILL PAD
							5					
2	SPT	6.2	7.7	50/0	0					**NO RECOVERY**		
3	NQ	8.5	9.0		.5	100				**HARD 5Y 5/2 LIGHT OLIVE GRAY WELL CEMENTED SILTSTONE**		
4	NQ	9.0	19.0		7.8	32				**MEDIUM HARD 5Y 5/2 LIGHT OLIVE GRAY CLAYSHALE** w/silt		
							10					
							15					
										MEDIUM HARD 5YR 5/2 PALE BROWN SILTY CLAYSHALE		
5	NQ	19.0	29.0		9.4	79				**MEDIUM HARD 5Y 6/4 DARK YELLOW SILTY**		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-26** DATE **5/13/08** SHEET **2** OF **5**

BORING START **3/24/08** BORING FINISH **3/25/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										CLAYSHALE		
										MEDIUM HARD 5Y 6/4 DARK YELLOW FINE GRAIN SILTY CLAYSHALE		
										MEDIUM SOFT N6 MEDIUM LIGHT GRAY CLAY SILTY SHALE		
							25					
										MEDIUM SOFT 5Y 4/2 GRAYISH RED CLAY SILTY SHALE		
6	NQ	29.0	39.0		10.3	81				**5R 4/2 GRAYISH RED SILTY CLAYSHALE**		
							30					
										MEDIUM HARD N6 MEDIUM LIGHT GRAY SILTY CLAYSHALE		
										HARD 5Y 7/2 YELLOWISH GRAY WELL CEMENTED CLAY SILTSTONE		
							35					
7	NQ	39.0	44.0		5.0	100				**HARD 10Y 6/6 DARK GREENISH YELLOW WELL CEMENTED FINE GRAIN SANDSTONE** high angle fracture @ 43.1'		SWL @ 16.0 AFTER 13.5 HRS
							40					
8	NQ	44.0	54.0		10.0	85				**HARD 10Y 6/6 DARK GREENISH YELLOW WELL CEMENTED FINE GRAIN SANDSTONE**		
							45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-26** DATE **5/13/08**

BORING START **3/24/08** BORING FINISH **3/25/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										HARD N8 VERY LIGHT GRAY WELL CEMENTED MEDIUM COARSE SANDSTONE		
							50					
										HARD N7 LIGHT GRAY WELL CEMENTED LIMESTONE		
										HARD N5 MEDIUM GRAY SILTSTONE w/very little clay		
9	NQ	54.0	61.7		5.2	40				**N5 MEDIUM LIGHT GRAY SILTY CLAYSHALE**		
							55					
										5R 4/2 GRAYISH RED SILTY CLAYSHALE		
							60					
										N5 MEDIUM LIGHT GRAY SILTY CLAYSHALE		
10	NQ	61.7	64.0		3.4	85				**HARD N5 MEDIUM GRAY WELL CEMENTED CLAY SILTSTONE**		
11	NQ	64.0	74.0		10.0	79				**HARD 5YR 3/2 GRAYISH BROWN CLAYSHALE**		
							65					
										HARD N5 MEDIUM GRAY CLAYSHALE		
										HARD N5 MEDIUM GRAY SILTSTONE		
										HARD 5YR 3/2 GRAYISH BROWN SILTY CLAYSHALE		
							70					
										HARD 5Y 5/2 LIGHT OLIVE SILTY CLAYSHALE w/fractures @ 70.0' & 70.7'		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-26** DATE **5/13/08** SHEET **4** OF **5**

BORING START **3/24/08** BORING FINISH **3/25/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	NQ	74.0	84.0		10.0	87	75			**HARD N5 MEDIUM GRAY WELL CEMENTED SILTSTONE** w/ little fine grain sandstone		
										HARD 5Y 7/2 YELLOWISH GRAY FINE GRAIN SANDSTONE		
							80			**N6 MEDIUM LIGHT GRAY SILTY CLAYSHALE**		
										HARD 5Y 7/2 YELLOWISH GRAY WELL CEMENTED SILTSTONE		
13	NQ	84.0	94.0		10.3	38	85			**HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED SILTSTONE** high angle fracture @ 78.0' - 79.0' w/iron staining		
										HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED SILTSTONE w/iron staining		
										5Y 7/2 YELLOWISH FINE GRAIN SANDSTONE		
							90			**HARD N5 MEDIUM GRAY WELL CEMENTED CLAY SILTSTONE** w/soft area 86.2' - 86.3'		
14	NQ	94.0	99.0		5.0	90	95			**HARD 5R 4/2 GRAYISH RED WELL CEMENTED CLAY SILTSTONE**		
										HARD N4 MEDIUM DARK GRAY WELL CEMENTED SILTSTONE w/very little clay		

Continued Next Page

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-26** DATE **5/13/08** SHEET **5** OF **5**

BORING START **3/24/08** BORING FINISH **3/25/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												STOPPED BORING @ 99.0'; TREMIE GROUTED FROM 99.0' TO GRADE USING ~45 GAL OF GROUT CEMENT TO 18" BELOW GROUND TO TOP OF GROUND

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

COORDINATES **N 535,863.0 E 1,728,908.9**

GROUND ELEVATION SYSTEM

BORING NO. **2008-28** DATE **5/13/08** SHEET **1** OF **6**

BORING START **3/25/08** BORING FINISH **3/26/08**

PIEZOMETER TYPE **NA** WELL TYPE **NA**

HGT. RISER ABOVE GROUND **NA** DIA **NA**

DEPTH TO TOP OF WELL SCREEN **NA** BOTTOM **NA**

WELL DEVELOPMENT **NA** BACKFILL **Quick Grout**

FIELD PARTY **ZLR/RMP** RIG **D-120**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												GROUNDING PROCEDURES NOT IN USE ON THIS BORING
1	SPT	1.1	2.6	3-4-5						**STIFF 5R 4/2 GRAYISH RED CLAYSHALE** tsf 1.75; w/trace of silt		
							5					
2	SPT	6.1	13.7	3/50						**STIFF 5R 4/2 GRAYISH RED CLAYSHALE** tsf 1.5; w/trace of silt		
										5Y 8/4 GRAYISH YELLOW WEATHERED FINE GRAIN SANDSTONE		
3	NQ	8.4	13.9		5.5	82				**HARD 10Y 6/6 DARK GREENISH YELLOW WELL CEMENTED WEATHERED FINE GRAIN SANDSTONE** vertical fracture @ 8.7'		AUGER REFUSAL @ 8.4'; STARTED CORING @ 8.4
							10					
4	NQ	13.9	23.9		10.0	72				**HARD 10Y 6/6 DARK GREENISH YELLOW WELL CEMENTED FINE GRAIN SANDSTONE**		
							15					

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
	6" x 3.25 HSA	
	9" x 6.25 HSA	
	HW CASING ADVANCER	4"
	NW CASING	3"
	SW CASING	6"
	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-28** DATE **5/13/08** SHEET **2** OF **6**

BORING START **3/25/08** BORING FINISH **3/26/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	NQ	23.9	33.9		10.0	31	25			**HARD 5Y 6/4 DUSKY YELLOW WELL CEMENTED MEDIUM TO COARSE GRAIN SANDSTONE**		
										5R 3/4 DUSKY RED CLAYSHALE		
							30					
6	NQ	33.9	43.9		8.5	59				**MEDIUM HARD 5R 4/2 GRAYISH RED SILTY CLAYSHALE**		
							35			**MEDIUM HARD N5 MEDIUM GRAY SILTY CLAYSHALE** high angle fracture @ 38.0'		
							40			**MEDIUM HARD 5R 4/2 GRAYISH RED SILTY CLAYSHALE**		
7	NQ	43.9	53.9		9.8	76				**HARD N5 MEDIUM GRAY WELL CEMENTED SILTY CLAYSHALE**		
							45			**HARD N5 MEDIUM GRAY SILTSTONE**		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER ______

COMPANY ______

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-28** DATE **5/13/08** SHEET **3** OF **6**

BORING START **3/25/08** BORING FINISH **3/26/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM SOFT N5 MEDIUM GRAY SILTY CLAYSHALE		
							50			**HARD 5Y 5/2 LIGHT OLIVE GRAY WELL CEMENTED SILTSTONE** w/little fine grain sandstone; verticle fracture @ 51.5'		
8	NQ	53.9	63.9		10.2	70				**MEDIUM HARD 10Y 6/6 DARK GREENISH YELLOW SILTY CLAYSHALE**		
							55			**HARD 10Y 6/6 DARK GREENISH YELLOW WELL CEMENTED SILTSTONE** w/trace of fine grain sandstone; vertical fracture @ 55.3'		LOST 70% OF DRILL WATER @ 55.0'
							60			**HARD 10Y 6/6 DARK GREENISH YELLOW SILTY CLAYSHALE** w/trace of fine grain sandstone w/limestone nodules; red silty clay (mud seams) throughout 62.0' - 63.0'; badly broken @ 62.5' - 63.9'; high angle fracture @ 59.7'		
9	NQ	63.9	73.9		9.9	79	65			**HARD N5 MEDIUM GRAY WELL CEMENTED SILTY CLAYSHALE** w/trace of fine grain sandstone; high angle fracture @ 64.2'; soft area 68.2' - 68.8'		
							70					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-28** DATE **5/13/08** SHEET **4** OF **6**

BORING START **3/25/08** BORING FINISH **3/26/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
10	NQ	73.9	83.9		10.1	69	75			**HARD 5B 5/1 MEDIUM BLUISH GRAY WELL CEMENTED SILTSTONE** w/trace of fine grain sandstone		
										MEDIUM HARD 5YR 4/4 MODERATE BROWN SILTY CLAYSHALE soft @ 78.4' - 82.3'		
							80					
										HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED CLAYEY SILTSTONE		
11	NQ	83.9	93.9		9.9	77	85			**HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED SILTY CLAYSHALE**		
							90					
										HARD N6 MEDIUM LIGHT GRAY WELL CEMENTED FINE GRAIN SANDSTONE w/trace of silt		
12	NQ	93.9	103.9		10.0	100	95			**HARD 10YR 6/6 DARK GREENISH YELLOW AND 10YR 6/2 PALE OLIVE WELL CEMENTED MEDIUM TO COARSE GRAIN SANDSTONE** some small amount of crossbedding		

Continued Next Page

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-28** DATE **5/13/08** SHEET **5** OF **6**

BORING START **3/25/08** BORING FINISH **3/26/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
							100					
13	NQ	103.9	113.9		10.0	100				**HARD 10Y 5/4 LIGHT OLIVE WELL CEMENTED MEDIUM TO COARSE GRAIN SANDSTONE**		
							105					
							110			**HARD N6 MEDIUM LIGHT GRAY SILTY CLAYSHALE**		
14	NQ	113.9	123.9		10	83				**HARD N5 MEDIUM GRAY CLAYEY SILTSTONE** very soft area 120.3' - 120.5'		
							115					
							120					
										MEDIUM HARD 5R 4/2 GRAYISH RED CLAYSHALE		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **Amos FGD Haul Road**

BORING NO. **2008-28** DATE **5/13/08** SHEET **6** OF **6**

BORING START **3/25/08** BORING FINISH **3/26/08**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
												STOPPED BORING @ 123.9'; TREMIE GROUTED FROM 123.9' TO GRADE; USED ~50 GALS; TOPPED BOREHOLE W/50 LBS OF QUICKCRETE

ARCADIS

Arcadis, 2017-2018

Boring Logs and Well Construction Diagrams

MW-1801A/B/C to MW-1810A

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 531,398.6 E 1,726,314.5**

GROUND ELEVATION **901.1** SYSTEM **NAD83/NAVD88**

Water Level, ft	51.0		
TIME			
DATE	7/18/2018		

BORING NO. **MW-1801A** DATE **1/11/19** SHEET **1** OF **4**

BORING START **12/18/17** BORING FINISH **12/21/17**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.05** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **55** BOTTOM **75**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	2.8		0				CL ML	0-2.8': No recovery - Silty CLAY overburden.		0-55': Riser
1	RC	2.8	7.7		38	14	5			2.8-7.1': SANDSTONE; strong to very strong field strength; 5Y 4/3 (Olive) with 5YR 5/6 (Yellowish Red); fine-grained texture; massive structure; moderately decomposed; slightly disintegrated; intensely fractured (mechanical breaks).		
									ML	7.1-7.2': SANDSTONE; very strong field strength; 5YR 5/6 (Yellowish Red); fine grained texture; massive structure; moderately decomposed; slightly disintegrated; intensely fractured. 7.2-7.7': SILT, unconsolidated; weak field strength; 5Y 4/3 (Olive); fine grained texture; massive structure; highly decomposed.		
2	RC	7.7	15.8		57	30	10 15			7.7-15.8': SILTSTONE to Silty SHALE; strong field strength; 5Y 4/3 (Olive) to 10R 3/2 (Dusky Red); fine-grained texture; massive structure; slightly to moderately decomposed; slightly disintegrated; intensely fractured (mechanical breaks).		
3	RC	15.8	25.8		120	64				15.8-16.2': Silty SHALE; strong field strength; 10R 3/2 (Dusky Red); fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; intensely fractured (mechanical breaks). 16.2-25.8'; Silty SHALE; very strong field strength; 5Y 4/3 (Olive); fine-grained texture; massive structure; slightly decomposed (moderately decomposed in intervals from		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1801A** DATE **1/11/19**

BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	15.8	25.8		120	64	25			20.8-21.6' bgs and 22.8-24.5' bgs); slightly disintegrated; intensely fractured (mechanical breaks).		
4	RC	25.8	35.8		120	29	30 35			25.8-35.8': Silty SHALE; strong to very strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure with thin shaley sandstone beds with trace mica; slightly decomposed; slightly disintegrated; bedding plane iron bearing minerals and calcite at 28.1' bgs fracture (HCl reactive).		Significant amount of lost water
5	RC	35.8	45.8		120	27	40 45			35.8-37.5': Silty SHALE; strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; moderately fractured (mechanical breaks). 37.5-40.8': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with laminations; slightly decomposed; slightly disintegrated; slightly fractured (mechanical breaks). 40.8-45.8': Silty SHALE; strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure; slightly decomposed (4" of clay at 44.9' bgs); moderately to slightly disintegrated; intensely fractured (mechanical breaks).		45-50.90': Bentonite Seal

Continued Next Page

JOB NUMBER WV015976.0005
COMPANY American Electric Power
PROJECT Amos Fly Ash Pond

BORING NO. MW-1801A DATE 1/11/19
BORING START 12/18/17 BORING FINISH 12/21/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	45.8	55.8		120	100	50			45.8-55.8': SHALE; strong to very strong field strength; 10R 3/2 (Dusky Red) to GLEY1 4/N (Dark Gray); fine-grained texture; massive structure with laminations; moderately to highly decomposed; gradationally with depth slightly to moderately disintegrated with interbedding; gradationally with depth highly to slightly fractured (mechanical breaks).		50.90-52': Secondary Sand Pack (Global #6) 52-77': Primary Sand Pack (Global #5) 55-75': Slotted PVC (20-slot) Screen
7	RC	55.8	65.8		120	84	55 60			55.8-61.7': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds of shale; fresh; competent with slight disintegration at 61.7' bgs; moderately fractured (mechanical breaks). 61.7-63': SANDSTONE; very strong field strength; 5Y 4/2 (Olive Gray); fine-grained texture; massive structure; fresh; competent with slight disintegration at 61.7' bgs; moderately fractured (mechanical breaks). 63-65.8': Shaley SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure; fresh; competent; moderately fractured (mechanical breaks).		
8	RC	65.8	75.8		120	81	65 70			65.8-69.2': Shaley SANDSTONE; strong field strength; GLEY 1 5/N (Gray); very fine-grained texture; massive structure; slightly to moderately decomposed with iron staining across beds; moderate disintegration; moderately fractured (mechanical breaks). 69.2-71': SANDSTONE; very strong field strength; 5Y 5/3 (Olive); fine-grained texture; massive structure; fresh; slight disintegration; unfractured. 71-75.8': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801A** DATE **1/11/19** SHEET **4** OF **4**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	65.8	75.8		120	81	75			texture; massive structure; fresh; competent; unfractured.		
										75.8-77': Micaceous SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thinly bedded mica; fresh; competent; moderately fractured (mechanical breaks).		
							80					
							85					
							90					
							95					

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 531,401.1 E 1,726,317.0**

GROUND ELEVATION **901.1** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1801B** DATE **1/11/19** SHEET **1** OF **9**

BORING START **12/18/17** BORING FINISH **12/21/17**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.8** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **198.4** BOTTOM **223**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 221.5	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	2.8		0				CL ML	0-2.8': No recovery - Silty CLAY overburden.		0-198.40': Riser
1	RC	2.8	7.7		38	14	5			2.8-7.1': SANDSTONE; strong to very strong field strength; 5Y 4/3 (Olive) with 5YR 5/6 (Yellowish Red); fine-grained texture; massive structure; moderately decomposed; slightly disintegrated; intensely fractured (mechanical breaks).		
									ML	7.1-7.2': SANDSTONE; very strong field strength; 5YR 5/6 (Yellowish Red); fine grained texture; massive structure; moderately decomposed; slightly disintegrated; intensely fractured. 7.2-7.7': SILT, unconsolidated; weak field strength; 5Y 4/3 (Olive); fine grained texture; massive structure; highly decomposed.		
2	RC	7.7	15.8		57	30	10 15			7.7-15.8': SILTSTONE to Silty SHALE; strong field strength; 5Y 4/3 (Olive) to 10R 3/2 (Dusky Red); fine-grained texture; massive structure; slightly to moderately decomposed; slightly disintegrated; intensely fractured (mechanical breaks).		
3	RC	15.8	25.8		120	64				15.8-16.2': Silty SHALE; strong field strength; 10R 3/2 (Dusky Red); fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; intensely fractured (mechanical breaks). 16.2-25.8'; Silty SHALE; very strong field strength; 5Y 4/3 (Olive); fine-grained texture; massive structure; slightly decomposed (moderately decomposed in intervals from		

AEP - AEP.GDT - 1/11/19 13:55 - C:\USERS\LWOODS\DESKTOP\FOR NICOLE BORING LOGS GINT FILES\AEP MOUNTAINEER.GPJ

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1801B | DATE 1/11/19 |

PROJECT Amos Fly Ash Pond | BORING START 12/18/17 | BORING FINISH 12/21/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	15.8	25.8		120	64	25			20.8-21.6' bgs and 22.8-24.5' bgs); slightly disintegrated; intensely fractured (mechanical breaks).		
4	RC	25.8	35.8		120	29	30 35			25.8-35.8': Silty SHALE; strong to very strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure with thin shaley sandstone beds with trace mica; slightly decomposed; slightly disintegrated; bedding plane iron bearing minerals and calcite at 28.1' bgs fracture (HCl reactive).		Significant amount of lost water
5	RC	35.8	45.8		120	27	40 45			35.8-37.5': Silty SHALE; strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; moderately fractured (mechanical breaks). 37.5-40.8': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with laminations; slightly decomposed; slightly disintegrated; slightly fractured (mechanical breaks). 40.8-45.8': Silty SHALE; strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure; slightly decomposed (4" of clay at 44.9' bgs); moderately to slightly disintegrated; intensely fractured (mechanical breaks).		43-192.8': Bentonite Seal

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801B** DATE **1/11/19** SHEET **3** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	45.8	55.8		120	100	50 55			45.8-55.8': SHALE; strong to very strong field strength; 10R 3/2 (Dusky Red) to GLEY1 4/N (Dark Gray); fine-grained texture; massive structure with laminations; moderately to highly decomposed; gradationally with depth slightly to moderately disintegrated with interbedding; gradationally highly to slightly fractured (mechanical breaks).		
7	RC	55.8	65.8		120	84	60 65			55.8-61.7': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds of shale; fresh; competent with slight disintegration at 61.7' bgs; moderately fractured (mechanical breaks). 61.7-63': SANDSTONE; very strong field strength; 5Y 4/2 (Olive Gray); fine-grained texture; massive structure; fresh; competent with slight disintegration at 61.7' bgs; moderately fractured (mechanical breaks). 63-65.8': Shaley SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure; fresh; competent; moderately fractured (mechanical breaks).		
8	RC	65.8	75.8		120	81	70			65.8-69.2': Shaley SANDSTONE; strong field strength; GLEY 1 5/N (Gray); very fine-grained texture; massive structure; slightly to moderately decomposed with iron staining across beds; moderate disintegration; moderately fractured (mechanical breaks). 69.2-71': SANDSTONE; very strong field strength; 5Y 5/3 (Olive); fine-grained texture; massive structure; fresh; slight disintegration; unfractured. 71-75.8': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1801B** DATE **1/11/19** SHEET **4** OF **9**

BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	65.8	75.8		120	81	75			texture; massive structure; fresh; competent; unfractured.		
9	RC	75.8	85.8		120	98	80			75.8-83.7': Micaceous SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thinly bedded mica; fresh; competent; moderately fractured (mechanical breaks).		
							85			83.7-85.8': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray); very fine-grained texture; massive structure; fresh; competent; moderately fractured (mechanical breaks).		
10	RC	85.8	95.8		120	86	90 95			85.8-95.8': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thinly bedded intervals; fresh; competent; moderately fractured (mechanical breaks).		
11	RC	95.8	105.8		120	48				95.8-98.2': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure; fresh; slightly disintegrated; moderately fractured (mechanical breaks).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801B** DATE **1/11/19** SHEET **5** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	95.8	105.8		120	48	100			98.2-101.3': Clayey SHALE; strong field strength; 10R3/4 (Dusky Red); fine-grained texture; massive structure; fresh; moderately disintegrated; slightly fractured (mechanical breaks).		
							105			101.3-105.8': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray) mottling; fine-grained texture; massive structure; fresh; moderately disintegrated; intensely fractured (mechanical breaks).		
12	RC	105.8	115.8		120	70				105.8-108.5': SHALE; strong field strength; 10R 3/4 (Dusky Red) mottled GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds; fresh; slightly disintegrated; moderately fractured (mechanical breaks).		
							110			108.5-111': Silty and Clayey SHALE; strong field strength; GLEY 1 4/N (Dark Gray) mottled whitish gray; fine-grained texture with chunky mottling/clay; massive structure with mottling; moderately to highly decomposed; moderately disintegrated; intensely fractured (mechanical breaks).		
							115			111-115.8': Fine Sandy SHALE; strong field strength; 10R 3/4 (Dusky Red) mottled GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds; fresh; slightly disintegrated; moderately fractured (mechanical breaks).		
13	RC	115.8	125.8		120	79	120			115.8-123.6': Fine Sandy SHALE; strong field strength; GLEY 1 4/N (Dark Gray) with 10R 3/4 (Dusky Red) mottling (30% in coarse fragments); very fine-grained texture; medium bedded with coarse fragments; fresh; slightly disintegrated; slightly fractured (mechanical breaks).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801B** DATE **1/11/19** SHEET **6** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	RC	115.8	125.8		120	79	125			123.6-125.8': Clayey and Silty SHALE; moderate field strength; 10R 3/2 (Dusky Red) with GLEY 1 4/N (Dark Gray) mottling (10% in coarse fragments; very fine-grained texture; medium bedded with coarse fragments; moderately decomposed; slightly disintegrated; moderately fractured (mechanical breaks).		
14	RC	125.8	135.8		120	71	130, 135			125.8-126.5': Silty and Sandy SHALE; moderate field strength; 10R 3/2 (Dusky Red) with GLEY 1 4/N (Dark Gray) mottling (10% in coarse fragments; fine-grained texture; medium bedded with coarse fragments; moderately decomposed; slightly disintegrated; moderately fractured (mechanical breaks). 126.5-135.8': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds; fresh; slightly disintegrated; slightly fractured (mechanical breaks).		
15	RC	135.8	145.8		120	75	140, 145			135.8-138.5': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; fresh; competent; slightly fractured (mechanical breaks). 138.5-141.2': Silty SHALE, with 0.2' to 0.8' thick weathered bands; moderate to weak field strength; 5Y 5/3 (Olive) with GLEY 1 5/N (Gray) and 5Y 5/3 (Olive) bands; fine-grained texture; medium bedded; moderately decomposed with highly decomposed bands; moderately disintegrated, HCl reactivity in a weathered band at 136.9' bgs; moderately fractured (mechanical breaks). 141.2-148': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; fresh; competent; slightly fractured (mechanical breaks).		
16	RC	145.8	155.8		120	67				148-150.4': Silty SHALE; moderate field strength; 10R 4/3 (Weak Red) with GLEY 1 5/N (Gray) mottling; fine-grained texture; massive structure with mottling (30% in coarse		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1801B DATE 1/11/19 SHEET 7 OF 9

BORING START 12/18/17 BORING FINISH 12/21/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	145.8	155.8		120	67	155			fragments); moderately decomposed; slightly disintegrated; moderately fractured (mechanical breaks). 150.4-152.8': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; fresh; competent; slightly fractured (mechanical breaks). 152.4-155.8': Silty SHALE; moderate to weak field strength; 10R 3/4 (Dusky Red); fine-grained texture; massive structure with thin bedding; moderately weathered, highly decomposed; moderately disintegrated; moderately to intensely fractured (mechanical breaks).		
17	RC	155.8	165.8		120	33	160 165			155.8-157.1': Silty SHALE; moderate field strength; 10R 4/3 (Weak Red); fine-grained texture; massive structure with trace thin beds; moderately to highly decomposed; moderately disintegrated; moderately to intensely fractured (mechanical breaks). 157.1-160.3': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; slightly decomposed; slightly disintegrated; slightly fractured (mechanical breaks). 160.3-165.8': Silty SHALE; moderate field strength; 10R 3/4 (Dusky Red); fine-grained texture; massive structure with trace beds; moderately decomposed; moderately disintegrated; moderately fractured (mechanical breaks).		
18	RC	165.8	175.8			86	170 175			165.8-168.8': Silty SHALE; moderate field strength; 10R 3/4 (Dusky Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured (mechanical breaks only). 168.8-175.8'; SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin bedding; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks only).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801B** DATE **1/11/19** SHEET **8** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	175.8	185.8		120	100	180 185			175.8-176.9': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured (mechanical breaks only). 176.9-180.9': Silty SHALE; moderate field strength; 10R 3/4 (Dusky Red); very fine-grained; massive structure; moderately to highly (180-180.9' bgs) decomposed; moderately disintegrated; unfractured (mechanical breaks only). 180.9-185.8': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure, no bedding visible; fresh; slightly disintegrated; unfractured (mechanical breaks only).		
20	RC	185.8	195.8		120	100	190 195			185.8-188.7': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only). 188.7-189.4': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); very fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only). 189.4-190.9': Sandy SHALE, gradually less sandy with depth; strong to very strong field strength; GLEY 1 4/N (Dark Gray); very fine-grained texture; thinly bedded; fresh; moderately disintegrated (iron bearing mineral layer); unfractured (mechanical breaks only). 190.9-195.8': SHALE; strong field strength; GLEY 1 2.5/N (Black); very fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only).		192.80-194': Secondary Sand Pack (Global #6) 194-225': Primary Sand Pack (Global #5)
21	RC	195.8	205.8		104	100	200			195.8-197': SHALE; strong to moderate field strength; 10R 3/4 (Dusky Red); very fine-grained texture; thinly bedded, 1 to 3 cm thick gravel beds, angular at 197.1' bgs; moderately to highly (at base) decomposed; slightly disintegrated; unfractured (mechanical breaks only). 197-205.3': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded with limestone at 197.3' bgs, fragments 1-8 cm (20%); slightly to moderately decomposed; slightly disintegrated; unfractured (mechanical breaks only).		198.40-223': Slotted PVC (20-slot) Screen

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801B** DATE **1/11/19** SHEET **9** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
21	RC	195.8	205.8		104	100	205			205.3-205.8': SHALE; weak field strength, crumbly; 10R 3/4 (Dusky Red) with mottled fragments; fine-grained texture; thinly bedded; highly decomposed, crumbly; moderately disintegrated; unfractured (mechanical breaks only).		
22	RC	205.8	215.8		78	100	210, 215			205.8-215.8': Clayey SHALE; weak to moderate field strength; 10R 3/4 (Dusky Red), mottled; fine-grained texture with coarse fragments of shale, 1-2 cm 10%; massive structure with mottling; moderately to highly decomposed; slightly disintegrated; unfractured (mechanical breaks only).		
23	RC	215.8	225.8		110	100	220, 225			215.8-216.4': Clayey SHALE; weak to moderate field strength; 10R 3/4 (Dusky Red), mottled gray/tan; fine-grained texture; massive structure with mottling; moderately to highly decomposed; moderately to intensely disintegrated; unfractured (mechanical breaks only). 216.4-223.3': Silty SHALE; moderate to strong field strength; 10R 3/4 (Dusky Red), mottled; fine-grained texture; massive structure with mottling; moderately decomposed; moderately disintegrated; unfractured (mechanical breaks only). 223.3-225': Sandy SHALE; strong field strength; 10R 3/4 (Dusky Red); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only).		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 531,413.0 E 1,726,329.1**

GROUND ELEVATION **900.4** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1801C** DATE **1/11/19** SHEET **1** OF **13**

BORING START **12/18/17** BORING FINISH **12/21/17**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.8** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **237** BOTTOM **262**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 155.5	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	2.8		0				CL ML	0-2.8': No recovery - Silty CLAY overburden.		0-237': Riser
1	RC	2.8	7.7		38	14	5			2.8-7.1': SANDSTONE; strong to very strong field strength; 5Y 4/3 (Olive) with 5YR 5/6 (Yellowish Red); fine-grained texture; massive structure; moderately decomposed; slightly disintegrated; intensely fractured (mechanical breaks).		
									ML	7.1-7.2': SANDSTONE; very strong field strength; 5YR 5/6 (Yellowish Red); fine grained texture; massive structure; moderately decomposed; slightly disintegrated; intensely fractured. 7.2-7.7': SILT, unconsolidated; weak field strength; 5Y 4/3 (Olive); fine grained texture; massive structure; highly decomposed.		
2	RC	7.7	15.8		57	30	10, 15			7.7-15.8': SILTSTONE to Silty SHALE; strong field strength; 5Y 4/3 (Olive) to 10R 3/2 (Dusky Red); fine-grained texture; massive structure; slightly to moderately decomposed; slightly disintegrated; intensely fractured (mechanical breaks).		
3	RC	15.8	25.8		120	64				15.8-16.2': Silty SHALE; strong field strength; 10R 3/2 (Dusky Red); fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; intensely fractured (mechanical breaks). 16.2-25.8'; Silty SHALE; very strong field strength; 5Y 4/3 (Olive); fine-grained texture; massive structure; slightly decomposed (moderately decomposed in intervals from		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801C** DATE **1/11/19** SHEET **2** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	15.8	25.8		120	64	25			20.8-21.6' bgs and 22.8-24.5' bgs); slightly disintegrated; intensely fractured (mechanical breaks).		
4	RC	25.8	35.8		120	29	30 35			25.8-35.8': Silty SHALE; strong to very strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure with thin shaley sandstone beds with trace mica; slightly decomposed; slightly disintegrated; bedding plane iron bearing minerals and calcite at 28.1' bgs fracture (HCl reactive).		Significant amount of lost water
5	RC	35.8	45.8		120	27	40 45			35.8-37.5': Silty SHALE; strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; moderately fractured (mechanical breaks). 37.5-40.8': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with laminations; slightly decomposed; slightly disintegrated; slightly fractured (mechanical breaks). 40.8-45.8': Silty SHALE; strong field strength; 5Y 2/3 (Brown); fine-grained texture; massive structure; slightly decomposed (4" of clay at 44.9' bgs); moderately to slightly disintegrated; intensely fractured (mechanical breaks).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1801C** DATE **1/11/19** SHEET **3** OF **13**

BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	45.8	55.8		120	100	50, 55			45.8-55.8': SHALE; strong to very strong field strength; 10R 3/2 (Dusky Red) to GLEY1 4/N (Dark Gray); fine-grained texture; massive structure with laminations; moderately to highly decomposed; gradationally with depth slightly to moderately disintegrated with interbedding; gradationally with depth highly to slightly fractured (mechanical breaks).		
7	RC	55.8	65.8		120	84	60, 65			55.8-61.7': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds of shale; fresh; competent with slight disintegration at 61.7' bgs; moderately fractured (mechanical breaks). 61.7-63': SANDSTONE; very strong field strength; 5Y 4/2 (Olive Gray); fine-grained texture; massive structure; fresh; competent with slight disintegration at 61.7' bgs; moderately fractured (mechanical breaks). 63-65.8': Shaley SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure; fresh; competent; moderately fractured (mechanical breaks).		
8	RC	65.8	75.8		120	81	70			65.8-69.2': Shaley SANDSTONE; strong field strength; GLEY 1 5/N (Gray); very fine-grained texture; massive structure; slightly to moderately decomposed with iron staining across beds; moderate disintegration; moderately fractured (mechanical breaks). 69.2-71': SANDSTONE; very strong field strength; 5Y 5/3 (Olive); fine-grained texture; massive structure; fresh; slight disintegration; unfractured. 71-75.8': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1801C | DATE 1/11/19 |

PROJECT Amos Fly Ash Pond | BORING START 12/18/17 | BORING FINISH 12/21/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	65.8	75.8		120	81	75			texture; massive structure; fresh; competent; unfractured.		
9	RC	75.8	85.8		120	98	80			75.8-83.7': Micaceous SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thinly bedded mica; fresh; competent; moderately fractured (mechanical breaks).		
							85			83.7-85.8': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray); very fine-grained texture; massive structure; fresh; competent; moderately fractured (mechanical breaks).		
10	RC	85.8	95.8		120	86	90 95			85.8-95.8': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thinly bedded intervals; fresh; competent; moderately fractured (mechanical breaks).		
11	RC	95.8	105.8		120	48				95.8-98.2': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure; fresh; slightly disintegrated; moderately fractured (mechanical breaks).		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1801C | DATE 1/11/19 | SHEET 5 OF 13

PROJECT Amos Fly Ash Pond | BORING START 12/18/17 | BORING FINISH 12/21/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	95.8	105.8		120	48	100			98.2-101.3': Clayey SHALE; strong field strength; 10R3/4 (Dusky Red); fine-grained texture; massive structure; fresh; moderately disintegrated; slightly fractured (mechanical breaks).		
							105			101.3-105.8': Silty SHALE; strong field strength; GLEY 1 4/N (Dark Gray) mottling; fine-grained texture; massive structure; fresh; moderately disintegrated; intensely fractured (mechanical breaks).		
12	RC	105.8	115.8		120	70				105.8-108.5': SHALE; strong field strength; 10R 3/4 (Dusky Red) mottled GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds; fresh; slightly disintegrated; moderately fractured (mechanical breaks).		
							110			108.5-111': Silty and Clayey SHALE; strong field strength; GLEY 1 4/N (Dark Gray) mottled whitish gray; fine-grained texture with chunky mottling/clay; massive structure with mottling; moderately to highly decomposed; moderately disintegrated; intensely fractured (mechanical breaks).		
							115			111-115.8': Fine Sandy SHALE; strong field strength; 10R 3/4 (Dusky Red) mottled GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds; fresh; slightly disintegrated; moderately fractured (mechanical breaks).		
13	RC	115.8	125.8		120	79	120			115.8-123.6': Fine Sandy SHALE; strong field strength; GLEY 1 4/N (Dark Gray) with 10R 3/4 (Dusky Red) mottling (30% in coarse fragments); very fine-grained texture; medium bedded with coarse fragments; fresh; slightly disintegrated; slightly fractured (mechanical breaks).		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801C** DATE **1/11/19** SHEET **6** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	RC	115.8	125.8		120	79	125			123.6-125.8': Clayey and Silty SHALE; moderate field strength; 10R 3/2 (Dusky Red) with GLEY 1 4/N (Dark Gray) mottling (10% in coarse fragments; very fine-grained texture; medium bedded with coarse fragments; moderately decomposed; slightly disintegrated; moderately fractured (mechanical breaks).		
14	RC	125.8	135.8		120	71	130, 135			125.8-126.5': Silty and Sandy SHALE; moderate field strength; 10R 3/2 (Dusky Red) with GLEY 1 4/N (Dark Gray) mottling (10% in coarse fragments; fine-grained texture; medium bedded with coarse fragments; moderately decomposed; slightly disintegrated; moderately fractured (mechanical breaks). 126.5-135.8': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with thin beds; fresh; slightly disintegrated; slightly fractured (mechanical breaks).		
15	RC	135.8	145.8		120	75	140, 145			135.8-138.5': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; fresh; competent; slightly fractured (mechanical breaks). 138.5-141.2': Silty SHALE, with 0.2' to 0.8' thick weathered bands; moderate to weak field strength; 5Y 5/3 (Olive) with GLEY 1 5/N (Gray) and 5Y 5/3 (Olive) bands; fine-grained texture; medium bedded; moderately decomposed with highly decomposed bands; moderately disintegrated, HCl reactivity in a weathered band at 136.9' bgs; moderately fractured (mechanical breaks). 141.2-148': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; fresh; competent; slightly fractured (mechanical breaks).		
16	RC	145.8	155.8		120	67				148-150.4': Silty SHALE; moderate field strength; 10R 4/3 (Weak Red) with GLEY 1 5/N (Gray) mottling; fine-grained texture; massive structure with mottling (30% in coarse		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801C** DATE **1/11/19** SHEET **7** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	145.8	155.8		120	67				fragments); moderately decomposed; slightly disintegrated; moderately fractured (mechanical breaks).		
										150.4-152.8': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; fresh; competent; slightly fractured (mechanical breaks).		
							155			152.4-155.8': Silty SHALE; moderate to weak field strength; 10R 3/4 (Dusky Red); fine-grained texture; massive structure with thin bedding; moderately weathered, highly decomposed; moderately disintegrated; moderately to intensely fractured (mechanical breaks).		
17	RC	155.8	165.8		120	33				155.8-157.1': Silty SHALE; moderate field strength; 10R 4/3 (Weak Red); fine-grained texture; massive structure with trace thin beds; moderately to highly decomposed; moderately disintegrated; moderately to intensely fractured (mechanical breaks).		
							160			157.1-160.3': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin beds; slightly decomposed; slightly disintegrated; slightly fractured (mechanical breaks).		
							165			160.3-165.8': Silty SHALE; moderate field strength; 10R 3/4 (Dusky Red); fine-grained texture; massive structure with trace beds; moderately decomposed; moderately disintegrated; moderately fractured (mechanical breaks).		
18	RC	165.8	175.8			86				165.8-168.8': Silty SHALE; moderate field strength; 10R 3/4 (Dusky Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured (mechanical breaks only).		
							170			168.8-175.8'; SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; massive structure with thin bedding; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks only).		
							175					

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801C** DATE **1/11/19** SHEET **8** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	175.8	185.8		120	100	180 185			175.8-176.9': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured (mechanical breaks only). 176.9-180.9': Silty SHALE; moderate field strength; 10R 3/4 (Dusky Red); very fine-grained; massive structure; moderately to highly (180-180.9' bgs) decomposed; moderately disintegrated; unfractured (mechanical breaks only). 180.9-185.8': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure, no bedding visible; fresh; slightly disintegrated; unfractured (mechanical breaks only).		
20	RC	185.8	195.8		120	100	190 195			185.8-188.7': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only). 188.7-189.4': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); very fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only). 189.4-190.9': Sandy SHALE, gradually less sandy with depth; strong to very strong field strength; GLEY 1 4/N (Dark Gray); very fine-grained texture; thinly bedded; fresh; moderately disintegrated (iron bearing mineral layer); unfractured (mechanical breaks only). 190.9-195.8': SHALE; strong field strength; GLEY 1 2.5/N (Black); very fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only).		194-233': Bentonite Seal
21	RC	195.8	205.8		104	100	200			195.8-197': SHALE; strong to moderate field strength; 10R 3/4 (Dusky Red); very fine-grained texture; thinly bedded, 1 to 3 cm thick gravel beds, angular at 197.1' bgs; moderately to highly (at base) decomposed; slightly disintegrated; unfractured (mechanical breaks only). 197-205.3': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded with limestone at 197.3' bgs, fragments 1-8 cm (20%); slightly to moderately decomposed; slightly disintegrated; unfractured (mechanical breaks only).		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1801C | DATE 1/11/19 | SHEET 9 OF 13

PROJECT Amos Fly Ash Pond | BORING START 12/18/17 | BORING FINISH 12/21/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
21	RC	195.8	205.8		104	100	205			205.3-205.8': SHALE; weak field strength, crumbly; 10R 3/4 (Dusky Red) with mottled fragments; fine-grained texture; thinly bedded; highly decomposed, crumbly; moderately disintegrated; unfractured (mechanical breaks only).		
22	RC	205.8	215.8		78	100	210, 215			205.8-215.8': Clayey SHALE; weak to moderate field strength; 10R 3/4 (Dusky Red), mottled; fine-grained texture with coarse fragments of shale, 1-2 cm 10%; massive structure with mottling; moderately to highly decomposed; slightly disintegrated; unfractured (mechanical breaks only).		
23	RC	215.8	225.8		110	100	220, 225			215.8-216.4': Clayey SHALE; weak to moderate field strength; 10R 3/4 (Dusky Red), mottled gray/tan; fine-grained texture; massive structure with mottling; moderately to highly decomposed; moderately to intensely disintegrated; unfractured (mechanical breaks only). 216.4-223.3': Silty SHALE; moderate to strong field strength; 10R 3/4 (Dusky Red), mottled; fine-grained texture; massive structure with mottling; moderately decomposed; moderately disintegrated; unfractured (mechanical breaks only). 223.3-225.8': Sandy SHALE; strong field strength; 10R 3/4 (Dusky Red); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only).		
24	RC	225.8	235.8		120	100				225.8-230.3': Silty SHALE; strong field strength; 10R 3/4 (Dusky Red); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured (mechanical breaks only).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1801C** DATE **1/11/19** SHEET **10** OF **13**

BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
24	RC	225.8	235.8		120	100	230			230.3-235.8'; Sandy SHALE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only).		233-234': Secondary Sand Pack (Global #6) 234-264': Primary Sand Pack (Global #5)
							235					
25	RC	235.8	245.8		120	100	240			235.8-236.4': SHALE; strong field strength; 10YR 3/4 (Dark Yellowish Brown); fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only). 236.4-245.8': SANDSTONE; very strong field strength; GLEY 1 5/10GY (Greenish Gray); medium-grained texture, micaceous; thinly bedded; fresh; moderately disintegrated, calcite mineralization (HCl reactive) in the lower 2.2' of the interval; unfractured (mechanical breaks only).		237-262': Slotted PVC (20-slot) Screen
							245					
26	RC	245.8	255.8		120	100	250			245.8-255.8': SANDSTONE; very strong field strength; GLEY 1 5/10GY (Greenish Gray); medium-grained sandy texture; thinly bedded; fresh; moderately disintegrated, calcite mineralization in light colored bedded intervals at 253.4-255.8' bgs; unfractured (mechanical breaks only).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801C** DATE **1/11/19** SHEET **11** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
26	RC	245.8	255.8		120	100	255					
27	RC	255.8	265.8		120	100	260, 265			255.8-256.4': CONGLOMERATE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture; conglomerate with angular fragments 1-8 cm 30-40%; moderately decomposed at upper contact; moderately to intensely disintegrated, calcite mineralization (effervescent to acid); unfractured (mechanical breaks only). 256.4-258.8': Sandy SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks only). 258.8-261.4': SANDSTONE; very strong field strength; GLEY 1 4/5G4 (Dark Greenish Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only). 261.4-265.8': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks only).		
28	RC	265.8	275.8		120	100	270, 275			265.8-271.7': Clayey SHALE; strong field strength; 10YR 4/3 (Brown); fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only). 271.7-273.1': SHALE; strong to moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks only). 273.1-275.8': Clayey SHALE; strong field strength; 10YR 4/3 (Brown); fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only).		
29	RC	275.8	285.8		120	100				275.8-276.8': Sandy SHALE; very strong field strength; GLEY 1 5/10GY (Greenish Gray); fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only). 276.8-285.8': Sandy SHALE; very strong field strength; GLEY 1 5/N (Gray); fine to medium-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1801C** DATE **1/11/19** SHEET **12** OF **13**

BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
29	RC	275.8	285.8		120	100	285			only).		
30	RC	285.8	295.8		120	100	290 295			285.8-295.8': Micaceous SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine grading to medium-grained (at 282.1' bgs) texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only).		
31	RC	295.8	305.8		120	100	300			295-303.7': Micaceous SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); medium to coarse-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only).		
							305			303.7-304.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks only).		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801C** DATE **1/11/19** SHEET **13** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/18/17** BORING FINISH **12/21/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										304.7-305.8': SHALE; moderate field strength; GLEY 1 5/10GY (Greenish Gray); very fine-grained texture; massive structure; fresh; competent; unfractured (mechanical breaks only).		
							310					
							315					
							320					
							325					
							330					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 533,246.5 E 1,724,120.0**

GROUND ELEVATION **887.8** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1802A** DATE **1/11/19** SHEET **1** OF **3**

BORING START **12/6/17** BORING FINISH **12/8/17**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.12** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **46.6** BOTTOM **66.6**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 61.4	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	5.7		0		5			NO RECOVERY.		0-201': Riser
1	RC	5.7	15.7		117	59	10			SHALE; strong field strength; 10R 3/2; fine-grained texture.		
										SANDSTONE; strong field strength; 10YR 3/2 (dusky red), 10Y5GY 3/2 (v. dark greyish olive), 5Y 4/1 (dark gray); micaceous; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured.		
										SHALE; strong field strength; 10R 3/2; fine-grained texture.		
										SANDSTONE; strong field strength; 10YR 3/2 (dusky red), 10Y5GY 3/2 (v. dark greyish olive), 5Y 4/1 (dark gray); micaceous; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured.		
							15			SANDSTONE; strong field strength; 5Y 3/2 (dark olive gray); fine-grained texture; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured. Note: Interbedded shale present.		
2	RC	15.7	25.7		117	41				SANDSTONE; strong field strength; 5Y 3/2 (dark olive gray); fine-grained texture; massive; micaceous; occasional thin to medium bedding; slightly decomposed; slightly		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **M. McCann**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1802A** DATE **1/11/19** SHEET **2** OF **3**

BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	15.7	25.7		117	41				disintegrated; moderately fractured. Note: Interbedded shaly siltstone present.		
										SHALE; strong field strength; 10R 3/2, 5Y 3/2; fine-grained texture.		
							25			SHALE; very weak to strong field strength; 10R 3/2, 5Y 3/2; micaceous; slightly decomposed; slightly desintegrated; moderately fratured. Note: Siltstone laminations. Blackmineralization from 21.4 - 21.7' bgs. Interbedded sandstone at 18.5 - 18. 7' bgs. Highly decomposed claystone/mudstone (silty clay, blocky) from 29-29.5 ft.		
3	RC	25.7	35.7		117	50				SILTSTONE; strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; massive.		
							30			SHALE; moderate field strength; 10R 3/2 (dusky red); massive; slightly decomposed; very intensely fractured. Note: Transition to siltstone at 31.6' bgs.		201-248': Bentonite Seal
										SILTSTONE; strong to very strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; fine to medium grained; laminated; slightly decomposed; slightly to moderately fractured along bedding plane.		
							35			SHALE; strong to very strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; massive; slightly decomposed; slightly to moderately fractured along bedding plane.		
4	RC	35.7	45.7		120	71	40			SANDSTONE; very strong field strength; GLEY1 3/N to GLEY1 6/N; fine to medium grained; massive with laminations; fresh decomposition; competent disintegration; slight to moderate fractures along bedding plane. Note: Shale laminations from 47.2 - 52.3'. Reacts to HCl 47.2 - 64.0'. Medium to coarse grained from 55.7 - 64.0'.		248-249': Secondary Sand Pack (Global #6) 249-274.5': Primary Sand Pack (Global #5)
							45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1802A** DATE **1/11/19** SHEET **3** OF **3**

BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	RC	45.7	55.7		120	78	50, 55					253-273': Slotted PVC (20-slot) Screen
6	RC	55.7	65.7		119.5	88	60, 65			SHALE; very strong field strength; GLEY1 3/N, GLEY 10R 3/2; fine to medium grained; massive; fresh to slightly decomposed; slightly disintegrated; very intensely fractured.		
							70					

AEP - AEP.GDT - 1/11/19 13:55 - C:\USERS\LWOODS\DESKTOP\FOR NICOLE BORING LOGS GINT FILES\AEP MOUNTAINEER.GPJ

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** | BORING NO. **MW-1802B** | DATE **1/11/19** | SHEET **1** OF **8**

PROJECT **Amos Fly Ash Pond** | BORING START **12/6/17** | BORING FINISH **12/8/17**

COORDINATES **N 533,242.0 E 1,724,120.0** | PIEZOMETER TYPE **NA** | WELL TYPE **OW**

GROUND ELEVATION **887.9** SYSTEM **NAD83/NAVD88** | HGT. RISER ABOVE GROUND **2.89** | DIA **2"**

DEPTH TO TOP OF WELL SCREEN **176** BOTTOM **196**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	196.6		
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	5.7		0					NO RECOVERY.		0-159.2': Riser
							5					
1	RC	5.7	15.7		117	59				SHALE; strong field strength; 10R 3/2; fine-grained texture.		
										SANDSTONE; strong field strength; 10YR 3/2 (dusky red), 10Y5GY 3/2 (v. dark greyish olive), 5Y 4/1 (dark gray); micaceous; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured.		
										SHALE; strong field strength; 10R 3/2; fine-grained texture.		
							10			SANDSTONE; strong field strength; 10YR 3/2 (dusky red), 10Y5GY 3/2 (v. dark greyish olive), 5Y 4/1 (dark gray); micaceous; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured.		
							15			SANDSTONE; strong field strength; 5Y 3/2 (dark olive gray); fine-grained texture; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured. Note: Interbedded shale present.		
2	RC	15.7	25.7		117	41				SANDSTONE; strong field strength; 5Y 3/2 (dark olive gray); fine-grained texture; massive; micaceous; occasional thin to medium bedding; slightly decomposed; slightly		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **M. McCann**

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1802B DATE 1/11/19

BORING START 12/6/17 BORING FINISH 12/8/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	15.7	25.7		117	41	25			disintegrated; moderately fractured. Note: Interbedded shaly siltstone present. SHALE; strong field strength; 10R 3/2, 5Y 3/2; fine-grained texture. SHALE; very weak to strong field strength; 10R 3/2, 5Y 3/2; micaceous; slightly decomposed; slightly desintegrated; moderately fratured. Note: Siltstone laminations. Blackmineralization from 21.4 - 21.7' bgs. Interbedded sandstone at 18.5 - 18. 7' bgs. Highly decomposed claystone/mudstone (silty clay, blocky) from 29-29.5 ft.		
3	RC	25.7	35.7		117	50	30			SILTSTONE; strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; massive. SHALE; moderate field strength; 10R 3/2 (dusky red); massive; slightly decomposed; very intensely fractured. Note: Transition to siltstone at 31.6' bgs. SILTSTONE; strong to very strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; fine to medium grained; laminated; slightly decomposed; slightly to moderately fractured along bedding plane. SHALE; strong to very strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; massive; slightly decomposed; slightly to moderately fractured along bedding plane.		
4	RC	35.7	45.7		120	71	35 40 45			SANDSTONE; very strong field strength; GLEY1 3/N to GLEY1 6/N; fine to medium grained; massive with laminations; fresh decomposition; competent disintegration; slight to moderate fractures along bedding plane. Note: Shale laminations from 47.2 - 52.3' bgs react with HCl. Medium to coarse grained from 55.7 - 64.0'.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802B** DATE **1/11/19** SHEET **3** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	RC	45.7	55.7		120	78	50					
							55					
6	RC	55.7	65.7		119.5	88	60					
							65			SHALE; very strong field strength; GLEY1 3/N, GLEY 10R 3/2; fine to medium grained; massive; fresh to slightly decomposed; slightly disintegrated; very intensely fractured.		
7	RC	65.7	75.7		117	55	70			SANDSTONE; very strong field strength; GLEY1 3/N, GLEY1 3/10GY, GLEY1 3/10Y; massive; fresh decomposition; slightly fractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802B** DATE **1/11/19** SHEET **4** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
7	RC	65.7	75.7		117	55	75			SHALE; weak to very strong field strength; GLEY 10R 3/2, massive; slight to moderate decomposition; competent to slightly disintegrated; slightly fractured at bed plane joints.		
8	RC	75.7	85.7		118	57	80			SANDSTONE; very strong field strength; GLEY3 10/Y; massive with laminations; fresh decomposition; slightly to moderate disintegration; slightly fractured. Note: Mechanical fractures and 80', possible natural fractures at 82.1', horizontal fracture at 85'. No mineralization at fractures, fractures are natural to smooth.		
9	RC	85.7	95.7		120	92	85 90			SANDSTONE; very strong field strength; GLEY1 3/N to GLEY1 5/N; fine to medium grained; massive with thin laminations; fresh to slight decomposition; moderate disintegration; slightly to moderately fractured. Note: Possible natural fractures (joints, horizontal) at 87.0', 88.7', 89.8', 90.2', 91.3', 92.7'. Very narrow to narrow other mechanical/bed plane no mineralization joints and possible natural fractures (joint) at 96.4' (10 degree, very narrow, smooth to rough), 97.5' (15 degree), 98.8' (horizontal joint), 99.5' (40 degree), 105' (25 degree, smooth to very narrow), 102.5' (horizontal joint), 103' (healed vertical joint/unconformity).		
10	RC	95.7	105.7		120	88	95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1802B** DATE **1/11/19** SHEET **5** OF **8**

BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
10	RC	95.7	105.7		120	88	100 105					
11	RC	105.7	115.7		120	85	110 115			SHALE; moderate to strong field strength; GLEY1 3N, GLEY1 10R 3/2, 5Y 2.5/1; massive; moderately to highly decomposed; slightly disintegrated (Fe staining); moderate to intensely mechanically fractured. SANDSTONE; very strong field strength; GLEY1 3/N; fine to medium grained; massive; fresh decomposition; competent disintegration; slightly fractured. Note: Slightly fractured at 114.1' (possible natural fracture, no mineralization due to core deterioration. SHALE; very strong field strength; GLEY1 3/N, GLEY1 4/5G1; fine grained; micaceous interbedded; fresh to highly decomposed; competent disintegration; slightly fractured.		
12	RC	115.7	125.7		118	92	120			Note: Moderate to strong field strength in shale beds from 116.2 - 116.4' bgs. Fe staining from 115.9 - 116.2' bgs. Possible natural fracture (joint, smooth, very narrow, Fe stained) at 8.3' bgs. SANDSTONE; very strong field strength; GLEY1 4/5G1, GLEY1 3/N, GLEY1 5/N; fine to medium grained; micaceous; massive with laminations; fresh decomposition; slightly to moderately disintegrated; slightly fractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802B** DATE **1/11/19** SHEET **6** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	RC	115.7	125.7		118	92	125					
13	RC	125.7	135.7		112.8	66				SANDSTONE; very strong field strength; GLEY1 5/N, fine to medium grained; massive with laminations; fresh decomposition; slightly disintegrated; unfractured.		
							130			SHALE; moderate to strong field strength; GLEY1 4/5G1, GLEY1 3/N, GLEY1 3/2; massive with thin laminations; slightly to moderately decomposed; slightly disintegrated; slightly fractured. Note: Transition to siltstone and clay with increasing depth. Intensely fractured at base of bed plane. HCl reaction at some fractures 29.3 to 131 .6' bgs (horizontal).		
							135			SANDSTONE; very strong field strength; GLEY1 3/N, fine grained; massive with laminations; fresh decomposition; competent disintegration. Note: Possible horizontal fracture (natural) at 132.2' (no mineralization), other mechanical breaks. Possible natural fracture at 135.8' bgs (horizontal).		
14	RC	135.7	145.7		120	78				SANDSTONE; very strong field strength; GLEY1 3/N; fine grained; massive; freshly decomposed; competent disintegration.		
							140			SHALE; very strong field strength; GLEY1 3/N; micaceous; massive with laminations; freshly decomposed; slightly disintegrated. Note: Possible natural horizontal fracture at 140.1', 140.7', and 141.5'. No mineralization, slightly to moderately fractured due to drilling/mechanics.		
							145			SHALE; strong to very strong field strength; 10R 3/2, GLEY1 5/N mottling; massive; slightly to moderately decomposed; slightly disintegrated. Note: 20 degree fracture at 142.8-145.2' (possible natural fracture).		
15	RC	145.7	155.7		120	84						

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802B** DATE **1/11/19** SHEET **7** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	RC	145.7	155.7		120	84				SANDSTONE; strong to very strong field strength; 10YR 3/2 to GLEY1 3/N; fine grained; micaceous; massive with laminations; slightly decomposed; slightly disintegrated.		
										Note: Horizontal fracture (clay/silt, bed plane joint, other mechanical breaks from drilling (slight to moderate)) from 151.8-151 .9' bgs.		
										SANDSTONE; GLEY1 3/N; fine to medium grained, micaceous; massive with laminations; fresh decomposition; competent disintegration.		
							155			SHALE; GLEY1 3/N; fine grained in laminated thin beds; miceceous; massive with laminations; fresh decomposition; slightly disintegrated.		
16	RC	155.7	165.7		112	58				SHALE; very strong field strength; GLEY1 3/10CY to 10R 3/2; massive with laminations; fresh to moderate decomposition; slightly to moderately disintegrated with depth.		159.2-170.9': Bentonite Seal
							160			Note: Pitted/lenses at 155.7-158.4' and 161.8-165.0' bgs. Bed plane joints/breaks due to mechanical/drilling.		
							165			SILSTONE; very strong field strength; GLEY1 3/N; massive with laminations; micaceous; freshly decomposed; competent disintegration.		
17	RC	165.7	175.7		120	24	170					170.9-172.1': Secondary Sand Pack (Global #6) 172.1-198': Primary Sand Pack (Global #5)
							175					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1802B** DATE **1/11/19** SHEET **8** OF **8**

BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
18	RC	175.7	185.7		119	19	180 185			SILTSTONE; very strong field strength; GLEY1 3/10GY; 10R 3/2; 10YR 4/6 (mottling with depth); massive with laminations; massive clay shale; freshly decomposed; highly decomposed in laminations; competent disintegration. Note: Possible transformation to limestone at 183.6-183.8' bgs. Intensely fractured due to drilling, difficult to determine presence of natural joints.		176-196': Slotted PVC (20-slot) Screen
19	RC	185.7	195.7		115	18	190 195 200			SHALE; very weak to moderate field strength; 10R 3/2; massive; moderately to highly decomposed; slightly to moderately disintegrated; intensely fractured. Note: Intensely fractured from 185.7-186.7. All breaks likely due to drilling/mechanism. 10YR 4/6 mottling to GLEY1 8/N mottling increasing with depth. Slightly decomposed; slightly disintegrated; partly healed joints from 195.7-198'. 40 degree joint at 196.3. Other mechanical breaks present.		

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 533,237.3 E 1,724,120.3**

GROUND ELEVATION **888.1** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1802C** DATE **1/11/19** SHEET **1** OF **13**

BORING START **12/6/17** BORING FINISH **12/8/17**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.81** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **253** BOTTOM **273**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 274.6	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	5.7		0		5			NO RECOVERY.		0-201': Riser
1	RC	5.7	15.7		117	59	10			SHALE; strong field strength; 10R 3/2; fine-grained texture. SANDSTONE; strong field strength; 10YR 3/2 (dusky red), 10Y5GY 3/2 (v. dark greyish olive), 5Y 4/1 (dark gray); micaceous; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured. SHALE; strong field strength; 10R 3/2; fine-grained texture. SANDSTONE; strong field strength; 10YR 3/2 (dusky red), 10Y5GY 3/2 (v. dark greyish olive), 5Y 4/1 (dark gray); micaceous; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured.		
2	RC	15.7	25.7		117	41	15			SANDSTONE; strong field strength; 5Y 3/2 (dark olive gray); fine-grained texture; massive; occasional thin to medium bedding; slightly decomposed; slightly disintegrated; moderately fractured. Note: Interbedded shale present. SANDSTONE; strong field strength; 5Y 3/2 (dark olive gray); fine-grained texture; massive; micaceous; occasional thin to medium bedding; slightly decomposed; slightly		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **M. McCann**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **2** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	15.7	25.7		117	41				disintegrated; moderately fractured. Note: Interbedded shaly siltstone present.		
										SHALE; strong field strength; 10R 3/2, 5Y 3/2; fine-grained texture.		
							25			SHALE; very weak to strong field strength; 10R 3/2, 5Y 3/2; micaceous; slightly decomposed; slightly desintegrated; moderately fratured. Note: Siltstone laminations. Black mineralization from 21.4 - 21.7' bgs. Interbedded sandstone at 18.5 - 18. 7' bgs. Highly decomposed claystone/mudstone (silty clay, blocky) from 29-29.5 ft.		
3	RC	25.7	35.7		117	50				SILTSTONE; strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; massive.		
							30			SHALE; moderate field strength; 10R 3/2 (dusky red); massive; slightly decomposed; very intensely fractured. Note: Transition to siltstone at 31.6' bgs.		
										SILTSTONE; strong to very strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; fine to medium grained; laminated; slightly decomposed; slightly to moderately fractured along bedding plane.		
							35			SHALE; strong to very strong field strength; 5YR 4/1 (dark gray), GLEY1 3/N, GLEY1 6/N, GLEY1 2.5/N; massive; slightly decomposed; slightly to moderately fractured along bedding plane.		
4	RC	35.7	45.7		120	71						
							40 45			SANDSTONE; very strong field strength; GLEY1 3/N to GLEY1 6/N; fine to medium grained; massive with laminations; fresh decomposition; competent disintegration; slight to moderate fractures along bedding plane. Note: Shale laminations from 47.2 - 52.3' bgs react with HCI. Medium to coarse grained from 55.7 - 64.0'.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **3** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	RC	45.7	55.7		120	78	50					
							55					
6	RC	55.7	65.7		119.5	88	60					
							65			SHALE; very strong field strength; GLEY1 3/N, GLEY 10R 3/2; fine to medium grained; massive; fresh to slightly decomposed; slightly disintegrated; very intensely fractured.		
7	RC	65.7	75.7		117	55	70			SANDSTONE; very strong field strength; GLEY1 3/N, GLEY1 3/10GY, GLEY1 3/10Y; massive; fresh decomposition; slightly fractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **4** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
7	RC	65.7	75.7		117	55	75			SHALE; weak to very strong field strength; GLEY 10R 3/2, massive; slight to moderate decomposition; competent to slightly disintegrated; slightly fractured at bed plane joints.		
8	RC	75.7	85.7		118	57	80, 85			SANDSTONE; very strong field strength; GLEY3 10/Y; massive with laminations; fresh decomposition; slightly to moderate disintegration; slightly fractured. Note: Mechanical fractures and 80', possible natural fractures at 82.1', horizontal fracture at 85'. No mineralization at fractures, fractures are natural to smooth.		
9	RC	85.7	95.7		120	92	90, 95			SANDSTONE; very strong field strength; GLEY1 3/N to GLEY1 5/N; fine to medium grained; massive with thin laminations; fresh to slight decomposition; moderate disintegration; slightly to moderately fractured. Note: Possible natural fractures (joints, horizontal) at 87.0', 88.7', 89.8', 90.2', 91.3', 92.7'. Very narrow to narrow other mechanical/bed plane no mineralization joints and possible natural fractures (joint) at 96.4' (10 degree, very narrow, smooth to rough), 97.5' (15 degree), 98.8' (horizontal joint), 99.5' (40 degree), 105' (25 degree, smooth to very narrow), 102.5' (horizontal joint), 103' (healed vertical joint/unconformity).		
10	RC	95.7	105.7		120	88						

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **5** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
10	RC	95.7	105.7		120	88	100					
							105					
11	RC	105.7	115.7		120	85				SHALE; moderate to strong field strength; GLEY1 3N, GLEY1 10R 3/2, 5Y 2.5/1; massive; moderately to highly decomposed; slightly disintegrated (Fe staining); moderate to intensely mechanically fractured.		
							110			SANDSTONE; very strong field strength; GLEY1 3/N; fine to medium grained; massive; fresh decomposition; competent disintegration; slightly fractured. Note: Slightly fractured at 114.1' (possible natural fracture, no mineralization due to core deterioration.		
							115			SHALE; very strong field strength; GLEY1 3/N, GLEY1 4/5G1; fine grained; micaceous interbedded; fresh to highly decomposed; competent disintegration; slightly fractured.		
12	RC	115.7	125.7		118	92				Note: Moderate to strong field strength in shale beds from 116.2 - 116.4' bgs. Fe staining from 115.9 - 116.2' bgs. Possible natural fracture (joint, smooth, very narrow, Fe stained) at 8.3' bgs.		
							120			SANDSTONE; very strong field strength; GLEY1 4/5G1, GLEY1 3/N, GLEY1 5/N; fine to medium grained; micaceous; massive with laminations; fresh decomposition; slightly to moderately disintegrated; slightly fractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **6** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	RC	115.7	125.7		118	92	125					
13	RC	125.7	135.7		112.8	66				SANDSTONE; very strong field strength; GLEY1 5/N, fine to medium grained; massive with laminations; fresh decomposition; slightly disintegrated; unfractured.		
							130			SHALE; moderate to strong field strength; GLEY1 4/5G1, GLEY1 3/N, GLEY1 3/2; massive with thin laminations; slightly to moderately decomposed; slightly disintegrated; slightly fractured. Note: Transition to siltstone and clay with increasing depth. Intensely fractured at base of bed plane. HCl reaction at some fractures 29.3 to 131 .6' bgs (horizontal).		
							135			SANDSTONE; very strong field strength; GLEY1 3/N, fine grained; massive with laminations; fresh decomposition; competent disintegration. Note: Possible horizontal fracture (natural) at 132.2' (no mineralization), other mechanical breaks. Possible natural fracture at 135.8' bgs (horizontal).		
14	RC	135.7	145.7		120	78				SANDSTONE; very strong field strength; GLEY1 3/N; fine grained; massive; freshly decomposed; competent disintegration.		
							140			SHALE; very strong field strength; GLEY1 3/N; micaceous; massive with laminations; freshly decomposed; slightly disintegrated. Note: Possible natural horizontal fracture at 140.1', 140.7', and 141.5'. No mineralization, slightly to moderately fractured due to drilling/mechanics.		
							145			SHALE; strong to very strong field strength; 10R 3/2, GLEY1 5/N mottling; massive; slightly to moderately decomposed; slightly disintegrated. Note: 20 degree fracture at 142.8-145.2' (possible natural fracture).		
15	RC	145.7	155.7		120	84						

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **7** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	RC	145.7	155.7		120	84				SANDSTONE; strong to very strong field strength; 10YR 3/2 to GLEY1 3/N; fine grained; micaceous; massive with laminations; slightly decomposed; slightly disintegrated.		
										Note: Horizontal fracture (clay/silt, bed plane joint, other mechanical breaks from drilling (slight to moderate)) from 151.8-151 .9' bgs.		
										SANDSTONE; GLEY1 3/N; fine to medium grained, micaceous; massive with laminations; fresh decomposition; competent disintegration.		
							155			SHALE; GLEY1 3/N; fine grained in laminated thin beds; miceceous; massive with laminations; fresh decomposition; slightly disintegrated.		
16	RC	155.7	165.7		112	58						
										SHALE; very strong field strength; GLEY1 3/10CY to 10R 3/2; massive with laminations; fresh to moderate decomposition; slightly to moderately disintegrated with depth.		
							160			Note: Pitted/lenses at 155.7-158.4' and 161.8-165.0' bgs. Bed plane joints/breaks due to mechanical/drilling.		
										SILSTONE; very strong field strength; GLEY1 3/N; massive with laminations; micaceous; freshly decomposed; competent disintegration.		
							165					
17	RC	165.7	175.7		120	24						
							170					
							175					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **8** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
18	RC	175.7	185.7		119	19	180 185			SILTSTONE; very strong field strength; GLEY1 3/10GY; 10R 3/2; 10YR 4/6 (mottling with depth}; massive with laminations; massive clay shale; freshly decomposed; highly decomposed in laminations; competent disintegration. Note: Possible transformation to limestone at 183.6-183.8' bgs. Intensely fractured due to drilling, difficult to determine presence of natural joints.		
19	RC	185.7	195.7		115	18	190 195			SHALE; very weak to moderate field strength; 10R 3/2; massive; moderately to highly decomposed; slightly to moderately disintegrated; intensely fractured. Note: Intensely fractured from 185.7-186.7. All breaks likely due to drilling/mechanism. 10YR 4/6 mottling to GLEY1 8/N mottling increasing with depth. Slightly decomposed; slightly disintegrated; partly healed joints from 195.7-205.7'. 40 degree joint at 196.3', vertical joint at 201-201.4', possible natural fractures (35-40 degrees) at 199.2, 200.4-201 .0' (extremely narrow). Other mechanical breaks present.		
20	RC	195.7	205.7		118.5	47	200					201-248': Bentonite Seal

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1802C DATE 1/11/19

BORING START 12/6/17 BORING FINISH 12/8/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
20	RC	195.7	205.7		118.5	47	205					
21	RC	205.7	215.7		120	91	210 215			SHALE; very strong field strength; GLEY1 4/N to GLEY1 3/5G1; massive with thin to medium bedded siltstone; fresh decomposition; competent to slight disintegration; mechanical fractures. Note: Very weak to moderate field strength at 216.2-216.5' bgs.		
22	RC	215.7	225.7		118.8	43	220 225			SHALE; strong to very strong; 10R 3/2; massive; slightly decomposed; slightly to moderately disintegrated; mechanical fractures.		
23	RC	225.7	235.7		120	82						

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1802C | DATE 1/11/19 | SHEET 10 OF 13

PROJECT Amos Fly Ash Pond | BORING START 12/6/17 | BORING FINISH 12/8/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
23	RC	225.7	235.7		120	82	230 235			SHALE; very strong field strength; GLEY1 3/5 G1, 10R 3/2, fine grained; massive with thin to medium beds of shaley sandstone to siltstone; freshly decomposed; slight disintegrated; mechanical fractures. Note: Interbedded with shale, micaceous sandstone, and siltstone. Mottling from 229.4-229.9' and 232.8-233.8' bgs. Horizontal fracture filled with soft clay at 233.4' bgs.		
24	RC	235.7	245.7		120	88	240 245			SANDSTONE; very strong field strength; GLEY1 5/N, 10R 3/2 (thin beds); very fine to fine grained shales; medium to coarse grained sandstone; micaceous; massive with laminations; freshly decomposed; competent to slightly disintegrated. Note: Primarily mechanical, possible horizontal smooth fracture at 235.9'. Transition to GLEY1 3/N to 5/N with mechanical breaks at 245.7 to 255.7' bgs.		
25	RC	245.7	255.7		120	100	250					248-249': Secondary Sand Pack (Global #6) 249-274.5': Primary Sand Pack (Global #5) 253-273': Slotted PVC (20-slot)

Continued Next Page

JOB NUMBER WV015976.0005
COMPANY American Electric Power
PROJECT Amos Fly Ash Pond

BORING NO. MW-1802C DATE 1/11/19 SHEET 11 OF 13
BORING START 12/6/17 BORING FINISH 12/8/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
25	RC	245.7	255.7		120	100	255					Screen
26	RC	255.7	265.7		120	87	260 265			SANDSTONE; very strong field strength; GLEY1 5/N; fine to medium grained; massive with laminations and thinly bedded/foliated/banded; freshly decomposed; slightly disintegrated; slightly fractured. Note: Mechanical bedding plane fractures. Healed unconformity (30 degree upper, 20 degree lower) at 257.7-258.5' bgs. GLEY1 3/N with 10R 3/2 mottling at 265.7-275.7. Highly decomposed at 270.0-270.3' bgs (clay with very fine sand). Very weak decomposition at 275.2' bgs. Slightly fractured at 265.7-275.7' bgs.		
27	RC	265.7	275.7		120	68	270 275					
28	RC	275.7	285.7		117.6	41				SHALE; strong to very strong field strength; GLEY1 3/N to 2.5/N; massive with laminations; moderately decomposed; slightly disintegrated; moderately fractured. Note: Coat at 279.8-280.8' bgs with pyrite lenses and laminations. Thin beds of highly decomposed shale to silty clay throughout to 279.8' bgs. Moderate to intensely fractured		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802C** DATE **1/11/19** SHEET **12** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
28	RC	275.7	285.7		117.6	41				(mechanical) with depth.		
										SANDSTONE; very strong field strength; GLEY1 3/N; massive with laminations to thin beds of very fine sand; freshly decomposed; slightly disintegrated; slightly fractured. Note: Micaceous trace pyrite lenses, fine grained.		
							285					
29	RC	285.7	295.7		120	83						
							290			SANDSTONE; fine to medium grained; micaceous; little pyrite lenses; very strong field strength; GLEY1 6/N; massive with laminations; freshly decomposed; competent disintegration; slightly fractured. Note: Transition to 5Y 2.5/1 at 293.4-293.5' bgs, transition to GLEY1 5/N at 293.5-295.7' bgs. Transition to slightly decomposed, slightly disintegrated; and slightly to moderately fractured with depth (mechanical).		
							295					
30	RC	295.7	305.7		115.2	62						
										SANDSTONE; fine grained; trace pyrite lenses (30 degree); strong to very strong field strength; GLEY2 4/586 to 10R 3/2 with depth; massive with laminations; moderately decomposed; moderately disintegrated.		
							300			SHALE; strong to very strong field strength; GLEY2 4/5B6 to 10R 3/2; massive with laminations; slightly to moderately decomposed; slightly disintegrated; slightly to moderately fractured. Note: HCI reactive lenses. Tight, 45 degree smooth fracture at 298.3' bgs. Slightly to moderately fractured joints at 311.7' bgs.		
							305					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1802C** DATE **1/11/19** SHEET **13** OF **13**

BORING START **12/6/17** BORING FINISH **12/8/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
31	RC	305.7	315.7		97.2	65	310					
							315					
							320					
							325					
							330					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 534,006.7 E 1,723,941.6**

GROUND ELEVATION **904.3** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1803B** DATE **1/11/19** SHEET **1** OF **8**

BORING START **12/12/17** BORING FINISH **12/15/17**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.81** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **171** BOTTOM **196**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 196.9	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	4.0		0				CL ML	0-4': No recovery - Silty CLAY overburden.		0-171': Riser
1	RC	4.0	9.5		25	NR	5			4-9.4': SILTSTONE; strong field strength; 5Y 4/3 (Olive) with 5YR 5/8 (Yellowish Red) mottling; massive structure; moderately decomposed; slightly disintegrated; intensely to moderately fractured (mechanical breaks).		
2	RC	9.5	14.5		58.5	28	10			9.4-9.5': Clayey SHALE; weak field strength; 10R 3/2 (Dusky Red); massive structure; highly decomposed; slightly disintegrated; intensely to moderately fractured (mechanical breaks). 9.5-13.6': Clayey SHALE; very weak to moderate field strength; 10R 3/2 (Dusky Red) to 5Y 4/3 (Olive) with 7.5 YR 5/8 (Strong Brown) mottling; massive structure; slightly decomposed with highly to moderately decomposed thin beds; slightly to moderately disintegrated; intensely to moderately fractured (mechanical breaks).		
3	RC	14.5	24.5		120	50	15			13.6-14.5': SILTSTONE; very strong field strength; 5Y 4/3 (Olive); massive structure; slightly decomposed; slightly disintegrated; intensely to moderately fractured (mechanical breaks). 14.5-19.5': SILTSTONE grading to Shaley Sandstone; very strong field strength; 10R 3/2 (Dusky Red) and 5Y 4/3 (Olive); fine-grained texture; massive structure; slightly decomposed; slightly to moderately disintegrated, reactive to HCl from 18.5-19.3'		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **M. McCann**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19** SHEET **2** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	14.5	24.5		120	50				bgs; moderately fractured, primarily due to mechanical breaks but very narrow horizontal fractures at 18.6', 19.2', and 19.4' bgs, with iron staining, smooth to rough.		Significant loss of water
										19.5-21.9': Clayey SHALE; very weak to moderate field strength; 10R 3/2 (Dusky Red) to 5Y 4/3 (Olive) with 7.5 YR 5/8 (Strong Brown) mottling; massive structure; moderately fractured (mechanical breaks).		
										21.9-23.6': SILTSTONE; strong field strength; 10R 3/2 (Dusky Red) to 5Y 4/3 (Olive) with 7.5 YR 5/8 (Strong Brown) mottling; massive structure; slightly decomposed; slightly disintegrated; moderately fractured, with a fracture zone from 22-22.3' bgs.		
4	RC	24.5	34.5		116	64	25			23.6-24.7': Clayey SHALE; moderate field strength; GLEY 1 4/N (Gray); massive structure; slightly decomposed; competent; moderately fractured (mechanical breaks).		
							30			24.7-38.6': Interbedded SHALE with Siltstone and Shaley Sandstone, micaceous at depth; very strong field strength with strong field strength in laminations; GLEY 1 5/N (Dark Gray) and 10R 3/2 (Dusky Red) to GLEY 2 3/5BG (Very Dark Greenish Gray); Sandstone has a fine-grained texture; massive structure with laminations; fresh with moderate decomposition in some bedded intervals; slight disintegration, reacts to HCl (lenses, pitted) from 29.4-35.2' bgs; moderately fractured (mechanical breaks), possible natural fracture at 25.2' bgs - iron stained, very narrow.		
5	RC	34.5	44.5		120	70	35					
							40			38.6-48.3': SHALE; strong to very strong field strength, with moderately strong thin beds; GLEY 1 5/N (Dark Gray) and 10R 3/2 (Dusky Red) to GLEY 2 3/5BG (Very Dark Greenish Gray); massive structure; fresh, slightly to highly decomposed thin beds; slightly to moderately decomposed; slightly to moderately fractured (mechanical breaks).		
6	RC	44.5	54.5		120	63	45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	44.5	54.5		120	63	50			48-3-54.5': Interbedded SHALE, Siltstone, and Shaley Sandstone; very strong field strength with weak to very weak field strength in laminations (52.4-52.5' bgs and 53.8-54.3' bgs); GLEY 1 5/N (Dark Gray) and 10R 3/2 (Dusky Red) to GLEY 2 3/5BG (Very Dark Greenish Gray); Sandstone has a fine-grained texture; massive structure with laminations and thin beds; fresh with moderate to high decomposition in medium bedded intervals; slight to moderate disintegration, (clay); moderately fractured (mechanical breaks).		
7	RC	54.5	64.5		118	87	55 60			54.5-55.5': Shaley SANDSTONE; very strong field strength; GLEY 1 5/N (Dark Gray); fine to medium-grained texture; massive structure with Shaley laminations, micaceous; fresh; competent; moderately fractured (mechanical breaks). 55.5-80': SANDSTONE; very strong field strength; GLEY 1 5/N (Dark Gray); fine/medium to medium/coarse-grained texture; massive structure with Shaley laminations, especially 75.5-75.7' and 79.6-80' bgs, micaceous; fresh; competent; moderately fractured (mechanical breaks), possible horizontal natural fracture at 58.6' bgs.		
8	RC	64.5	74.5		120	99	65 70					

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19** SHEET **4** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	64.5	74.5		120	99						
9	RC	74.5	84.5		107.5	87	75					
							80			80-84.5': SHALE; strong field strength, moderate field strength in thin beds; GLEY 1 3/N (Very Dark Gray); massive structure; fresh with moderately decomposed from 80.1-80.5' bgs; slightly disintegrated, pitted upper interval; moderately fractured, horizontal very narrow fracture at 80.1' bgs.		
10	RC	84.5	94.5		120	60	85 90			84.5-94.5': SHALE; strong to very strong field strength, soft Clay at 91.9' bgs, moderate field strength 94-94.5' bgs; GLEY 1 3/N (Very Dark Gray) with 10R 3/2 (Dusky Red) mottling at base; massive structure; fresh, moderately decomposed from 94-94.5' bgs; moderately disintegrated; moderately fractured (mechanical breaks), possible horizontal natural fracture at 91-94' bgs, very narrow, trace clay.		
11	RC	94.5	104.5		114	70	95			94.5-97.5': Shaley SANDSTONE; strong to moderate field strength, very weak at 96.8-96.9' bgs; 10R 3/2 (Dusky Red) with GLEY 1 3/N (Very Dark Gray); massive structure; moderately decomposed, highly from 96.8-96.9' bgs; slightly to moderately disintegrated,		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19** SHEET **5** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	94.5	104.5		114	70	100			97.5-123.4': Shaley SANDSTONE, micaceous; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray) with 10R3/2 (Dusky Red) mottling in upper 1.2'; fine to medium-grained texture; massive structure with Shaley laminations; slightly decomposed to fresh		
12	RC	104.5	114.5		120	98	105 110					
13	RC	114.5	124.5		119	98	115 120					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19** SHEET **6** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										123.4-124.5': SANDSTONE; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray); coarse-grained texture; massive structure; fresh; slightly disintegrated (cementations/grains are HCl reactive); moderately fractured (mechanical breaks), possible horizontal natural fracture at 123.9' bgs - clayey, infilled, rough.		
14	RC	124.5	134.5		117.5	63	125			124.5-127': SHALE; moderate to strong field strength; GLEY 1 3/N (Very Dark Gray) with 5Y 5/4 (Olive) and 10R 3/2 (Dusky Red); massive structure; slightly decomposed; competent; moderately to intensely fractured with depth (mechanical and horizontal breaks), very narrow 55 degree joint at 125.3' bgs.		
							130			127-135.5': Shaley SANDSTONE with laminated Shales and clayey Shales; very strong field strength, thin beds of very stiff clay, laminated shales have weak field strength at 128.8-128.9', 131.2-131.3', 131.8-132.6, 134.1', and 134.8-135.5' bgs; GLEY 2 3/10G (Very Dark Greenish Gray) with 10R 3/2 (Dusky Red) at top, 5Y 5/4 (Olive) and 10R 3/2 (Dusky Red) at 128.2-129.9' bgs; fine-grained texture; massive structure with laminated, thin bedding of shale and clayey shale; fresh to moderately decomposed; competent to moderately and intensely disintegrated in intervals noted in field strength; moderately to intensely fractured (mechanical breaks), possible horizontal natural fracture at 128.5' bgs, discolored.		
15	RC	134.5	144.5		120	90	135			135.5-145': Shaley SANDSTONE, micaceous; very strong field strength; GLEY 2 3/10G (Very Dark Greenish Gray) with GLEY 1 5/N (Gray) at 139.5' bgs; fine-grained to fine/medium-grained texture with depth; massive structure with shaley laminations; fresh; slightly disintegrated with HCl reactivity; moderately fractured (mechanical breaks).		
							140					
16	RC	144.5	154.5		112.5	65	145			145-147': SHALE grading to clayey Shale with depth; very strong field strength, thin beds of soft clay, weak shale; GLEY 1 4/N (Dark Gray) with 10R 3/2 (Dusky Red); massive structure; fresh, highly decomposed in thin beds; competent, moderately to intensely disintegrated in thin beds; moderately fractured (mechanical breaks).		
										147-154.5': Interbedded Shaley SANDSTONE and SHALE; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray) with 10R 3/2		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19** SHEET **7** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	144.5	154.5		112.5	65				(Dusky Red) mottling; fine-grained texture; massive structure; slightly decomposed; slightly disintegrated, lenses and grains in Sandstone reactive to HCl, little euhedral pyrite pitting; moderately fractured (mechanical breaks).		
17	RC	154.5	164.5		120	62	155			154.5-158.3': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained, micaceous texture; massive structure; fresh; competent, laminations slightly reactive to HCl; moderately fractured (mechanical breaks).		
										158.3-159': Shaley SANDSTONE; very strong field strength, with a very weak thin bed at 158.8' bgs; GLEY 2 4/10G (Dark Greenish Gray); fine-grained, micaceous texture; massive structure with Shale laminations; fresh to slightly decomposed; competent, laminations slightly reactive to HCl, moderately disintegrated at 158.3' bgs (clay); intensely fractured (mechanical breaks).		
							160			159-166': SHALE; very strong field strength with thin to medium beds of medium stiff clay to weak Shale; 10R 3/2 (Dusky Red); massive structure; fresh, with moderately to highly decomposed beds; competent, with moderately to intensely disintegrated in beds; intensely fractured (mechanical breaks).		164-167': Bentonite Seal
18	RC	164.5	174.5		120	88	165			166-169': Interbedded Shaley SANDSTONE, Clayey SHALE, and CLAYSTONE/MUDSTONE; very strong (Sandstone) to weak (Shale) field strength; GLEY 2 4/10G (Dark Greenish Gray) Sandstone and 10R 3/2 (Dusky Red) Shale; fine to medium grained texture (Sandstone); thin to medium bedded with massive structure; fresh Sandstone, with highly decomposed Shale; competent Sandstone, with moderately to intensely disintegrated Shale, HCl reactive laminations; slightly fractured (mechanical breaks).		167-168': Secondary Sand Pack (Global #6) 168-198': Primary Sand Pack (Global #5)
							170			169-172.2': SANDSTONE; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray); fine/medium-grained, micaceous texture; massive structure with micaceous laminations; fresh; slightly disintegrated, laminations slightly reactive to HCl; slightly fractured (mechanical breaks).		171-196': Slotted PVC (20-slot) Screen
19	RC	174.5	184.5		120	67	175			172.2-174.5': SHALE with highly weathered Claystone/Mudstone; very strong field strength		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803B** DATE **1/11/19** SHEET **8** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	174.5	184.5		120	67				with very weak beds; 10R 3/2 (Dusky Red); massive structure; fresh to highly decomposed in beds; slightly disintegrated, with moderately to intensely disintegrated beds; slightly fractured (mechanical breaks).		
							180			174.5-189.3': SHALE; very strong field strength with very weak to moderately strong beds at 179.8-183.3', 183.8-183.9', 184.1', 184.2-184.5', 184.8-184.9', 185-185.1', 186-186.2', 186.5-186.8', 187.2-187.5', and 188.6 bgs; 10R 3/2 (Dusky Red) with GLEY 2 4/10G (Dark Greenish Gray), GLEY 1 3/N (Very Dark Gray), and 5Y 4/2 (Olive Gray) mottling; massive structure; fresh, with moderately to highly decomposed beds in weak zones (above); competent, with slightly to intensely (clayey) disintegrated beds in very weak to moderate zones (above); intensely fractured (mechanical breaks), especially 176.9-179' bgs.		
20	RC	184.5	194.5		120	35	185					
							190			189.3-195.8': SHALE; very strong field strength with weak beds at 190-190.8', 192.6', 193', and 193.2' bgs; GLEY 1 4/N (Dark Gray) and GLEY 1 3/N (Very Dark Gray), with 10R 3/2 (Dusky Red) and GLEY 2 4/10G (Dark Greenish Gray); massive structure; fresh, with slightly to highly decomposed beds in weak zones (above); slightly disintegrated, HCl reactive in beds at 191.9-192' bgs, and moderately to intensely disintegrated in weak beds (above); mechanical breaks at bedding plane joints throughout.		
							195			195.8-197': Clayey SHALE to Claystone/Mudstone; moderate to strong field strength; GLEY 1 4/N (Dark Gray) and 5Y 4/4 (Olive), with 10R 3/2 (Dusky Red) laminations and mottling - reverses with depth; massive structure; moderately decomposed (medium to thin beds of very soft clay to weak to very weak Claystone/Mudstone); slightly disintegrated, HCl reactive in beds with depth; very intensely fractured (mechanical breaks), possible horizontal natural fracture at 196.5' bgs, fully healed.		
							200					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** — BORING NO. **MW-1803C** — DATE **1/11/19** — SHEET **1** OF **14**

PROJECT **Amos Fly Ash Pond** — BORING START **12/12/17** — BORING FINISH **12/15/17**

COORDINATES **N 534,010.6 E 1,723,944.6** — PIEZOMETER TYPE **NA** — WELL TYPE **OW**

GROUND ELEVATION **904.0** SYSTEM **NAD83/NAVD88** — HGT. RISER ABOVE GROUND **2.91** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **253** BOTTOM **273.4**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	273.7		
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	4.0		0				CL ML	0-4': No recovery - Silty CLAY overburden.		0-253': Riser
1	RC	4.0	9.5		25	NR	5			4-9.4': SILTSTONE; strong field strength; 5Y 4/3 (Olive) with 5YR 5/8 (Yellowish Red) mottling; massive structure; moderately decomposed; slightly disintegrated; intensely to moderately fractured (mechanical breaks).		
2	RC	9.5	14.5		58.5	28	10			9.4-9.5': Clayey SHALE; weak field strength; 10R 3/2 (Dusky Red); massive structure; highly decomposed; slightly disintegrated; intensely to moderately fractured (mechanical breaks). 9.5-13.6': Clayey SHALE; very weak to moderate field strength; 10R 3/2 (Dusky Red) to 5Y 4/3 (Olive) with 7.5 YR 5/8 (Strong Brown) mottling; massive structure; slightly decomposed with highly to moderately decomposed thin beds; slightly to moderately disintegrated; intensely to moderately fractured (mechanical breaks).		
3	RC	14.5	24.5		120	50	15			13.6-14.5': SILTSTONE; very strong field strength; 5Y 4/3 (Olive); massive structure; slightly decomposed; slightly disintegrated; intensely to moderately fractured (mechanical breaks). 14.5-19.5': SILTSTONE grading to Shaley Sandstone; very strong field strength; 10R 3/2 (Dusky Red) and 5Y 4/3 (Olive); fine-grained texture; massive structure; slightly decomposed; slightly to moderately disintegrated, reactive to HCl from 18.5-19.3'		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **M. McCann**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **2** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	14.5	24.5		120	50				bgs; moderately fractured, primarily due to mechanical breaks but very narrow horizontal fractures at 18.6', 19.2', and 19.4' bgs, with iron staining, smooth to rough.		Significant loss of water
										19.5-21.9': Clayey SHALE; very weak to moderate field strength; 10R 3/2 (Dusky Red) to 5Y 4/3 (Olive) with 7.5 YR 5/8 (Strong Brown) mottling; massive structure; moderately fractured (mechanical breaks).		
										21.9-23.6': SILTSTONE; strong field strength; 10R 3/2 (Dusky Red) to 5Y 4/3 (Olive) with 7.5 YR 5/8 (Strong Brown) mottling; massive structure; slightly decomposed; slightly disintegrated; moderately fractured, with a fracture zone from 22-22.3' bgs.		
4	RC	24.5	34.5		116	64	25			23.6-24.7': Clayey SHALE; moderate field strength; GLEY 1 4/N (Gray); massive structure; slightly decomposed; competent; moderately fractured (mechanical breaks).		
							30			24.7-38.6': Interbedded SHALE with Siltstone and Shaley Sandstone, micaceous at depth; very strong field strength with strong field strength in laminations; GLEY 1 5/N (Dark Gray) and 10R 3/2 (Dusky Red) to GLEY 2 3/5BG (Very Dark Greenish Gray); Sandstone has a fine-grained texture; massive structure with laminations; fresh with moderate decomposition in some bedded intervals; slight disintegration, reacts to HCl (lenses, pitted) from 29.4-35.2' bgs; moderately fractured (mechanical breaks), possible natural fracture at 25.2' bgs - iron stained, very narrow.		
5	RC	34.5	44.5		120	70	35					
							40			38.6-48.3': SHALE; strong to very strong field strength, with moderately strong thin beds; GLEY 1 5/N (Dark Gray) and 10R 3/2 (Dusky Red) to GLEY 2 3/5BG (Very Dark Greenish Gray); massive structure; fresh, slightly to highly decomposed thin beds; slightly to moderately decomposed; slightly to moderately fractured (mechanical breaks).		
6	RC	44.5	54.5		120	63	45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1803C** DATE **1/11/19** SHEET **3** OF **14**

BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	44.5	54.5		120	63	50			48-3-54.5': Interbedded SHALE, Siltstone, and Shaley Sandstone; very strong field strength with weak to very weak field strength in laminations (52.4-52.5' bgs and 53.8-54.3' bgs); GLEY 1 5/N (Dark Gray) and 10R 3/2 (Dusky Red) to GLEY 2 3/5BG (Very Dark Greenish Gray); Sandstone has a fine-grained texture; massive structure with laminations and thin beds; fresh with moderate to high decomposition in medium bedded intervals; slight to moderate disintegration, (clay); moderately fractured (mechanical breaks).		
7	RC	54.5	64.5		118	87	55 60			54.5-55.5': Shaley SANDSTONE; very strong field strength; GLEY 1 5/N (Dark Gray); fine to medium-grained texture; massive structure with Shaley laminations, micaceous; fresh; competent; moderately fractured (mechanical breaks). 55.5-80': SANDSTONE; very strong field strength; GLEY 1 5/N (Dark Gray); fine/medium to medium/coarse-grained texture; massive structure with Shaley laminations, especially 75.5-75.7' and 79.6-80' bgs, micaceous; fresh; competent; moderately fractured (mechanical breaks), possible horizontal natural fracture at 58.6' bgs.		
8	RC	64.5	74.5		120	99	65 70					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **4** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	64.5	74.5		120	99						
9	RC	74.5	84.5		107.5	87	75					
							80			80-84.5': SHALE; strong field strength, moderate field strength in thin beds; GLEY 1 3/N (Very Dark Gray); massive structure; fresh with moderately decomposed from 80.1-80.5' bgs; slightly disintegrated, pitted upper interval; moderately fractured, horizontal very narrow fracture at 80.1' bgs.		
10	RC	84.5	94.5		120	60	85 90			84.5-94.5': SHALE; strong to very strong field strength, soft Clay at 91.9' bgs, moderate field strength 94-94.5' bgs; GLEY 1 3/N (Very Dark Gray) with 10R 3/2 (Dusky Red) mottling at base; massive structure; fresh, moderately decomposed from 94-94.5' bgs; moderately disintegrated; moderately fractured (mechanical breaks), possible horizontal natural fracture at 91-94' bgs, very narrow, trace clay.		
11	RC	94.5	104.5		114	70	95			94.5-97.5': Shaley SANDSTONE; strong to moderate field strength, very weak at 96.8-96.9' bgs; 10R 3/2 (Dusky Red) with GLEY 1 3/N (Very Dark Gray); massive structure; moderately decomposed, highly from 96.8-96.9' bgs; slightly to moderately disintegrated, HCl reactive lenses; intensely fractured (mechanical and horizontal breaks),		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **5** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	94.5	104.5		114	70	100			very narrow to narrow with high decomposition and clay - possible mechanical exaggeration. 97.5-123.4': Shaley SANDSTONE, micaceous; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray) with 10R3/2 (Dusky Red) mottling in upper 1.2'; fine to medium-grained texture; massive structure with Shaley laminations; slightly decomposed to fresh at depth; slightly to moderately disintegrated (HCl reactive in lenses and laminations); moderately to slightly fractured (mechanical breaks), possible horizontal natural fracture at 98.8' bgs (very narrow, clayey) possible natural horizontal fracture at 114' bgs (very narrow, smooth, clayey).		
12	RC	104.5	114.5		120	98	105 110					
13	RC	114.5	124.5		119	98	115 120					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **6** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										123.4-124.5': SANDSTONE; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray); coarse-grained texture; massive structure; fresh; slightly disintegrated (cementations/grains are HCl reactive); moderately fractured (mechanical breaks), possible horizontal natural fracture at 123.9' bgs - clayey, infilled, rough.		
14	RC	124.5	134.5		117.5	63	125			124.5-127': SHALE; moderate to strong field strength; GLEY 1 3/N (Very Dark Gray) with 5Y 5/4 (Olive) and 10R 3/2 (Dusky Red); massive structure; slightly decomposed; competent; moderately to intensely fractured with depth (mechanical and horizontal breaks), very narrow 55 degree joint at 125.3' bgs.		
							130			127-135.5': Shaley SANDSTONE with laminated Shales and clayey Shales; very strong field strength, thin beds of very stiff clay, laminated shales have weak field strength at 128.8-128.9', 131.2-131.3', 131.8-132.6, 134.1', and 134.8-135.5' bgs; GLEY 2 3/10G (Very Dark Greenish Gray) with 10R 3/2 (Dusky Red) at top, 5Y 5/4 (Olive) and 10R 3/2 (Dusky Red) at 128.2-129.9' bgs; fine-grained texture; massive structure with laminated, thin bedding of shale and clayey shale; fresh to moderately decomposed; competent to moderately and intensely disintegrated in intervals noted in field strength; moderately to intensely fractured (mechanical breaks), possible horizontal natural fracture at 128.5' bgs, discolored.		
15	RC	134.5	144.5		120	90	135					
							140			135.5-145': Shaley SANDSTONE, micaceous; very strong field strength; GLEY 2 3/10G (Very Dark Greenish Gray) with GLEY 1 5/N (Gray) at 139.5' bgs; fine-grained to fine/medium-grained texture with depth; massive structure with shaley laminations; fresh; slightly disintegrated with HCl reactivity; moderately fractured (mechanical breaks).		
16	RC	144.5	154.5		112.5	65	145			145-147': SHALE grading to clayey Shale with depth; very strong field strength, thin beds of soft clay, weak shale; GLEY 1 4/N (Dark Gray) with 10R 3/2 (Dusky Red); massive structure; fresh, highly decomposed in thin beds; competent, moderately to intensely disintegrated in thin beds; moderately fractured (mechanical breaks).		
										147-154.5': Interbedded Shaley SANDSTONE and SHALE; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray) with 10R 3/2		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	144.5	154.5		112.5	65				(Dusky Red) mottling; fine-grained texture; massive structure; slightly decomposed; slightly disintegrated, lenses and grains in Sandstone reactive to HCl, little euhedral pyrite pitting; moderately fractured (mechanical breaks).		
17	RC	154.5	164.5		120	62	155			154.5-158.3': SANDSTONE; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained, micaceous texture; massive structure; fresh; competent, laminations slightly reactive to HCl; moderately fractured (mechanical breaks).		157-248.90': Bentonite Seal
							160			158.3-159': Shaley SANDSTONE; very strong field strength, with a very weak thin bed at 158.8' bgs; GLEY 2 4/10G (Dark Greenish Gray); fine-grained, micaceous texture; massive structure with Shale laminations; fresh to slightly decomposed; competent, laminations slightly reactive to HCl, moderately disintegrated at 158.3' bgs (clay); intensely fractured (mechanical breaks).		
										159-166': SHALE; very strong field strength with thin to medium beds of medium stiff clay to weak Shale; 10R 3/2 (Dusky Red); massive structure; fresh, with moderately to highly decomposed beds; competent, with moderately to intensely disintegrated in beds; intensely fractured (mechanical breaks).		
18	RC	164.5	174.5		120	88	165					
							170			166-169': Interbedded Shaley SANDSTONE, Clayey SHALE, and CLAYSTONE/MUDSTONE; very strong (Sandstone) to weak (Shale) field strength; GLEY 2 4/10G (Dark Greenish Gray) Sandstone and 10R 3/2 (Dusky Red) Shale; fine to medium grained texture (Sandstone); thin to medium bedded with massive structure; fresh Sandstone, with highly decomposed Shale; competent Sandstone, with moderately to intensely disintegrated Shale, HCl reactive laminations; slightly fractured (mechanical breaks).		
										169-172.2': SANDSTONE; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray); fine/medium-grained, micaceous texture; massive structure with micaceous laminations; fresh; slightly disintegrated, laminations slightly reactive to HCl; slightly fractured (mechanical breaks).		
19	RC	174.5	184.5		120	67	175			172.2-174.5': SHALE with highly weathered Claystone/Mudstone; very strong field strength		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	174.5	184.5		120	67				with very weak beds; 10R 3/2 (Dusky Red); massive structure; fresh to highly decomposed in beds; slightly disintegrated, with moderately to intensely disintegrated beds; slightly fractured (mechanical breaks).		
							180			174.5-189.3': SHALE; very strong field strength with very weak to moderately strong beds at 179.8-183.3', 183.8-183.9', 184.1', 184.2-184.5', 184.8-184.9', 185-185.1', 186-186.2', 186.5-186.8', 187.2-187.5', and 188.6 bgs; 10R 3/2 (Dusky Red) with GLEY 2 4/10G (Dark Greenish Gray), GLEY 1 3/N (Very Dark Gray), and 5Y 4/2 (Olive Gray) mottling; massive structure; fresh, with moderately to highly decomposed beds in weak zones (above); competent, with slightly to intensely (clayey) disintegrated beds in very weak to moderate zones (above); intensely fractured (mechanical breaks), especially 176.9-179' bgs.		
20	RC	184.5	194.5		120	35	185					
							190			189.3-195.8': SHALE; very strong field strength with weak beds at 190-190.8', 192.6', 193', and 193.2' bgs; GLEY 1 4/N (Dark Gray) and GLEY 1 3/N (Very Dark Gray), with 10R 3/2 (Dusky Red) and GLEY 2 4/10G (Dark Greenish Gray); massive structure; fresh, with slightly to highly decomposed beds in weak zones (above); slightly disintegrated, HCl reactive in beds at 191.9-192' bgs, and moderately to intensely disintegrated in weak beds (above); mechanical breaks at bedding plane joints throughout.		
21	RC	194.5	204.5		93.5	22	195					
							200			195.8-204.5': Clayey SHALE to Claystone/Mudstone; weak to moderate to strong field strength, weakest in beds at 199.6-204.5' bgs; GLEY 1 4/N (Dark Gray) and 5Y 4/4 (Olive), with 10R 3/2 (Dusky Red) laminations and mottling - reverses with depth; massive structure; moderately decomposed, and highly decomposed at 199.6-204.5' bgs (medium to thin beds of very soft clay to weak to very weak Claystone/Mudstone); slightly disintegrated, HCl reactive in beds with depth, and intensely disintegrated in weak beds (199.6-204.5' bgs); very intensely fractured (mechanical breaks), possible horizontal		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1803C** DATE **1/11/19** SHEET **9** OF **14**

BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
21	RC	194.5	204.5		93.5	22				natural fracture at 196.5' bgs, fully healed, tight fractures, 10-40 degrees at 197.7-199.1' bgs.		
22	RC	204.5	214.5		77.2	25	205 210			204.5-214.5': Clayey SHALE to Claystone/Mudstone; weak to moderate to strong field strength; 10R 3/2 (Dusky Red), with GLEY 1 4/N (Dark Gray), GLEY 1 7/N (Light Gray), and 5Y 4/4 (Olive) mottling; massive structure; moderately decomposed, and highly decomposed in weak beds throughout; moderately to slightly disintegrated; very intensely fractured (mechanical breaks), due to decomposition throughout.		
23	RC	214.5	224.5		114	47	215 220			214.5-221.6': SHALE; moderate to strong field strength; 10R 3/2 (Dusky Red), with GLEY 1 4/N (Dark Gray), GLEY 1 7/N (Light Gray), and 5Y 4/4 (Olive) mottling; massive structure; moderately decomposed, and highly decomposed in laminations and beds at 219-221.5' bgs; moderately disintegrated, and intensely disintegrated in at 219-221.5' bgs; very intensely to moderately fractured (mechanical breaks), fully healed, tight fractures, very narrow bedded intervals, 20-40 degrees at 214.5-219' and 220.4' bgs with clay and HCl reactive calcite infilling. 221.6-224.5': SILTSTONE to Sandstone; very strong field strength and very weak to weak beds at 222.3' bgs; GLEY 2 4/10G (Dark Greenish Gray) with 10R 3/2 (Dusky Red) mottling; fine-grained texture; massive structure; slightly decomposed, and moderately to highly decomposed in weak laminations and beds at 222.3' bgs; slightly disintegrated, Sandstone is HCl reactive, trace micaceousness; very intensely to moderately fractured, mechanical breaks at bedding plane joints of weaker material.		
24	RC	224.5	234.5		120	70	225			224.5-232': SILTSTONE to micaceous Sandstone; very strong field strength with weak		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **10** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
24	RC	224.5	234.5		120	70	230			bedding; GLEY 2 4/10G (Dark Greenish Gray) with 10R 3/2 (Dusky Red) mottling in bedding; fine-grained texture; massive structure with Shale laminations; slightly decomposed to fresh; slightly disintegrated, HCl reactive in Sandstone units, veining; slightly fractured (mechanical breaks). 232-234.5': SHALE to Clayey Shale; very strong field strength with weak Shale bedding; GLEY 2 4/10G (Dark Greenish Gray) and 10R 3/2 (Dusky Red); massive structure; fresh, with slightly decomposed weak shale bedding; slightly to moderately/intensely disintegrated, in thin bedding; moderately fractured (mechanical breaks).		
25	RC	234.5	244.5		119	49	235 240			234.5-244.5': SHALE to Clayey Shale; very strong field strength with very weak to weak clayey Shale bedding at 234.8-235', 235.4-235.5', 240.1-240.3', 242.2-242.4', and 243.8-243.9' bgs; 10R 3/2 (Dusky Red) with GLEY 2 4/10G (Dark Greenish Gray); massive structure; slightly decomposed with highly decomposed clayey Shale bedding (see above intervals); slightly disintegrated with moderately disintegrated and HCl reactive clayey Shale bedding (see above intervals); intensely to moderately fractured (mechanical breaks), fully healed tight to very narrow fractures at 237.2-237.4' bgs (0-40 degrees) and 241.1' bgs (20 degrees).		
26	RC	244.5	254.5		120	78	245 250			244.5-247.6': Clayey SHALE grading to SHALE with depth; very strong field strength with weak clayey bedding at 246-246.2' and 247.4' bgs; 10R 3/2 (Dusky Red) with GLEY 2 4/10G (Dark Greenish Gray) and 5Y 4/4 (Olive) mottling; massive structure; slightly decomposed with highly decomposed weak clayey bedding (see above intervals); slightly disintegrated with HCl reactive clayey veins, clasts at 244.5-245.2' bgs; moderately fractured (mechanical breaks), possible fully healed fracture at 246-246.2' bgs (20 degrees). 247.6-254.5': SANDSTONE and Shaley SANDSTONE with interbedded Shale; very strong field strength with medium stiff to stiff clay and weak Shale bedding at 247.6-247.9' and 250.3-250.7' bgs; GLEY 2 4/10G (Dark Greenish Gray) Sandstone and 10R 3/2 (Dusky Red) Shale; massive structure with Shaley Sandstone and Shale laminations and medium bedding; fresh with moderately to highly		248.90-250': Secondary Sand Pack (Global #6) 250-275': Primary Sand Pack (Global #5) 253-273.40': Slotted PVC (20-slot)

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **11** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										decomposed weak clayey bedding (see above intervals); competent with moderate to intensely disintegrated clayey bedding; slightly fractured (mechanical breaks).		Screen
27	RC	254.5	264.5		120	99	255			254.5-256.4': SHALE, some Sandstone lenses with depth; very strong field strength with very stiff clay and weak Shale bedding at 256-256.4' bgs; GLEY 2 4/10G (Dark Greenish Gray) with 10R 3/2 (Dusky Red) mottling at 254.5-255.3' bgs; massive structure with laminations; slightly decomposed with moderately to highly decomposed thin bedding at 256-256.4' bgs; competent with moderate to intensely disintegrated bedding at 256-256.4' bgs; slightly fractured (mechanical breaks at weakest rock interfaces).		
							260			256.4-270.2': SANDSTONE with Shaley Sandstone (256.4-257.5' bgs), micaceous; very strong field strength; GLEY 1 5/5G-1 (Greenish Gray); fine-grained (Shaley Sandstone) and medium to coarse-grained (Sandstone) texture; massive structure with laminations and trace thin to medium (0.2') bedding of fine-grained Sandstone; fresh; competent, HCl reactivity (cementation) with depth; slightly fractured (mechanical breaks at weakest rock interfaces), 1" void at 256.5' bgs - no mineralization, likely due to drilling.		
28	RC	264.5	274.5		119	92	265					
							270			270.2-272': SANDSTONE with lenses of Shale throughout; very strong field strength; GLEY 1 5/5G-1 (Greenish Gray) Sandstone, GLEY 2 4/10G (Dark Greenish Gray) Shale; medium to coarse-grained texture; massive structure with approximately 50% lenses; fresh; slightly disintegrated, HCl reactivity, cementation; slightly fractured (mechanical breaks at weakest rock intervals).		
29	RC	274.5	284.5		114	85	275			272-274.5': Interbedded SHALE, Shaley SANDSTONE, and SANDSTONE; very strong field strength with weak 0.5 cm laminations at 273.8' bgs; GLEY 1 3/N (Very Dark Gray) and GLEY 2 4/10G (Dark Greenish Gray); fine-grained to fine/medium-grained texture; massive structure with laminations, interbedded units vary from thin to medium bedding; fresh; slightly disintegrated; slightly fractured (mechanical breaks), possible natural horizontal fractures at 271.6', 271.7', 272', and 272.6', all smooth, very narrow, clayey - may be altered by drilling, breaks at bedding plane		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1803C** DATE **1/11/19** SHEET **12** OF **14**

PROJECT **Amos Fly Ash Pond** BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
29	RC	274.5	284.5		114	85				joints. 274.5-275.6': SANDSTONE, micaceous; very strong field strength; GLEY 2 4/10G (Dark Greenish Gray); medium-grained texture with fine-grained laminations; massive structure with laminations; fresh; slightly disintegrated, cementation reactive to HCl; slightly fractured (mechanical breaks). 275.6-284.5': SHALE; very strong field strength with weak clayey Shale bedding at 280.1' and 281.1' bgs; GLEY 2 3/10G (Very Dark Greenish Gray) with 10R 3/2 (Dusky Red) 0.4" bedding; fine-grained texture; massive structure with some thinly bedded Siltstone and Sandstone; fresh with moderate to highly decomposed thin clayey bedding (see weak intervals above); slightly disintegrated, with thin bedding and lenses of HCl reactive material, little laminations and lenses of pyrite at 280.6-284' bgs; moderately fractured (mechanical breaks at weaker bedding planes).		
30	RC	284.5	294.5		120	89	285 290			284.5-294.5': SHALE, little interbedded sandy Shale throughout with varying degrees of weathering; very strong field strength with weak to moderate strength clayey Shale bedding in highly weathered zones at 286.1-286.2', 286.25-286.3', 286.3-286.6', 286.9-287.6', 287.7-288', 288.2-291.9', 292.5-292.8', 293', 293.3-293.5', 293.6-293.7', and 293.9-294.5' bgs; GLEY 1 4/N (Dark Gray) with 10R 3/2 (Dusky Red) and 5Y 3/1 (Very Dark Gray) bedding; massive structure with laminations and thin bedding; slightly to highly decomposed; competent to moderately disintegrated; moderately fractured (mechanical breaks along bedding plane joints).		
31	RC	294.5	304.5		120	78	295 300			294.5-296.7': SHALE, clayey Shale; very strong field strength with weak clayey Shale bedding; GLEY 1 3/N (Very Dark Gray); massive structure; fresh with moderately decomposed bedding; competent with moderately disintegrated bedding; intensely to very intensely fractured (mechanical breaks). 296.7-297': COAL; strong field strength; GLEY 1 2.5/N (Black); massive structure; fresh; slightly disintegrated with lenses/laminations of HCl reactive material, possibly dissolution around framboidal pyrite - crystallization; mechanical breaks. 297-304.5': Interbedded SHALE and Shaley Sandstone; very strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; massive structure with laminated thin to medium bedded Sandstone; fresh; competent; mechanical breaks.		
32	RC	304.5	314.5		120	92	305					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1803C DATE 1/11/19 SHEET 13 OF 14

BORING START 12/12/17 BORING FINISH 12/15/17

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	RC	304.5	314.5		120	92				304.5-309.3': Shaley SANDSTONE with Sandstone bedding; very strong field strength; GLEY 1 4/N (Dark Gray) to GLEY 1 6/N (Gray); fine-grained texture with some medium grains, micaceous; massive structure with laminated to thin bedding; fresh; competent; mechanical breaks.		
							310			309.3-316.2': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); medium to coarse-grained texture with depth, some fine-grained laminations, trace Coal laminations, micaceous; massive structure with some Shale laminations; fresh; competent, coarse-grained Sandstone cementation and trace Coal lenses are reactive to HCl; mechanical breaks, possible natural fracture at 316.1' bgs (very narrow, rough to smooth).		
33	RC	314.5	324.5		120	88	315					
							320			316.2-324.5': SHALE some Shaley Sandstone bedding; very strong field strength; GLEY 1 4/N (Dark Gray); very fine to fine-grained texture; massive structure with Coal laminations and thin fine-grained Shaley Sandstone; fresh; little laminations of Coal with little to trace euhedral pyrite mineralization - trace pyrite lenses; mechanical breaks, possible natural fracture at 320' bgs (30 degrees, very narrow, trace clay), intensely fractured 317.3-317.8' bgs (smooth, clayey, very narrow).		
34	RC	324.5	334.5		22.8	14	325			324.5-334.5': Clayey and Sandy SHALE; very strong (sandy Shale), and moderate to strong (clay Shale) field strength; GLEY 1 4/N (Dark Gray) to GLEY 2 3/10G (Very Dark Greenish Gray) with 10R 3/2 (Dusky Red) and little 5Y 5/4 (Olive) mottling; very fine-grained (sandy Shale) texture; massive structure; fresh to slightly decomposed; slightly disintegrated, trace HCl reactive lenses; sandy Shale is unfractured, clayey Shale is intensely fractured (mechanical breaks).		
							330					324.5-334.5' bgs run drilled without NQ rod. Attempted to capture core in NQ rod during second

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1803C** DATE **1/11/19** SHEET **14** OF **14**

BORING START **12/12/17** BORING FINISH **12/15/17**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
34	RC	324.5	334.5		22.8	14						run, but only recovered 1.9 ft. Next run was overdrilled 5' to capture 329.5-334.5' bgs.
35	RC	334.5	339.5		59	47	335			334.5-338.5': Shaley SANDSTONE to Shale with depth; very strong to strong field strength; GLEY 2 4/10G (Dark Greenish Gray) to 10R 3/2 (Dusky Red); massive structure; fresh; competent to slightly disintegrated, trace HCl reactive lenses; intensely fractured (mechanical breaks - unable to determine if natural fractures are present).		
							340					
							345					
							350					
							355					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 533,349.8 E 1,725,662.5**

GROUND ELEVATION **858.5** SYSTEM **NAD83/NAVD88**

Water Level, ft	▽ 17.9	▼	▼
TIME			
DATE	7/18/2018		

BORING NO. **MW-1804A** DATE **1/11/19** SHEET **1** OF **3**

BORING START **5/21/18** BORING FINISH **5/23/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.32** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **27.5** BOTTOM **47.5**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	14.3		0				CL ML	0-14.3': No recovery - Silty CLAY overburden.		0-27.50': Riser
							5					
												7-18.90': Bentonite Seal
							10					
1	RC	14.3	24.3		120	14	15			14.3-17.1': SHALE; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated, mottling; intensely fractured.		
										17.1-19.2': SANDSTONE; moderate to strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly fractured.	▽	
										19.2-26.5': SHALE; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly		18.90-19.90': Secondary Sand

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1804A** DATE **1/11/19** SHEET **2** OF **3**

BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	RC	14.3	24.3		120	14				bedded; moderately decomposed; moderately disintegrated, iron staining in bedded intervals and vertical fractures; moderately fractured with iron-stained vertical fractures.		Pack (Global #6) 19.90-49': Primary Sand Pack (Global #5)
2	RC	24.3	34.3		120	7	25			26.5-29.7': Interbedded SHALE and SANDSTONE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed in some bedded intervals in the top 3' of the interval; slightly disintegrated; slightly to moderately fractured.		27.50-47.50': Slotted PVC (20-slot) Screen
							30			29.7-34.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
3	RC	34.3	44.3			NR	35 40			34.3-45.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
4	RC	44.4	54.4			NR	45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1804A DATE 1/11/19 SHEET 3 OF 3

BORING START 5/21/18 BORING FINISH 5/23/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	44.4	54.4			NR				45.3-49': SHALE; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated, calcite layer from 46.8-46.9' bgs; moderately fractured.		
							50					
							55					
							60					
							65					
							70					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 533,352.4 E 1,725,659.0**

GROUND ELEVATION **859.2** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1804B** DATE **1/11/19** SHEET **1** OF **8**

BORING START **5/21/18** BORING FINISH **5/23/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **1.72** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **152** BOTTOM **177**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	∇ 179.1	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	14.3		0		5 10		CL ML	0-14.3': No recovery - Silty CLAY overburden.		0-152': Riser
1	RC	14.3	24.3		120	14	15			14.3-17.1': SHALE; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated, mottling; intensely fractured.		
										17.1-19.2': SANDSTONE; moderate to strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly fractured.		
										19.2-26.5': SHALE; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1804B** DATE **1/11/19** SHEET **2** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	RC	14.3	24.3		120	14				bedded; moderately decomposed; moderately disintegrated, iron staining in bedded intervals and vertical fractures; moderately fractured with iron-stained vertical fractures.		
2	RC	24.3	34.3		120	7	25					
										26.5-29.7': Interbedded SHALE and SANDSTONE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed in some bedded intervals in the top 3' of the interval; slightly disintegrated; slightly to moderately fractured.		
							30			29.7-34.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
3	RC	34.3	44.3			NR	35			34.3-45.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							40					
4	RC	44.4	54.4			NR	45					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1804B** DATE **1/11/19** SHEET **3** OF **8**

BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	44.4	54.4			NR	50			45.3-55.2': SHALE; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated, calcite layer from 46.8-46.9' bgs; moderately fractured, and moderately to intensely fractured from 53.4-54.3' bgs.		
5	RC	54.3	64.3		63	23	55 60			55.2-64.3': SHALE, weathered; very weak field strength; 2.5YR 4/3 (Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated with mottling, intensely disintegrated in the top 2' of the interval with calcite nodules; moderately fractured.		
6	RC	64.3	74.3		90	25	65 70			64.3-74.6': SHALE, weathered; weak field strength; 2.5YR 4/3 (Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated; moderately fractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1804B** DATE **1/11/19** SHEET **4** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	64.3	74.3		90	25						
7	RC	74.3	84.3		106	29	75 80			74.6-75.5': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, calcite reactive to HCl; unfractured. 75.5-84.3': SHALE with Sandy Shale; weak to very weak field strength; GLEY 4/5GY (Dark Greenish Gray); fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated, clay-filled fractures and mottling; moderately to intensely fractured.		
8	RC	84.3	94.3			NR	85 90			84.3-86': SHALE; very weak field strength; GLEY 4/5GY (Dark Greenish Gray); fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated, clay-filled fractures and mottling; moderately to intensely fractured. 86-94.3': Interbedded Shale and Sandstone, grading to SANDSTONE with depth; very strong grading to strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed grading to fresh; slightly disintegrated, calcite deposits in Sandstone, iron staining where Interbedded Shale/Sandstone grades to Sandstone, top of Sandstone interval has large calcite deposits and veining; slightly fractured.		
9	RC	94.3	104.3		120	62	95			94.3-97.9': SANDSTONE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; slightly fractured.		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1804B | DATE 1/11/19 |

PROJECT Amos Fly Ash Pond | BORING START 5/21/18 | BORING FINISH 5/23/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
9	RC	94.3	104.3		120	62	100			97.9-107.4': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed in bedded intervals; slightly disintegrated, iron staining and calcite deposits at top and bottom of interval; slightly to moderately fractured.		
10	RC	104.3	114.3		109	12	105					
							110			107.4-110.7': SHALE; weak field strength; GLEY 5/N (Gray) and 2.5YR 4/3 (Reddish Brown) mottled; fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated with mottling; intensely fractured.		
										110.7-114.3': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; slightly fractured.		
11	RC	114.3	121.0		56.4	NR	115			114.3-119.2': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, thin calcite deposits in bedded intervals.		
										119.2-120': SHALE; weak field strength; 10R 3/2 (Dusky Red); fine-grained texture; massive structure; highly decomposed; moderately disintegrated with mottling; moderately fractured with slickenslides.		
12	RC	120.0	124.3			NR	120			120-124.3': SHALE; weak field strength; 10R 3/2 (Dusky Red); fine-grained texture; massive structure; highly decomposed; moderately disintegrated with mottling; intensely fractured with clay-filled slickenslides.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1804B** DATE **1/11/19** SHEET **6** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
13	RC	124.3	134.3		120	44	125	124.3-124.8': SHALE; weak field strength; 10R 3/2 (Dusky Red); fine-grained texture; massive structure; highly decomposed; slightly disintegrated; moderately to highly fractured.	
								124.8-127.6': Interbedded SHALE and SANDSTONE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed between bedded intervals; slightly disintegrated, thin, reactive calcite beds; moderately fractured.	
							130	127.6-129.7': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated, acid-reactive calcite deposits throughout interval; slightly fractured.	
								129.7-133.8': Interbedded SHALE and SANDSTONE; moderate to strong field strength; 10R 3/2 (Dusky Red) and GLEY 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed and moderately decomposed in some bedded intervals; slightly disintegrated; moderately fractured.	134-147.50': Bentonite Seal
14	RC	134.3	144.3		114	38	135	133.8-134.3': SHALE; moderate field strength; 10R 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated with mottling; moderately fractured.	
							140	134.3-140.9': SHALE; moderate field strength; 10R 3/2 (Dusky Red); fine-grained texture; thinly bedded, massive structure from 138.6-140.9' bgs; moderately decomposed in bedded intervals; moderately disintegrated with mottling, intense mottling from 138.6-140.9' bgs; moderately fractured.	
								140.9-143.2': SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.	
								143.2-144.8': SHALE; moderate field strength; 10R 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated with mottling; moderately fractured.	
15	RC	144.3	154.3		120	28	145	144.8-153.9': Interbedded SHALE and SANDSTONE; strong field strength, becomes moderate at 153.1' bgs; GLEY 5/N (Gray) with red Shale beds; fine-grained texture; thinly bedded; moderately decomposed, becomes highly decomposed at 153.1' bgs; slightly disintegrated, 0.1" calcite deposits at 150.3' and 153.1' bgs; slightly fractured, moderately fractured at the bottom of the interval.	147.50-148.70': Secondary Sand Pack (Global #6) 148.70-180.40': Primary Sand Pack

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1804B** DATE **1/11/19** SHEET **7** OF **8**

PROJECT **Amos Fly Ash Pond** BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	RC	144.3	154.3		120	28				153.9-154.3': SHALE; weak field strength; GLEY 7/N (Light Gray); fine-grained texture.		(Global #5) 152-177': Slotted PVC (20-slot) Screen
16	RC	154.3	164.3		116	41	155 160			154.3-164.3': SHALE, weathered; weak field strength; 10R 3/2 (Dusky Red) mottled with GLEY 4/N (Dark Gray); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated with mottling and 10% and 3-5 mm calcite nodules; moderately fractured with clay-filled fractures.		
17	RC	164.3	174.3		118	53	165 170			164.3-174.3': SHALE, weathered; weak field strength; 10R 3/2 (Dusky Red) mottled with GLEY 4/N (Dark Gray); fine-grained texture; massive structure; highly decomposed; slightly disintegrated with calcite deposits in vertical fractures; moderately fractured with vertical fractures.		
18	RC	174.3	184.3		120	53	175			174.3-179.2': SHALE, weathered; weak field strength; red; fine-grained texture; intensely disintegrated with mottling, clay-filled fractures, and calcite; moderately fractured with clay-filled		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1804B** DATE **1/11/19** SHEET **8** OF **8**

BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
18	RC	174.3	184.3		120	53				fractures.		
							180			179.2-180.2': Sandy SHALE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded.		
										180.2-184.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture, micaceous; thinly bedded; fresh; moderately disintegrated, caclite deposits throughout; slightly fractured, two fractures from 180.2-181.2' bgs.		
							185					
							190					
							195					
							200					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 533,272.3 E 1,727,730.1**

GROUND ELEVATION **883.3** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1805B** DATE **1/11/19** SHEET **1** OF **9**

BORING START **1/9/18** BORING FINISH **1/18/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.34** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **192** BOTTOM **212**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	211.8		
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	3.0		0				CL ML	0-3': No recovery - Silty CLAY overburden.		0-192': Riser
1	RC	3.0	9.3		75.5	100	5			3-6.9': SANDSTONE; very strong field strength; GLEY 1 4/5GY (Greenish Gray); very fine-grained texture; thinly bedded; moderately decomposed; competent; all mechanical breaks.		
										6.9-9,5': Sandy SHALE; moderate field strength; GLEY 1 4/5GY (Greenish Gray) with red mottling; very fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated; all mechanical breaks.		
2	RC	9.3	14.3		60	100	10			9.5-15.1': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); very fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
3	RC	14.3	24.3		120	100	15			15.1-32': SANDSTONE; strong field strength; 10 YR 5/2 (Grayish Brown); fine to medium-grained texture, grading; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillsepie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805B** DATE **1/11/19** SHEET **2** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	14.3	24.3		120	100						
4	RC	24.3	34.3		120	100	25					
							30			32-34.8': SHALE; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
5	RC	34.3	44.3		120	100	35			34.8-39.4': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
							40			39.4-44.3': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
6	RC	44.3	54.3			NR	45			44.3-62.1': Clayey SHALE; moderate to weak field strength; 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed, three 5 cm highly		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1805B** DATE **1/11/19** SHEET **3** OF **9**

BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	44.3	54.3			NR	50			decomposed layers at 55.3-55.5' bgs; slightly disintegrated; all mechanical breaks.		
7	RC	54.3	64.3		120	100	55, 60			62.1-64.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
8	RC	64.3	74.3		120	100	65, 70			64.3-80.8': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture grading to medium/fine-grained, with sandy Shale at 76.1-76.5' bgs; thinly bedded, micaceous; fresh; competent; all mechanical breaks.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805B** DATE **1/11/19** SHEET **4** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	64.3	74.3		120	100						
9	RC	74.3	84.3		120	100	75 80			80.8-90.3': SHALE; moderate field strength; GLEY 1 2.5/N (Black); fine-grained shaley texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
10	RC	84.3	94.3		120	100	85 90			90.3-93.3': Clayey SHALE; moderate to strong field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks. 93.3-95.1': SHALE; moderate field strength; GLEY 1 2.5/N (Black); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
11	RC	94.3	104.3		61	51	95			95.1-106.4': SHALE, highly weathered; weak field strength; 2.5YR 3/2 (Dusky Red) with 5-10 cm gray and gray-green fragments; fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated; all mechanical breaks; note that the 68" of		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1805B | DATE 1/11/19 | SHEET 5 OF 9

PROJECT Amos Fly Ash Pond | BORING START 1/9/18 | BORING FINISH 1/18/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	94.3	104.3		61	51	100			unrecovered material between sample runs 11 and 12 are assumed to be from 99.5-105.1' bgs in this interval.		
12	RC	104.3	114.3		110	92	105, 110			106.4-107.2': SANDSTONE; strong field strength; GLEY 1 2.5/N (Black); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks. 107.2-114.3': SHALE with high diameter fragments; moderate field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; all mechanical breaks.		
13	RC	114.3	124.3		100	83	115, 120			114.3-124.9': SHALE with large fragments; moderate field strength; 2.5YR 3/2 (Dusky Red) with GLEY 1 3/4 (Dark Reddish Brown) fragments; fine-grained texture; thinly bedded; moderately to highly decomposed; slightly disintegrated; all mechanical breaks.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805B** DATE **1/11/19** SHEET **6** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
14	RC	124.3	134.3		120	100	125			124.9-142.4': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							130					
15	RC	134.3	144.3		120	100	135					
							140			142.4-146.6': SHALE with 2-3 mm clay layers; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately decomposed with highly decomposed zone at 143.8-144' bgs; moderately disintegrated; unfractured.		
16	RC	144.3	154.3		120	100	145			146.6-156.9': Clayey SANDSTONE; moderate to strong field strength; GLEY 1 4/N (Dark Gray) to GLEY 1 3/N (Very Dark Gray); very fine-grained to fine-grained texture; thinly bedded; slightly to moderately decomposed, 3-5 mm 10% highly decomposed layers; moderately to slightly disintegrated;		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805B** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	144.3	154.3		120	100				unfractured.		
17	RC	154.3	164.3		120	100	155					
										156.9-160.7': Clayey SHALE; weak field strength; 2.5 YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately to highly decomposed; moderately disintegrated; unfractured.		
							160			160.7-164.3': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately to slightly decomposed; slightly disintegrated; unfractured.		
18	RC	164.3	174.3		120	100	165			164.3-165.8': Clayey SHALE; moderate to weak field strength; 2.5 YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated; unfractured.		
										165.8-172.3': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
							170					
										172.3-177.9': Clayey SHALE; moderate field strength; 2.5 YR 3/2 (Dusky Red) with gray and tan mottling at depth; fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated; unfractured.		174-188': Bentonite Seal
19	RC	174.3	184.3		120	100	175					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1805B** DATE **1/11/19** SHEET **8** OF **9**

BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	174.3	184.3		120	100						
							180			177.9-193.4': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; fresh, highly decomposed clayey Shale bedding at 180.9-181.4' bgs; competent; unfractured.		
20	RC	184.3	194.3		120	100	185					
							190					188-189': Secondary Sand Pack (Global #6) 189-214': Primary Sand Pack (Global #5)
												192-212': Slotted PVC (20-slot) Screen
										193.4-194.3': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately to slightly decomposed; slightly disintegrated; unfractured.		
21	RC	194.3	204.3		114	95	195			194.3-199.9': SHALE; moderate to strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture with 3-5 mm angular 10% limestone fragments at 196.5-199.9; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
							200			199.9-204.3': SHALE, highly weathered; weak field strength; 10R 4/3 (Weak Red) with gray mottling; fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805B** DATE **1/11/19** SHEET **9** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
21	RC	194.3	204.3		114	95				unfractured.		
22	RC	204.3	214.3		106.8	89	205 210			204.3-214': Clayey SHALE; moderate field strength; 10R 4/3 (Weak Red) with larger gray mottling; fine-grained texture; massive structure with 5-10 mm fragments; moderately decomposed; moderately disintegrated; unfractured.		
							215 220 225					

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** | BORING NO. **MW-1805C** | DATE **1/11/19** | SHEET **1** OF **13**

PROJECT **Amos Fly Ash Pond** | BORING START **1/9/18** | BORING FINISH **1/18/18**

COORDINATES **N 533,273.9 E 1,727,725.7** | PIEZOMETER TYPE **NA** | WELL TYPE **OW**

GROUND ELEVATION **882.3** SYSTEM **NAD83/NAVD88** | HGT. RISER ABOVE GROUND **3.59** | DIA **2"**

DEPTH TO TOP OF WELL SCREEN **232** BOTTOM **262**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 262.5	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	3.0		0				CL ML	0-3': No recovery - Silty CLAY overburden.		0-232': Riser
1	RC	3.0	9.3		75.5	100	5			3-6.9': SANDSTONE; very strong field strength; GLEY 1 4/5GY (Greenish Gray); very fine-grained texture; thinly bedded; moderately decomposed; competent; all mechanical breaks.		
										6.9-9,5': Sandy SHALE; moderate field strength; GLEY 1 4/5GY (Greenish Gray) with red mottling; very fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated; all mechanical breaks.		
2	RC	9.3	14.3		60	100	10			9.5-15.1': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); very fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
3	RC	14.3	24.3		120	100	15			15.1-32': SANDSTONE; strong field strength; 10 YR 5/2 (Grayish Brown); fine to medium-grained texture, grading; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillsepie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1805C** DATE **1/11/19**

BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	14.3	24.3		120	100						
4	RC	24.3	34.3		120	100	25					
							30			32-34.8': SHALE; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
5	RC	34.3	44.3		120	100	35			34.8-39.4': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
							40			39.4-44.3': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
6	RC	44.3	54.3			NR	45			44.3-62.1': Clayey SHALE; moderate to weak field strength; 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed, three 5 cm highly		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **3** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	44.3	54.3			NR	50			decomposed layers at 55.3-55.5' bgs; slightly disintegrated; all mechanical breaks.		
7	RC	54.3	64.3		120	100	55, 60			62.1-64.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
8	RC	64.3	74.3		120	100	65, 70			64.3-80.8': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture grading to medium/fine-grained, with sandy Shale at 76.1-76.5' bgs; thinly bedded, micaceous; fresh; competent; all mechanical breaks.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **4** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	64.3	74.3		120	100						
9	RC	74.3	84.3		120	100	75					
							80			80.8-90.3': SHALE; moderate field strength; GLEY 1 2.5/N (Black); fine-grained shaley texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
10	RC	84.3	94.3		120	100	85					
							90			90.3-93.3': Clayey SHALE; moderate to strong field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
										93.3-95.1': SHALE; moderate field strength; GLEY 1 2.5/N (Black); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; all mechanical breaks.		
11	RC	94.3	104.3		61	51	95			95.1-106.4': SHALE, highly weathered; weak field strength; 2.5YR 3/2 (Dusky Red) with 5-10 cm gray and gray-green fragments; fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated; all mechanical breaks; note that the 68" of		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	94.3	104.3		61	51	100			unrecovered material between sample runs 11 and 12 are assumed to be from 99.5-105.1' bgs in this interval.		
12	RC	104.3	114.3		110	92	105			106.4-107.2': SANDSTONE; strong field strength; GLEY 1 2.5/N (Black); fine-grained texture; thinly bedded; fresh; competent; all mechanical breaks.		
							110			107.2-114.3': SHALE with high diameter fragments; moderate field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; all mechanical breaks.		
13	RC	114.3	124.3		100	83	115			114.3-124.9': SHALE with large fragments; moderate field strength; 2.5YR 3/2 (Dusky Red) with GLEY 1 3/4 (Dark Reddish Brown) fragments; fine-grained texture; thinly bedded; moderately to highly decomposed; slightly disintegrated; all mechanical breaks.		
							120					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **6** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
14	RC	124.3	134.3		120	100	125			124.9-142.4': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							130					
15	RC	134.3	144.3		120	100	135					
							140					
										142.4-146.6': SHALE with 2-3 mm clay layers; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately decomposed with highly decomposed zone at 143.8-144' bgs; moderately disintegrated; unfractured.		
16	RC	144.3	154.3		120	100	145					
										146.6-156.9': Clayey SANDSTONE; moderate to strong field strength; GLEY 1 4/N (Dark Gray) to GLEY 1 3/N (Very Dark Gray); very fine-grained to fine-grained texture; thinly bedded; slightly to moderately decomposed, 3-5 mm 10% highly decomposed layers; moderately to slightly disintegrated;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1805C** DATE **1/11/19**

BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	144.3	154.3		120	100				unfractured.		
17	RC	154.3	164.3		120	100	155					
										156.9-160.7': Clayey SHALE; weak field strength; 2.5 YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately to highly decomposed; moderately disintegrated; unfractured.		
							160					
										160.7-164.3': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately to slightly decomposed; slightly disintegrated; unfractured.		
18	RC	164.3	174.3		120	100	165			164.3-165.8': Clayey SHALE; moderate to weak field strength; 2.5 YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated; unfractured.		
										165.8-172.3': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
							170					
										172.3-177.9': Clayey SHALE; moderate field strength; 2.5 YR 3/2 (Dusky Red) with gray and tan mottling at depth; fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated; unfractured.		
19	RC	174.3	184.3		120	100	175					

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **8** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	174.3	184.3		120	100						
							180			177.9-193.4': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; fresh, highly decomposed clayey Shale bedding at 180.9-181.4' bgs; competent; unfractured.		
20	RC	184.3	194.3		120	100	185					
							190					
										193.4-194.3': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately to slightly decomposed; slightly disintegrated; unfractured.		
21	RC	194.3	204.3		114	95	195			194.3-199.9': SHALE; moderate to strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture with 3-5 mm angular 10% limestone fragments at 196.5-199.9; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
							200			199.9-204.3': SHALE, highly weathered; weak field strength; 10R 4/3 (Weak Red) with gray mottling; fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **9** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
21	RC	194.3	204.3		114	95				unfractured.		
22	RC	204.3	214.3		106.8	89	205			204.3-221.3': Clayey SHALE; moderate field strength; 10R 4/3 (Weak Red) with larger gray mottling; fine-grained texture; massive structure with 5-10 mm fragments; moderately decomposed; moderately disintegrated; unfractured.		
							210					
23	RC	214.2	224.2		120	100	215					
							220			221.3-232.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
24	RC	224.3	234.3		120	100	225					225-228': Bentonite Seal

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **10** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
24	RC	224.3	234.3		120	100	230					228-229': Secondary Sand Pack (Global #6) 229-264': Primary Sand Pack (Global #5)
										232.3-247.1': SHALE; moderate field strength; 2.5 YR 3/2 (Dusky Red) with gray mottling with depth; fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured.		232-262': Slotted PVC (20-slot) Screen
25	RC	234.3	244.3		120	100	235 240					
26	RC	244.3	254.3		120	100	245					
							250			247.1-264.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured - all mechanical breaks.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1805C** DATE **1/11/19** SHEET **11** OF **13**

BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
27	RC	254.3	264.3		120	100	255					
							260					
28	RC	264.3	274.3		120	100	265			264.3-268': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained grading to medium-grained texture with depth; thinly bedded; fresh; competent; unfractured.		
							270			268-273.7': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); medium-grained texture; thinly bedded; fresh; competent; unfractured.		
										273.7-274.6': SHALE; strong field strength; GLEY 1 4/N (Dark Gray) grading to GLEY 1 5/N (Gray) with depth; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
29	RC	274.3	284.3		120	100	275			274.6-276.4': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
										276.4-277.4': SHALE; strong to moderate field strength; GLEY 1 3/N (Very Dark Gray); very fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1805C** DATE **1/11/19** SHEET **12** OF **13**

PROJECT **Amos Fly Ash Pond** BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
29	RC	274.3	284.3		120	100				unfractured. 277.4-285': SANDSTONE; strong field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
30	RC	284.3	294.3		120	100	285			285-290.4': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
							290			290.4-294.3': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture, micaceous; thinly bedded; fresh; competent; unfractured.		
31	RC	294.3	304.3		120	100	295			294.3-297': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
										297-299.6': COAL with Shale; weak field strength; GLEY 2 3/5 (Very Dark Bluish Gray); fine-grained texture; medium bedded; slightly decomposed; slightly disintegrated; unfractured.		
							300			299.6-306.1': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
32	RC	304.3	314.3			NR	305					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1805C** DATE **1/11/19** SHEET **13** OF **13**

BORING START **1/9/18** BORING FINISH **1/18/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
32	RC	304.3	314.3			NR				306.1-313.1': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine to medium-grained texture with 5-10 mm framboidal pyrite nodule layers; thinly bedded; fresh; slightly disintegrated; unfractured.		
							310					
										313.1-314.3': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
33	RC	314.3	324.3			NR	315			314.3-322.7': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded with 2-5 cm angular Limestone fragments at base/contact; fresh; competent; unfractured.		
							320					
										322.7-324.3': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly to moderately decomposed; slightly disintegrated; unfractured.		
							325					
							330					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806A** DATE **1/11/19** SHEET **1** OF **4**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

COORDINATES **N 532,750.9 E 1,728,577.2** PIEZOMETER TYPE **NA** WELL TYPE **OW**

GROUND ELEVATION **889.6** SYSTEM **NAD83/NAVD88** HGT. RISER ABOVE GROUND **3.5** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **60.4** BOTTOM **80.4**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	∇ 25.6	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	24.0		0		5 10 15		CL ML	0-24': No recovery - Silty CLAY overburden.		0-60.40': Riser

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806A** DATE **1/11/19** SHEET **2** OF **4**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	24.0		0							
1	RC	24.0	30.7		72	90	25			24-30.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded with unconformities from 25.7-26.2' bgs, cross-bedding; fresh; competent; unfractured (mechanical breaks).		
							30					
2	RC	30.7	40.7		120	NR				30.7-33.2': SHALE; moderate to weak field strength; 10R 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured (mechanical breaks).		
										33.2-34.7': SHALE with sand; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks).		
							35			34.7-35.2': SHALE, weathered; weak field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated; unfractured (mechanical breaks).		
										35.2-40.7': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture with medium-grained texture from 36.7-37' bgs; thinly bedded; fresh; competent to slightly disintegrated; slightly fractured, vertical fracture at 40.1' bgs with iron staining.		
							40					
3	RC	40.7	50.7		120	100				40.7-44.2': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							45			44.2-45.1': SHALE, weathered; weak field strength; GLEY 1 7/N (Light Gray) with 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; highly decomposed; moderately		45-56': Bentonite Seal

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1806A DATE 1/11/19 SHEET 3 OF 4

BORING START 3/28/18 BORING FINISH 4/3/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	40.7	50.7		120	100				disintegrated; unfractured (mechanical breaks).		
										45.1-48.4': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							50			48.4-50.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks).		
4	RC	50.7	60.7		120	100				50.3-50.7': SHALE; weak field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately to highly decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							55			50.7-55.9': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks).		
							60			55.9-61': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks).		56-57': Secondary Sand Pack (Global #6) 57-81': Primary Sand Pack (Global #5)
5	RC	60.7	70.7			NR	65 70			61-70.7': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture with fine-grained texture from 62.6-63.2' bgs and 66-66.3' bgs; thinly bedded; fresh; competent; unfractured (mechanical breaks).		60.40-80.40': Slotted PVC (20-slot) Screen
6	RC	70.7	80.7		120	100				70.7-74.6': SANDSTONE; strong to moderate field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded; fresh;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806A** DATE **1/11/19** SHEET **4** OF **4**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	70.7	80.7		120	100				competent with calcite mineralization from 71.5-72.1' bgs, grades to moderately disintegrated from 74.1-74.6' bgs; unfractured (mechanical breaks).		
							75			74.6-75.7': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along bedded intervals; unfractured (mechanical breaks).		
										75.7-77': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; two vertical fractures from 75.9-76.4' bgs, no mineralization or staining.		
							80			77-81': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray) to gray-green; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along bedded intervals; unfractured (mechanical breaks).		
							85					
							90					
							95					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

COORDINATES N 532,748.3 E 1,728,573.2

GROUND ELEVATION 889.5 SYSTEM NAD83/NAVD88

Water Level, ft	▽ 210.4	▼	▼
TIME			
DATE	7/18/2018		

BORING NO. MW-1806B DATE 1/11/19 SHEET 1 OF 9

BORING START 3/28/18 BORING FINISH 4/3/18

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.57 DIA 2"

DEPTH TO TOP OF WELL SCREEN 195 BOTTOM 210

WELL DEVELOPMENT Surge/Purge BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) RIG Direct Circulation - Wireline Core

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	24.0		0		5 10 15		CL ML	0-24': No recovery - Silty CLAY overburden.		0-195': Riser

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806B** DATE **1/11/19** SHEET **2** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	24.0		0							
1	RC	24.0	30.7		72	90	25			24-30.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded with unconformities from 25.7-26.2' bgs, cross-bedding; fresh; competent; unfractured (mechanical breaks).		
							30					
2	RC	30.7	40.7		120	NR				30.7-33.2': SHALE; moderate to weak field strength; 10R 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured (mechanical breaks).		
										33.2-34.7': SHALE with sand; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks).		
							35			34.7-35.2': SHALE, weathered; weak field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated; unfractured (mechanical breaks).		
										35.2-40.7': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture with medium-grained texture from 36.7-37' bgs; thinly bedded; fresh; competent to slightly disintegrated; slightly fractured, vertical fracture at 40.1' bgs with iron staining.		
							40					
3	RC	40.7	50.7		120	100				40.7-44.2': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							45			44.2-45.1': SHALE, weathered; weak field strength; GLEY 1 7/N (Light Gray) with 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; highly decomposed; moderately		

Continued Next Page

JOB NUMBER WV015976.0005
COMPANY American Electric Power
PROJECT Amos Fly Ash Pond
BORING NO. MW-1806B DATE 1/11/19
BORING START 3/28/18 BORING FINISH 4/3/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	40.7	50.7		120	100				disintegrated; unfractured (mechanical breaks).		
										45.1-48.4': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							50			48.4-50.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks).		
										50.3-50.7': SHALE; weak field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately to highly decomposed; slightly disintegrated; unfractured (mechanical breaks).		
4	RC	50.7	60.7		120	100	55			50.7-55.9': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks).		
							60			55.9-61': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks).		
5	RC	60.7	70.7			NR	65 70			61-70.7': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture with fine-grained texture from 62.6-63.2' bgs and 66-66.3' bgs; thinly bedded; fresh; competent; unfractured (mechanical breaks).		Set mud-trough to re-circulate drilling water.
6	RC	70.7	80.7		120	100				70.7-74.6': SANDSTONE; strong to moderate field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded; fresh;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806B** DATE **1/11/19** SHEET **4** OF **9**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	70.7	80.7		120	100				competent with calcite mineralization from 71.5-72.1' bgs, grades to moderately disintegrated from 74.1-74.6' bgs; unfractured (mechanical breaks).		
							75			74.6-75.7': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along bedding planes; unfractured (mechanical breaks).		
										75.7-77': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; two vertical fractures from 75.9-76.4' bgs, no mineralization or staining.		
							80			77-89.3': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray) to gray-green; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along bedded intervals; unfractured (mechanical breaks).		
7	RC	80.7	90.7		120	100	85					
							90			89.3-90.7': SHALE; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated, mottling noted; moderately fractured, two vertical fractures at top contact (89.3-89.6' bgs), no mineralization.		
8	RC	90.7	100.7		115	96				90.7-95.2': SHALE; strong field strength; GLEY 1 4/N (Dark Gray) with gray-green; fine-grained texture; thinly bedded; slightly decomposed between bedding; competent; unfractured.		
							95			95.2-100.7': SHALE, weathered; weak field strength; 2.5YR 3/4 (Dark Reddish Brown) mottled; fine-grained texture; massive structure; slightly decomposed; moderately disintegrated, mottling noted; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806B** DATE **1/11/19** SHEET **5** OF **9**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	90.7	100.7		115	96	100					
9	RC	100.7	110.7		88	10	105			100.7-108': SHALE, weathered; weak field strength; 2.5YR 4/2 (Weak Red) mottled gray-green; fine-grained texture; massive structure; highly decomposed; moderately disintegrated, mottling noted; unfractured.		
							110			108-109.1': SANDSTONE; moderate field strength, weathered at upper contact; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; intensely disintegrated, calcite mineralization in fracture; vertical fracture from 108-108.1' bgs.		
10	RC	110.7	120.7		120	100	115			109.1-110.7': SHALE; strong field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							120			110.7-120.7': SHALE; strong to moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with GLEY 1 4/N (Dark Gray) from 116.4-118.3' bgs; fine-grained texture; massive structure with thin bedding from 116.4-118.3' bgs; slightly decomposed; moderate disintegration, gray shale filled vertical fractures; slightly fractured, vertical fracture with iron staining and no calcite reaction at 116.8' bgs.		
11	RC	120.7	130.7		120	16				120.7-123.8': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray) with 2.5YR 3/4 (Dark Reddish Brown) mottling; fine-grained texture; massive structure; moderately decomposed with high decomposition between bedded intervals; moderate disintegration, mottling noted; slightly fractured, vertical fracture		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806B** DATE **1/11/19** SHEET **6** OF **9**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	120.7	130.7		120	16	125, 130			121.1-121.4' bgs, and vertical and horizontal fractures from 123-123.6' bgs filled with clays and shale sediments. 123.8-126.4': SANDSTONE; strong field strength; GLEY 1 4/5 (Dark Gray-Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured. 126.4-128.1': SHALE; moderate field strength; GLEY 1 4/5GY (Dark Greenish Gray); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, mottling noted; unfractured. 128.1-130.7': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
12	RC	130.7	140.7		120	NR	135, 140			130.7-140.7': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated, iron staining noted in bedded intervals at 132', 132.6', 134.7', 134.9', 135.3', 135.7', 136.1', 136.4', and 136.6' bgs, calcite mineralization noted in light colored bedded intervals at 131', 131.4', 136.7', 137.8', and 139', bgs; unfractured.		
13	RC	140.7	150.7		120	26	145			140.7-141': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured. 141-144.1': SHALE; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated with iron staining in the 141.6-141.8' bgs bedding plane; filled vertical fracture from 141.8-142.1. 144.1-146.4': SHALE; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with GLEY 1 4/5 (Dark Gray-Gray) mottling; fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; vertical fracture at 146.4' bgs, no mineralization. 146.4-150.7': SHALE; moderate to strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806B** DATE **1/11/19** SHEET **7** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	RC	140.7	150.7		120	26						
14	RC	150.7	160.7		120	NR				150.7-151.2': SHALE; moderate to strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured.		
							155			151.2-157': SHALE; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with gray mottling; fine-grained texture; thinly bedded with limestone fragments 2-3 cm from 154-154.6' bgs; moderately decomposed; slightly to moderately disintegrated; filled vertical fracture at 155.5' bgs bedding plane, no mineralization or calcite.		
										157-159.3': SHALE; weak field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated, mottling noted; unfractured.		
							160			159.3-160.7': SHALE; moderate to strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured.		
15	RC	160.7	170.7			NR				160.7-162.7': Sandy SHALE grading to Sandstone; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured.		
							165			162.7-166.1': SANDSTONE; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured.		
										166.1-167.3': SHALE, weathered; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured.		
							170			167.3-170.7': SANDSTONE; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded with cross bedding from 169.7-170.7' bgs; fresh; competent; unfractured.		
16	RC	170.7	180.7		120	100	175			170.7-180.7': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806B** DATE **1/11/19** SHEET **8** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	170.7	180.7		120	100	180					178.10-190.60': Bentonite Seal
17	RC	180.7	190.7			NR	185 190			180.7-181.4': SANDSTONE grading to Shale at base; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured. 181.4-190.7': SHALE with Sandstone lenses with mud from 182.3-182.5' bgs; moderate field strength; GLEY 1 5/N (Gray) grading to 2.5YR 3/4 (Dark Reddish Brown) at 182.7' bgs; fine-grained texture; thinly bedded; slightly to moderately decomposed with layers of high decomposition between beds in the top 1.5' bgs; slightly to moderately disintegrated with mottling, iron staining, and calcite in the 184.5-184.9' bgs Sandstone lens; vertical fracture filled with clay at 188.8' bgs.		
18	RC	190.7	195.7		60	100	195			190.7-196.5': SHALE; moderate field strength; GLEY 1 5/N (Gray) with red mottling; fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated with red mottling; slicken-slides at 192.3', 192.5', 195.1', and 195.4' bgs, no mineralization.		190.60-191.80': Secondary Sand Pack (Global #6) 191.80-211': Primary Sand Pack (Global #5) 195-211': Slotted PVC (20-slot) Screen
19	RC	195.7	205.7		120	100	200			196.5-205.9': SHALE, weathered; weak field strength; GLEY 1 5/N (Gray), becomes 2.5YR 3/4 (Dark Reddish Brown) with gray mottling at 202.6' bgs; fine-grained texture with 2-3 cm limestone fragments from 196.5-202.6' bgs; massive structure; moderately decomposed with layers of high decomposition; moderately disintegrated with mottling; slicken-slides at 196.2', 196.5', 202.6', 205.5', and 205.6' bgs.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806B** DATE **1/11/19** SHEET **9** OF **9**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	195.7	205.7		120	100	205					
20	RC	205.7	210.7		60	100	210			205.9-210.7': SHALE, slightly weathered; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; moderately to highly decomposed between weathered bedded intervals; moderately disintegrated with mottling, clay filled fractures; unfractured.		
										210.7-211': SHALE, weathered; very weak field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated with mottling; unfractured.		
							215					
							220					
							225					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

COORDINATES N 532,746.0 E 1,728,569.1

GROUND ELEVATION 889.0 SYSTEM NAD83/NAVD88

BORING NO. MW-1806C DATE 1/11/19 SHEET 1 OF 12

BORING START 3/28/18 BORING FINISH 4/3/18

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.78 DIA 2"

DEPTH TO TOP OF WELL SCREEN 225 BOTTOM 255

WELL DEVELOPMENT Surge/Purge BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) RIG Direct Circulation - Wireline Core

Water Level, ft	▽ 257.4	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	24.0		0		5 10 15		CL ML	0-24': No recovery - Silty CLAY overburden.		0-225': Riser

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806C** DATE **1/11/19** SHEET **2** OF **12**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	24.0		0							
1	RC	24.0	30.7		72	90	25, 30			24-30.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded with unconformities from 25.7-26.2' bgs, cross-bedding; fresh; competent; unfractured (mechanical breaks).		
2	RC	30.7	40.7		120	NR	35, 40			30.7-33.2': SHALE; moderate to weak field strength; 10R 3/2 (Dusky Red); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured (mechanical breaks). 33.2-34.7': SHALE with sand; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks). 34.7-35.2': SHALE, weathered; weak field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated; unfractured (mechanical breaks). 35.2-40.7': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture with medium-grained texture from 36.7-37' bgs; thinly bedded; fresh; competent to slightly disintegrated; slightly fractured, vertical fracture at 40.1' bgs with iron staining.		
3	RC	40.7	50.7		120	100	45			40.7-44.2': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured (mechanical breaks). 44.2-45.1': SHALE, weathered; weak field strength; GLEY 1 7/N (Light Gray) with 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; highly decomposed; moderately		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806C** DATE **1/11/19** SHEET **3** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	40.7	50.7		120	100				disintegrated; unfractured (mechanical breaks).		
										45.1-48.4': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							50			48.4-50.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks).		
4	RC	50.7	60.7		120	100				50.3-50.7': SHALE; weak field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately to highly decomposed; slightly disintegrated; unfractured (mechanical breaks).		
							55			50.7-55.9': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured (mechanical breaks).		
							60			55.9-61': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured (mechanical breaks).		
5	RC	60.7	70.7			NR	65, 70			61-70.7': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture with fine-grained texture from 62.6-63.2' bgs and 66-66.3' bgs; thinly bedded; fresh; competent; unfractured (mechanical breaks).		Set mud-trough to re-circulate drilling water.
6	RC	70.7	80.7		120	100				70.7-74.6': SANDSTONE; strong to moderate field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded; fresh;		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1806C | DATE 1/11/19 | SHEET 4 OF 12

PROJECT Amos Fly Ash Pond | BORING START 3/28/18 | BORING FINISH 4/3/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	70.7	80.7		120	100				competent with calcite mineralization from 71.5-72.1' bgs, grades to moderately disintegrated from 74.1-74.6' bgs; unfractured (mechanical breaks).		
							75			74.6-75.7': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along bedded intervals; unfractured (mechanical breaks).		
										75.7-77': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; two vertical fractures from 75.9-76.4' bgs, no mineralization or staining.		
							80			77-89.3': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray) to gray-green; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along bedded intervals; unfractured (mechanical breaks).		
7	RC	80.7	90.7		120	100	85					
							90			89.3-90.7': SHALE; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated, mottling noted; moderately fractured, two vertical fractures at top contact (89.3-89.6' bgs), no mineralization.		
8	RC	90.7	100.7		115	96				90.7-95.2': SHALE; strong field strength; GLEY 1 4/N (Dark Gray) with gray-green; fine-grained texture; thinly bedded; slightly decomposed between bedding; competent; unfractured.		
							95			95.2-100.7': SHALE, weathered; weak field strength; 2.5YR 3/4 (Dark Reddish Brown) mottled; fine-grained texture; massive structure; slightly decomposed; moderately disintegrated, mottling noted; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER WV015976.0005
COMPANY American Electric Power
PROJECT Amos Fly Ash Pond

BORING NO. MW-1806C DATE 1/11/19
BORING START 3/28/18 BORING FINISH 4/3/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	90.7	100.7		115	96	100					
9	RC	100.7	110.7		88	10	105			100.7-108': SHALE, weathered; weak field strength; 2.5YR 4/2 (Weak Red) mottled gray-green; fine-grained texture; massive structure; highly decomposed; moderately disintegrated, mottling noted; unfractured.		
							110			108-109.1': SANDSTONE; moderate field strength, weathered at upper contact; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; intensely disintegrated, calcite mineralization in fracture; vertical fracture from 108-108.1' bgs.		
10	RC	110.7	120.7		120	100	115			109.1-110.7': SHALE; strong field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; fresh; competent; unfractured. 110.7-120.7': SHALE; strong to moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with GLEY 1 4/N (Dark Gray) from 116.4-118.3' bgs; fine-grained texture; massive structure with thin bedding from 116.4-118.3' bgs; slightly decomposed; moderate disintegration, gray shale filled vertical fractures; slightly fractured, vertical fracture with iron staining and no calcite reaction at 116.8' bgs.		
							120					
11	RC	120.7	130.7		120	16				120.7-123.8': SHALE; moderate field strength; GLEY 1 4/N (Dark Gray) with 2.5YR 3/4 (Dark Reddish Brown) mottling; fine-grained texture; massive structure; moderately decomposed with high decomposition between bedded intervals; moderate disintegration, mottling noted; slightly fractured, vertical fracture		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1806C | DATE 1/11/19 |

PROJECT Amos Fly Ash Pond | BORING START 3/28/18 | BORING FINISH 4/3/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	120.7	130.7		120	16	125			121.1-121.4' bgs, and vertical and horizontal fractures from 123-123.6' bgs filled with clays and shale sediments.		
										123.8-126.4': SANDSTONE; strong field strength; GLEY 1 4/5 (Dark Gray-Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
										126.4-128.1': SHALE; moderate field strength; GLEY 1 4/5GY (Dark Greenish Gray); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, mottling noted; unfractured.		
							130			128.1-130.7': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
12	RC	130.7	140.7		120	NR	135			130.7-140.7': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated, iron staining noted in bedded intervals at 132', 132.6', 134.7', 134.9', 135.3', 135.7', 136.1', 136.4', and 136.6' bgs, calcite mineralization noted in light colored bedded intervals at 131', 131.4', 136.7', 137.8', and 139', bgs; unfractured.		
							140					
13	RC	140.7	150.7		120	26				140.7-141': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured.		
							145			141-144.1': SHALE; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated with iron staining in the 141.6-141.8' bgs bedding plane; filled vertical fracture from 141.8-142.1.		
										144.1-146.4': SHALE; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with GLEY 1 4/5 (Dark Gray-Gray) mottling; fine-grained texture; massive structure; slightly decomposed; slightly disintegrated; vertical fracture at 146.4' bgs, no mineralization.		
										146.4-150.7': SHALE; moderate to strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806C** DATE **1/11/19** SHEET **7** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
13	RC	140.7	150.7		120	26						
14	RC	150.7	160.7		120	NR	155			150.7-151.2': SHALE; moderate to strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured. 151.2-157': SHALE; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with gray mottling; fine-grained texture; thinly bedded with limestone fragments 2-3 cm from 154-154.6' bgs; moderately decomposed; slightly to moderately disintegrated; filled vertical fracture at 155.5' bgs bedding plane, no mineralization or calcite. 157-159.3': SHALE; weak field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated, mottling noted; unfractured. 159.3-160.7': SHALE; moderate to strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured.		
15	RC	160.7	170.7			NR	160 165 170			160.7-162.7': Sandy SHALE grading to Sandstone; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured. 162.7-166.1': SANDSTONE; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; unfractured. 166.1-167.3': SHALE, weathered; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured. 167.3-170.7': SANDSTONE; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded with cross bedding from 169.7-170.7' bgs; fresh; competent; unfractured.		
16	RC	170.7	180.7		120	100	175			170.7-180.7': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806C** DATE **1/11/19**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
16	RC	170.7	180.7		120	100	180					
17	RC	180.7	190.7			NR	185, 190			180.7-181.4': SANDSTONE grading to Shale at base; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured. 181.4-190.7': SHALE with Sandstone lenses with mud from 182.3-182.5' bgs; moderate field strength; GLEY 1 5/N (Gray) grading to 2.5YR 3/4 (Dark Reddish Brown) at 182.7' bgs; fine-grained texture; thinly bedded; slightly to moderately decomposed with layers of high decomposition between beds in the top 1.5' bgs; slightly to moderately disintegrated with mottling, iron staining, and calcite in the 184.5-184.9' bgs Sandstone lens; vertical fracture filled with clay at 188.8' bgs.		183-220': Bentonite Seal
18	RC	190.7	195.7		60	100	195			190.7-196.5': SHALE; moderate field strength; GLEY 1 5/N (Gray) with red mottling; fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated with red mottling; slicken-slides at 192.3', 192.5', 195.1', and 195.4' bgs, no mineralization.		
19	RC	195.7	205.7		120	100	200			196.5-205.9': SHALE, weathered; weak field strength; GLEY 1 5/N (Gray), becomes 2.5YR 3/4 (Dark Reddish Brown) with gray mottling at 202.6' bgs; fine-grained texture with 2-3 cm limestone fragments from 196.5-202.6' bgs; massive structure; moderately decomposed with layers of high decomposition; moderately disintegrated with mottling; slicken-slides at 196.2', 196.5', 202.6', 205.5', and 205.6' bgs.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806C** DATE **1/11/19** SHEET **9** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
19	RC	195.7	205.7		120	100	205					
20	RC	205.7	210.7		60	100	210			205.9-210.7': SHALE, slightly weathered; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; moderately to highly decomposed between weathered bedded intervals; moderately disintegrated with mottling, clay filled fractures; unfractured.		
21	RC	210.7	220.7		70	58	215			210.7-215.6': SHALE, weathered; very weak field strength; 2.5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated with mottling; unfractured.		
							220			215.6-220.7': SHALE, moderately weathered; moderate field strength; 2.5YR 3/4 (Dark Reddish Brown) with tan mottling; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated with mottling and clay filled fractures; unfractured, slicken-slide at 209.5' bgs.		220-221': Secondary Sand Pack (Global #6)
22	RC	220.7	230.7		120	NR				220.7-221.9': SHALE; strong field strength; 10YR 4/2 (Dark Grayish Brown); fine-grained texture; thinly bedded; slightly to moderately decomposed; moderately disintegrated, calcite reacts to HCl in fractures; moderately fractured, fractures filled with calcite.		221-255': Primary Sand Pack (Global #5)
							225			221.9-223.7': Sandy SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly to moderately decomposed; moderately disintegrated, calcite reacts to HCl in light colored lenses at 223' bgs; unfractured.		225-255': Slotted PVC (20-slot) Screen
										223.7-225.8': SHALE; strong field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; slightly to moderately decomposed; moderately disintegrated;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1806C** DATE **1/11/19** SHEET **10** OF **12**

BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
22	RC	220.7	230.7		120	NR	230			unfractured. 225.8-229.6': Interbedded SHALE; strong field strength; GLEY 1 4/N (Dark Gray) and 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; slightly to moderately decomposed; moderately disintegrated; unfractured.		
23	RC	230.7	240.7		120	100	235 240			229.6-230.7': SHALE; strong field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; thinly bedded; slightly to moderately decomposed; moderately disintegrated; unfractured. 230.7-240.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture, micaceous; thinly bedded; fresh; competent; unfractured.		
24	RC	240.7	250.7		120	100	245 250			240.7-250.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine to medium-grained texture; thinly bedded; fresh; slightly disintegrated, very thin HCl-reactive calcite deposits from 246.3-247.6' bgs, iron staining and calcite band (5 mm thick) at 249.7' bgs; unfractured.		
25	RC	250.7	260.7		120	100				250.7-260.7': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray) to GLEY 1 6/N (Gray); fine to medium-grained texture grading to medium-grained texture; thinly bedded with 3-5 mm limestone fragments at 253.4-253.6' bgs; fresh; slightly disintegrated, calcite deposits in light colored beds; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806C** DATE **1/11/19** SHEET **11** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
25	RC	250.7	260.7		120	100	255					
							260					
26	RC	260.7	270.7		120	100				260.7-263.1': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); medium-grained texture grading to fine-grained texture with depth; thinly bedded; fresh; competent; unfractured.		
										263.1-265.7': Interbedded SHALE and SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							265			265.7-269.7': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); medium-grained texture grading to fine-grained texture with depth; thinly bedded; fresh; slightly disintegrated, calcite at 267.8-269' bgs; unfractured.		
							270			269.7-270.7': SHALE; red-gray/green mottled; fine-grained texture; thinly bedded; slightly to moderately decomposed in bedding at 269.8-270.7' bgs; moderately disintegrated, mottling noted; unfractured.		
27	RC	270.7	280.7		120	100				270.7-271': SHALE; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly to moderately decomposed; slightly disintegrated; unfractured.		
										271-273.6': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							275			273.6-280.7': Sandy SHALE grading to Shale at base; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly to moderately disintegrated, large calcite deposit/nodule at 275' bgs, pyrite nodules from 278.5-280.7' bgs with calcite deposits in bedding plane top contact from 278.5-278.3' bgs, coal fragments from 286.7-287.3' bgs; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1806C** DATE **1/11/19** SHEET **12** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **3/28/18** BORING FINISH **4/3/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
27	RC	270.7	280.7		120	100						
28	RC	280.7	290.7		120	100				280.7-284.6': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; competent; unfractured.		
							285			284.6-288.9': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine to medium-grained texture, micaceous; thinly bedded; fresh; competent to slightly disintegrated, slight calcite mineralization - reactive to acid - in light colored Sandstone from 287.7-288.9' bgs; unfractured.		
							290			288.9-290.7': SHALE, weathered; weak field strength; GLEY 2 2.5/10B (Blueish Black); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; unfractured.		
							295					
							300					
							305					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 530,862.8 E 1,722,479.9**

GROUND ELEVATION **862.0** SYSTEM **NAD83/NAVD88**

Water Level, ft	∇ 106.6	▼	▼
TIME			
DATE	7/18/2018		

BORING NO. **MW-1807A** DATE **1/11/19** SHEET **1** OF **5**

BORING START **5/15/18** BORING FINISH **5/16/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.96** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **95** BOTTOM **115**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	19.0		0		5, 10, 15		CL ML	0-19': No recovery - Silty CLAY overburden.		0-95': Riser
1	RC	19.0	24.0		22	20				19-24': SHALE with thin beds of Sandy Shale, grading to Shale; strong field strength; GLEY		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807A** DATE **1/11/19** SHEET **2** OF **5**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	RC	19.0	24.0		22	20				6/4R (Greenish Gray); fine-grained texture; thinly bedded; moderately decomposed at fractures; moderately disintegrated at fractures, iron staining in fracture from 23.8-24' bgs; moderately fractured.		
2	RC	24.0	34.0		120	33	25 30			24-34': Silty SHALE; moderate field strength; 10YR 4/3 (Brown); fine-grained texture; massive structure; moderately decomposed with gray and tan mottling; slightly to moderately disintegrated in fractures; moderately fractured.		
3	RC	34.0	44.0		52	15	35 40			34-44': Clayey SHALE, weathered; weak field strength; 10YR 3/3 (Dark Brown); fine-grained, clayey texture; massive structure; highly decomposed with low recovery; moderately disintegrated, mottling; moderately to intensely fractured, slickenslides.		
4	RC	44.0	54.0		76	16	45			44-54': SHALE, highly weathered at 46.9' bgs; moderate field strength, becomes very weak at 46.9' bgs; 10YR 3/3 (Dark Brown); fine-grained texture, clayey at 46.9' bgs; massive structure;		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1807A** DATE **1/11/19** SHEET **3** OF **5**

PROJECT **Amos Fly Ash Pond** BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	44.0	54.0		76	16	50			moderately decomposed, becomes highly decomposed at 46.9' bgs; moderately disintegrated, with intense mottling; moderately fractured, clay-filled slickenslides.		
5	RC	54.0	64.0		108	59	55			54-57.5': SHALE; moderate field strength; 2.5Y 6/3 (Light Yellowish Brown); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, with mottling and iron staining in fractures; moderately fractured, silt and clay-filled.		
							60			57.5-61.4': Sandy SHALE interbedded with Sand lenses; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded, interbedded with sand lenses, sand lens from 60.1-60.3' bgs; slightly decomposed; moderately disintegrated, with iron staining in fractures and sand lenses at 60.1-60.3' bgs; moderately fractured, large fracture from 57.6-58.5' bgs.		
										61.4-64': SHALE, weathered; very weak field strength; GLEY 3/N (Very Dark Gray); fine-grained texture; massive structure; highly decomposed; slightly disintegrated; unfractured.		
6	RC	64.0	74.0		120	33	65			64-70.3': SHALE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, large calcite nodules and large vein-filled fractures; moderately fractured.		
							70			70.3-74': Sandy SHALE with Sandy lenses; strong field strength; GLEY 6/N (Gray); fine-grained texture; fresh; slightly disintegrated, reactive calcite in sandy lenses,		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1807A | DATE 1/11/19 | SHEET 4 OF 5

PROJECT Amos Fly Ash Pond | BORING START 5/15/18 | BORING FINISH 5/16/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	64.0	74.0		120	33				iron staining at top of lens contact, 73.3-73.5' bgs; unfractured.		
7	RC	74.0	84.0		120	54	75			74-76.1': Sandy SHALE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; slightly to moderately fractured.		
							80			76.1-84': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); thinly bedded, base Sandstone 81.2-83.2' bgs; fresh; moderately disintegrated, iron staining in fractures and sand lense, no calcite reactivity; moderately fractured, vertical oval fracture at 76.1-76.4' bgs, iron staiing at 81.7' and 82.2' bgs.		81-82': Lost circulation fluid.
8	RC	84.0	94.0		54	15	85			84-94.3': SHALE, weathered; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture with 3-5 and 5-10 cm calcite nodules; thinly bedded to massively structured; highly decomposed - weathered; moderately disintegrated, large small calcite nodules with iron staining around edges; moderately fractured.		
							90					88-91': Bentonite Seal 89': Circulation fluid returned. 91-92': Secondary Sand Pack (Global #6) 92-116': Primary Sand Pack (Global #5)
9	RC	94.0	104.0			NR	95			94.3-102.5': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, slight calcite reactivity in sandy lenses; slightly fractured, large vertical fracture at 100.4-101.2' bgs, no iron staining or calcite in fractures.		95-115': Slotted PVC (20-slot) Screen

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807A** DATE **1/11/19** SHEET **5** OF **5**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
9	RC	94.0	104.0			NR	100					
										102.5-104': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated, significant iron staining in fractures; moderately fractured, large vertical fracture with iron staining from 103.3-104' bgs, no calcite.		103-104': Loss of water circulation.
10	RC	104.0	114.0		120	20	105			104-113': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated from 104-105.8' bgs, significant iron staining; slightly fractured.		109': Return of water.
							110			113-115.2': SHALE; moderate field strength; GLEY 3/N (Very Dark Gray), lightens with depth; fine-grained texture; massive structure; slightly to moderately decomposed; slightly disintegrated; moderately fractured.		
11	RC	114.0	124.0			84	115			115.2-116': SHALE; moderate to weak field strength; 10R 4/3 (Brown); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated, mottled clay-filled fractures; moderately fractured.		
							120					

AEP - AEP.GDT - 1/11/19 13:56 - C:\USERS\LWOODS\DESKTOP\FOR NICOLE BORING LOGS GINT FILES\AEP MOUNTAINEER.GPJ

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

COORDINATES N 530,865.3 E 1,722,475.1

GROUND ELEVATION 861.1 SYSTEM NAD83/NAVD88

BORING NO. MW-1807B DATE 1/11/19 SHEET 1 OF 9

BORING START 5/15/18 BORING FINISH 5/16/18

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 4.05 DIA 2"

DEPTH TO TOP OF WELL SCREEN 133 BOTTOM 153

WELL DEVELOPMENT Surge/Purge BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) RIG Direct Circulation - Wireline Core

Water Level, ft	▽ 123.4	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	19.0		0		5, 10, 15		CL ML	0-19': No recovery - Silty CLAY overburden.		0-133': Riser
1	RC	19.0	24.0		22	20				19-24': SHALE with thin beds of Sandy Shale, grading to Shale; strong field strength; GLEY		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1807B | DATE 1/11/19 | SHEET 2 OF 9

PROJECT Amos Fly Ash Pond | BORING START 5/15/18 | BORING FINISH 5/16/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	RC	19.0	24.0		22	20				6/4R (Greenish Gray); fine-grained texture; thinly bedded; moderately decomposed at fractures; moderately disintegrated at fractures, iron staining in fracture from 23.8-24' bgs; moderately fractured.		
2	RC	24.0	34.0		120	33	25 30			24-34': Silty SHALE; moderate field strength; 10YR 4/3 (Brown); fine-grained texture; massive structure; moderately decomposed with gray and tan mottling; slightly to moderately disintegrated in fractures; moderately fractured.		
3	RC	34.0	44.0		52	15	35 40			34-44': Clayey SHALE, weathered; weak field strength; 10YR 3/3 (Dark Brown); fine-grained, clayey texture; massive structure; highly decomposed with low recovery; moderately disintegrated, mottling; moderately to intensely fractured, slickenslides.		
4	RC	44.0	54.0		76	16	45			44-54': SHALE, highly weathered at 46.9' bgs; moderate field strength, becomes very weak at 46.9' bgs; 10YR 3/3 (Dark Brown); fine-grained texture, clayey at 46.9' bgs; massive structure;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807B** DATE **1/11/19**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	44.0	54.0		76	16	50			moderately decomposed, becomes highly decomposed at 46.9' bgs; moderately disintegrated, with intense mottling; moderately fractured, clay-filled slickenslides.		
5	RC	54.0	64.0		108	59	55			54-57.5': SHALE; moderate field strength; 2.5Y 6/3 (Light Yellowish Brown); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, with mottling and iron staining in fractures; moderately fractured, silt and clay-filled.		
							60			57.5-61.4': Sandy SHALE interbedded with Sand lenses; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded, interbedded with sand lenses, sand lens from 60.1-60.3' bgs; slightly decomposed; moderately disintegrated, with iron staining in fractures and sand lenses at 60.1-60.3' bgs; moderately fractured, large fracture from 57.6-58.5' bgs.		
										61.4-64': SHALE, weathered; very weak field strength; GLEY 3/N (Very Dark Gray); fine-grained texture; massive structure; highly decomposed; slightly disintegrated; unfractured.		
6	RC	64.0	74.0		120	33	65			64-70.3': SHALE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, large calcite nodules and large vein-filled fractures; moderately fractured.		
							70			70.3-74': Sandy SHALE with Sandy lenses; strong field strength; GLEY 6/N (Gray); fine-grained texture; fresh; slightly disintegrated, reactive calcite in sandy lenses,		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807B** DATE **1/11/19** SHEET **4** OF **9**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
6	RC	64.0	74.0		120	33				iron staining at top of lens contact, 73.3-73.5' bgs; unfractured.		
7	RC	74.0	84.0		120	54	75			74-76.1': Sandy SHALE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated; slightly to moderately fractured.		
							80			76.1-84': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); thinly bedded, base Sandstone 81.2-83.2' bgs; fresh; moderately disintegrated, iron staining in fractures and sand lense, no calcite reactivity; moderately fractured, vertical oval fracture at 76.1-76.4' bgs, iron staiing at 81.7' and 82.2' bgs.		81-82': Lost circulation fluid.
8	RC	84.0	94.0		54	15	85 90			84-94.3': SHALE, weathered; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture with 3-5 and 5-10 cm calcite nodules; thinly bedded to massively structured; highly decomposed - weathered; moderately disintegrated, large small calcite nodules with iron staining around edges; moderately fractured.		89': Circulation fluid returned.
9	RC	94.0	104.0			NR	95			94.3-102.5': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, slight calcite reactivity in sandy lenses; slightly fractured, large vertical fracture at 100.4-101.2' bgs, no iron staining or calcite in fractures.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807B** DATE **1/11/19** SHEET **5** OF **9**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
9	RC	94.0	104.0			NR	100					
										102.5-104': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated, significant iron staining in fractures; moderately fractured, large vertical fracture with iron staining from 103.3-104' bgs, no calcite.		103-104': Loss of water circulation.
10	RC	104.0	114.0		120	20	105			104-113': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; moderately disintegrated from 104-105.8' bgs, significant iron staining; slightly fractured.		109': Return of water.
							110			113-115.2': SHALE; moderate field strength; GLEY 3/N (Very Dark Gray), lightens with depth; fine-grained texture; massive structure; slightly to moderately decomposed; slightly disintegrated; moderately fractured.		
11	RC	114.0	124.0			84	115			115.2-120.3': SHALE; moderate to weak field strength; 10R 4/3 (Brown); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated, mottled clay-filled fractures; moderately fractured.		
							120			120.3-122.8': SHALE; moderate to strong field strength; fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated, iron staining between bedded intervals; slightly fractured, calcite reactivity bewtten beds in top 0.4'.		
										122.8-131.4': SHALE; moderate field strength; 10R 3/3 (Dark Brown); fine-grained texture;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1807B** DATE **1/11/19** SHEET **6** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	RC	124.0	134.0		120	27	125			thinly bedded; slightly decomposed; slightly disintegrated between bedded intervals; slightly fractured, calcite-filled.		126-129': Bentonite Seal
							130			131.4-133.7': SHALE with thin Sandstone lenses; strong field strength, moderate at bedding contact with red Shale; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed, moderately decomposed at bedding plane contact; slightly disintegrated; slightly fractured.		129-130': Secondary Sand Pack (Global #6) 130-155': Primary Sand Pack (Global #5) 133-153': Slotted PVC (20-slot) Screen
13	RC	134.0	139.0		60	48	135			133.7-134': SHALE, weathered; weak field strength; GLEY 4/10Y (Dark Greenish Gray); fine-grained texture; massive structure; highly decomposed; slightly disintegrated; moderately fractured. 134-136.7': SHALE; moderate field strength, weak at weathered bedding plane; GLEY 5/10Y (Greenish Gray); fine-grained texture; thinly bedded; slightly decomposed, moderately decomposed at bedded intervals; slightly disintegrated, moderately desintegrated at bedded intervals, iron staining; slightly fractured.		
14	RC	139.0	144.0		45	NR	140			136.7-139': SHALE, weathered; weak field strength; 5YR 3/3 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately to intensely disintegrated with mottling, iron staining, and 20% 3-5 mm calcite nodules; moderately fractured. 139-144': SHALE, weathered; weak field strength; 5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; intensely disintegrated with calcite nodules (10% from 139-139.5' bgs, 2% from 139.5-144' bgs); moderately to intensely fractured, clay and silt-filled, mechanical breaks.		
15	RC	144.0	154.0		120	NR	145			144-154': SHALE, weathered; weak field strength; 5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; intensely disintegrated with 2 cm-thick calcite veins at 152.4', 152.6', and		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807B** DATE **1/11/19** SHEET **7** OF **9**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	RC	144.0	154.0		120	NR				153.6' bgs; moderately to intensely fractured, slickenslides, mechanical breaks.		
16	RC	154.0	164.0		120	NR	155			154-160.7': SHALE, weathered; weak field strength; 5YR 3/4 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; moderately disintegrated, mottled, clay-fileld fractures; moderately fractured, mechanical breaks.		
							160			160.7-164': SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, no calcite reactivity; slightly fractured, clay-filled vertical fractures from 162.1-162.5' bgs.		
17	RC	164.0	174.0		118	NR	165			164-169.1': SANDSTONE; strong field strength; 5YR 3/4 (Dark Reddish Brown); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							170			169.1-174': SHALE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; massive structure; slightly decomposed, moderately decomposed at bedded intervals; moderately disintegrated, mottling, calcite deposits in bedded intervals and fractures, 3%3-5 mm calcite nodules below 1 foot; moderately fractured, clay-filled, slickenslides from 169.1-170.1' bgs.		
18	RC	174.0	184.0		120	NR	175			174-184': SHALE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; massive structure; slightly decomposed, moderately decomposed at bedded intervals;		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1807B** DATE **1/11/19** SHEET **8** OF **9**

BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
18	RC	174.0	184.0		120	NR	180			intensely disintegrated, mottling and intense calcite deposits within mottling at 182.6' bgs; moderately fractured, clay-filled, slickenslides, mechanical breaks.		
19	RC	184.0	194.0		120	48	185			184-186.7': SHALE; moderate field strength, becoming strong towards 186.7' bgs; GLEY 4/N (Dark Gray); fine-grained texture, becoming sandy; massive structure grading to thin beds; slightly decomposed; slightly disintegrated; slightly fractured, clay-filled.		
										186.7-189.3': SANDSTONE; strong field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated with calcite deposits in light colored layers; moderately fractured, large vertical fracture from 186.7-189.3' bgs.		
							190			189.3-191.7': Interbedded SHALE and SANDSTONE; strong to moderate field strength; 5YR 3/4 (Dark Reddish Brown) and GLEY 4/N (Dark Gray); fine-grained texture; massive structure grading to thin beds; moderately decomposed; moderately disintegrated, 5% 3-5 mm calcite nodules in Shale and bedding contacts; moderately fractured, clay-filled.		
										191.7-194': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture, micaceous; thinly bedded; fresh; slightly disintegrated, slight acid reaction to HCl starting at 192.7' bgs; unfractured.		
20	RC	194.0	204.0		112	NR	195			194-200.2': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine- to medium-grained texture interbedded; thinly bedded; fresh; slightly to moderately disintegrated, light colored medium-grained layers contain calcite deposits, cross-bedding calcite deposits; unfractured.		
							200			200.2-204': Interbedded SHALE; strong field strength in sandy gray Shale, moderate field strength in red Shale bedding planes; GLEY 4/N (Dark Gray) and 5YR 3/4 (Dark Reddish		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1807B** DATE **1/11/19** SHEET **9** OF **9**

PROJECT **Amos Fly Ash Pond** BORING START **5/15/18** BORING FINISH **5/16/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
20	RC	194.0	204.0		112	NR				Brown); fine-grained texture; thinly bedded; moderately decomposed within red Shale bedded intervals; slightly disintegrated, calcite in thin layers and small nodules; unfractured.		
							205					
							210					
							215					
							220					
							225					

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**
PROJECT **Amos Fly Ash Pond**
COORDINATES **N 530,578.0 E 1,723,313.9**
GROUND ELEVATION **857.6** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1808A** DATE **1/11/19** SHEET **1** OF **5**
BORING START **4/17/18** BORING FINISH **4/19/18**
PIEZOMETER TYPE **NA** WELL TYPE **OW**
HGT. RISER ABOVE GROUND **2.98** DIA **2"**
DEPTH TO TOP OF WELL SCREEN **84.2** BOTTOM **109.2**
WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**
FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 82.3	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	14.0		0		5, 10		CL ML	0-14': No recovery - Silty CLAY overburden.		0-84.20': Riser
1	RC	14.0	19.0			NR	15			14-18.5': Interbedded gray SANDSTONE and SHALE; thinly bedded; weathered.		
										18.5-19': Gray, weathered SANDSTONE.		
2	RC	19.0	29.0		120	100				19-23.3': SANDSTONE; moderate to strong field strength; 10YR 4/4 (Dark Yellowish		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808A** DATE **1/11/19** SHEET **2** OF **5**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	19.0	29.0		120	100				Brown) from 19-20.5' bgs, 10YR 2/2 (Very Dark Brown) from 20.5-21.1' bgs, and GLEY 1 7/N (Light Gray) from 21.1-23.3' bgs; medium-grained texture; thinly bedded; moderately decomposed at color change contacts, fresh elsewhere; slightly disintegrated, iron staining at 23.3' bgs, strong calcite reaction to HCl at 21.1-23.3' bgs in light colored Sandstone; unfractured - all breaks mechanical.		
							25			23.3-36.9': SHALE with interbedded Sandstone; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh with zones of high decomposition at 26.9' bgs and slight to moderate decomposition at 27.4' bgs; slightly disintegrated; unfractured - all breaks mechanical.		
3	RC	29.0	39.0		120	25	30					98% drilling water return to surface
							35			36.9-43.9': Clayey SHALE; moderate field strength with weak field stength in some bedded intervals; 10R 4/3 (Weak Red); fine-grained texture; massive structure; moderately to highly decomposed, clayey; moderately disintegrated, high clacite reaction to HCl in light colored fragments and veins; unfractured, slicken slides at 30.3' and 30.6' bgs.		
4	RC	39.0	49.0			NR	40					
							45			43.9-51.8': SHALE; moderate field strength; 10R 4/3 (Weak Red) and GLEY 1 5/N (Gray) mottled; fine-grained texture; massive structure; moderately decomposed; moderately		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808A** DATE **1/11/19** SHEET **3** OF **5**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	39.0	49.0			NR				disintegrated; unfractured.		
5	RC	49.0	59.0		120	NR	50					
										51.8-56.5': SHALE, Sandy Calcite beds; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly to moderately disintegrated, two large calcite channels; moderately fractured at 56.5' bgs.		
							55					
										56.5-62.1': SHALE; moderate field strength; 10YR 4/2 (Weak Red) with gray and red mottling; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, mottled; moderately to intensely fractured, large vertical fracture from 56.5-58.5' bgs.		
6	RC	59.0	69.0			NR	60					
										62.1-65.8': SHALE; moderate to weak field strength; 10YR 4/2 (Weak Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured.		
							65					
										65.8-76.2': SHALE; strong to moderate field strength; GLEY 1 5/N (Gray); fine-grained texture with 3-5 cm calcite fragments; thinly bedded; slightly decomposed; moderately disintegrated, numerous calcite veins which react to HCl, iron staining; unfractured.		
7	RC	69.0	79.0			NR	70					70-80': Bentonite Seal

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808A** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
7	RC	69.0	79.0			NR	75			76.2-79': SANDSTONE; strong field strength; 10YR 7/2 (Pale Red); fine-grained texture; thinly bedded; fresh; competent with calcite mineralization at 76.2' bgs; moderately fractured, oval fracture with iron staining at 77.8' bgs, vertical fracture at 78.3' bgs.		
8	RC	79.0	89.0			NR	80			79-84.8': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh to slightly decomposed; moderately disintegrated, calcite deposits in sandy beds; unfractured.		80-81': Secondary Sand Pack (Global #6) 81-111': Primary Sand Pack (Global #5)
							85			84.8-88.6': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately decomposed and moderately to highly decomposed from 87.2-88.6' bgs; slightly disintegrated, becoming moderately disintegrated at 87.2' bgs with mottling; slightly fractured, two vertical fractures at 86.8' bgs and 87' bgs.		84.20-109.20': Slotted PVC (20-slot) Screen
9	RC	89.0	99.0		120	100	90 95			88.6-101.5': SHALE; strong field strength; GLEY 1 3/10GY (Very Dark Greenish Gray); fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated, numerous calcite-filled veins; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1808A** DATE **1/11/19** SHEET **5** OF **5**

BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
9	RC	89.0	99.0		120	100						
10	RC	99.0	109.0		120	NR	100			101.5-109.9': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent to slightly disintegrated with numerous calcite veins and deposits noted in lighter colored bedded intervals; fractured, four parallel vertical fractures with iron staining from 104.2-104.9' bgs.		
							105					
11	RC	109.0	119.0		120	20	110			109.9-112': SHALE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly to moderately disintegrated, calcite veins; unfractured.		
							115					
							120					

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power | BORING NO. MW-1808B | DATE 1/11/19 | SHEET 1 OF 7

PROJECT Amos Fly Ash Pond | BORING START 4/17/18 | BORING FINISH 4/19/18

COORDINATES N 530,576.0 E 1,723,317.3 | PIEZOMETER TYPE NA | WELL TYPE OW

GROUND ELEVATION 857.6 | SYSTEM NAD83/NAVD88 | HGT. RISER ABOVE GROUND 2.47 | DIA 2"

DEPTH TO TOP OF WELL SCREEN 138.5 BOTTOM 158.5

WELL DEVELOPMENT Surge/Purge | BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) | RIG Direct Circulation - Wireline Core

Water Level, ft	154.4		
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	14.0		0				CL ML	0-14': No recovery - Silty CLAY overburden.		0-138.50': Riser
							5					
							10					
1	RC	14.0	19.0			NR	15			14-18.5': Interbedded gray SANDSTONE and SHALE; thinly bedded; weathered.		
										18.5-19': Gray, weathered SANDSTONE.		
2	RC	19.0	29.0		120	100				19-23.3': SANDSTONE; moderate to strong field strength; 10YR 4/4 (Dark Yellowish		

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808B** DATE **1/11/19** SHEET **2** OF **7**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	19.0	29.0		120	100	25			Brown) from 19-20.5' bgs, 10YR 2/2 (Very Dark Brown) from 20.5-21.1' bgs, and GLEY 1 7/N (Light Gray) from 21.1-23.3' bgs; medium-grained texture; thinly bedded; moderately decomposed at color change contacts, fresh elsewhere; slightly disintegrated, iron staining at 23.3' bgs, strong calcite reaction to HCl at 21.1-23.3' bgs in light colored Sandstone; unfractured - all breaks mechanical. 23.3-36.9': SHALE with interbedded Sandstone; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh with zones of high decomposition at 26.9' bgs and slight to moderate decomposition at 27.4' bgs; slightly disintegrated; unfractured - all breaks mechanical.		
3	RC	29.0	39.0		120	25	30 35			36.9-43.9': Clayey SHALE; moderate field strength with weak field stength in some bedded intervals; 10R 4/3 (Weak Red); fine-grained texture; massive structure; moderately to highly decomposed, clayey; moderately disintegrated, high clacite reaction to HCl in light colored fragments and veins; unfractured, slicken slides at 30.3' and 30.6' bgs.		98% drilling water return to surface
4	RC	39.0	49.0			NR	40 45			43.9-51.8': SHALE; moderate field strength; 10R 4/3 (Weak Red) and GLEY 1 5/N (Gray) mottled; fine-grained texture; massive structure; moderately decomposed; moderately		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808B** DATE **1/11/19** SHEET **3** OF **7**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	39.0	49.0			NR				disintegrated; unfractured.		
5	RC	49.0	59.0		120	NR	50					
										51.8-56.5': SHALE, Sandy Calcite beds; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly to moderately disintegrated, two large calcite channels; moderately fractured at 56.5' bgs.		
							55					
										56.5-62.1': SHALE; moderate field strength; 10YR 4/2 (Weak Red) with gray and red mottling; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, mottled; moderately to intensely fractured, large vertical fracture from 56.5-58.5' bgs.		
6	RC	59.0	69.0			NR	60					
										62.1-65.8': SHALE; moderate to weak field strength; 10YR 4/2 (Weak Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured.		
							65					
										65.8-76.2': SHALE; strong to moderate field strength; GLEY 1 5/N (Gray); fine-grained texture with 3-5 cm calcite fragments; thinly bedded; slightly decomposed; moderately disintegrated, numerous calcite veins which react to HCl, iron staining; unfractured.		
7	RC	69.0	79.0			NR	70					

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808B** DATE **1/11/19** SHEET **4** OF **7**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
7	RC	69.0	79.0			NR	75			76.2-79': SANDSTONE; strong field strength; 10YR 7/2 (Pale Red); fine-grained texture; thinly bedded; fresh; competent with calcite mineralization at 76.2' bgs; moderately fractured, oval fracture with iron staining at 77.8' bgs, vertical fracture at 78.3' bgs.		
8	RC	79.0	89.0			NR	80			79-84.8': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh to slightly decomposed; moderately disintegrated, calcite deposits in sandy beds; unfractured.		
							85			84.8-88.6': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately decomposed and moderately to highly decomposed from 87.2-88.6' bgs; slightly disintegrated, becoming moderately disintegrated at 87.2' bgs with mottling; slightly fractured, two vertical fractures at 86.8' bgs and 87' bgs.		
9	RC	89.0	99.0		120	100	90			88.6-101.5': SHALE; strong field strength; GLEY 1 3/10GY (Very Dark Greenish Gray); fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated, numerous calcite-filled veins; unfractured.		
							95					

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808B** DATE **1/11/19** SHEET **5** OF **7**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
9	RC	89.0	99.0		120	100						
10	RC	99.0	109.0		120	NR	100 105			101.5-109.9': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent to slightly disintegrated with numerous calcite veins and deposits noted in lighter colored bedded intervals; fractured, four parallel vertical fractures with iron staining from 104.2-104.9' bgs.		
11	RC	109.0	119.0		120	20	110 115			109.9-112.1': SHALE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly to moderately disintegrated, calcite veins; unfractured. 112.1-113.9': SANDSTONE; moderately field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated with calcite veins from 115.4-116.8' bgs; fractured, large vertical fracture from 112.1-113.9' bgs through the Sandstone. 113.9-119': SHALE; moderate to weak field strength; 2.5YR 4/3 (Reddish Brown); fine-grained texture; massive structure; moderately decomposed at bedded intervals; moderately disintegrated, mottling from 116.8-119' bgs, calcite veins from 119-120.8' bgs; slightly fractured, vertical fracture at 115.4' bgs.		
12	RC	119.0	129.0		120	NR	120			113.9-120.8': SHALE; strong field strength; 2.5YR 4/3 (Reddish Brown); fine-grained texture; massive structure; moderately decomposed, mottling; moderately disintegrated, calcite veins; slightly fractured. 120.8-123.5': SHALE with Sandstone beds; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; slightly fractured, vertical fractures at 120.9' and 121.2' bgs.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808B** DATE **1/11/19** SHEET **6** OF **7**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	RC	119.0	129.0		120	NR	125			123.5-127.4': SHALE; strong field strength; 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated, mottling; unfractured.		
										127.4-129': Sandy SHALE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; sightly disintegrated; unfractured.		
13	RC	129.0	139.0		120	23	130			129-130.8': Sandy SHALE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
										130.8-137.2': SHALE; strong field strength; interbedded GLEY 5/N (Gray) and 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; fresh; slightly disintegrated; slightly to moderately fractured at 137.2' bgs.		131-134': Bentonite Seal
							135					134-135': Secondary Sand Pack (Global #6) 135-165': Primary Sand Pack (Global #5)
										137.2-139.9': SHALE with Limestone fragments; moderate field strength; GLEY 1 3/10GY (Very Dark Greenish Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated; moderately fractured, several fractures from 136.3-137.2' bgs.		138.50-158.50': Slotted PVC (20-slot) Screen
14	RC	139.0	149.0		120	33	140			139.9-163.2': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated, mottling, clay/silt-filled fractures; moderately fractured.		
							145					
15	RC	149.0	159.0		120	74						

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808B** DATE **1/11/19** SHEET **7** OF **7**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	RC	149.0	159.0		120	74	155					
16	RC	159.0	169.0		120	20	160					
							165			163.2-165': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, calcite in light colored bedded intervals; moderately fractured.		
							170					
							175					

AEP - AEP.GDT - 1/11/19 13:56 - C:\USERS\LWOODS\DESKTOP\FOR NICOLE BORING LOGS GINT FILES\AEP MOUNTAINEER.GPJ

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

COORDINATES N 530,573.8 E 1,723,321.9

GROUND ELEVATION 857.5 SYSTEM NAD83/NAVD88

BORING NO. MW-1808C DATE 1/11/19 SHEET 1 OF 12

BORING START 4/17/18 BORING FINISH 4/19/18

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.99 DIA 2"

DEPTH TO TOP OF WELL SCREEN 215 BOTTOM 240

WELL DEVELOPMENT Surge/Purge BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) RIG Direct Circulation - Wireline Core

Water Level, ft	▽ 168.9	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	14.0		0		5 10		CL ML	0-14': No recovery - Silty CLAY overburden.		0-215': Riser
1	RC	14.0	19.0			NR	15			14-18.5': Interbedded gray SANDSTONE and SHALE; thinly bedded; weathered.		
										18.5-19': Gray, weathered SANDSTONE.		
2	RC	19.0	29.0		120	100				19-23.3': SANDSTONE; moderate to strong field strength; 10YR 4/4 (Dark Yellowish		

TYPE OF CASING USED		
X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808C** DATE **1/11/19** SHEET **2** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	19.0	29.0		120	100				Brown) from 19-20.5' bgs, 10YR 2/2 (Very Dark Brown) from 20.5-21.1' bgs, and GLEY 1 7/N (Light Gray) from 21.1-23.3' bgs; medium-grained texture; thinly bedded; moderately decomposed at color change contacts, fresh elsewhere; slightly disintegrated, iron staining at 23.3' bgs, strong calcite reaction to HCl at 21.1-23.3' bgs in light colored Sandstone; unfractured - all breaks mechanical.		
							25			23.3-36.9': SHALE with interbedded Sandstone; moderate field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh with zones of high decomposition at 26.9' bgs and slight to moderate decomposition at 27.4' bgs; slightly disintegrated; unfractured - all breaks mechanical.		
3	RC	29.0	39.0		120	25	30					98% drilling water return to surface
							35					
										36.9-43.9': Clayey SHALE; moderate field strength with weak field stength in some bedded intervals; 10R 4/3 (Weak Red); fine-grained texture; massive structure; moderately to highly decomposed, clayey; moderately disintegrated, high clacite reaction to HCl in light colored fragments and veins; unfractured, slicken slides at 30.3' and 30.6' bgs.		
4	RC	39.0	49.0			NR	40					
							45			43.9-51.8': SHALE; moderate field strength; 10R 4/3 (Weak Red) and GLEY 1 5/N (Gray) mottled; fine-grained texture; massive structure; moderately decomposed; moderately		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808C** DATE **1/11/19** SHEET **3** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	39.0	49.0			NR				disintegrated; unfractured.		
5	RC	49.0	59.0		120	NR	50					
										51.8-56.5': SHALE, Sandy Calcite beds; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly to moderately disintegrated, two large calcite channels; moderately fractured at 56.5' bgs.		
							55					
										56.5-62.1': SHALE; moderate field strength; 10YR 4/2 (Weak Red) with gray and red mottling; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, mottled; moderately to intensely fractured, large vertical fracture from 56.5-58.5' bgs.		
6	RC	59.0	69.0			NR	60					
										62.1-65.8': SHALE; moderate to weak field strength; 10YR 4/2 (Weak Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated; unfractured.		
							65					
										65.8-76.2': SHALE; strong to moderate field strength; GLEY 1 5/N (Gray); fine-grained texture with 3-5 cm calcite fragments; thinly bedded; slightly decomposed; moderately disintegrated, numerous calcite veins which react to HCl, iron staining; unfractured.		
7	RC	69.0	79.0			NR	70					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1808C** DATE **1/11/19** SHEET **4** OF **12**

BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
7	RC	69.0	79.0			NR	75			76.2-79': SANDSTONE; strong field strength; 10YR 7/2 (Pale Red); fine-grained texture; thinly bedded; fresh; competent with calcite mineralization at 76.2' bgs; moderately fractured, oval fracture with iron staining at 77.8' bgs, vertical fracture at 78.3' bgs.		
8	RC	79.0	89.0			NR	80 85			79-84.8': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh to slightly decomposed; moderately disintegrated, calcite deposits in sandy beds; unfractured. 84.8-88.6': SHALE; moderate field strength; GLEY 1 3/N (Very Dark Gray); fine-grained texture; thinly bedded; moderately decomposed and moderately to highly decomposed from 87.2-88.6' bgs; slightly disintegrated, becoming moderately disintegrated at 87.2' bgs with mottling; slightly fractured, two vertical fractures at 86.8' bgs and 87' bgs.		
9	RC	89.0	99.0		120	100	90 95			88.6-101.5': SHALE; strong field strength; GLEY 1 3/10GY (Very Dark Greenish Gray); fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated, numerous calcite-filled veins; unfractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808C** DATE **1/11/19** SHEET **5** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
9	RC	89.0	99.0		120	100						
10	RC	99.0	109.0		120	NR	100					
										101.5-109.9': SANDSTONE; very strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent to slightly disintegrated with numerous calcite veins and deposits noted in lighter colored bedded intervals; fractured, four parallel vertical fractures with iron staining from 104.2-104.9' bgs.		
							105					
11	RC	109.0	119.0		120	20	110			109.9-112.1': SHALE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly to moderately disintegrated, calcite veins; unfractured.		
										112.1-113.9': SANDSTONE; moderately field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated with calcite veins from 115.4-116.8' bgs; fractured, large vertical fracture from 112.1-113.9' bgs through the Sandstone.		
							115			113.9-119': SHALE; moderate to weak field strength; 2.5YR 4/3 (Reddish Brown); fine-grained texture; massive structure; moderately decomposed at bedded intervals; moderately disintegrated, mottling from 116.8-119' bgs, calcite veins from 119-120.8' bgs; slightly fractured, vertical fracture at 115.4' bgs.		
12	RC	119.0	129.0		120	NR	120			113.9-120.8': SHALE; strong field strength; 2.5YR 4/3 (Reddish Brown); fine-grained texture; massive structure; moderately decomposed, mottling; moderately disintegrated, calcite veins; slightly fractured.		
										120.8-123.5': SHALE with Sandstone beds; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; slightly fractured, vertical fractures at 120.9' and 121.2' bgs.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1808C DATE 1/11/19 SHEET 6 OF 12

BORING START 4/17/18 BORING FINISH 4/19/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
12	RC	119.0	129.0		120	NR	125			123.5-127.4': SHALE; strong field strength; 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated, mottling; unfractured.		
										127.4-129': Sandy SHALE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; sightly disintegrated; unfractured.		
13	RC	129.0	139.0		120	23	130			129-130.8': Sandy SHALE; strong field strength; GLEY 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							135			130.8-137.2': SHALE; strong field strength; interbedded GLEY 5/N (Gray) and 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; fresh; slightly disintegrated; slightly to moderately fractured at 137.2' bgs.		
										137.2-139.9': SHALE with Limestone fragments; moderate field strength; GLEY 1 3/10GY (Very Dark Greenish Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated; moderately fractured, several fractures from 136.3-137.2' bgs.		
14	RC	139.0	149.0		120	33	140			139.9-163.2': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; moderately to highly decomposed; moderately disintegrated, mottling, clay/silt-filled fractures; moderately fractured.		
							145					
15	RC	149.0	159.0		120	74						

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808C** DATE **1/11/19** SHEET **7** OF **12**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
15	RC	149.0	159.0		120	74	155					
16	RC	159.0	169.0		120	20	160					
							165			163.2-171.1': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, calcite in light colored bedded intervals from 165.7-167.1' bgs; moderately fractured.		
17	RC	169.0	179.0		120	36	170					
							175			171.4-179': SHALE; moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1808C** DATE **1/11/19**

BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
17	RC	169.0	179.0		120	36						
18	RC	179.0	189.0		120	33	180			179-185': SHALE; strong to moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated with mottling; moderately fractured.		
							185			185-186.3': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
										186.3-189': SHALE; strong to moderate field strength; 2.5YR 3/6 (Dark Red); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated with mottling; moderately fractured.		
19	RC	189.0	199.0			NR	190			189-191.5': SHALE; strong field strength; 2.5YR 3/6 (Dark Red), grades to gray; fine-grained texture; massive structure; slightly decomposed; competent; unfractured.		
										191.5-199': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture, micaceous; thinly bedded; fresh; competent; unfractured.		
							195					
20	RC	199.0	209.0		120	100	200			199-210.3': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1808C** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
20	RC	199.0	209.0		120	100	205					208-211': Bentonite Seal
21	RC	209.0	219.0		120	100	210			210.3-216.9': Interbedded SHALE and SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		211-212': Secondary Sand Pack (Global #6) 212-242': Primary Sand Pack (Global #5)
							215			216.9-219': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded; fresh; competent; unfractured.		215-240': Slotted PVC (20-slot) Screen
22	RC	219.0	229.0		120	19	220 225			219-229': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded; fresh; competent; slightly fractured, one vertical fracture from 221-221.4' bgs.		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos Fly Ash Pond

BORING NO. MW-1808C DATE 1/11/19 SHEET 10 OF 12

BORING START 4/17/18 BORING FINISH 4/19/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
22	RC	219.0	229.0		120	19						
23	RC	229.0	239.0			NR	230, 235			229-239': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded; fresh; competent grading to moderately disintegrated, reactive calcite lenses from 237-239' bgs; unfractured.		
24	RC	239.0	249.0		120	34	240, 245			239-241.9': Sandy SHALE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded; fresh; slightly disintegrated, calcite veins; unfractured. 241.9-244.2': SHALE; moderate field strength; 2.5YR 3/2 (Dusky Red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; unfractured. 244.2-248.3': SHALE; moderate field strength; GLEY 1 3/5GY (Very Dark Greenish Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured. 248.3-249': SANDSTONE with Shale fragments; strong field strength; GLEY 1 8/N (White); fine-grained texture; thinly bedded with Shale fragments; fresh; competent; unfractured.		
25	RC	249.0	259.0		120	40	250			249-251.2': SHALE; strong field strength; GLEY 1 5/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured. 251.2-254.8': SHALE; moderate field strength with weak field strength in some bedding planes; 2.5YR 3/3 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1808C** DATE **1/11/19** SHEET **11** OF **12**

BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
25	RC	249.0	259.0		120	40	255			decomposed in bedded intervals; slightly disintegrated; unfractured.		
										254.8-259': SHALE; strong field strength; 10YR 3/3 (Dark Brown) mottled dark tan, red, and gray; fine-grained texture; massive structure with 2-3 cm calcite-limestone fragments and silt filled fractures; slightly decomposed; moderately disintegrated, mottled with calcite deposits around fractures; moderately fractured.		
26	RC	259.0	269.0		120	69	260 265			259-269': SHALE; moderate field strength; 10YR 3/3 (Dark Brown) mottled tan and gray changing to 2.5YR 3/3 (Dark Reddish Brown) mottled red at 262.1' bgs; fine-grained texture with trace 3-5 cm angular limestone fragments; massive structure; slightly to moderately decomposed; moderately disintegrated, mottled with silt/clay filled fractures and slicken slides; moderately fractured.		
27	RC	269.0	279.0		120	60	270			269-272.6': SHALE; moderate field strength; 2.5YR 3/3 (Dark Reddish Brown) mottled tan and gray; fine-grained texture; massive structure; slightly to moderately decomposed; moderately disintegrated, mottled with silt/clay filled fractures and slicken slides; moderately fractured.		
							275			272.6-279': SHALE; moderate to strong field strength, becomes less mottled and more sandy towards 279' bgs; GLEY 1 3/5GY (Very Dark Greenish Gray) with red mottling; fine-grained texture becoming sandy from 277.5-279' bgs; thinly bedded; slightly decomposed in some bedded intervals; slightly disintegrated; moderately fractured.		
28	RC	279.0	289.0		0	0				279-289': No return of drilling fluid.		Lost circulation fluid

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1808C** DATE **1/11/19** SHEET **12** OF **12**

BORING START **4/17/18** BORING FINISH **4/19/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
28	RC	279.0	289.0		0	0	285					
							290					
							295					
							300					
							305					

AEP - AEP.GDT - 1/11/19 13:56 - C:\USERS\LWOODS\DESKTOP\FOR NICOLE BORING LOGS GINT FILES\AEP MOUNTAINEER.GPJ

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 530,459.4 E 1,722,189.3**

GROUND ELEVATION **738.1** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1809A** DATE **1/11/19** SHEET **1** OF **6**

BORING START **3/1/18** BORING FINISH **3/2/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.03** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **57** BOTTOM **72**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 47.9	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	25.8		0		5 10 15		CL ML	0-25.8': No recovery - Silty CLAY overburden.		0-57': Riser

Continued Next Page

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** | BORING NO. **MW-1809A** | DATE **1/11/19** | SHEET **2** OF **6**

PROJECT **Amos Fly Ash Pond** | BORING START **3/1/18** | BORING FINISH **3/2/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	25.8		0		25					
1	RC	25.8	35.8		108	NR	30		CL	25.8-30.8': Unconsolidated CLAY; very weak field strength; 5YR 4/2 (Dark Reddish Gray); fine-grained texture; massive structure; highly decomposed; intensely disintegrated; very intensely fractured.		
										30.8-32.4': SHALE; moderate field strength; 5YR 5/2 (Reddish Gray); fine-grained texture; laminated structure; slightly decomposed; slightly disintegrated; unfractured.		
										32.4-33.8': SANDSTONE; strong field strength; GLEY 1 5/10GY (Greenish Gray); fine-grained texture; laminated structure; fresh; competent; unfractured.		
							35			33.8-38.3': SHALE; weak field strength; 5YR 3/2 (Dark Reddish Brown); fine-grained texture; laminated structure; moderately decomposed; moderately disintegrated; unfractured.		
2	RC	35.8	45.8		114	95						
							40			38.3-43.8': SANDSTONE; strong field strength; GLEY 1 4/5G_/1 (Grayish Green); fine-grained texture; thinly cross-bedded; fresh; competent; unfractured.		
							45			43.8-45.8': SHALE; weak field strength; 5YR 3/2 (Dark Reddish Brown); fine-grained texture; laminated structure; moderately decomposed; moderately disintegrated; unfractured.		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1809A** DATE **1/11/19** SHEET **3** OF **6**

PROJECT **Amos Fly Ash Pond** BORING START **3/1/18** BORING FINISH **3/2/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
3	RC	45.8	55.8		84	NR				45.8-59.2': SHALE; weak field strength; 5YR 3/2 (Dark Reddish Brown); fine-grained texture; massive structure; highly decomposed; intensely disintegrated; slightly fractured.		48.60-52.60': Bentonite Seal
							50					
												56.60-54.40': Secondary Sand Pack (Global #6)
							55					54.40-74': Primary Sand Pack (Global #5)
4	RC	55.8	65.8		120	NR						57-72': Slotted PVC (20-slot) Screen
							60			59.2-65.8': SANDSTONE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; laminated structure with massive structure at 64' bgs; fresh; slightly disintegrated; slightly fractured - fracture at 64' bgs.		
							65					
5	RC	65.8	75.8		120	100				65.8-67': SANDSTONE; moderate field strength; GLEY 1 4/5G_/1 (Grayish Green); fine-grained texture; laminated structure; moderately decomposed; moderately disintegrated; unfractured.		
										67-69.5': SHALE; weak field strength; 5YR 3/4 (Dark Reddish Brown); fine-grained texture; laminated structure; highly decomposed; intensely disintegrated; unfractured.		
							70			69.5-75.8': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); fine-grained texture; thinly bedded with massive structure at 70.2-72.4' bgs; fresh; competent; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1809A** DATE **1/11/19**

BORING START **3/1/18** BORING FINISH **3/2/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	RC	65.8	75.8		120	100	75					
6	RC	75.8	85.8		120	100	80, 85			75.8-77': SHALE; strong field strength; GLEY 1 4/N (Dark Gray); fine-grained texture; laminated structure - cross-bedded at contact; fresh; slightly disintegrated; unfractured. 77-85.8': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); interbedded medium and fine-grained texture; thinly bedded with both planar and cross-bedding; fresh; competent; unfractured.		
7	RC	85.8	95.8		120	100	90, 95			85.8-93.5': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); interbedded medium and fine-grained texture with rare clasts; thinly bedded with both planar and cross-bedding; fresh; competent; unfractured. 93.5-93.8': SHALE; weak field strength; GLEY 1 4/10GY (Dark Greenish Gray); fine-grained texture; laminated structure; moderately decomposed; moderately disintegrated; unfractured.		
8	RC	95.8	105.8		120	100				93.8-95.8': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); interbedded medium and fine-grained texture with rare clasts; thinly bedded with both planar and cross-bedding; fresh; competent; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1809A** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **3/1/18** BORING FINISH **3/2/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
8	RC	95.8	105.8		120	100	100			95.8-100.8': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); interbedded medium and fine-grained texture; thinly bedded with both planar and cross-bedding; fresh; slightly decomposed with framboidal pyrite mineralization; unfractured.		
							105			100.8-105.8': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture; massive structure to thinly bedded, uneven beds at 105' bgs; fresh; slightly decomposed with euhedral pyrite mineralization; unfractured.		
9	RC	105.8	115.8		120	100	110 115			105.8-115.8': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture with fine-grained mud interbedded sparsely; thinly bedded with medium bedded mud at 105.8-107.8' bgs; fresh; competent; unfractured.		
10	RC	115.8	125.8			NR	120			115.8-123.3': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture with fine-grained mud interbedded sparsely; medium bedded with thinly bedded mud at 117.8-118.8' bgs; fresh; slightly disintegrated with euhedral pyrite mineralization; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1809A** DATE **1/11/19** SHEET **6** OF **6**

PROJECT **Amos Fly Ash Pond** BORING START **3/1/18** BORING FINISH **3/2/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
10	RC	115.8	125.8			NR	125			123.3-125.8': SHALE; weak field strength; GLEY 1 4/5G_/2 (Grayish Green); fine-grained texture; laminated structure; moderately decomposed; moderately disintegrated; unfractured.		
							130					
							135					
							140					
							145					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 530,152.2 E 1,723,192.4**

GROUND ELEVATION **735.3** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1810A** DATE **1/11/19** SHEET **1** OF **6**

BORING START **2/26/18** BORING FINISH **2/27/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.07** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **60** BOTTOM **80**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 68.4	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	8.2		0		5		CL ML	0-8.2': No recovery - Silty CLAY overburden.		0-60': Riser
1	RC	8.2	14.0		14	NR	10			8.2-8.6': WOOD		
										8.6-14': SANDSTONE; moderate field strength; GLEY 1 4/10Y (Dark Greenish Gray); fine-grained texture; thinly bedded; slightly decomposed; moderately disintegrated; unfractured (mechanical breaks).		
2	RC	14.0	24.0		12	NR	15		CL ML	14-18': Silty CLAY, unconsolidated; light brown with gray mottling.		
									CL ML	18-24': Silty CLAY, unconsolidated; red with tan mottling.		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1810A** DATE **1/11/19**

PROJECT **Amos Fly Ash Pond** BORING START **2/26/18** BORING FINISH **2/27/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
2	RC	14.0	24.0		12	NR						
0	NR	24.0	28.0		0		25			24-28': No recovery.		
3	RC	28.0	34.0		72	NR	30		CL ML	28-35.8': Silty CLAY, unconsolidated; weak field strength; red with tan and gray mottling.		
4	RC	34.0	44.0		120	83	35			35.8-40.6': SHALE; moderate field strength; 5YR 3/4 (Reddish Brown), red and gray-green; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
							40			40.6-42.8': Shaley SANDSTONE; moderate field strength; GLEY 1 5/5GY (Greenish Gray); very fine-grained texture; thinly bedded at fracture; slightly decomposed; slightly disintegrated with mineralization in fracture; slightly fractured, fracture at 41.3' bgs.		
										42.8-44': SANDSTONE; moderate field strength; 5Y 4/2 (Olive Gray); fine-grained texture; thinly bedded at fracture; slightly decomposed; slightly disintegrated with mineralization in fracture; slightly fractured, fracture at 43.1' bgs.		
5	RC	44.0	54.0		120	NR	45					

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1810A** DATE **1/11/19** SHEET **3** OF **6**

PROJECT **Amos Fly Ash Pond** BORING START **2/26/18** BORING FINISH **2/27/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
5	RC	44.0	54.0		120	NR				44-46.7': SHALE; moderate field strength; 5Y 4/2 (Olive Gray); fine-grained texture; thinly bedded; moderately decomposed; moderately disintegrated; slightly fractured, possible high vertical fractures at 44.4-45.8' bgs.		
							50			46.7-54': SHALE; moderate to weak field strength; 5YR 3/2 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately to highly decomposed, highly decomposed zone at 51.6-52.8' bgs; moderately disintegrated; unfractured.		50-53': Bentonite Seal 53-54': Secondary Sand Pack (Global #6)
6	RC	54.0	64.0		120	100	55 60			54-64': SHALE; moderate field strength; 5YR 3/2 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed, 5-10 mm thin bedding of moderate decomposition; moderately disintegrated in decomposition zones; unfractured.		54-82': Primary Sand Pack (Global #5) 60-80': Slotted PVC (20-slot) Screen
7	RC	64.0	74.0		110.4	92	65			64-65': SHALE; moderate field strength; 5YR 3/2 (Dark Reddish Brown); fine-grained texture; thinly bedded; moderately decomposed; competent; unfractured.		
							70			65-74': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); fine-grained grading to medium-grained texture; thinly bedded; fresh; competent; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

BORING NO. **MW-1810A** DATE **1/11/19** SHEET **4** OF **6**

BORING START **2/26/18** BORING FINISH **2/27/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
7	RC	64.0	74.0		110.4	92						
8	RC	74.0	84.0		120	100	75 80			74-89': SANDSTONE; very strong field strength; GLEY 1 5/N (Gray); medium-grained texture; thinly bedded with non-linear uneven bedded intervals at 83-84' and 87.5' bgs; fresh; competent; unfractured.		
9	RC	84.0	89.0		60	100	85					
10	RC	89.0	94.0		60	100	90			89-94': SANDSTONE; very strong to strong field strength; GLEY 1 6/N (Gray); medium-grained texture; thinly bedded (89-93' bgs) grading to massive structure at 93' bgs; fresh; competent; unfractured.		
11	RC	94.0	104.0		120	NR	95			94-104': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); medium-grained texture; massive structure 94-96' bgs with randomly aligned grains, thinly bedded at 96-104' bgs; fresh; competent; unfractured.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1810A** DATE **1/11/19** SHEET **5** OF **6**

PROJECT **Amos Fly Ash Pond** BORING START **2/26/18** BORING FINISH **2/27/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
11	RC	94.0	104.0		120	NR	100					
12	RC	104.0	114.0		120	100	105, 110			104-114': SANDSTONE; strong field strength; GLEY 1 5/N (Gray); medium-grained texture with fine-grained texture (1" clay bed) at 110' bgs; thinly bedded at 104-113' bgs (uneven bedding at 108' bgs, randomly oriented grains) and massive structure at 113-114' bgs; fresh; slightly disintegrated, iron mineralization at 113' bgs; unfractured.		
13	RC	114.0	124.0		120	100	115			114-117.8': SANDSTONE; strong field strength; GLEY 1 6/N (Gray); medium-grained texture; massive structure; fresh; competent; unfractured.		
							120			117.8-123': MUDSTONE; weak field strength; GLEY 1 2.5/N (Black) to 5YR 3/4 (Dark Reddish Brown) in iron oxidized zones; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated with iron oxidation; unfractured.		
										123-124': SHALE; strong field strength; GLEY 1 7/5GY (Light Greenish Gray); fine-grained		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1810A** DATE **1/11/19** SHEET **6** OF **6**

PROJECT **Amos Fly Ash Pond** BORING START **2/26/18** BORING FINISH **2/27/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										texture; laminated structure; fresh; slightly disintegrated; unfractured.		
							125					
							130					
							135					
							140					
							145					

ARCADIS

West Virginia Department of Environmental Protection, 2018

Monitoring Well Construction Approvals

MW-1801A/B/C to MW-1810

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0001-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0001-18
Grid Location:
a. Latitude: 38 27 23 .0
b. Longitude: 81 50 45 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1801A

Purpose of Monitoring Well:
Assessment

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

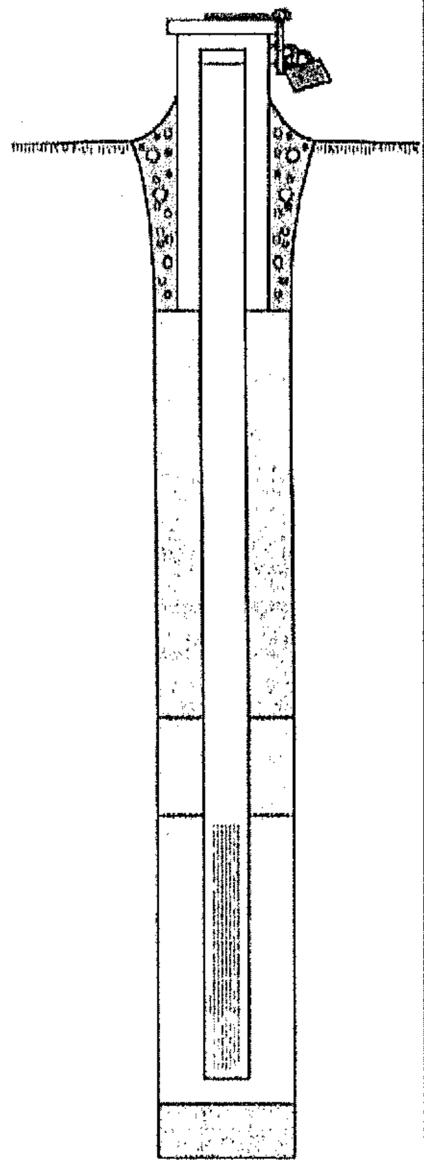
Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 45 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 52 ft.
15.Depth to Top of Screen: 55.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 75 ft.
19.Bottom of Filter Pack: 77.1 ft.
20.Bottom of Borehole: 77.1 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:



[redacted]

<< Return

Home | Log Out

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0002-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0002-18
Grid Location:
a. Latitude: 38 27 23 .0
b. Longitude: 81 50 45 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1801B

Purpose of Monitoring Well:
Assessment

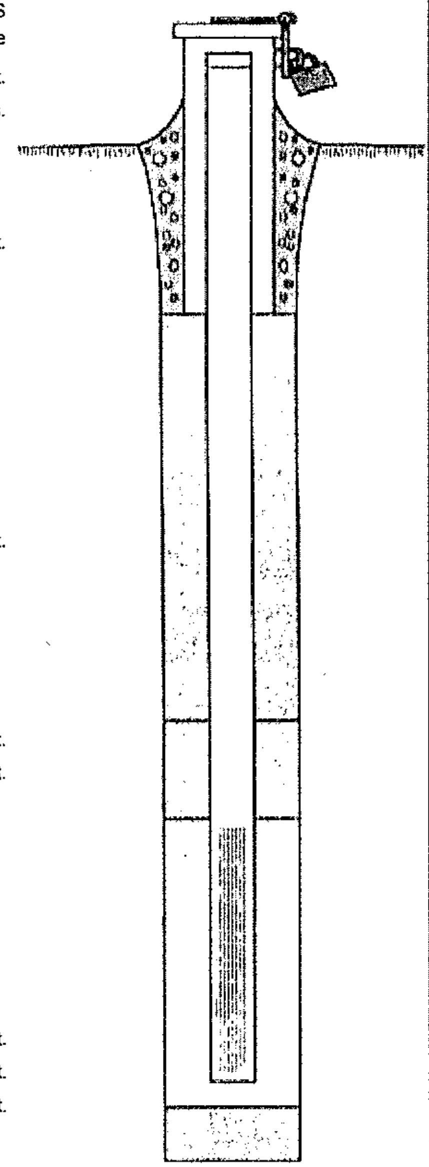
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock:	YES
2.Protective Cover:	Protective Cover Pipe
3.Monitoring Well Reference Point:	0 ft.
4.Borehole Diameter:	6 inches.
5.Ground Surface Seal:	
a.Material: bentonite-cement grout	
b.Installation Procedure: gravity	
6.Surface Seal Bottom/Annular Space Top:	2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.	
c.Material: PVC	
d.Installation Procedure: hand set	
8.Annular Space Seal:	
a.Material: high solids grout -	
b.Installation Procedure: tremie pipe-pumped	
9.Well Development Procedure: airlift -	
10.Drilling Method Used: air rotary -	
11.Annular Space Seal Bottom/Filter Seal Top:	53 ft.
12.Drilling Fluid Used: Yes Source: Water	
13.Filter Pack Seal:	
a.Material: bentonite pellet	
b.Installation Procedure: Gravity Fed	
c.Volume Added: 1250 pounds	
14.Bottom of Bentonite Seal/Filter Pack Top:	194 ft.
15.Depth to Top of Screen:	198.4 ft.
16.Screen:	
a.Material: PVC	
b.Installation Procedure: hand set	
c.Slot Size: 0.02 inches. d.Screen Length: 24.6 ft.	
17.Filter Pack:	
a.Material: fine sand	
b.Installation Procedure: gravity	
18.Well Depth:	223 ft.
19.Bottom of Filter Pack:	225 ft.
20.Bottom of Borehole:	225 ft.
21.Backfill Material (below filter pack): N/A	
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump	
23.Special Circumstances and Exceptions: No Variance Number:	
[redacted]	

<< Return

Home | Log Out

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0003-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0003-18
Grid Location:
a. Latitude: 38 27 23 .0
b. Longitude: 81 50 45 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1801C

Purpose of Monitoring Well:
Assessment

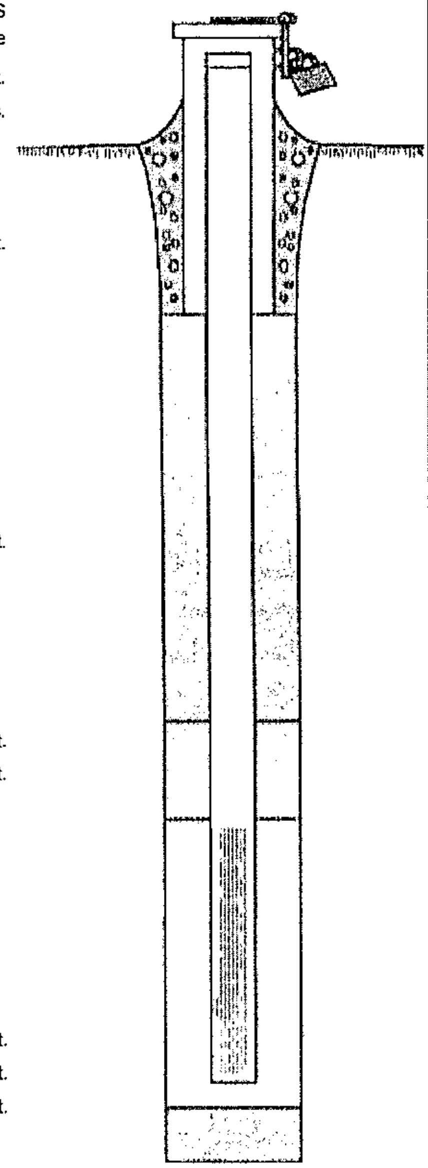
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 194 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 550 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 234 ft.
15.Depth to Top of Screen: 237.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 24.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 262 ft.
19.Bottom of Filter Pack: 264 ft.
20.Bottom of Borehole: 264 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
[redacted]

<< Return

Home | Log Out

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0004-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0004-18
Grid Location:
a. Latitude: 38 27 41 .0
b. Longitude: 81 51 13 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1802A

Purpose of Monitoring Well:
Assessment

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

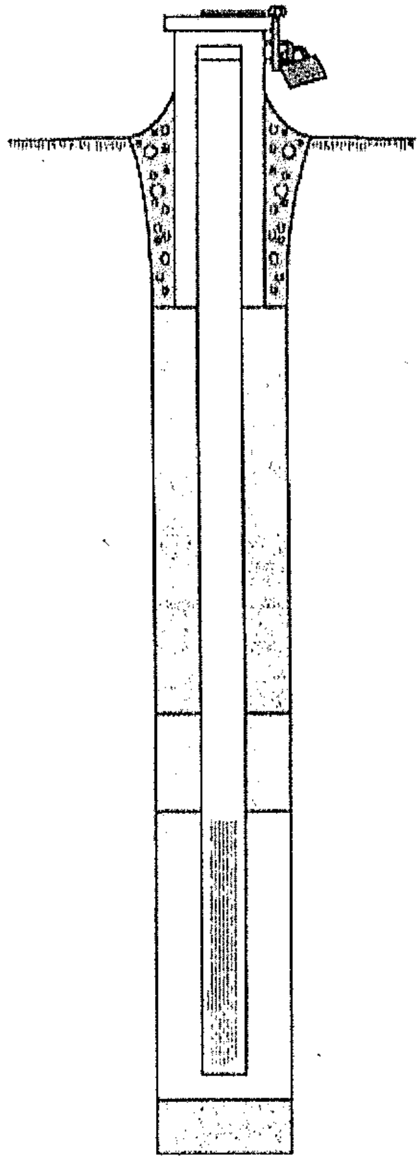
Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 30 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 42 ft.
15.Depth to Top of Screen: 46.6 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 66 ft.
19.Bottom of Filter Pack: 67 ft.
20.Bottom of Borehole: 67 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0005-18
Approved

Site Name/Physical Address:	Well Registration No. WV00528-0005-18	Purpose of Monitoring Well:
Site: John E. Amos Plant	Grid Location:	Assessment
Line 1: 1530 Winfield Rd.	a. Latitude: 38 27 41 .0	
Line 2:	b. Longitude: 81 51 13 .0	
City: Winfield	c. Method Used: GPS	
State: WV		
Zip: 25213-	Company/Project Well No.:	
County: Putnam	MW-1802B	
Well Owner (Name, Firm, Address):	**Installed By (Name, Firm, Address):**	**Date Well Installed:**
Owner: American Electric Power	Installer: AEP Dolan Lab	08/09/2018
Line 1: 1 Riverside Plaza	Line 1: 4001 Bixby Rd.	
Line 2:	Line 2:	**Driller's WV Cert No.**
City: Columbus	City: Groveport	WV00528
State: OH	State: OH	
Zip: 43215-	Zip: 43125-	
Phone: 614-836-4200	Phone: 614-836-4200	

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES

2.Protective Cover: Protective Cover Pipe

3.Monitoring Well Reference Point: 0 ft.

4.Borehole Diameter: 6 inches.

5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity

6.Surface Seal Bottom/Annular Space Top: 2 ft.

7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set

8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped

9.Well Development Procedure: airlift -

10.Drilling Method Used: air rotary -

11.Annular Space Seal Bottom/Filter Seal Top: 159.2 ft.

12.Drilling Fluid Used: Yes Source: Water

13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds

14.Bottom of Bentonite Seal/Filter Pack Top: 172.1 ft.

15.Depth to Top of Screen: 176.6 ft.

16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.

17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity

18.Well Depth: 196 ft.

19.Bottom of Filter Pack: 198 ft.

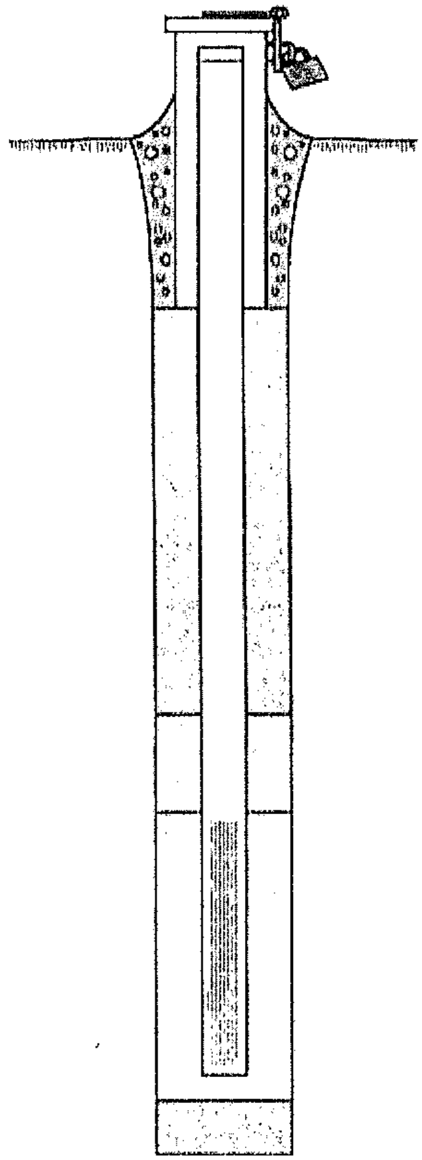
20.Bottom of Borehole: 198 ft.

21.Backfill Material (below filter pack): N/A

22.Decontamination Procedures: Liqui-Nox w/high pressure water pump

23.Special Circumstances and Exceptions: No Variance Number:

24.WV Contractor License No.

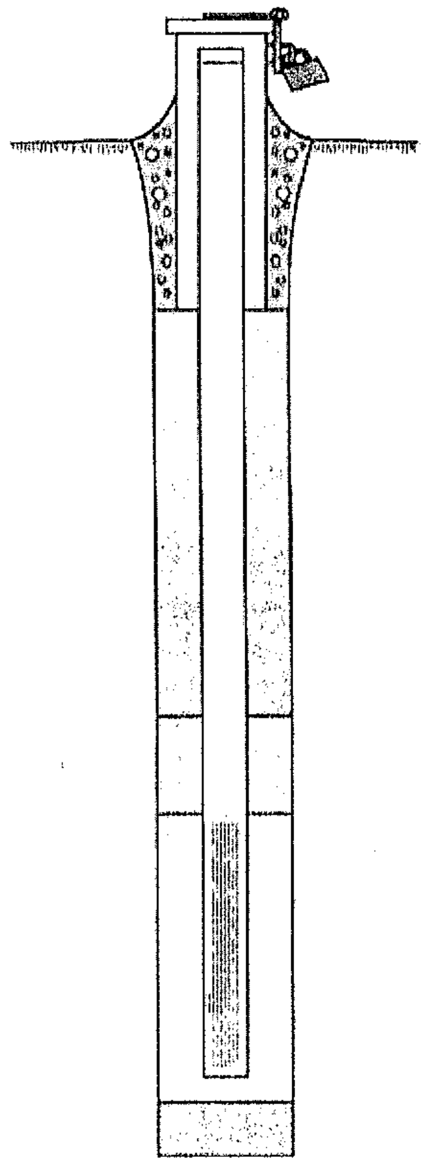


State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0006-18
Approved

Site Name/Physical Address:	**Well Registration No.** WV00528-0006-18	**Purpose of Monitoring Well:**
Site: John E. Amos Plant	**Grid Location:**	Assessment
Line 1: 1530 Winfield Rd.	**a. Latitude:** 38 27 41 .0	
Line 2:	**b. Longitude:** 81 51 13 .0	
City: Winfield	**c. Method Used:** GPS	
State: WV		
Zip: 25213-	**Company/Project Well No.:**	
County: Putnam	MW-1802C	
Well Owner (Name, Firm, Address):	**Installed By (Name, Firm, Address):**	**Date Well Installed:**
Owner: American Electric Power	Installer: AEP Dolan Lab	08/09/2018
Line 1: 1 Riverside Plaza	Line 1: 4001 Bixby Rd.	
Line 2:	Line 2:	**Driller's WV Cert No.**
City: Columbus	City: Groveport	WV00528
State: OH	State: OH	
Zip: 43215-	Zip: 43125-	
Phone: 614-836-4200	Phone: 614-836-4200	

Section B: (all number fields must be in decimal format)



1.Cap and Lock:	YES
2.Protective Cover:	Protective Cover Pipe
3.Monitoring Well Reference Point:	0 ft.
4.Borehole Diameter:	6 inches.
5.Ground Surface Seal:	
a.Material: bentonite-cement grout	
b.Installation Procedure: gravity	
6.Surface Seal Bottom/Annular Space Top:	2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.	
c.Material: PVC	
d.Installation Procedure: hand set	
8.Annular Space Seal:	
a.Material: high solids grout -	
b.Installation Procedure: tremie pipe-pumped	
9.Well Development Procedure: airlift -	
10.Drilling Method Used: air rotary -	
11.Annular Space Seal Bottom/Filter Seal Top:	201 ft.
12.Drilling Fluid Used: Yes Source: Water	
13.Filter Pack Seal:	
a.Material: bentonite pellet	
b.Installation Procedure: Gravity Fed	
c.Volume Added: 1000 pounds	
14.Bottom of Bentonite Seal/Filter Pack Top:	249 ft.
15.Depth to Top of Screen:	253.6 ft.
16.Screen:	
a.Material: PVC	
b.Installation Procedure: hand set	
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.	
17.Filter Pack:	
a.Material: fine sand	
b.Installation Procedure: gravity	
18.Well Depth:	273 ft.
19.Bottom of Filter Pack:	274.5 ft.
20.Bottom of Borehole:	274.5 ft.
21.Backfill Material (below filter pack): N/A	
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump	
23.Special Circumstances and Exceptions: No Variance Number:	
24.WV Contractor License No.	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0007-18
Approved

Site Name/Physical Address:	Well Registration No. WV00528-0007-18	Purpose of Monitoring Well:
Site: John E. Amos Plant	Grid Location:	Assessment
Line 1: 1530 Winfield Rd.	a. Latitude: 38 27 48 .0	
Line 2:	b. Longitude: 81 51 15 .0	
City: Winfield	c. Method Used: GPS	
State: WV		
Zip: 25213-	Company/Project Well No.:	
County: Putnam	MW-1803B	
Well Owner (Name, Firm, Address):	**Installed By (Name, Firm, Address):**	**Date Well Installed:**
Owner: American Electric Power	Installer: AEP Dolan Lab	08/09/2018
Line 1: 1 Riverside Plaza	Line 1: 4001 Bixby Rd.	
Line 2:	Line 2:	**Driller's WV Cert No.**
City: Columbus	City: Groveport	WV00528
State: OH	State: OH	
Zip: 43215-	Zip: 43125-	
Phone: 614-836-4200	Phone: 614-836-4200	

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES

2.Protective Cover: Protective Cover Pipe

3.Monitoring Well Reference Point: 0 ft.

4.Borehole Diameter: 6 inches.

5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity

6.Surface Seal Bottom/Annular Space Top: 2 ft.

7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set

8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped

9.Well Development Procedure: airlift -

10.Drilling Method Used: air rotary -

11.Annular Space Seal Bottom/Filter Seal Top: 153 ft.

12.Drilling Fluid Used: Yes Source: Water

13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds

14.Bottom of Bentonite Seal/Filter Pack Top: 168 ft.

15.Depth to Top of Screen: 171.4 ft.

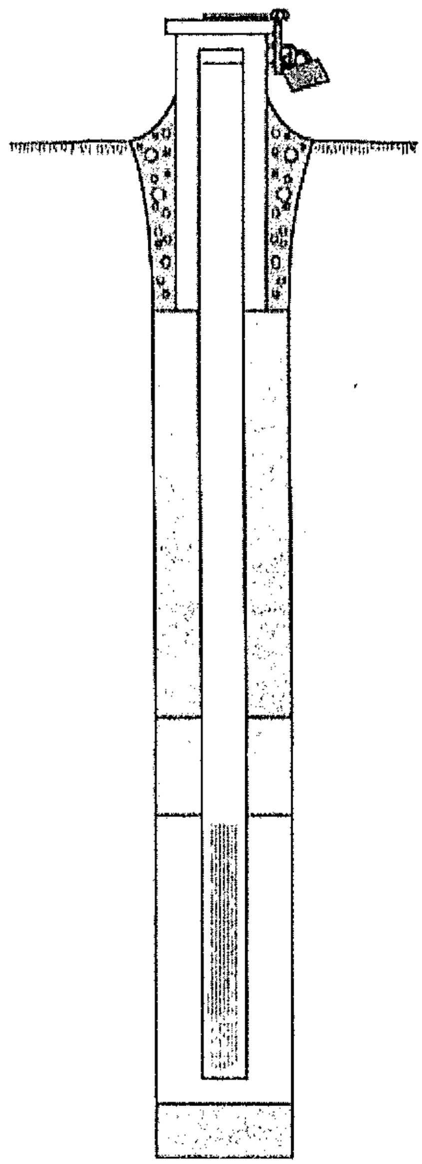
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 24.6 ft.

17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity

18.Well Depth: 196 ft.

19.Bottom of Filter Pack: 197 ft.

20.Bottom of Borehole: 197 ft.



21.Backfill Material (below filter pack): N/A

22.Decontamination Procedures: Liqui-Nox w/high pressure water pump

23.Special Circumstances and Exceptions: No Variance Number:

24.WV Contractor License No.

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0008-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0008-18
Grid Location:
a. Latitude: 38 27 48 .0
b. Longitude: 81 51 15 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1803C

Purpose of Monitoring Well:
Assessment

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

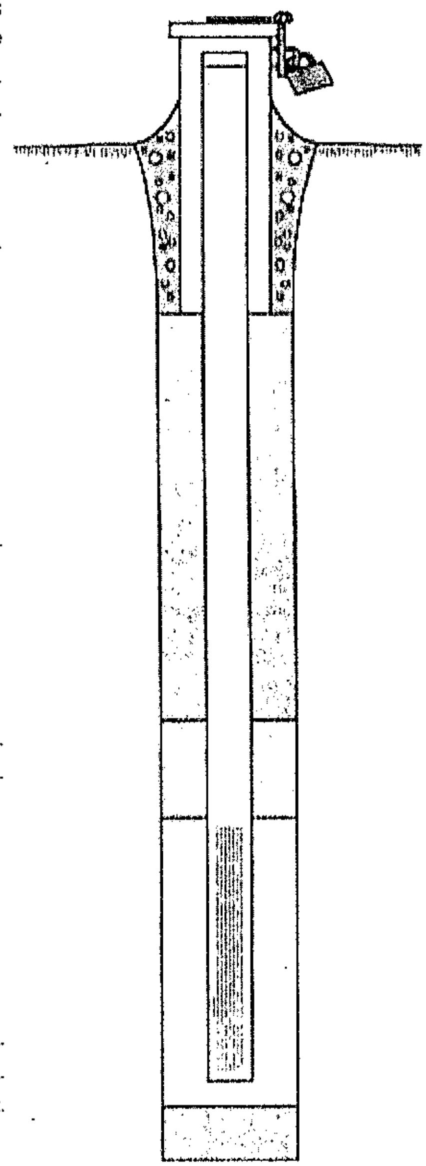
Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 157 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 1200 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 250 ft.
15.Depth to Top of Screen: 253.6 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 273 ft.
19.Bottom of Filter Pack: 275 ft.
20.Bottom of Borehole: 275 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00528-0001-19
Approved

Site Name/Physical Address:

Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0001-19
Grid Location:
a. Latitude: 38 27 42 .0
b. Longitude: 81 50 53 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1804A

Purpose of Monitoring Well:
Assessment

Well Owner (Name, Firm, Address):

Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):

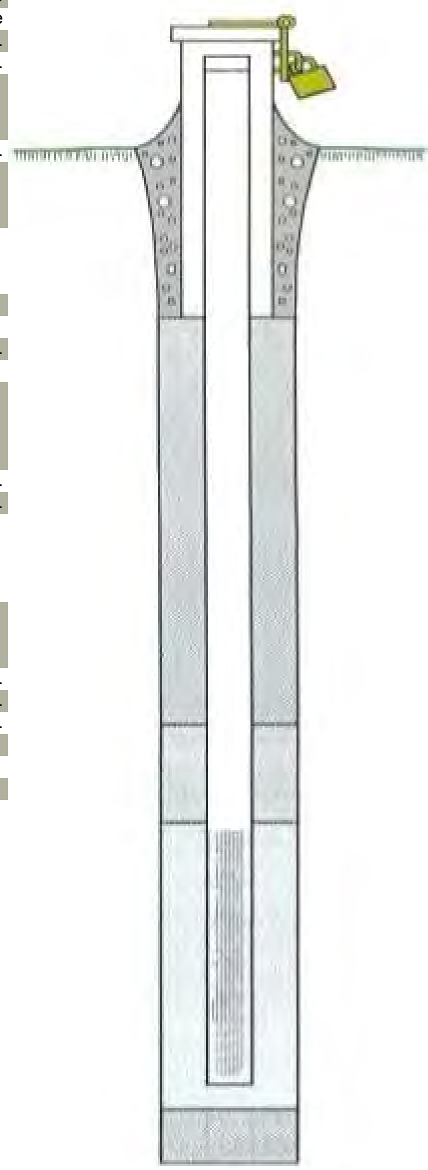
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
05/31/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock:	YES
2.Protective Cover:	Protective Cover Pipe
3.Monitoring Well Reference Point:	0 ft.
4.Borehole Diameter:	6 inches.
5.Ground Surface Seal: a.Material: bentonite-cement grout b.Installation Procedure: gravity	
6.Surface Seal Bottom/Annular Space Top:	2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches. c.Material: PVC d.Installation Procedure: hand set	
8.Annular Space Seal: a.Material: high solids grout - b.Installation Procedure: tremie pipe-pumped	
9.Well Development Procedure: airlift -	
10.Drilling Method Used: air rotary -	
11.Annular Space Seal Bottom/Filter Seal Top:	7 ft.
12.Drilling Fluid Used: Yes Source: Water	
13.Filter Pack Seal: a.Material: bentonite pellet b.Installation Procedure: Gravity Fed c.Volume Added: 150 pounds	
14.Bottom of Bentonite Seal/Filter Pack Top:	18.9 ft.
15.Depth to Top of Screen:	27.9 ft.
16.Screen: a.Material: PVC b.Installation Procedure: hand set c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.	
17.Filter Pack: a.Material: fine sand b.Installation Procedure: gravity	
18.Well Depth:	47.9 ft.
19.Bottom of Filter Pack:	49 ft.
20.Bottom of Borehole:	49 ft.
21.Backfill Material (below filter pack): N/A	
22.Decontamination Procedures: Liquid-Nox w/high pressure water pump	
23.Special Circumstances and Exceptions: No Variance Number:	
24.WV Contractor License No.	



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0009-18
Approved

Site Name/Physical Address: Site: John E. Amos Plant Line 1: 1530 Winfield Rd. Line 2: City: Winfield State: WV Zip: 25213- County: Putnam	**Well Registration No.** WV00528-0009-18 **Grid Location:** **a. Latitude:** 38 27 42 .0 **b. Longitude:** 81 50 53 .0 **c. Method Used:** GPS **Company/Project Well No.:** MW-1804B	**Purpose of Monitoring Well:** Assessment
Well Owner (Name, Firm, Address): Owner: American Electric Power Line 1: 1 Riverside Plaza Line 2: City: Columbus State: OH Zip: 43215- Phone: 614-836-4200	**Installed By (Name, Firm, Address):** Installer: AEP Dolan Lab Line 1: 4001 Bixby Rd. Line 2: City: Groveport State: OH Zip: 43125- Phone: 614-836-4200	**Date Well Installed:** 08/09/2018 **Driller's WV Cert No.** WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 134 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 148.7 ft.
15.Depth to Top of Screen: 152.6 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 24.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 177 ft.
19.Bottom of Filter Pack: 180.4 ft.
20.Bottom of Borehole: 194.3 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0010-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0010-18
Grid Location:
a. Latitude: 38 27 41 .0
b. Longitude: 81 50 27 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1805B

Purpose of Monitoring Well:
Assessment

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

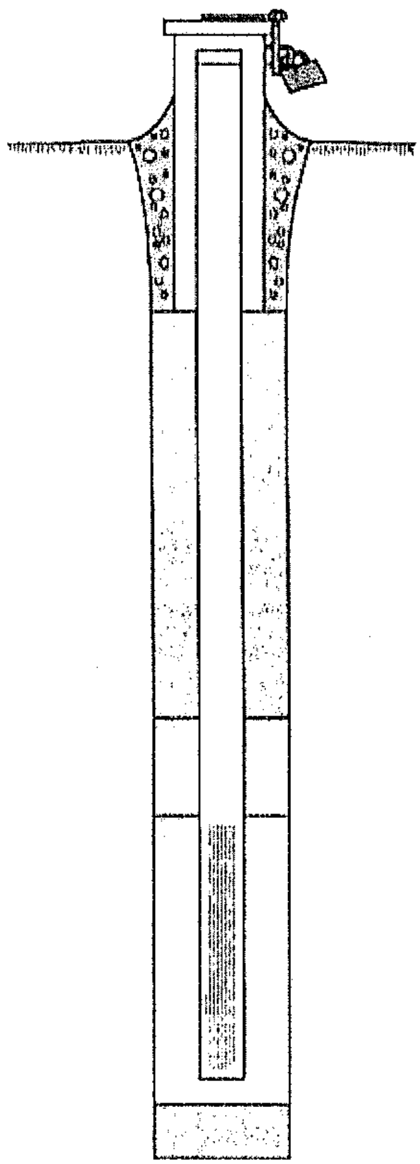
Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 174 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 189 ft.
15.Depth to Top of Screen: 192.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 212 ft.
19.Bottom of Filter Pack: 214 ft.
20.Bottom of Borehole: 214 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0011-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0011-18
Grid Location:
a. Latitude: 38 27 41 .0
b. Longitude: 81 50 27 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1805C

Purpose of Monitoring Well:
Assessment

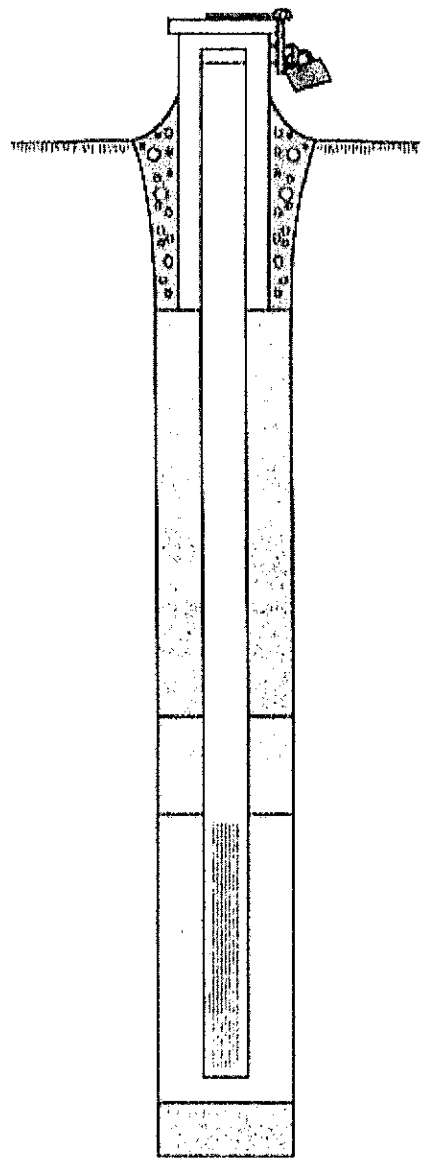
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 200 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 350 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 229 ft.
15.Depth to Top of Screen: 232.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 29.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 262 ft.
19.Bottom of Filter Pack: 264.5 ft.
20.Bottom of Borehole: 264.5 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.

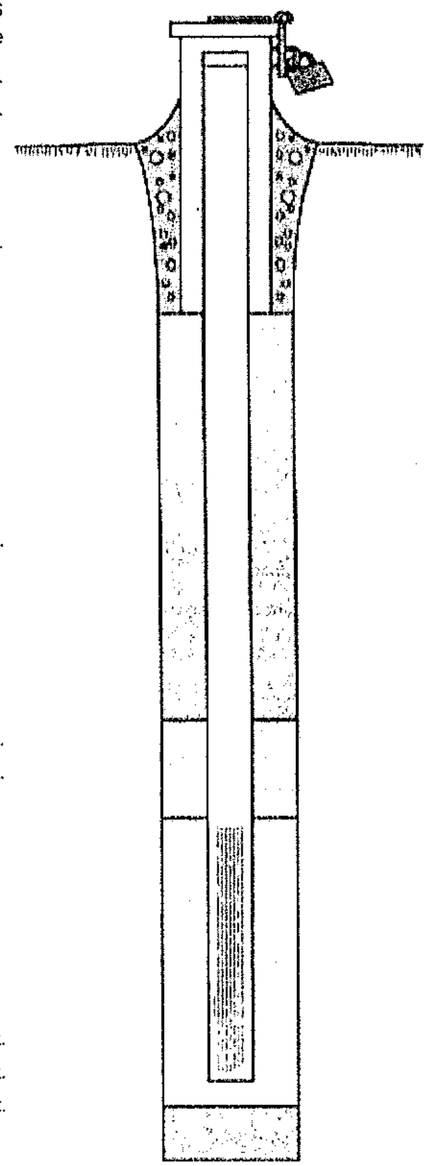
State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0012-18
Approved

Site Name/Physical Address:	Well Registration No. WV00528-0012-18	Purpose of Monitoring Well:
Site: John E. Amos Plant Line 1: 1530 Winfield Rd. Line 2: City: Winfield State: WV Zip: 25213- County: Putnam	**Grid Location:** **a. Latitude:** 38 27 36 .0 **b. Longitude:** 81 50 17 .0 **c. Method Used:** GPS **Company/Project Well No.:** MW-1806A	Assessment
Well Owner (Name, Firm, Address):	**Installed By (Name, Firm, Address):**	**Date Well Installed:**
Owner: American Electric Power Line 1: 1 Riverside Plaza Line 2: City: Columbus State: OH Zip: 43215- **Phone:** 614-836-4200	Installer: AEP Dolan Lab Line 1: 4001 Bixby Rd. Line 2: City: Groveport State: OH Zip: 43125- **Phone:** 614-836-4200	08/09/2018 **Driller's WV Cert No.** WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
 a.Material: bentonite-cement grout
 b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
 c.Material: PVC
 d.Installation Procedure: hand set
8.Annular Space Seal:
 a.Material: high solids grout -
 b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 45 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
 a.Material: bentonite pellet
 b.Installation Procedure: Gravity Fed
 c.Volume Added: 150 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 57 ft.
15.Depth to Top of Screen: 60.4 ft.
16.Screen:
 a.Material: PVC
 b.Installation Procedure: hand set
 c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.
17.Filter Pack:
 a.Material: fine sand
 b.Installation Procedure: gravity
18.Well Depth: 80 ft.
19.Bottom of Filter Pack: 81 ft.
20.Bottom of Borehole: 81 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0013-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0013-18
Grid Location:
a. Latitude: 38 27 36 .0
b. Longitude: 81 50 17 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1806B

Purpose of Monitoring Well:
Assessment

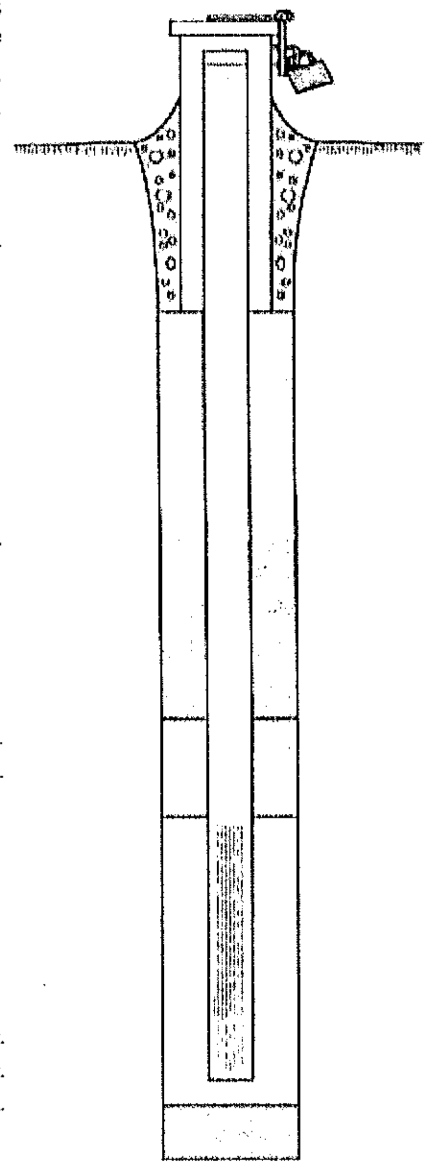
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 178.1 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 191.8 ft.
15.Depth to Top of Screen: 195.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 14.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 210 ft.
19.Bottom of Filter Pack: 211 ft.
20.Bottom of Borehole: 211 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00629-1806-18

Site Name/Physical Address:

Site: American Electric Ash Pond
Line 1: Bills Creek Pond Road
Line 2: Bills Creek Pond Road
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00629-1806-18
Grid Location:
a. Latitude: 38 27 36 .0
b. Longitude: 81 50 17 .0
c. Method Used: Computer Mapped/Generated Coordinates

Company/Project Well No.:
MW-1806-C

Purpose of Monitoring Well:
DEP requirement for background monitoring

Well Owner (Name, Firm, Address):

Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

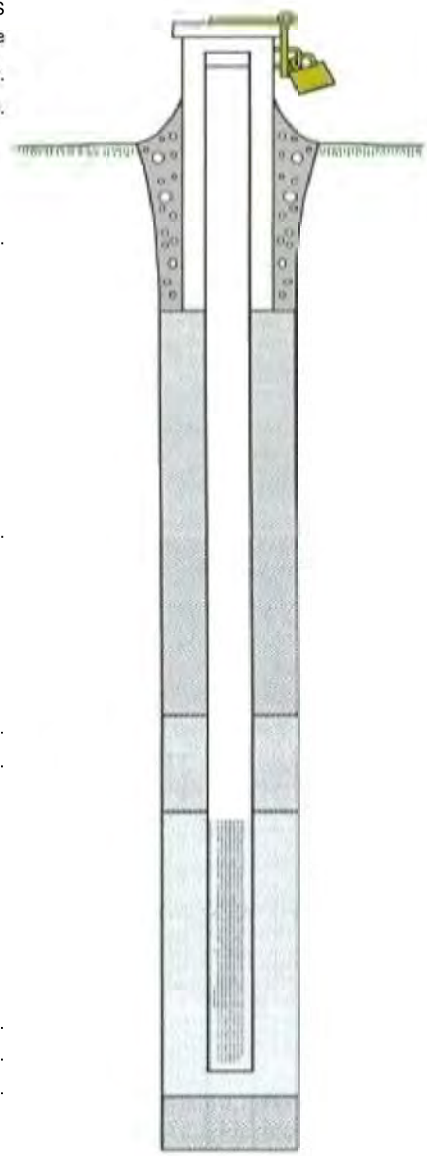
Installed By (Name, Firm, Address):

Installer: Larry Bartlett, DLZ Corp.
Line 1: 6121 Huntley Road
Line 2:
City: Columbus
State: OH
Zip: 43229-
Phone: 614-888-0040

Date Well Installed:
05/06/2018

Driller's WV Cert No.
WV00629

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
 a.Material: concrete
 b.Installation Procedure: Hand Placed
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
 c.Material: PVC
 d.Installation Procedure: Hand Set
8.Annular Space Seal:
 a.Material: cement grout -
 b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: mud rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 197 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
 a.Material: bentonite pellet
 b.Installation Procedure: Gravity Fed
 c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 220 ft.
15.Depth to Top of Screen: 225 ft.
16.Screen:
 a.Material: PVC
 b.Installation Procedure: set by hand
 c.Slot Size: 0.01 inches. d.Screen Length: 30 ft.
17.Filter Pack:
 a.Material: fine sand
 b.Installation Procedure: Gravity
18.Well Depth: 255 ft.
19.Bottom of Filter Pack: 255 ft.
20.Bottom of Borehole: 290.7 ft.
21.Backfill Material (below filter pack): #5 Sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00629-1807-18
Approved

Site Name/Physical Address:
Site: American Electric Power Amos Ash Pond
Line 1: Bills Creek Pond Road
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00629-1807-18
Grid Location:
a. Latitude: 38 27 17 .0
b. Longitude: 81 51 33 .0
c. Method Used: Survey

Company/Project Well No.:
MW-1807A

Purpose of Monitoring Well:
Monitoring background conditions

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: WV
Zip: 25213-
Phone: 614-836-4200

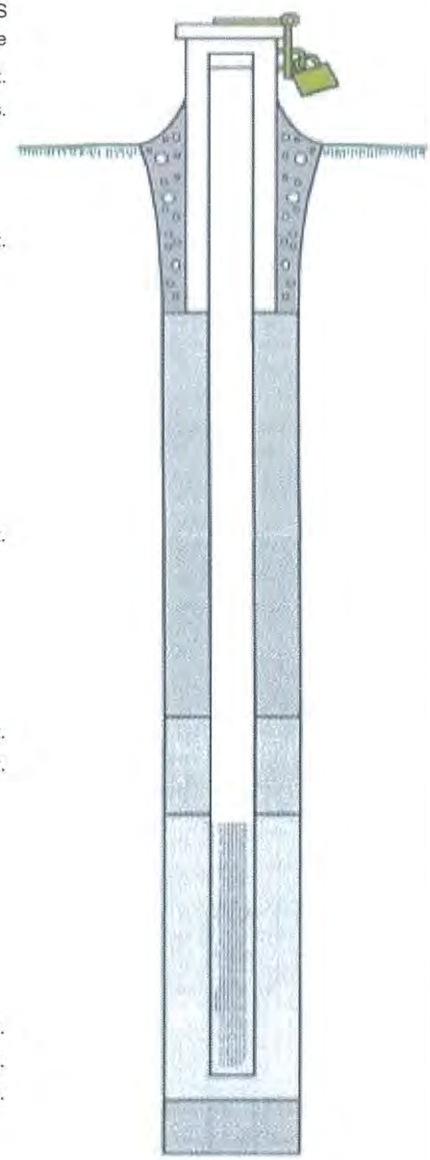
Installed By (Name, Firm, Address):
Installer: Larry Bartlett
Line 1: 6121 Huntley Road
Line 2:
City: Columbus
State: OH
Zip: 43229-
Phone: 614-888-0040

Date Well Installed:
05/29/2018

Driller's WV Cert No.
WV00629

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: surge/purge -
10.Drilling Method Used: mud rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 88 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 50 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 91 ft.
15.Depth to Top of Screen: 95 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: Gravity
18.Well Depth: 115 ft.
19.Bottom of Filter Pack: 116 ft.
20.Bottom of Borehole: 116 ft.
21.Backfill Material (below filter pack): NA
22.Decontamination Procedures: High Pressure hot water
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00629-0002-18
Approved

Site Name/Physical Address:
Site: American Electric Power Amos Ash Pond
Line 1: Bills Creek Pond Road
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00629-0002-18
Grid Location:
a. Latitude: 38 27 17 .0
b. Longitude: 81 51 32 .0
c. Method Used: Survey

Company/Project Well No.:
MW-1807B

Purpose of Monitoring Well:
Monitoring Background Conditions

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

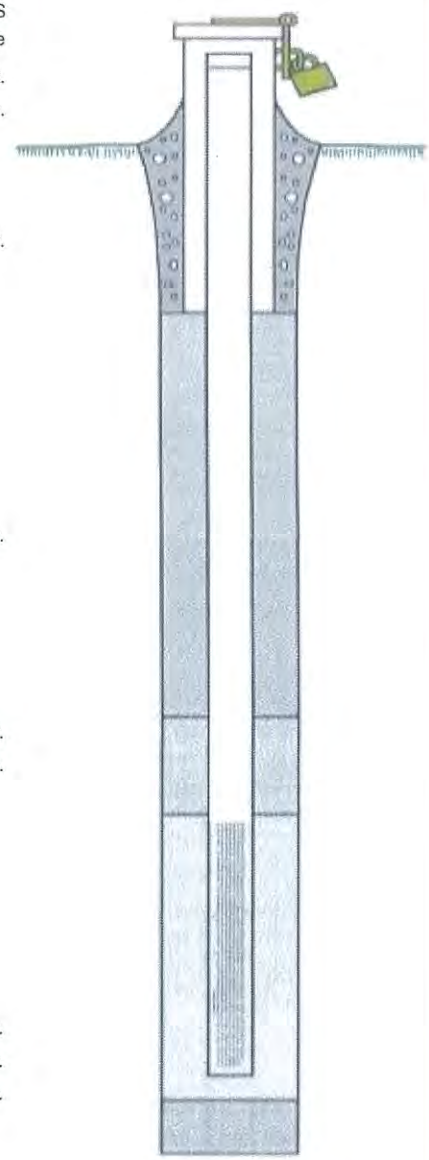
Installed By (Name, Firm, Address):
Installer: Larry Bartlett
Line 1: DLZ Corp.
Line 2:
City: Columbus
State: OH
Zip: 43229-
Phone: 614-888-0400

Date Well Installed:
06/01/2018

Driller's WV Cert No.
WV00629

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: tremie pipe pumped
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: cement grout -
b.Installation Procedure: tremie pipe-gravity
9.Well Development Procedure: surge/purge -
10.Drilling Method Used: mud rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 126 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 50 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 129 ft.
15.Depth to Top of Screen: 133 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: Gravity
18.Well Depth: 153 ft.
19.Bottom of Filter Pack: 155.7 ft.
20.Bottom of Borehole: 155.7 ft.
21.Backfill Material (below filter pack): NA
22.Decontamination Procedures: High Pressure hot water
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00629-0003-18
Approved

Site Name/Physical Address:
Site: American Electric Power Amos Ash Pond
Line 1: Bills Creek Pond Road
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00629-0003-18
Grid Location:
a. Latitude: 38 27 14 .0
b. Longitude: 81 51 22 .0
c. Method Used: Survey

Company/Project Well No.:
MW-1808A

Purpose of Monitoring Well:
monitoring background conditions

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

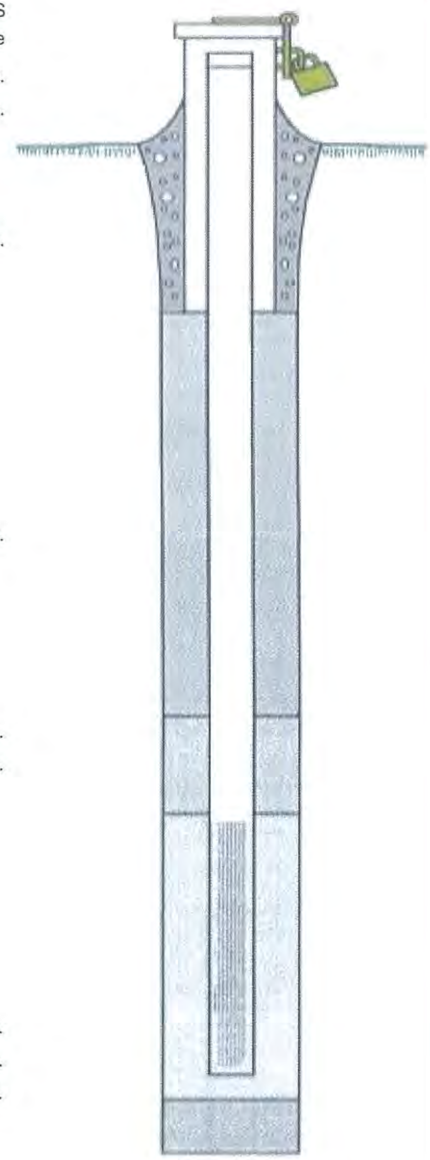
Installed By (Name, Firm, Address):
Installer: Larry Bartlett
Line 1: DLZ Corp
Line 2:
City: Columbus
State: OH
Zip: 43229-
Phone: 614-888-0400

Date Well Installed:
05/07/2018

Driller's WV Cert No.
WV00629

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: cement grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: surge/purge -
10.Drilling Method Used: mud rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 70 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 150 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 80 ft.
15.Depth to Top of Screen: 84.2 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 25 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: Gravity
18.Well Depth: 109.2 ft.
19.Bottom of Filter Pack: 112.7 ft.
20.Bottom of Borehole: 112.7 ft.
21.Backfill Material (below filter pack): NA
22.Decontamination Procedures: High Pressure hot water
23.Special Circumstances and Exceptions: No Variance Number:



<< Return

Home | Log Out

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00629-0004-18
Approved

Site Name/Physical Address:
Site: American Electric Power Amos Ash Pond
Line 1: Bills Creek Pond Road
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00629-0004-18
Grid Location:
a. Latitude: 38 27 14 .0
b. Longitude: 81 51 22 .0
c. Method Used: Survey

Company/Project Well No.:
MW-1808B

Purpose of Monitoring Well:
Monitoring background conditions

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

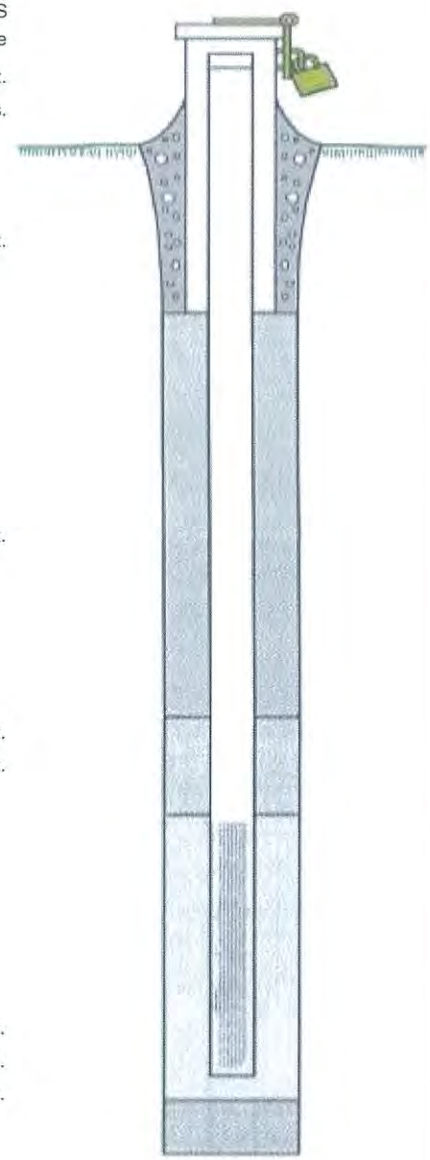
Installed By (Name, Firm, Address):
Installer: Larry Bartlett
Line 1: DLZ Corp
Line 2:
City: Columbus
State: OH
Zip: 43229-
Phone: 614-888-0400

Date Well Installed:
05/07/2018

Driller's WV Cert No.
WV00629

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: cement grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: surge/purge -
10.Drilling Method Used: mud rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 131 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 134 ft.
15.Depth to Top of Screen: 138.5 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: Gravity
18.Well Depth: 158.5 ft.
19.Bottom of Filter Pack: 165 ft.
20.Bottom of Borehole: 165 ft.
21.Backfill Material (below filter pack): NA
22.Decontamination Procedures: High Pressure hot water
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction

Well Number: WV00629-0005-18
Approved

Site Name/Physical Address:
Site: American Electric Power Amos Ash Pond
Line 1: Bills Creek Pond Road
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00629-0005-18
Grid Location:
a. Latitude: 38 27 14 .0
b. Longitude: 81 51 22 .0
c. Method Used: Survey

Company/Project Well No.:
MW-1808C

Purpose of Monitoring Well:
Monitoring background conditions

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

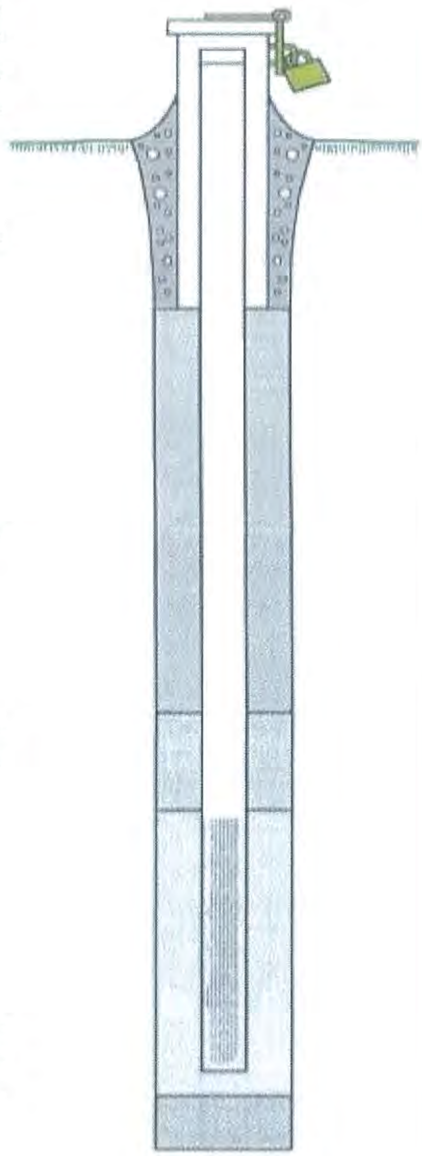
Installed By (Name, Firm, Address):
Installer: Larry Bartlett
Line 1: DLZ Corp
Line 2:
City: Columbus
State: OH
Zip: 43229-
Phone: 614-888-0400

Date Well Installed:
05/08/2018

Driller's WV Cert No.
WV00629

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: cement grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: surge/purge -
10.Drilling Method Used: mud rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 208 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 211 ft.
15.Depth to Top of Screen: 215 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 25 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: Gravity
18.Well Depth: 240 ft.
19.Bottom of Filter Pack: 242 ft.
20.Bottom of Borehole: 242 ft.
21.Backfill Material (below filter pack): NA
22.Decontamination Procedures: High Pressure hot water
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.



State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0014-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0014-18
Grid Location:
a. Latitude: 38 27 13 .0
b. Longitude: 81 51 37 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1809

Purpose of Monitoring Well:
Assessment

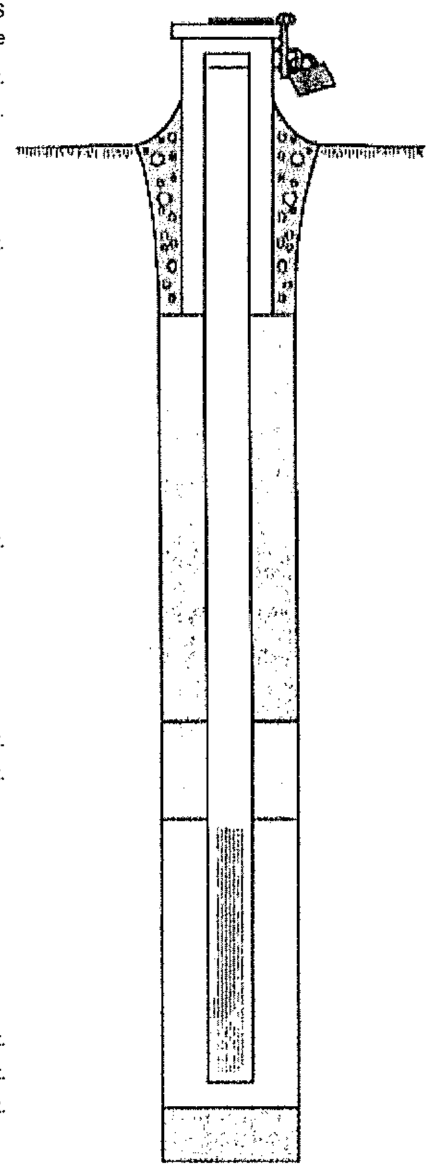
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 48 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 54 ft.
15.Depth to Top of Screen: 57.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 14.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 72 ft.
19.Bottom of Filter Pack: 74 ft.
20.Bottom of Borehole: 125.8 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0015-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0015-18
Grid Location:
a. Latitude: 38 27 10 .0
b. Longitude: 81 51 24 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1810

Purpose of Monitoring Well:
Assessment

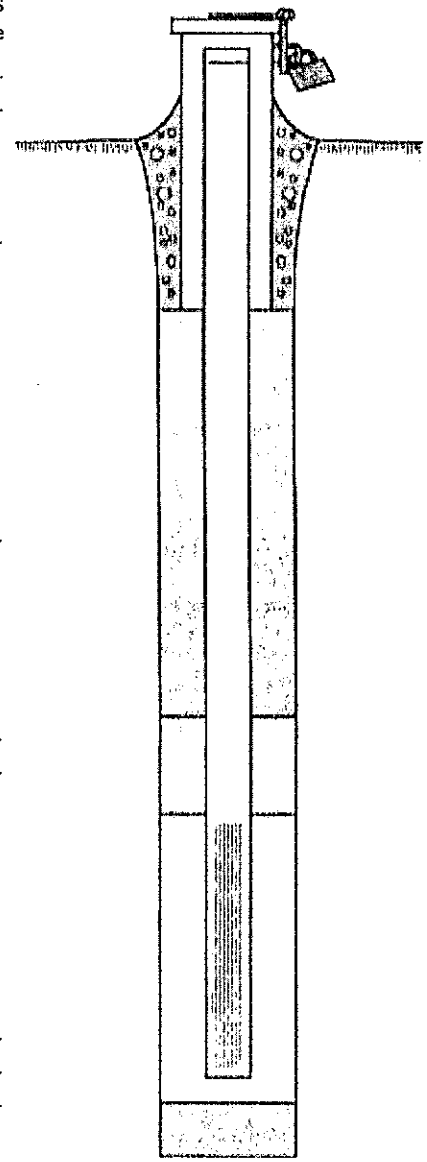
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/09/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 6 inches.
5.Ground Surface Seal:
a.Material: bentonite-cement grout
b.Installation Procedure: gravity
6.Surface Seal Bottom/Annular Space Top: 2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.
c.Material: PVC
d.Installation Procedure: hand set
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: tremie pipe-pumped
9.Well Development Procedure: airlift -
10.Drilling Method Used: air rotary -
11.Annular Space Seal Bottom/Filter Seal Top: 47 ft.
12.Drilling Fluid Used: Yes Source: Water
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 54 ft.
15.Depth to Top of Screen: 60.4 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: hand set
c.Slot Size: 0.02 inches. d.Screen Length: 19.6 ft.
17.Filter Pack:
a.Material: fine sand
b.Installation Procedure: gravity
18.Well Depth: 80 ft.
19.Bottom of Filter Pack: 82 ft.
20.Bottom of Borehole: 125.8 ft.
21.Backfill Material (below filter pack): N/A
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
23.Special Circumstances and Exceptions: No Variance Number:
24.WV Contractor License No.

APPENDIX C

Well Survey

Banks Well Report

Prepared for:

ARCADIS U.S., INC.-Columbus
630 Plaza Drive, Suite 600
Highlands Ranch, CO 80129

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report

AMOS PLANT

WV

PO #: WV015976.0004

ES-124909

Thursday, July 20, 2017

Banks Environmental Data, Inc. - 1601 Rio Grande, Ste. 331 - Austin, TX 78701 - 800.531.5255 P - 512.478.1433 F
www.banksenvdata.com

Table of Contents

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Banks Environmental Data, Inc. - 1601 Rio Grande, Ste. 331 - Austin, TX 78701 - 800.531.5255 P - 512.478.1433 F
www.banksenvdata.com

Geographic Summary

Location
WV
Target location is 0.316 square miles and has a 6.52 mile perimeter

Coordinates	
Longitude & Latitude in Degrees Minutes Seconds	NA
Longitude & Latitude in Decimal Degrees	NA
X and Y in UTM	NA

Elevation
NA

Zip Codes Searched

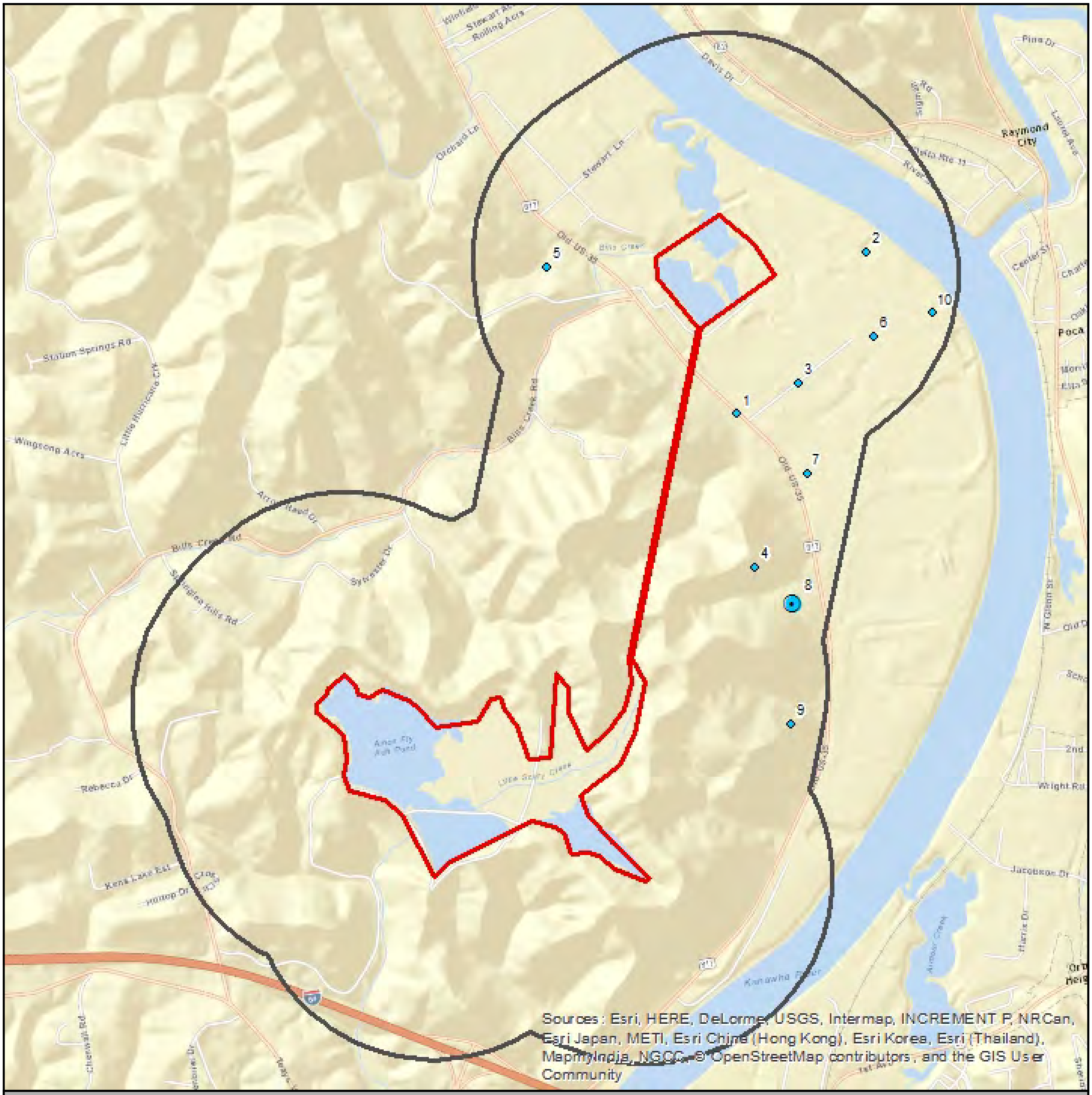
Search Distance	Zip Codes (historical zip codes included)
Target Property	25213, 25070, 25109, 25124
0.5 miles	25143, 25159, 25213, 25070, 25109, 25124, 25560

Topos Searched

Search Distance	Topo Name
Target Property	Saint Albans (1980)
0.5 miles	Saint Albans (1980)

Summary Map - 0.5 Mile Buffer

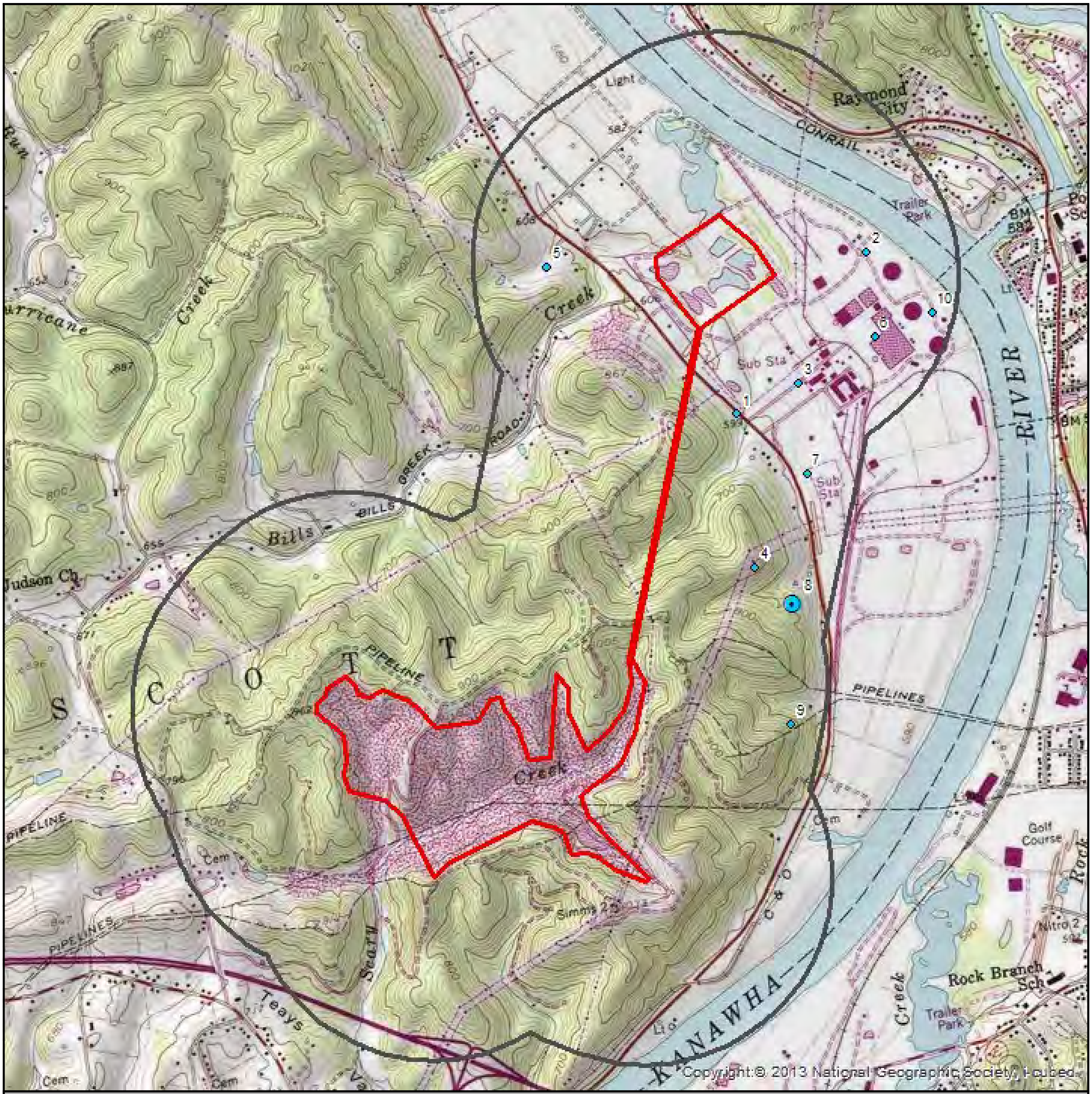
BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP



AMOS PLANT

Topographic Overlay Map - 0.5 Mile Buffer

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP



AMOS PLANT

Well

Well Cluster

Target Property

Search Buffer

Target Property Quad Name(s)
Saint Albans (1980)

1 : 25,000

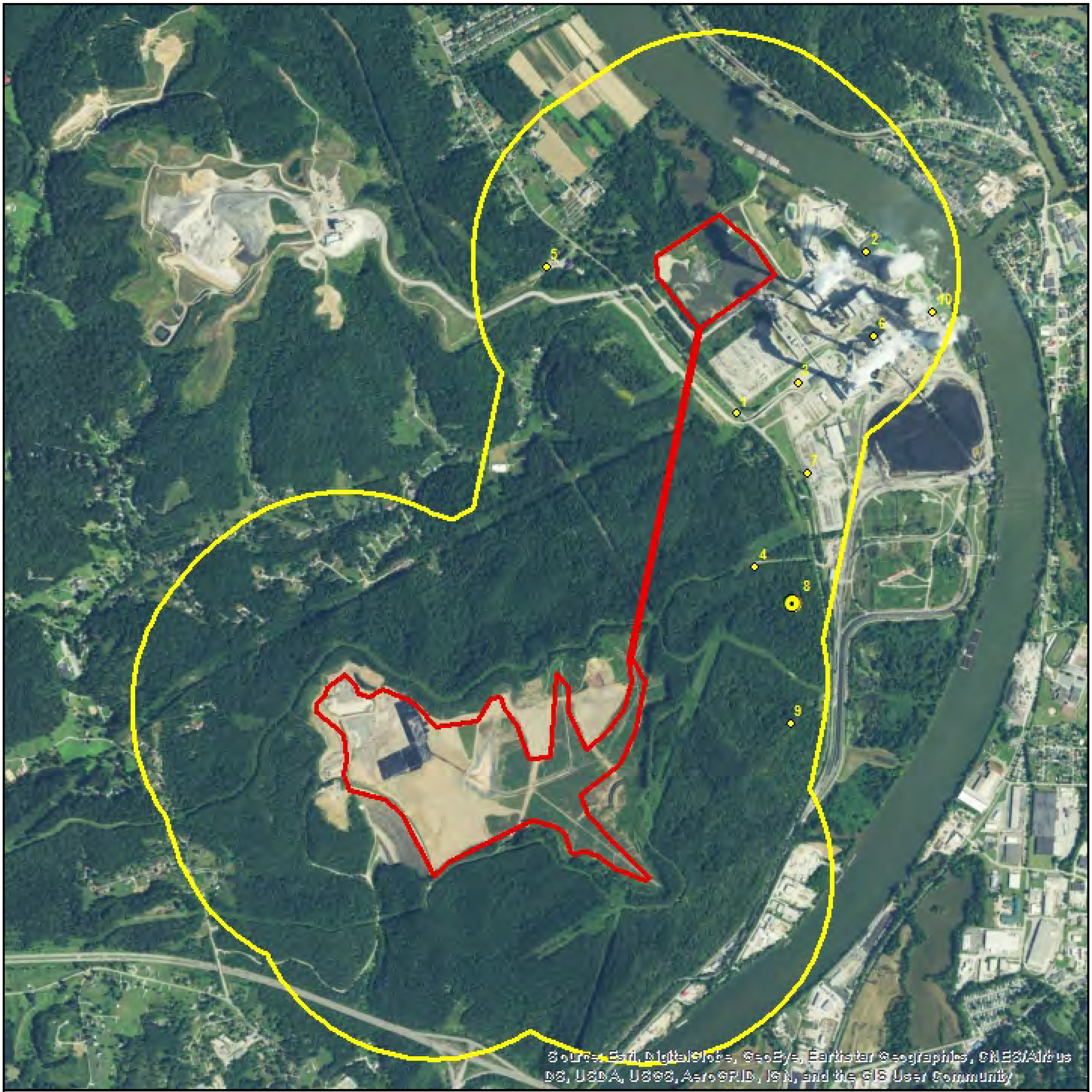
1 inch = 0.395 miles
1 inch = 2083 feet

Lambert Conformal Conic Projection
1983 North American Datum
First Standard Parallel: 33 0' 00" North
Second Standard Parallel: 45 0' 00" North
Central Meridian: 96 0' 00" West
Latitude of Origin: 39 0' 00" North

N

Current Imagery Overlay Map - 0.5 Mile Buffer

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP



AMOS PLANT

Well
Well Cluster
Target Property
Search Buffer

1 : 25,000
1 inch = 0.395 miles
1 inch = 2083 feet
1 centimeter = 0.250 kilometers
1 centimeter = 250 meters

N

Lambert Conformal Conic Projection
1983 North American Datum
First Standard Parallel: 33 0' 00" North
Second Standard Parallel: 45 0' 00" North
Central Meridian: 96 0' 00" West
Latitude of Origin: 39 0' 00" North

Water Well Details

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Map ID	Source ID	Dataset	Owner of Well	Type of Well	Depth Drilled	Completion Date	Longitude	Latitude	Elevation	Driller's Logs
1	USGS-382818081495101	WW USGS	USGS	Not Reported	15	01/01/1960	-81.830687	38.471758	603 ft	N/A
2	USGS-382838081492301	WW USGS	USGS	Not Reported	20	01/01/1960	-81.822909	38.477314	587 ft	N/A
3	USGS-382821081493901	WW USGS	USGS	Not Reported	25	01/01/1960	-81.827354	38.472591	587 ft	N/A
4	USGS-382756081495201	WW USGS	USGS	Not Reported	15	01/01/1960	-81.830965	38.465647	828 ft	N/A
5	USGS-382843081502101	WW USGS	USGS	Not Reported	128	01/01/1938	-81.839021	38.478702	616 ft	N/A
6	USGS-382826081492401	WW USGS	USGS	Not Reported	56	01/01/1960	-81.823187	38.47398	591 ft	N/A
7	USGS-382808081494001	WW USGS	USGS	Not Reported	25	01/01/1960	-81.827631	38.46898	587 ft	N/A
8	USGS-382750081494601	WW USGS	USGS	Not Reported	57	01/01/1930	-81.829298	38.46398	703 ft	N/A
8	USGS-382750081494602	WW USGS	USGS	Not Reported	28	01/01/1915	-81.829298	38.46398	703 ft	N/A
9	USGS-382733081495001	WW USGS	USGS	Not Reported	37	01/01/1920	-81.830409	38.459258	748 ft	N/A
10	USGS-382828081491301	WW USGS	USGS	Not Reported	20	01/01/1960	-81.820131	38.474536	589 ft	N/A

Well Summary

Water Well Dataset	# of Wells
WW USGS	11
Total Count	**11**

Dataset Descriptions and Sources

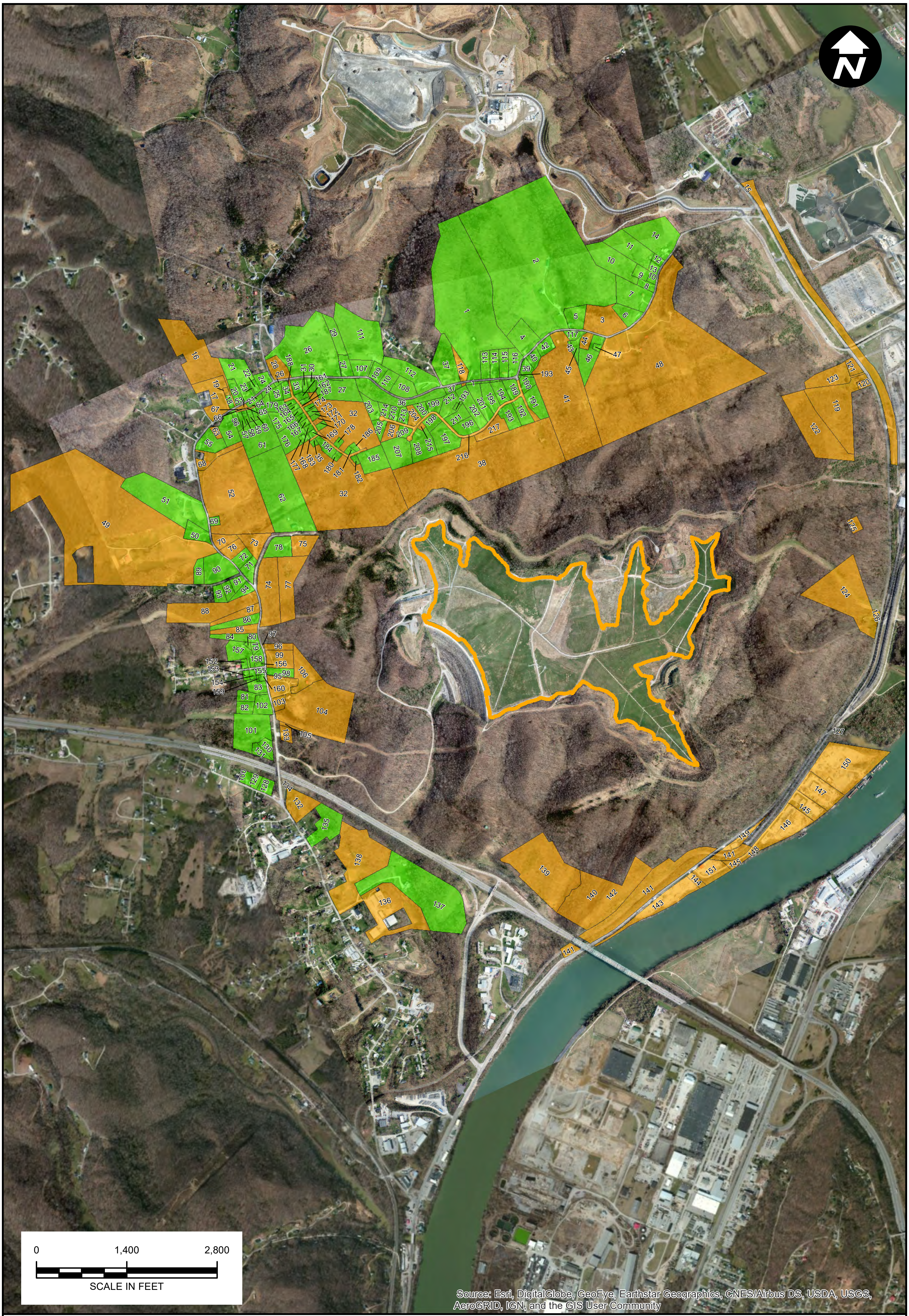
BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Dataset	Source	Dataset Description	Update Schedule	Data Requested	Data Obtained	Data Updated	Source Updated
WV WW - West Virginia Water Wells	West Virginia Department of Health and Human Resources	This dataset contains groundwater well information provided by West Virginia Department of Health and Human Resources.	As requested	N/A	N/A	N/A	N/A
WW USGS - USGS Water Wells	U.S. Geological Survey	This dataset contains groundwater well records from the U.S. Geological Survey.	Semi-annually	04/18/2017	04/18/2017	05/07/2017	04/18/2017

Disclaimer

The Banks Environmental Data Water Well Report was prepared from existing state water well databases and/or additional file data/records research conducted at the state agency and the U.S. Geological Survey. Banks Environmental Data has performed a thorough and diligent search of all groundwater well information provided and recorded. All mapped locations are based on information obtained from the source. Although Banks performs quality assurance and quality control on all research projects, we recognize that any inaccuracies of the records and mapped well locations could possibly be traced to the appropriate regulatory authority or the actual driller. It may be possible that some water well schedules and logs have never been submitted to the regulatory authority by the water driller and, thus, may explain the possible unaccountability of privately drilled wells. It is uncertain if the above listing provides 100% of the existing wells within the area of review. Therefore, Banks Environmental Data cannot fully guarantee the accuracy of the data or well location(s) of those maps and records maintained by the regulatory authorities.

Putnam County Public Services District Potable Water Survey



LEGEND

- Database And Public Record Review Indicate Parcel Is Serviced By The Public Potable Water Supply
- Database And Public Record Review Were Unable To Determine The Source For Potable Water For This Parcel, If Present
- CCR Unit Boundary

NOTES:

1. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. PARCEL LOCATIONS FROM WVU GIS CLEARINGHOUSE.
4. WEST VIRGINIA 1983 STATE PLANAR COORDINATES
5. INFORMATION PROVIDED BY PUTNAM COUNTY PUBLIC SERVICES DISTRICT.

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

POTABLE WELL SEARCH REGIONAL MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
C-1

CITY: Novi DIV: ENV DB: TRY PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane West Virginia South FIPS 4702 Feet
Z:\GISProjects_ENV\AEP\Amos\mxd\Potable Well Search Appendix\AmosRegionalMapParcelsPortrait.mxd PLOTTED: 1/18/2019 11:23:35 AM BY: akens

Table C-1
Potable Well Search Summary
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Potable Source Confirmation	Parcel ID	Map ID	Parcel Size	Physical address	Year Constructed	Land Use	Owner	Owner Address
Yes	40-10- 205-0053-0001	12	0.51787	356 BILLS CRK RD, WINFIELD WV	1900	101 - Residential 1 Family	STANLEY TERESSA L & RICKEY A	356 BILLS CRK RD, WINFIELD WV
Yes	40-10- 215-0011-0000	24	1.540583	1734 BILLS CRK RD, WINFIELD WV	1953	101 - Residential 1 Family	SHAFER DANIEL O	1070 BILLS CREEK RD, WINFIELD WV
Yes	40-10- 215-0029-0003	72	1.260765	2391 BILLS CRK RD, WINFIELD WV	1998	101 - Residential 1 Family	TAYLOR THOMAS D III &	PO BOX 298, SCOTT DEPOT WV
Yes	40-10- 215-0029-0009	78	2.703695	147 COUGAR MOUNTAIN RD, WINFIELD WV	2012	101 - Residential 1 Family	SWEENEY PHILIP D II &	147 COUGAR MOUNTAIN RD, WINFIELD WV
Yes	40-10- 215-0033-0003	80	0.184	46 KENS LAKE EST RD, WINFIELD WV	1976	100 - Residential Vacant	MOLLOHAN WHITNEY L	46 KENS LAKE EST RD, WINFIELD WV
Yes	40-10- 215-0042-0003	98	1.163599	2145 BILLS CRK RD, WINFIELD WV	1962	100 - Residential Vacant	SNYDER WILLIAM R ET UX	2145 BILLS CREEK RD, WINFIELD WV
Yes	40-10- 215-0075-0000	111	10.554821	1450 BILLS CRK RD, WINFIELD WV	2013	101 - Residential 1 Family	WHEELER MICHAEL S & TERESA R	1450 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0205-0048-0000	1	39.641702	1090 BILLS CRK RD, WINFIELD WV	1900	112 - Active Farm	BUZZARD LLOYD DANIEL	1090 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0205-0049-0000	2	79.456499	440 BILLS CRK RD, WINFIELD WV	2007	112 - Active Farm	MCB FARMS LLC	440 BILLS CRK RD, WINFIELD WV
Yes	40-10-0205-0049-0002	4	3.693111	500 BILLS CRK RD, WINFIELD WV	1963	101 - Residential 1 Family	FAIRCHILD LANCE C & MELANIE	500 BILLS CRK RD, WINFIELD WV
Yes	40-10-0205-0049-0003	5	2.326726	750 BILLS CRK RD, WINFIELD WV	1980	101 - Residential 1 Family	GUY CHARLES W ET UX	380 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0205-0050-0000	6	2.061352	260 BILLS CRK RD, WINFIELD WV	1960	101 - Residential 1 Family	FOSTER M STEPHEN	1721 WINFIELD RD, WINFIELD WV
Yes	40-10-0205-0051-0000	7	4.738801	240 BILLS CREEK RD, WINFIELD WV	1997	101 - Residential 1 Family	COLEMAN BRIAN ET UX	240 BILLS CREEK, WINFIELD WV
Yes	40-10-0205-0052-0000	8	0.75605	230 BILLS CRK RD, WINFIELD WV	1947	110 - Salvage Value Building	WYMER JANET GAIL ET CON	398 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0205-0052-0001	9	1.061665	398 BILLS CRK RD, WINFIELD WV	1966	101 - Residential 1 Family	WYMER PAUL E ET UX	398 BILLS CRK RD, WINFIELD WV
Yes	40-10-0205-0052-0002	10	6.263197			100 - Residential Vacant	WYMER PAUL E ET UX	398 BILLS CRK RD, WINFIELD WV
Yes	40-10-0205-0053-0000	11	5.166967			109 - Auxiliary Improvement	WYMER PAUL E ET UX	398 BILLS CRK RD, WINFIELD WV
Yes	40-10-0205-0053-0002	13	0.55599	190 BILLS CRK RD, WINFIELD WV	NA	108 - Mobile Home	SNYDER JOYCE K	PO BOX 373, NITRO WV
Yes	40-10-0205-0054-0000	14	7.302649	312 BILLS CRK RD, WINFIELD WV	1964	101 - Residential 1 Family	ALLISON THERESA	312 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0006-0002	18	0.388266	1166 BILLS CRK RD, WINFIELD WV	1988	101 - Residential 1 Family	PARSONS RAYMOND E ET UX	1836 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0008-0000	20	1.248307	1160 BILLS CRK RD, WINFIELD WV	2002	101 - Residential 1 Family	HARPOLD RANDALL CLARK ET UX	1818 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0009-0000	21	4.945652	1130 BILLS CRK RD, WINFIELD WV	1963	101 - Residential 1 Family	SMITH DAVID B	1798 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0009-0001	22	0.490998	1770 BILLS CRK RD, WINFIELD WV	1975	101 - Residential 1 Family	PAYNE JOHN R	1770 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0009-0003	23	0.108919	1770 BILLS CRK RD, WINFIELD WV	1975	100 - Residential Vacant	PAYNE JOHN R & JUDITH YVONNE	1770 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0012-0000	25	0.990225	1725 BILLS CRK RD, WINFIELD WV	1957	101 - Residential 1 Family	TERRY NELLIE Y	1725 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0013-0000	26	16.571687	1506 BILLS CRK RD, WINFIELD WV	1956	101 - Residential 1 Family	NEARY FRANK D ET UX	1506 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0013-0001	27	6.190993	1506 BILLS CRK RD, WINFIELD WV	1964	101 - Residential 1 Family	NEARY FRANK & PATRICIA G	1506 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0013-0006	29	2.398821	955 BILLS CRK RD, WINFIELD WV	1991	102 - Residential 2 Family	NEARY FRANK D ET UX	1506 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0014-0000	30	0.630041	1605 BILLS CRK RD, WINFIELD WV	1956	101 - Residential 1 Family	FORD MARK S II & JESSICA	1605 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0014-0001	31	0.364756	983 BILLS CREEK RD, WINFIELD WV	1986	101 - Residential 1 Family	LEWIS MARY ANN	1627 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0015-0001	33	0.8167	23 SPRINGLEA DR, WINFIELD WV	1967	101 - Residential 1 Family	ROLLYSON STEPHEN E ET UX	103 SPRINGLEA DR, WINFIELD WV
Yes	40-10-0215-0015-0006	34	0.705335	1011 BILLS CRK RD, WINFIELD WV	1967	101 - Residential 1 Family	CHILDRESS DOROTHY J	1687 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0015-0008	35	0.24334	120 SPRINGLEA HILLS , WINFIELD WV	1980	101 - Residential 1 Family	BRAGG NANCY RUTH ET AL	107 BRAGG FARM RD, CHARLESTON WV
Yes	40-10-0215-0016-0000	36	5.126583	1409 BILLS CREEK RD, WINFIELD WV	1946	101 - Residential 1 Family	CURRY WILLIAM J ET UX	1409 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0018-0000	37	5.476825	1182 BILLS CRK RD, WINFIELD WV	1958	101 - Residential 1 Family	HUNTER LORRAINE M	17 THORNHILL ESTS, POCA WV
Yes	40-10-0215-0019-0002	39	0.979611	475 BILLS CRK RD, WINFIELD WV	1997	101 - Residential 1 Family	BURDETTE LESLIE L & MARY M	945 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0020-0000	40	0.967697	473 BILLS CRK RD, WINFIELD WV	1996	101 - Residential 1 Family	GRIGSBY DAVID E ET UX	895 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0021-0001	42	1.199409	471 BILLS CRK RD, WINFIELD WV	1994	101 - Residential 1 Family	DUNLAP RONALD I ET UX	471 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0021-0002	43	0.227472	701 BILLS CRK RD, WINFIELD WV	NA	100 - Residential Vacant	BUSH LINDA MCCORMICK	701 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0022-0001	45	0.84929	701 BILLS CRK RD, WINFIELD WV	NA	108 - Mobile Home	BUSH LINDA MCCORMICK	701 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0023-0000	46	3.252579	351 BILLS CRK RD, WINFIELD WV		100 - Residential Vacant	HAULDREN RUSSELL D & MARK E	351 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0023-0001	47	0.368875	689 BILLS CREEK RD, WINFIELD WV	1958	108 - Mobile Home	JUSTICE PHYLLIS M ET AL	659 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0025-0001	50	2.050981	2286 BILLS CRK RD, WINFIELD WV	1955	101 - Residential 1 Family	HARTLEY EDSEL L ET UX	2286 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0026-0003	51	12.947141	1632 BILLS CREEK RD, WINFIELD WV	2006	101 - Residential 1 Family	DYER BENJAMIN W ET UX	1632 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0028-0002	54	2.593486	1341 BILLS CREEK RD, WINFIELD WV	1954	101 - Residential 1 Family	COVERT MARY K	1891 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0028-0003	55	2.488699	1491 BILLS CRK RD, WINFIELD WV	1993	101 - Residential 1 Family	WARNER NATHANIEL G ET AL	2003 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0028-0004	56	0.570345	1311 BILLS CREEK RD, WINFIELD WV	1969	101 - Residential 1 Family	SABER CHARLES R ET UX	12 MAGPIE DR, WINFIELD WV

Table C-1
Potable Well Search Summary
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

ARCADIS Design & Consultancy for natural and built assets

Potable Source Confirmation	Parcel ID	Map ID	Parcel Size	Physical address	Year Constructed	Land Use	Owner	Owner Address
Yes	40-10-0215-0028-0005	57	0.428144	1281 BILLS CRK RD, WINFIELD WV	1969	101 - Residential 1 Family	GOWMAN DAVID R & DONNA R	18 MAGPIE DR, WINFIELD WV
Yes	40-10-0215-0028-0006	58	0.363414	1251 BILLS CRK RD, WINFIELD WV	1969	101 - Residential 1 Family	FLEMING KEITH W ET UX	1251 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0028-0007	59	0.326813	46 MAGPIE RD, WINFIELD WV	1969	101 - Residential 1 Family	DENNISON WALTER L	46 MAGPIE RD, WINFIELD WV
Yes	40-10-0215-0028-0008	60	0.335488	1191 BILLS CRK RD, WINFIELD WV	1969	101 - Residential 1 Family	ISNER GARY W ET UX	1191 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0028-0010	61	7.053467	1175 BILLS CRK RD, WINFIELD WV	2001	101 - Residential 1 Family	BROWNING BILLY S JR	PO BOX 542, TEAYS WV
Yes	40-10-0215-0028-0011	62	17.953175	233 BILLS CRK RD, WINFIELD AL	NA	109 - Auxiliary Improvement	KAPP KENNETH M ET UX	14368 DOE RUN, HARVEST AL
Yes	40-10-0215-0028-0013	64	0.031674	1191 BILLS CRK RD, WINFIELD WV	1969	100 - Residential Vacant	ISNER GARY W ET UX	1191 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0028-0020	69	0.505742	1641 BILLS CRK , WINFIELD WV	1966	101 - Residential 1 Family	BIAS MELISSA	2247 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0029-0002	71	1.362386	1803 BILLS CRK RD, WINFIELD WV	2007	101 - Residential 1 Family	SELBE JAMES RAY	2481 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0033-0002	79	0.476285	2142 BILLS CRK RD, WINFIELD WV	1999	101 - Residential 1 Family	WOODALL ANGELA J	2142 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0033-0006	81	1.169064	2350 BILLS CREEK RD, WINFIELD WV	1969	112 - Active Farm	SLATER CRAIG S ET UX	2350 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0033-0008	82	1.180655	2350 BILLS CREEK RD, WINFIELD WV	1969	112 - Active Farm	SLATER CRAIG S ET UX	2350 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0033-0009	83	1.305471	2270 BILLS CRK, WINFIELD WV	NA	112 - Active Farm	SLATER CRAIG SCOTT ET UX	2350 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0034-0000	84	1.899564	2118 BILLS CRK RD, WINFIELD WV	1959	101 - Residential 1 Family	DAVIS MATTHEW L	2140 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0036-0000	86	1.99251	2588 BILLS CRK RD, WINFIELD WV	1962	101 - Residential 1 Family	MURPHY DANIEL	RT 4 BOX 9, HURRICANE WV
Yes	40-10-0215-0039-0000	89	1.333315	1720 BILLS CRK RD, WINFIELD WV	NA	100 - Residential Vacant	CONNER EDWIN T	2362 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0040-0000	90	4.178862	1720 BILLS CREEK RD, WINFIELD WV	1958	101 - Residential 1 Family	CONNER EDWIN T ET UX	2362 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0040-0001	91	0.891494	1800 BILLS CRK (REBECCA DR) RD, WINFIELD WV	1974	101 - Residential 1 Family	RUCKER DONALD GAY ET UX	2452 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0040-0002	92	0.930995	5 REBECCA DR, WINFIELD WV	1969	101 - Residential 1 Family	ALLEY DAVID G	5 REBECCA DR, WINFIELD WV
Yes	40-10-0215-0040-0003	93	1.075798	9 REBECCA DR, WINFIELD WV	1972	101 - Residential 1 Family	CRAWFORD CLINTON H ET AL	79 REBECCA DR, WINFIELD WV
Yes	40-10-0215-0041-0000	94	1.014125	2000 BILLS CREEK RD, WINFIELD WV	1989	101 - Residential 1 Family	CRACE RANDY B II	2484 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0066-0000	100	0.724083	4826 TEAYS VALLEY RD, WINFIELD WV	1963	101 - Residential 1 Family	STOWERS PHYLLIS JEAN	4826 TEAYS VALLEY RD, SCOTT DEPOT WV
Yes	40-10-0215-0067-0000	101	6.581074	2440 BILLS CRK RD, WINFIELD WV	1962	101 - Residential 1 Family	VELEAIR C SMITH MANAGEMENT LLC	112 BROOKS ST, CHARLESTON WV
Yes	40-10-0215-0068-0000	102	1.839382	2410 BILLS CRK RD, WINFIELD WV	NA	100 - Residential Vacant	HALSTEAD JASON ET AL	RR 1 BOX 28-10, RED HOUSE WV
Yes	40-10-0215-0073-0000	107	1.570166	1466 BILLS CREEK RD, WINFIELD WV	1963	101 - Residential 1 Family	THOMPSON LEONARD F JR ET UX	1466 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0074-0000	108	2.19403	1392 BILLS CRK RD, WINFIELD WV	1980	109 - Auxiliary Improvement	WELCH GREGORY L ET UX	1392 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0074-0001	109	1.323028	1430 BILLS CRK RD, WINFIELD WV	1980	101 - Residential 1 Family	BOWLING JAMES B	880 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0074-0002	110	1.414863	1392 BILLS CRK RD, WINFIELD WV	1980	101 - Residential 1 Family	WELCH GREGORY L ET UX	1392 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0075-0001	112	5.143059	714 BILLS CRK RD, WINFIELD WV	1994	101 - Residential 1 Family	CARNEFIX TIMOTHY ET UX	714 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0077-0000	113	1.548338	1060 BILLS CRK RD, WINFIELD WV	1974	101 - Residential 1 Family	COLE JOHN ROBERT ET UX	650 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0078-0000	114	1.533095	1036 BILLS CRK RD, WINFIELD WV	1975	101 - Residential 1 Family	BENNETT BETTY D	620 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0079-0000	115	1.516558	1008 BILLS CRK RD, WINFIELD WV	1970	101 - Residential 1 Family	WILLIAMS FRANK D	1008 BILLS CRK RD, WINFIELD WV
Yes	40-10-0215-0080-0000	116	1.762246	982 BILLS CRK RD, WINFIELD WV	1974	101 - Residential 1 Family	SMITHSON JASON T ET UX	560 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0215-0081-0000	117	0.734412	749 BILLS CRK RD, WINFIELD WV	NA	108 - Mobile Home	DUFFIELD GRETA M	98 SUNSET DR, SCOTT DEPOT WV
Yes	40-10-0225-0009-0000	128	1.152622	4832 TEAYS VALLEY RD, WINFIELD WV	1930	105 - Mixed Residential/Commercial	HAZELETT PATRICK	313 SUNSET DR, HURRICANE WV
Yes	40-10-0225-0009-0001	129	0.722299	4830 TEAYS VALLEY RD, WINFIELD WV	1991	101 - Residential 1 Family	CI REALTY LLC	209 1ST AVE S, NITRO WV
Yes	40-10-0225-0009-0002	130	0.978086	2500 BILLS CREEK RD, WINFIELD WV	NA	108 - Mobile Home	SHIVLEY REBECCA A	2500 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0225-0009-0003	131	0.869937	2530 BILLS CREEK RD, WINFIELD WV	1977	101 - Residential 1 Family	WOODS JAMES F JR ET UX	2960 BILLS CREEK RD, WINFIELD WV
Yes	40-10-0225-0024-0000	135	4.69236	4852 TEAYS VALLEY RD, WINFIELD WV	1960	101 - Residential 1 Family	LACKEY MARY LOU	9407 TEAYS VALLEY RD, SCOTT DEPOT WV
Yes	40-10-0225-0058-0002	137	20.778296	3761 TEAYS VALLEY RD, WINFIELD WV	2006	112 - Active Farm	VANSCOY EDDIE ET UX	3761 TEAYS VALLEY RD, HURRICANE WV
Yes	40-10-215A-0013-0000	152	0.344175	62 KENS LAKE EST RD, WINFIELD WV	1997	101 - Residential 1 Family	WILLIAMS DANIER L &	62 KENS LAKE EST RD, WINFIELD WV
Yes	40-10-215A-0024-0000	153	0.344175	63 KENS LAKE EST RD, WINFIELD WV	1994	101 - Residential 1 Family	ARMENTROUT DAVID B	63 KENS LAKE EST, WINFIELD WV
Yes	40-10-215A-0025-0000	154	0.344153	43 KENS LAKE EST DR, WINFIELD WV	1979	101 - Residential 1 Family	BOGGESS GARY R ET AL	414 CIRCLE DR, HURRICANE WV
Yes	40-10-215A-0026-0000	155	0.312271	2749 BILLS CRK RD, WINFIELD WV	1970	101 - Residential 1 Family	PAYTON LORETTA	2749 BILLS CREEK RD, WINFIELD WV
Yes	40-10-215A-0027-0000	156	0.227152	18 KENS LAKE EST RD, WINFIELD WV	1972	101 - Residential 1 Family	MILES DOUGLAS L ET UX	18 KENS LAKE EST RD, WINFIELD WV
Yes	40-10-215A-0031-0000	157	2.397207	46 KENS LAKE EST RD, WINFIELD WV	1976	101 - Residential 1 Family	MOLLOHAN WHITNEY L	46 KENS LAKE EST RD, WINFIELD WV
Yes	40-10-215A-0035-0000	158	0.918433	18 KENS LAKE EST RD, WINFIELD WV	1972	100 - Residential Vacant	MILES DOUGLAS L ET UX	18 KENS LAKE EST RD, WINFIELD WV

Table C-1
Potable Well Search Summary
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Potable Source Confirmation	Parcel ID	Map ID	Parcel Size	Physical address	Year Constructed	Land Use	Owner	Owner Address
Yes	40-10-215A-0037-0000	159	0.077639	2766 BILLS CRK RD, WINFIELD WV	2002	100 - Residential Vacant	POLLEY PAUL J	2766 BILLS CREEK RD, WINFIELD WV
Yes	40-10-215A-0038-0000	160	0.229409	2766 BILLS CRK RD, WINFIELD WV	2002	101 - Residential 1 Family	POLLEY PAUL J	2766 BILLS CREEK RD, WINFIELD WV
Yes	40-10-215B-0002-0000	161	0.457522	107 SPRINGLEA DR, WINFIELD WV	1969	101 - Residential 1 Family	ERWIN DAVID A ET UX	107 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0003-0000	162	0.282437	109 SPRINGLEA DR, WINFIELD WV	1967	101 - Residential 1 Family	GRIFFIN BILLY R & PAULA P	109 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0004-0000	163	0.305324	82 SPRINGLEA DR, WINFIELD WV	NA	100 - Residential Vacant	LAMBERT JOHN P ET UX	82 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0005-0000	164	0.294275	108 SPRINGLEA DR, WINFIELD WV	1975	101 - Residential 1 Family	LAMBERT JOHN P ET UX	108 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0006-0000	165	0.335789	110 SPRINGLEA DR, WINFIELD WV	1972	101 - Residential 1 Family	HUTCHINS WILLIAM J ET UX	98 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0008-0000	166	0.321789	112 SPRINGLEA DR, WINFIELD WV	1978	101 - Residential 1 Family	ROBERTS MICHAEL SCOTT	122 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0009-0000	167	0.307855	114 SPRINGLEA DR, WINFIELD WV	1974	101 - Residential 1 Family	WORKMAN LEOTA JANE	11342 W LITTLE KANAWHA HWY, CRESTON WV
Yes	40-10-215B-0010-0000	168	0.296019	116 SPRINGLEA DR, WINFIELD WV	1975	101 - Residential 1 Family	COOK HARRY J	116 SPRINGLEA, WINFIELD WV
Yes	40-10-215B-0011-0000	169	0.297176	172 SPRINGLEA DR, WINFIELD WV	1975	101 - Residential 1 Family	BOWMAN JACK LEE ET UX	172 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0012-0000	170	0.369121	151 SPRINGLEA DR, WINFIELD WV	1976	100 - Residential Vacant	LOVE SCOTT P ET UX	151 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0014-0000	172	0.293271	115 SPRINGLEA DR, WINFIELD WV	1973	101 - Residential 1 Family	WEBSTER BRETT D ET UX	115 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0015-0000	173	0.309064	113 SPRINGLEA DR, WINFIELD WV	1973	101 - Residential 1 Family	LEWIS RAD K ET UX	113 SPRINGLEA EST, WINFIELD WV
Yes	40-10-215B-0016-0000	174	0.307709	111 SPRINGLEA DR, WINFIELD WV	1971	101 - Residential 1 Family	MCMASTER ERIC & SHAWN	111 SPRINGLEA HILLS, WINFIELD WV
Yes	40-10-215B-0017-0000	175	2.265675	98 SPRINGLEA DR, WINFIELD WV	NA	100 - Residential Vacant	HUTCHINS WILLIAM J ET UX	98 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0018-0000	176	3.127917	2 SORRENTO PL, WINFIELD WV	1994	101 - Residential 1 Family	THOMAS CHRISTOPHER &	2 SORRENTO PL, WINFIELD WV
Yes	40-10-215B-0018-0001	177	0.282655	49 SORRENTO PL, WINFIELD WV	1993	101 - Residential 1 Family	SHREWSBURY TODD H ET UX	49 SORRENTO PL, WINFIELD WV
Yes	40-10-215B-0019-0000	178	0.341475	127 SPRINGLEA DR, WINFIELD WV	1981	101 - Residential 1 Family	CONLEY GABRIEL S ET UX	245 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0020-0000	179	1.511128	120 SPRINGLEA DR, WINFIELD WV	NA	100 - Residential Vacant	SPRINGLEA HILLS PROPERTY OWNER	PO BOX 723, SCOTT DEPOT WV
Yes	40-10-215B-0021-0000	180	0.344506	126 SPRINGLEA DR, WINFIELD WV	1992	101 - Residential 1 Family	CRAFT CHARLES EARNEST	270 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0022-0000	181	0.314877	305 SPRINGLEA DR, WINFIELD WV	1992	101 - Residential 1 Family	BROWN DAVID FRANKLIN &	305 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0023-0000	182	0.29095	134 SPRINGLEA DR, WINFIELD WV	1992	101 - Residential 1 Family	MOORE DANIEL E	134 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0025-0000	184	1.102127	120 SPRINGLEA DR, WINFIELD WV	1976	101 - Residential 1 Family	BROWN WILLIAM F JR	120 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0026-0000	185	3.436233	330 SPRINGLEA DR, WINFIELD WV	1992	101 - Residential 1 Family	BURGROFF ROBERT P ET UX	330 SPRINGLEA DR, WINFIELD WV
Yes	40-10-215B-0027-0000	186	0.282838	135 SPRINGLEA DR, WINFIELD WV	1994	101 - Residential 1 Family	WITHROW JAMES E JR ET UX	135 SPRINGLEA HILLS, WINFIELD WV
Yes	40-10-215C-0001-0000	189	1.277111	2 SYLVESTER DR, WINFIELD WV	1997	101 - Residential 1 Family	CHILDERS STEPHEN R ET UX	2 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0002-0000	190	1.083025	1 SYLVESTER DR, WINFIELD WV	2005	101 - Residential 1 Family	RIPPETOE RONALD L ET UX	1 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0003-0000	191	2.521485	1 JUNEBUG LN, WINFIELD WV	1997	101 - Residential 1 Family	SERGENT TONY A ET UX	1 JUNEBUG LN, WINFIELD WV
Yes	40-10-215C-0004-0000	192	1.834651	3 SYLVESTER DR, WINFIELD WV	1996	101 - Residential 1 Family	RAWLINGS RENEE & ANDREW	3 SLVESTER DR, WINFIELD WV
Yes	40-10-215C-0005-0000	193	2.217772	5 SYLVESTER DR, WINFIELD WV	1998	101 - Residential 1 Family	MINIGH MARK & SARA	5 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0006-0000	194	1.467691	4 SYLVESTER DR, WINFIELD WV	1996	101 - Residential 1 Family	OQUINN ROBERT O ET UX	4 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0007-0000	195	1.926352	6 SYLVESTER DR, WINFIELD WV	1999	101 - Residential 1 Family	JANEY SARAH M	6 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0008-0000	196	1.75422	12 SYLVESTER DR, WINFIELD WV	1999	101 - Residential 1 Family	CHANEY SHANNON JAMES ET UX	12 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0009-0000	197	3.359674	13 SYLVESTER DR, WINFIELD WV	1999	101 - Residential 1 Family	LEGG MICHAEL T ET UX	13 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0010-0000	198	1.064107	15 SYLVESTER DR, WINFIELD WV	2002	101 - Residential 1 Family	WELLS THOMAS E	15 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0011-0000	199	1.090153	18 SYLVESTER DR, WINFIELD WV	2000	101 - Residential 1 Family	CARTER BRANDON S ET UX	18 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0012-0000	200	0.827506	20 SYLVESTER DR, WINFIELD WV	2000	101 - Residential 1 Family	CUNNINGHAM EDWARD CHARLES II	20 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0013-0000	201	2.10977	8 SYLVESTER DR, WINFIELD WV	2005	101 - Residential 1 Family	FRYE ROBERT B ET UX	8 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0014-0000	202	2.713143	10 SYLVESTER DR, WINFIELD WV	2003	101 - Residential 1 Family	WHITE TODD R ET UX	10 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0015-0000	203	1.597337	29 PINSON DR, WINFIELD WV	2015	101 - Residential 1 Family	HARLEY STEPHEN & SARA	29 PINSON DR, WINFIELD WV
Yes	40-10-215C-0017-0000	205	1.027984	27 PINSON DR, WINFIELD WV	2001	101 - Residential 1 Family	LEWIS MICHAEL A & AMANDA K	27 PINSON DR, WINFIELD WV
Yes	40-10-215C-0019-0000	207	4.043762	17 SYLVESTER DR, WINFIELD WV	2002	109 - Auxiliary Improvement	STEPHENSON MONICA ET AL	17 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0020-0000	208	3.688172	17 SYLVESTER DR, WINFIELD WV	2002	101 - Residential 1 Family	STEPHENSON MONICA ET AL	17 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0021-0000	209	0.791561	23 PINSON DR, WINFIELD WV	2002	101 - Residential 1 Family	HALSTEAD JOHN	23 PINSON DR, WINFIELD WV
Yes	40-10-215C-0022-0000	210	0.711455	26 PINSON DR, WINFIELD WV	2003	101 - Residential 1 Family	BURGY GEORGE & JANE	26 PINSON DR, WINFIELD WV
Yes	40-10-215C-0023-0000	211	1.510577	14 SYLVESTER DR, WINFIELD WV	2012	101 - Residential 1 Family	ADKINS JASON M & JODI D	14 SYLVESTER DR, WINFIELD WV

Table C-1
Potable Well Search Summary
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Potable Source Confirmation	Parcel ID	Map ID	Parcel Size	Physical address	Year Constructed	Land Use	Owner	Owner Address
Yes	40-10-215C-0024-0000	212	1.88733	14 SYLVESTER DR, WINFIELD WV	2012	100 - Residential Vacant	ADKINS JASON M & JODI D	14 SYLVESTER DR, WINFIELD WV
Yes	40-10-215C-0025-0000	213	0.865668	24 PINSON DR, WINFIELD WV	2006	101 - Residential 1 Family	CRINER MICHAEL E ET UX	24 PINSON RD, WINFIELD WV
Yes	40-10-215C-0026-0000	214	0.753799	22 SYLVESTER DR, WINFIELD WV	2002	100 - Residential Vacant	LEGG GARY B SR ET UX	22 SYLVESTER DR, WINFIELD WV
No	40-10-0205-0049-0001	3	5.376392	NA	NA	100 - Residential Vacant	GUY CHARLES W ET UX	380 BILLS CRK RD, WINFIELD WV
No	40-10-0206-0092-0000	15	13.043455	NA	NA	700 - Utility Vacant Land	C & O RAILROAD COMPANY (CSXT)	500 WATER ST C910, JACKSONVILLE FL
No	40-10-0215-0006-0000	16	11.349637	NA	NA	100 - Residential Vacant	MORRISON C O	115 1ST ST, ELKVIEW WV
No	40-10-0215-0006-0001	17	4.782128	NA	NA	620 - Religious	JUDSON BAPTIST CHURCH	PUT CO TAX DEPT, WINFIELD WV
No	40-10-0215-0006-0003	19	0.223347	NA	NA	109 - Auxiliary Improvement	PARSONS RAYMOND E ET UX	1836 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0013-0005	28	2.079162	NA	NA	100 - Residential Vacant	NEARY FRANK D ET UX	920 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0015-0000	32	50.155329	NA	NA	109 - Auxiliary Improvement	BRAGG NANCY RUTH ET AL	107 BRAGG FARM RD, CHARLESTON WV
No	40-10-0215-0019-0001	38	42.593284	NA	NA	101 - Residential 1 Family	BIRD LEONARD R ET UX	2 JUNE BUG LN, WINFIELD WV
No	40-10-0215-0021-0000	41	25.943994	NA	NA	100 - Residential Vacant	DUNLAP RONALD I ET UX	863 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0022-0000	44	0.893286	NA	NA	101 - Residential 1 Family	HAULDREN RUSSELL D & MARK E	689 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0024-0000	48	80.272259	NA	NA	112 - Active Farm	SELBY DANIEL L	23 CHASE DR, HURRICANE WV
No	40-10-0215-0025-0000	49	80.592094	NA	NA	NA	NA	NA
No	40-10-0215-0028-0000	52	24.156532	NA	NA	100 - Residential Vacant	BIAS ROGER A	1625 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0028-0001	53	0.360258	NA	NA	100 - Residential Vacant	KELLEY L T	PO BOX 761, ST ALBANS WV
No	40-10-0215-0028-0012	63	0.488213	NA	NA	100 - Residential Vacant	GAYLOR J R	3958 TEAYS VALLEY RD, HURRICANE WV
No	40-10-0215-0028-0014	65	0.027706	NA	NA	100 - Residential Vacant	DENNISON WALTER L	1221 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0028-0015	66	0.027707	NA	NA	100 - Residential Vacant	FLEMING KEITH W ET UX	34 MAGPIE DR, WINFIELD WV
No	40-10-0215-0028-0016	67	0.027892	NA	NA	100 - Residential Vacant	GOWMAN DAVID R & DONNA R	18 MAGPIE DR, WINFIELD WV
No	40-10-0215-0028-0019	68	2.106102	NA	NA	109 - Auxiliary Improvement	BIAS ROGER A ET UX	1625 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0029-0001	70	1.497084	NA	NA	100 - Residential Vacant	BIAS ROGER ALLEN	1625 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0029-0004	73	2.542302	NA	NA	100 - Residential Vacant	SELBE JAMES RAY	2481 BILLS CRK RD, WINFIELD WV
No	40-10-0215-0029-0005	74	7.411019	NA	NA	100 - Residential Vacant	WENTZ DANNY RYAN	78 COUGAR MOUNTAIN DR, WINFIELD WV
No	40-10-0215-0029-0006	75	2.574924	NA	NA	101 - Residential 1 Family	MCKINNEY KEVIN DALE & RACHEL L	238 COUGAR MT DR, WINFIELD WV
No	40-10-0215-0029-0007	76	1.571892	NA	NA	100 - Residential Vacant	TAYLOR THOMAS D III &	PO BOX 298, SCOTT DEPOT WV
No	40-10-0215-0029-0008	77	6.368596	NA	NA	101 - Residential 1 Family	WENTZ DANNY RYAN	78 COUGAR MOUNTAIN DR, WINFIELD WV
No	40-10-0215-0035-0000	85	1.750607	NA	NA	100 - Residential Vacant	LAND RECOVERY MANAGEMENT	2414 YATES CROSSING RD, MILTON WV
No	40-10-0215-0037-0000	87	1.890292	NA	NA	100 - Residential Vacant	MURPHY DANIEL	RT 4 BOX 9, HURRICANE WV
No	40-10-0215-0038-0000	88	8.563272	NA	NA	109 - Auxiliary Improvement	CRACE RANDY B II	2484 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0042-0000	95	0.096894	NA	NA	100 - Residential Vacant	CROSS LUANA L	604 EVEREST CIR, SAINT ALBANS WV
No	40-10-0215-0042-0001	96	1.019887	NA	NA	101 - Residential 1 Family	THORNTON DAVID P ET AL	2677 BILLS CRK RD, WINFIELD WV
No	40-10-0215-0042-0002	97	0.047175	NA	NA	100 - Residential Vacant	THORNTON DAVID P ET AL	2141 BILLS CRK RD, WINFIELD WV
No	40-10-0215-0042-0004	99	2.759185	NA	NA	101 - Residential 1 Family	SNYDER WILLIAM R ET UX	2145 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0069-0000	103	0.927907	NA	NA	100 - Residential Vacant	CROSS LUANA L	604 EVEREST CIR, SAINT ALBANS WV
No	40-10-0215-0070-0000	104	20.226538	NA	NA	213 - Mobile Home Park	CROSS LUANA L	604 EVEREST CIR, SAINT ALBANS WV
No	40-10-0215-0070-0001	105	0.406846	NA	NA	100 - Residential Vacant	CROSS LUANA L	604 EVEREST CIR, SAINT ALBANS WV
No	40-10-0215-0070-0004	106	3.953464	NA	NA	101 - Residential 1 Family	BENNETT JOHN H ET AL	2381 BILLS CREEK RD, WINFIELD WV
No	40-10-0215-0082-0000	118	1.40012	NA	NA	112 - Active Farm	BUZZARD LLOYD DANIEL	1090 BILLS CREEK RD, WINFIELD WV
No	40-10-0216-0001-0000	119	11.726415	NA	NA	101 - Residential 1 Family	MORGAN BRANDT T	5725 WINFIELD RD, WINFIELD WV
No	40-10-0216-0001-0001	120	0.54019	NA	NA	101 - Residential 1 Family	MORGAN BRANDT T	5725 WINFIELD RD, WINFIELD WV
No	40-10-0216-0001-0002	121	1.067548	NA	NA	100 - Residential Vacant	MORGAN SARAH G ET AL	12331 DOE CROSSING LN, GLEN ALLEN VA
No	40-10-0216-0001-0003	122	11.044789	NA	NA	100 - Residential Vacant	MORGAN SARAH G ET AL	10731 COAL RIVER RD, SAINT ALBANS WV
No	40-10-0216-0001-0004	123	4.110473	NA	NA	101 - Residential 1 Family	MORGAN BRANDT T	5725 WINFIELD RD, WINFIELD WV
No	40-10-0216-0034-0000	124	14.98031	NA	NA	108 - Mobile Home	NEWMAN FRED D ET UX	603 SIXTH ST, NITRO WV
No	40-10-0216-0035-0001	125	0.917174	NA	NA	601 - Cemetery	MORGAN CEMETARY	WINFIELD WV

Table C-1
Potable Well Search Summary
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Potable Source Confirmation	Parcel ID	Map ID	Parcel Size	Physical address	Year Constructed	Land Use	Owner	Owner Address
No	40-10-0216-0035-0003	126	0.296189	NA	NA	700 - Utility Vacant Land	UNITED FUEL GAS COMPANY	WINFIELD WV
No	40-10-0216-0035-0005	127	0.031386	NA	NA	601 - Cemetery	ROBERT G SIMMS HEIRS	3389 WINFIELD RD, WINFIELD WV
No	40-10-0225-0010-0000	132	3.781726	NA	NA	101 - Residential 1 Family	CASTO LOIS F	277 CHES WAL RD, SCOTT DEPOT WV
No	40-10-0225-0010-0002	133	0.945983	NA	NA	660 - Police or Fire Station	TEAYS VALLEY VOLUNTEER FIRE	POPLAR FORK, SCOTT DEPOT WV
No	40-10-0225-0010-0003	134	0.013784	NA	NA	700 - Utility Vacant Land	BELL ATLANTIC WEST VIRGINIA	816 LEE ST FL 8, CHARLESTON WV
No	40-10-0225-0057-0000	136	10.922998	NA	NA	105 - Mixed Residential/Commercial	PUTNAM FARM & LAND COMPANY	PO BOX 1440, ST ALBANS WV
No	40-10-0225-0058-0003	138	15.255786	NA	NA	101 - Residential 1 Family	HOYLMAN LARRY R	PO BOX 1440, ST ALBANS WV
No	40-10-0225-0060-0001	139	17.108005	NA	NA	100 - Residential Vacant	SOLCO INC	PO BOX 429, NITRO WV
No	40-10-0225-0061-0000	140	16.160621	NA	NA	100 - Residential Vacant	SOLCO INC	PO BOX 429, NITRO WV
No	40-10-0225-0061-0001	141	16.746358	NA	NA	700 - Utility Vacant Land	C & O RAILROAD COMPANY (CSXT)	500 WATER ST C910, JACKSONVILLE FL
No	40-10-0225-0061-0002	142	0.016061	NA	NA	601 - Cemetery	S D CRAFT	GENERAL DELIVERY, WINFIELD WV
No	40-10-0225-0062-0000	143	5.894353	NA	NA	420 - Concrete Mfg	AMHERST INDUSTRIES INC	2 PORT AMHERST DR, CHARLESTON WV
No	40-10-0225-0063-0000	144	0.676163	NA	NA	400 - Vacant Industrial Land	AMHERST INDUSTRIES INC	2 PORT AMHERST DR, CHARLESTON WV
No	40-10-0226-0107-0001	145	4.316127	NA	NA	398 - Warehouse	ORDERS CONST CO INC ET AL	PO BOX 1448, ST ALBANS WV
No	40-10-0226-0107-0002	146	6.762313	NA	NA	420 - Concrete Mfg	ESSROC READY MIX CORP	2517 HIGHWAY 35 BLDG B STE 202, MANASQUAN NJ
No	40-10-0226-0107-0003	147	5.054888	NA	NA	420 - Concrete Mfg	FAST CAST INC	PO BOX 645, SCOTT DEPOT WV
No	40-10-0226-0107-0004	148	0.053673	NA	NA	600 - Vacant Exempt Land	SOUTH PUTNAM PUBLIC	PO BOX 147, SCOTT DEPOT WV
No	40-10-0226-0107-0005	149	1.365988	NA	NA	393 - Comm Auxiliary Improvement	TRINITY REBAR & CONCRETE	PO BOX 86, WINFIELD WV
No	40-10-0226-0107-0006	150	12.747322	NA	NA	393 - Comm Auxiliary Improvement	CENTRAL PROPERTIES LLC	515 SIXTH AVE, SAINT ALBANS WV
No	40-10-0226-0107-0007	151	3.153297	NA	NA	397 - Office/Warehouse	CENTRAL PROPERTIES LLC	515 6TH AVE, SAINT ALBANS WV
No	40-10-215B-0013-0000	171	0.294059	NA	NA	101 - Residential 1 Family	LOVE SCOTT P	151 SPRINGLEA DRIVE, WINFIELD WV
No	40-10-215B-0024-0000	183	1.111454	NA	NA	600 - Vacant Exempt Land	SPRINGLEA HILLS PROPERTY	PUTNAM CO TAX DEPT, WINFIELD WV
No	40-10-215B-0028-0000	187	1.146761	NA	NA	600 - Vacant Exempt Land	SPRINGLEA HILLS PROPERTY	3389 WINFIELD RD, WINFIELD WV
No	40-10-215B-0028-0001	188	0.003219	NA	NA	700 - Utility Vacant Land	PUTNAM PSD	PO BOX 147, SCOTT DEPOT WV
No	40-10-215C-0016-0000	204	1.124861	NA	NA	101 - Residential 1 Family	LEGG GARRY B SR ET UX	PO BOX 43, WINFIELD WV
No	40-10-215C-0018-0000	206	1.258213	NA	NA	100 - Residential Vacant	YOUNG WILLIAM C & CYNTHIA D	4022 FARMINGTON DR, HURRICANE WV
No	40-10-215C-0027-0000	215	0.208708	NA	NA	100 - Residential Vacant	SHADE EDWARD J	PO BOX 65, HURRICANE WV
No	40-10-215C-0028-0000	216	3.602693	NA	NA	600 - Vacant Exempt Land	HOLLY CREEK MEADOWS HOME	PO BOX 65, HURRICANE WV
No	40-10-215C-0029-0000	217	2.225441	NA	NA	600 - Vacant Exempt Land	HOLLY CREEK MEADOWS HOME	PO BOX 65, HURRICANE WV

NOTES:
Yes = Database and public record review indicate parcel is serviced by the public potable water supply confirmed by the Putnam County Public Service District.
No = Database and public record review were unable to determine the source for potable water for the parcel, if present.

APPENDIX D

Well Development Summary Table

Table D-1
Well Development Summary Table
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Monitoring Well ID	Development Event Date	Depth to Bottom (ft below TOC)	Depth to Water (ft below TOC)	Method	Water Volume Summary (gallons)	Purged Dry?	Turbidity (NTU)	Clarity	Well Flush Date	Volume Jetted (Gallons)	Volume Recovered/ Pumped (Gallons)	Turbidity/ Clarity	Well Stable (Y/N)	Well Dry (Y/N)
Downgradient														
MW-1801A	6/11/2018	78.5	50.04	Surge with/ Pump	76	No	NM	Clear					Y	
	6/28/2018		49.89	Surge with/ Pump	37	No	14.8	Clear						
				Total Removed	**113**									
MW-1801B	6/7/2018	226.1	79.2	Surge with/ Pump	40	Yes	NM	Silty - Red					N	
	6/28/2018		223.8	Surge with/ Pump	1	Yes	NM	Silty - Red						
				Total Removed	**41**									
MW-1801C	6/6/2018	264.2	70.93	Surge with/ Pump	90	No	NM	Silty					N	
	6/7/2018		171.9	Surge with/ Pump	82	No	NM	Silty						
	6/18/2018		95.05	Surge with/ Pump	22	No	NM	Cloudy						
	6/19/2018		194.4	Surge with/ Pump	39	No	NM	Cloudy						
	6/28/2018		82.14	Surge with/ Pump	75	No	NM	Cloudy						
	6/29/2018		119.94	Surge with/ Pump	55	No	NM	Cloudy						
				Total Removed	**363**									
MW-1802A	5/31/2018	69.52	55.59	Surge with/ Pump	5	Yes	NM	Heavy Silt	7/3/2018	100	97	<1000	N	N
	6/20/2018		56.15	Surge with/ Pump	5	Yes	NM	Cloudy						
	7/13/2018		56.6	Surge with/ Pump	6	Yes	NM	Cloudy						
	7/14/2018		Top of Pump	Surge with/ Pump	2	Yes	NM	Cloudy						
	7/16/2018		63	Surge with/ Pump	4	Yes	NM	Cloudy						
	7/17/2018		Top of Pump	Surge with/ Pump	3	Yes	NM	Cloudy						
	7/19/2018		Top of Pump	Surge with/ Pump	2.5	Yes	78.8	Cloudy						
				Total Removed	**27.5**									
MW-1802B	5/30/2018	199.7	113.6	Surge with/ Pump	15	Yes	NM	Heavy Silt	7/3/2018	100	97	<1000	N	Y
	6/20/2018		182.7	Surge with/ Pump	10.3	Yes	NM	Cloudy-Red						
				Total Removed	**25.3**									
MW-1803B	5/30/2018	199.4	127.58	Surge with/ Pump	16	Yes	NM	Silty	7/3/2018	100	60	<1000	N	Y
	6/20/2018		187.7	Surge with/ Pump	10.8	Yes	NM	Cloudy-Red						
	7/2/2018		196.04	Surge with/ Pump	38	yes	NM	Cloudy-Red						
				Total Removed	**64.8**									
MW-1804A	6/1/2018	50.85	16.76	Surge with/ Pump	65	No	NM	Clear	6/27/2018	--	33	CLEARING	N	N
	7/3/2018		15.6	Surge with/ Pump	50	No	NM	Clear						
				Total Removed	**115**									
MW-1804B	6/1/2018	180.45	19.58	Surge with/ Pump	35	Yes	NM	Cloudy	6/27/2018	100	85	>1000 NTU	N	Y
	6/21/2018		147.45	Surge with/ Pump	5	Yes	NM	Heavy Silt						
				Total Removed	**40**									

Table D-1
Well Development Summary Table
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Monitoring Well ID	Development Event Date	Depth to Bottom (ft below TOC)	Depth to Water (ft below TOC)	Method	Water Volume Summary (gallons)	Purged Dry?	Turbidity (NTU)	Clarity	Well Flush Date	Volume Jetted (Gallons)	Volume Recovered/ Pumped (Gallons)	Turbidity/ Clarity	Well Stable (Y/N)	Well Dry (Y/N)
MW-1805B	6/4/2018	215.5	41.35	Surge with/ Pump	35	Yes	NM	Cloudy	6/26/2018	150	97	>1000 NTU	N	Y
	6/21/2018		199.92	Surge with/ Pump	5	Yes	NM	Heavy Silt						
	6/22/2018		Top of Pump	Surge with/ Pump	4	Yes	NM	Cloudy						
	7/3/2018		Dry	**Total Removed**	**44**	NA	NM	NA						
MW-1805C	6/4/2018	265.55	210	Surge with/ Pump	25	Yes	NM	Heavy Silt	6/26/2018	100	100	>1000 NTU	N	Y
	6/21/2018		261	Surge with/ Pump	5	Yes	NM	Heavy Silt						
	6/22/2018		Top of Pump	Surge with/ Pump	2	Yes	NM	Heavy Silt						
				Total Removed	**32**									
MW-1806A	6/5/2018	83.5	22.61	Surge with/ Pump	45	No	NM	Cloudy	6/27/2018	150	270	27 NTU	Y	N
	6/21/2018		26.6	Surge with/ Pump	70	No	NM	Cloudy						
	6/22/2018		26.55	Surge with/ Pump	138	No	NM	Cloudy						
	6/25/2018		26.32	Surge with/ Pump	0	No	NM	Cloudy						
	6/27/2018		26.27	Surge with/ Pump	50	No	27	Clear						
				Total Removed	**303**									
MW-1806B	6/5/2018	213.75	155	Surge with/ Pump	14	Yes	NM	Heavy Silt	6/26/2018	150	150	>1000 NTU	N	Y
				Total Removed	**14**									
MW-1806C	6/5/2018	258.47	27.8	Surge with/ Pump	60	Yes	NM	Cloudy	6/26/2018	150	152.5	>1000 NTU	N	Y
	6/21/2018		241.01	Surge with/ Pump	8	Yes	NM	Cloudy						
	6/22/2018		253.25	Surge with/ Pump	0.5	Yes	NM	Cloudy						
	7/3/2018		255	Surge with/ Pump	2.5	Yes	NM	Cloudy						
				Total Removed	**71**									
MW-3	7/12/2018	312.2	273	Surge with/ Pump	29	Yes	NM	Cloudy						
				Total Removed	**29**									
MW-4	7/12/2018	249.1	232	Surge with/ Pump	15	Yes	NM	Cloudy						
				Total Removed	**15**									
MW-5	7/12/2018	112.1	32.9	Surge with/ Pump	35	Yes	5.4	Cloudy to clear						
				Total Removed	**35**									
Upgradient/Background														
MW-1802C	5/30/2018	276.4	110.6	Surge with/ Pump	25	Yes	NM	Cloudy	7/3/2018	100	100	<1000	N	N
	6/20/2018		214	Surge with/ Pump	50	Yes	NM	Cloudy						
	7/3/2018		252.35	Surge with/ Pump	3.5	Yes	NM	Cloudy						
	7/13/2018		Top of Pump	Surge with/ Pump	2.5	Yes	NM	Cloudy						
	7/14/2018		Top of Pump	Surge with/ Pump	2	Yes	NM	Cloudy						
	7/16/2018		Top of Pump	Surge with/ Pump	0.5	Yes	NM	Cloudy						
	7/19/2018		Top of Pump	Pump	0.5	Yes	250	Cloudy						
				Total Removed	**89**									

Table D-1
Well Development Summary Table
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Monitoring Well ID	Development Event Date	Depth to Bottom (ft below TOC)	Depth to Water (ft below TOC)	Method	Water Volume Summary (gallons)	Purged Dry?	Turbidity (NTU)	Clarity	Well Flush Date	Volume Jetted (Gallons)	Volume Recovered/ Pumped (Gallons)	Turbidity/ Clarity	Well Stable (Y/N)	Well Dry (Y/N)
MW-1803C	5/30/2018	276	252.25	Surge with/ Pump	3	Pump Clogged	NM	Heavy Silt	7/3/2018	100	100	>1000	N	Y
	6/20/2018		266.9	Surge with/ Pump	5	Yes	NM	Heavy Silt						
	7/2/2018		269.15	Surge with/ Pump	45	Yes	NM	Heavy Silt						
	7/13/2018		270.84	Surge with/ Pump	2	Yes	NM	Heavy Silt						
				Total Removed	**55**									
MW-1807A	6/12/2018	118.1	96.66	Surge with/ Pump	34	No	NM	Heavy Silt	7/10/2018	NA	NA	4.3	Y	N
	6/13/2018		105.67	Surge with/ Pump	18.5	No	NM	Heavy Silt						
	6/15/2018		106.8	Surge with/ Pump	52	No	NM	Heavy Silt						
	7/4/2018		106	Surge with/ Pump	20	No	NM	Clear						
	7/9/2018		107.9	Pump	50	No	>500	Clear						
	7/10/2018		107.5	Pump	40	No	4.3	Clear						
				Total Removed	**215**									
MW-1807B	6/12/2018	155.7	88.41	Surge with/ Pump	65	No	NM	Heavy Silt	7/10/2018	NA	NA	7.2	Y	N
	6/13/2018		123.4	Surge with/ Pump	59	No	NM	Turbid red-br						
	6/15/2018		124.3	Surge with/ Pump	119	No	NM	Heavy Silt						
	7/4/2018		123.5	Surge with/ Pump	20	No	NM	Slightly Cloudy						
	7/9/2018		124.64	Pump	35	No	>1000	Slightly Cloudy						
	7/10/2018		124.25	Pump	72.5	No	7.2	Clear						
				Total Removed	**371**									
MW-1808A	6/18/2018	112.71	81.51	Surge with/ Pump	16.5	No	NM	Silty				23.3	Y	
	6/19/2018		83.08	Surge with/ Pump	115.5	No	NM	Silty						
	6/20/2018		82.8	Surge with/ Pump	126	No	23.3	Clear						
				Total Removed	**258**									
MW-1808B	6/14/2018	161	21.5	Surge with/ Pump	20	Yes	NM	Heavy Silt	6/26/2018	150	145	>1000	N	Y
	6/15/2018		135.35	Surge with/ Pump	3.5	Yes	NM	Heavy Silt						
	6/18/2018		141.15	Surge with/ Pump	0	Yes	NM	Heavy Silt						
	6/22/2018		141.8	Surge with/ Pump	2	Yes	NM	Heavy Silt						
	7/4/2018		140.33	Surge with/ Pump	2	Yes	>1000	Cloudy						
	7/11/2018		154.36	Surge with/ Pump	5	Yes	>1000	Cloudy						
				Total Removed	**33**									

Table D-1
Well Development Summary Table
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Monitoring Well ID	Development Event Date	Depth to Bottom (ft below TOC)	Depth to Water (ft below TOC)	Method	Water Volume Summary (gallons)	Purged Dry?	Turbidity (NTU)	Clarity	Well Flush Date	Volume Jetted (Gallons)	Volume Recovered/ Pumped (Gallons)	Turbidity/ Clarity	Well Stable (Y/N)	Well Dry (Y/N)
MW-1808C	6/14/2018	243	125.35	Surge with/ Pump	52.5	No	NM	Heavy Silt					N	
	6/15/2018		190.91	Surge with/ Pump	15	No	NM	Heavy Silt						
	6/18/2018		169.24	Surge with/ Pump	23.5	Yes	NM	Heavy Silt						
	6/19/2018		194.82	Surge with/ Pump	15.5	Yes	NM	Heavy Silt						
	7/3/2018		161.1	Surge with/ Pump	18.5	Yes	NM	Heavy Silt						
	7/4/2018		197.31	Surge with/ Pump	14	Yes	NM	Heavy Silt						
	7/11/2018		169.95	Surge with/ Pump	23	Yes	NM	Cloudy						
	7/12/2018			Pump			<50							
				Total Removed	**162**									
MW-1809A	4/25/2018	75.12	48.95	Surge with/ Pump	30	No	NM	Cloudy					N	
	4/26/2018		50.4	Surge with/ Pump	40	No	NM	Clear						
				Total Removed	**70**									
MW-1810A	4/4/2018	83.71	67.9	Surge with/ Pump	68	No	NM	Cloudy					N	
				Total Removed	**68**									

NOTES:
Minimum purge volume is whichever is greater; 2x the volume of water introduced during drilling or 3x/10x the calculated well volume
If the well can be purged dry, 3x the well volume is the minimum target volume (unless 2x the volume of water introduced is greater)
If the well cannot be purged dry, 10x the well volume is the required minimum volume under west virginia law (unless 2x the volume of water introduced is greater)
ft = feet
bgs = below ground surface
amsl = above mean sea level
-- = not applicable
SRF = Stress Relief Fracture System
U = Upper Connellsville sandstone
C = Clarksburg disconformity (fissile shale and adjacent shale/sandstone
M = Morgantown sandstone and adjacent shale

APPENDIX E

Groundwater Model Details

APPENDIX E

GROUNDWATER FLOW MODEL SUMMARY

Introduction

Arcadis U.S., Inc. (Arcadis) developed a three-dimensional groundwater numerical flow model for the American Electric Power Service Corporation (AEP) Generating Plant (Plant) located on Winfield Road in Winfield, West Virginia to understand current hydrogeologic conditions and post-closure conditions after liner installation at the fly ash pond (FAP, CCR Unit). The groundwater flow model was constructed using the USGS MODFLOW code (McDonald and Harbaugh 1988) and utilized all available groundwater level data, aquifer testing data and lithologic data collected at the FAP (Site). The modeling discussed herein represents an update to the existing model developed for the Site (Arcadis, 2013). The primary objectives of the model updates are:

- Assess migration potential of site-related constituents of concern (COCs) under FAP closure condition; and
- Provide analytical parameters (i.e., groundwater flow directions and dilution factor) for geochemical evaluation and risk assessment to appraise potential changes in groundwater quality as well as possible impact to receptors from offsite migration and discharge of site-related COCs to adjacent surface water bodies.

Conceptual Site Model Updates

To assist with the update of the numerical model, a visual three-dimensional conceptual site model (CSM) of the Site was developed using Earth Volumetric Studio (EVS [Ctech, 2017]). The model was generated by sequential creation of various hydrostratigraphic model layers (geospatial, followed by hydrostratigraphic modeling) as well as other Site components as part of the CSM development. This visual model was created in a systematic fashion as follows:

- The topographical layer in the model was generated using the site geospatial and survey data (where available) as well as the digital elevation model (DEM) for the area from the geospatial database. The aerial and the various site features were imported from the geospatial database.
- The hydrostratigraphic model layers were developed by importing all site lithological logs from gINT format files, whereby the contacts of each geologic unit were identified based on the thorough review of each lithology boring and were then correlated to generate the geological surface. The hydrostratigraphic model was developed based on interpolation of the geological surfaces. These surfaces served as input to the updated numerical groundwater flow model.
- The onsite monitoring wells were also imported within the model based on well construction information.

- The ash volume was also represented by intruding between the ground surface that is prior to ash filling into the valley and the final construction surface of the fly ash pond.
- The other hydrologic features (i.e., surface water bodies) and dam structures were also incorporated into the visual three-dimensional CSM.

Numerical Groundwater Flow Model Development and Update

Model Discretization

The groundwater model grid covers an area of approximately 6.3 square miles. The horizontal finite-difference grid remains composed of 474 columns and 373 rows with grid spacing ranging from 10 ft by 10 ft in the vicinity of the Site to 90 ft by 90 ft along the most distant model boundaries. The model domain was designed to reflect all relevant hydraulic features within the surrounding area (i.e., Kanawha River and Bills Creek) and were located a sufficient distance from the Site to reduce the potential for boundary effects on simulated results. The model was rotated approximately 20 degrees counterclockwise to align with the prevailing groundwater flow directions at the Site and natural hydrologic boundaries.

The primary model updates involved modification of the model structure to reflect the updated hydrostratigraphic interpretation from the visual three-dimensional CSM. The revised groundwater model was discretized vertically into ten (10) model layers to provide a vertical profile representative of the Site hydrostratigraphic framework. Model layers 1 through 4 correspond to alternating sandstone and shale units including the Upper Connellsville sandstone and Lower Connellsville sandstone with silty to shaley interbeds. Model layers 5, 6, 7 and 8 correspond to the Clarksburg shale with siltstone and sandstone interbeds, Clarksburg highly fractured and weathered shale zone, Clarksburg shale with siltstone and sandstone interbeds and the Morgantown sandstone, respectively. Model layers 9 and 10 represent Birmingham red beds/shale with occasional sandstone (Graffton sandstone) and deep sandstone units, respectively.

Hydraulic Parameters

In the existing 2013 groundwater flow model, a background hydraulic conductivity value was assigned to each layer, with additional zones representing the fly ash pond (open water), upper fly ash, compacted fly ash, the fly ash impoundment dam, and alluvial material in the vicinity of the Kanawha River. Values of horizontal and vertical hydraulic conductivity for each of the model zones and layers are generally based upon hydraulic conductivity estimates for the appropriate material types and were varied during model calibration and sensitivity analysis. During the model updates, a new hydraulic conductivity zone was incorporated into the model to represent stress relief fracturing (SRF) discussed in Section 2.4 of this report. The hydraulic conductivity parameter values of the SRF and other zones representing the various hydrostratigraphic units were further adjusted in the model calibration process within a reasonable range as dictated by additional hydraulic testing results and regional hydrogeologic information. Given the importance of the SRF as a conduit for flow, the values of hydraulic conductivity for the SRF zones are generally much higher than values used to represent the less fractured portions of the units within each model layer.

Boundary Conditions

Similar to the existing 2013 model, the updated flow model includes six types of boundary conditions: no flow, river (head dependent flow) to represent Kanawha River, drains (head dependent flow) to represent localized streams (i.e., Bills Creek), well (constant flux) for pumping wells, and groundwater recharge (constant flux). No changes were made to any boundary conditions from the existing 2013 model during the steady-state recalibration process except for the estimated rate of recharge and the drain cell configuration. The drain boundaries were re-assigned in each layer based on updated model structure.

Groundwater Flow Model Calibration

Steady State Calibration

After the model structural updates were completed, the groundwater flow model was re-calibrated to 2012 observed groundwater levels. The model was calibrated to water level data from monitoring wells across the Site. The use of point data eliminates the potential for interpretive bias that may result from attempting to match a contoured potentiometric surface (Konikow 1978; Anderson and Woessner 1992). During the steady-state model revision, flow calibration was performed to satisfy the following equations within pre-determined acceptance criteria (Arcadis 2013):

$$RSTD = \sqrt{\frac{RSS}{n-p}} \qquad \text{(Eq.3-1)}$$

and

$$\bar{e} = \frac{1}{n}\sum_{i=1}^{n} e_i \qquad \text{(Eq.3-2)}$$

where RSTD is the residual standard deviation, RSS is the residual sum of squares, and e is the mean of all residuals. The residual is simply defined as the difference between the observed and simulated water level elevation measured at a target location.

Model recalibration was achieved by adjusting relevant hydraulic parameters and zone extents until simulated conditions closely matched the observed conditions. The simulated groundwater flow condition of the re-calibrated steady-state model was then used as the starting condition for the transient model calibration for the FAP closure period.

Transient Model Development

The transient or time-variant model was built to dynamically simulate the hydraulic variation within the impoundment prior to and during the geosynthetic cap installation.

For the transient model setup, the reclaimed water well was removed from the steady-state model as it was no longer operated during the liner installation based on communication with AEP staff. In addition, a dewatering well (DW-1) was introduced within the impoundment area near multi-port well STN-4-1 and was operated periodically during the construction phases.

Additionally, recharge zones were added within the FAP area and recharge values were adjusted to simulate the effect of liner installation processes from 2014 to 2017. The deployment of the geomembrane liner during Phase I construction began on June 25, 2015 and was completed on November 5, 2015 with 455 geomembrane panels installed. During Phase II construction, installation of the geomembrane began on May 31, 2016 and was completed on September 15, 2016 with 300 panels installed. During phase III construction, installation of the geomembrane began on April 13, 2017 was completed on July 15, 2017 with 81 panels installed. Based on this information, the simulation period was divided into 52 monthly stress periods to represent the temporal variations in precipitation recharge, aquifer storage, and groundwater levels.

Transient Model Calibration

The transient model was calibrated to time-varying groundwater levels collected from monitoring wells and piezometers between April 2014 and October 2018 by adjusting relevant storage parameters, dewatering well (DW-1) pumping rate, and the precipitation recharge distribution. **Figures 7A**, **7B** and **7C** illustrates the simulated groundwater elevation contours that represent October 2018 hydrologic conditions in the primary groundwater aquifer units at the Site (i.e. model layers 2, 6 and 8 representing Upper Connellsville sandstone, Clarksburg highly fractured and weathered shale zone, and Morgantown sandstone, respectively). As shown on **Figure 7A**, groundwater flows towards the Fly Ash Pond in the Upper Connellsville sandstone (model layer 2) from surrounding mountainous areas to the northwest and northeast and moves vertically downward to the lower layers. In model layer 6 (**Figure 7B**), outward radial flow patterns are maintained at the base of the impoundment, and groundwater discharges to the nearby surface water features (e.g., Bills Creek and Little Scary Creek) and migrates through SRF zones along the edge of the mountain to the deeper hydrogeologic units. In model layer 8 (i.e. Morgantown sandstone; **Figure 7C**), groundwater transmitted through SRF zones from the upper hydrogeologic units either discharges towards the Little Scary Creek and unnamed creek southwest of the dam, or continues to migrate vertically downward to Birmingham red beds and deep sandstone units and eventually discharges to the Kanawha River to the southeast. Overall, transient modeling results indicate that the simulated groundwater elevations have decreased up to approximately 10 feet from pre-closure conditions within the FAP area.

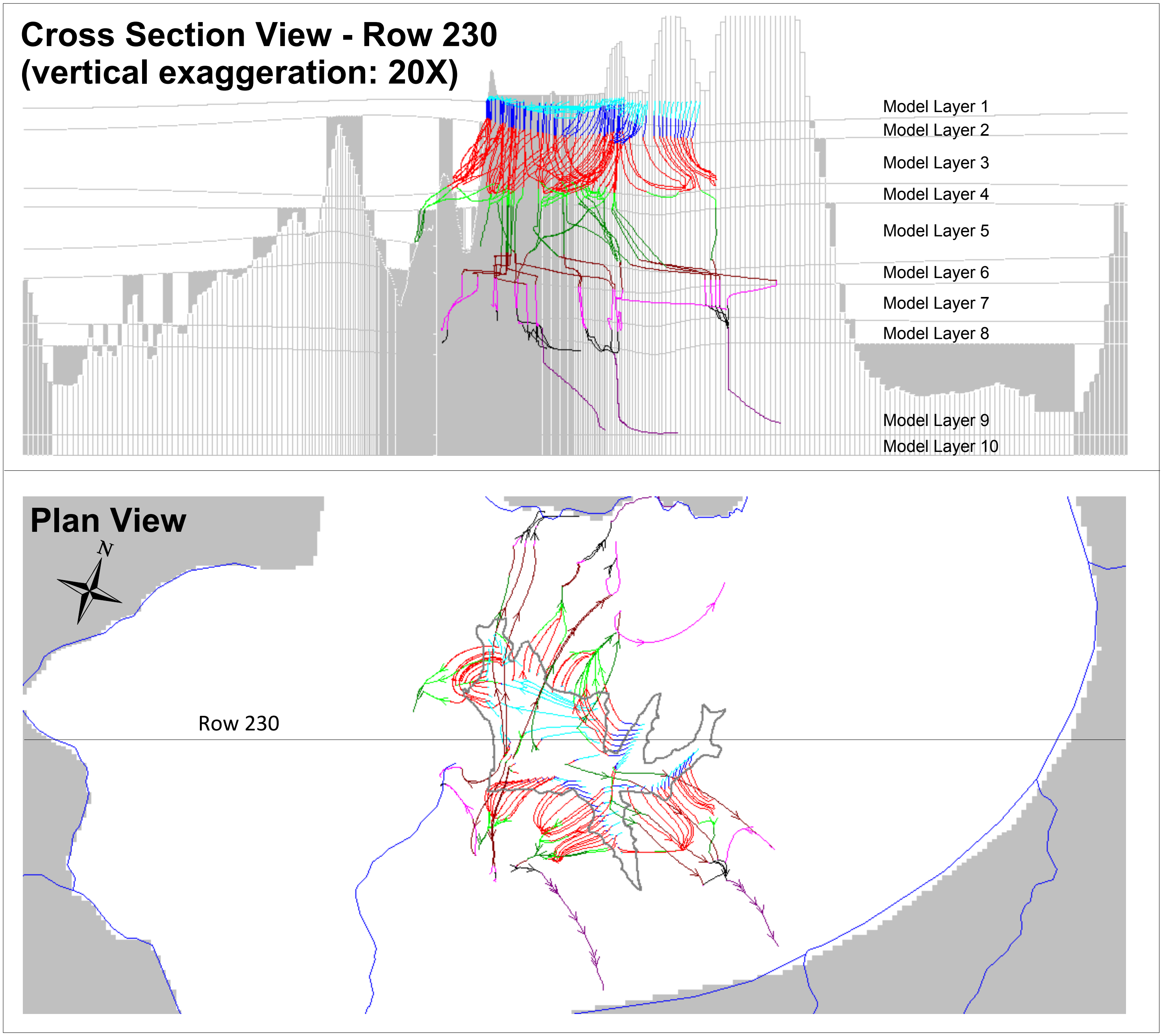
Pathline Analysis

A forward pathline analysis conducted using MODPATH (Pollock 1989) assisted in identifying the general flow patterns towards each monitoring well and surface water features. Particles were started in model layer 1 along the perimeter of the saturated fly ash deposit. Pathline analysis (**Figure E-1**) indicated that particles move laterally in model layer 1 within the FAP and then downward to model layers 2 to 9 with a simultaneous horizontal and downward trajectory. Particles generally show flow towards surface water features in model layers 2 through 8 with some of particles migrating to deeper layers where they ultimately discharge to the Kanawha River in model layer 9.

References

McDonald, M.G. and Harbaugh, A.W. 1988. A modular three-dimensional finite difference groundwater flow model: U.S. Geological Survey Techniques of Water Resources Investigations Book 6, Chapter A1.

Pollock, D.W. 1989. Documentation of computer programs to compute and display pathlines using results from the U.S. Geological Survey modular three-dimensional finite-difference ground-water flow model. U.S. Geological Survey Open-File Report 89-381.



Model Grid

Inactive Area (model no-flow boundary)

CCR Unit Boundary

Rivers and Streams

L1 Pathline (Conemaugh shale)

L2 Pathline (Upper Connellsville sandstone)

L3 Pathline (Shale with siltstone)

L4 Pathline (Lower Connellsville sandstone)

L5 Pathline (Clarksburg shale)

L6 Pathline (Clarksburg fractured shale)

L7 Pathline (Clarksburg shale with siltstone)

L8 Pathline (Morgantown sandstone)

L9 Pathline (Birmingham Red Beds)

Simulated Particle Pathline
(each arrow represents 5-year travel time)

AEP AMOS GENERATING PLANT - FLY ASH POND
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

SIMULATED GROUNDWATER PATHLINES
TRANSIENT MODEL - OCTOBER 2018

ARCADIS

FIGURE
E-1

APPENDIX F

Hydraulic Testing Results

Packer Test Logs

BEDROCK INJECTION PACKER TESTING LOG

Boring No.	MW-1801	Contractor	AEP	Page	1 of 1
Project	Amos FAP	Project No.	WV015976.0005	Arcadis Staff	Allan Gillespie
Site Location	Winfield, WV			Date	2/1/2018

Base of Top Packer (ft bgs/ft amsl)	175.0 725.39	Surface Elevation (ft amsl)	900.39
Top of Bottom Packer (ft bgs/ft amsl)	185.0 715.39	Distance from Gauge to Ground Surface (ft)	6.2
Depth to Water Prior to Install (ft bgs/ft amsl)	28.9 871.49	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	28.9 871.49		

Test 1

Constant Pressure (psi) 30

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	62.40	0.0	N/A
1	62.90	0.5	N/A
2	63.40	0.5	N/A
3	63.90	0.5	N/A
4	64.40	0.5	N/A
5	65.00	0.5	N/A
10	67.70	0.5	N/A
15	68.70	0.4	N/A
20			
25			
30			

Test 2

Constant Pressure (psi) 60

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	70.00	0.0	N/A
1	71.30	1.3	N/A
2	72.60	1.3	N/A
3	74.00	1.3	N/A
4	75.10	1.3	N/A
5	76.50	1.3	N/A
10	83.70	1.4	N/A
15	90.20	1.3	N/A
20	96.90	1.3	N/A
25	103.30	1.3	N/A
30	108.40	1.3	N/A

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =	9.4E-04	ft^3/s
h1 =	35.1	ft
h2 =	69.21	ft
H =	104.3	ft
r =	0.12	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	2.0E-05	cm/s

Zone 3
Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =	2.9E-03	ft^3/s
h1 =	35.1	ft
h2 =	138.4	ft
H =	173.5	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	3.7E-05	cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference

US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No. MW-1803 | Contractor AEP | Page 1 of 1

Project Amos FAP | Project No. WV015976.0005 | Arcadis Staff Allan Gillespie

Site Location Winfield, WV | Date 1/29/2018

Base of Top Packer (ft bgs/ft amsl)	60.0	844.04	Surface Elevation (ft amsl)	904.04
Top of Bottom Packer (ft bgs/ft amsl)	70.0	834.04	Distance from Gauge to Ground Surface (ft)	6.2
Depth to Water Prior to Install (ft bgs/ft amsl)	24.0	880.04	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	24.0	880.04		

Test 1
Constant Pressure (psi) 30

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	109.40	0.0	N/A
1	109.90	0.5	N/A
2	110.20	0.4	N/A
3	110.50	0.4	N/A
4	110.70	0.3	N/A
5	111.00	0.3	N/A
10	112.20	0.3	N/A
15	112.60	0.2	N/A
20	113.30	0.2	N/A
25			
30			

Test 2
Constant Pressure (psi)

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0			
1			
2			
3			
4			
5			
10			
15			
20			
25			
30			

Pre-Test 1
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =	4.3E-04	ft^3/s
h1 =	30.2	ft
h2 =	69.21	ft
H =	99.4	ft
r =	0.12	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	9.8E-06	cm/s

Zone 3
Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =		cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No. MW-1805 | Contractor AEP | Page 1 of 1

Project Amos FAP | Project No. WV015976.0005 | Arcadis Staff Allan Gillespie

Site Location Winfield, WV | Date 2/14/2018

Base of Top Packer (ft bgs/ft amsl)	247.0 635.32	Surface Elevation (ft amsl)	882.32
Top of Bottom Packer (ft bgs/ft amsl)	257.0 625.32	Distance from Gauge to Ground Surface (ft)	4.2
Depth to Water Prior to Install (ft bgs/ft amsl)	19.1 863.22	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	19.1 863.22		

Test 1

Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0		0.0	N/A
1		0.0	N/A
2		0.0	N/A
3		0.0	N/A
4		0.0	N/A
5		0.0	N/A
10		0.0	N/A
15		0.0	N/A
20		0.0	N/A
25			
30			

Test 2

Constant Pressure (psi) 100

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	83.40	0.0	N/A
1	83.80	0.4	N/A
2	84.00	0.3	N/A
3	84.20	0.3	N/A
4	84.50	0.3	N/A
5	84.80	0.3	N/A
10	86.30	0.3	N/A
15	87.60	0.3	N/A
20	88.80	0.3	N/A
25	90.10	0.3	N/A
30	91.30	0.3	N/A

Test 1

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =		cm/s

Zone 3

Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =	5.9E-04	ft^3/s
h1 =	23.3	ft
h2 =	230.7	ft
H =	254.0	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	5.2E-06	cm/s

Q= flow rate

H = h1+h2 = effective head

Cs = conductivity coefficient

h1 = distance between gage and water table

r = radius of test hole

h2 = applied pressure at gage

A = length of test section

Reference

US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

BEDROCK INJECTION PACKER TESTING LOG

Boring No.	MW-1806	Contractor	AEP	Page	1	of	1
Project	Amos FAP	Project No.	WV015976.0005	Arcadis Staff	Allan Gillespie		
Site Location	Winfield, WV			Date	4/4/2018		

Base of Top Packer (ft bgs/ft amsl)	225.0	663.96	Surface Elevation (ft amsl)	888.96
Top of Bottom Packer (ft bgs/ft amsl)	235.0	653.96	Distance from Gauge to Ground Surface (ft)	3.3
Depth to Water Prior to Install (ft bgs/ft amsl)	10.0	878.96	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	1.0	887.96		

Test 1

Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	0.00	0.0	N/A
1	10.10	10.1	N/A
2	22.50	11.3	N/A
3	30.40	10.1	N/A
4	41.40	10.4	N/A
5	51.80	10.4	N/A
10	96.80	9.7	N/A
15	141.00	9.4	N/A
20			
25			
30			

Test 2

Constant Pressure (psi) 100

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	0.00	0.0	N/A
1	14.50	14.5	N/A
2	29.20	14.6	N/A
3	43.60	14.5	N/A
4	57.10	14.3	N/A
5	75.90	15.2	N/A
10	147.60	14.8	N/A
15	225.20	15.0	N/A
20			
25			
30			

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =	2.1E-02	ft^3/s
h1 =	4.3	ft
h2 =	138.42	ft
H =	142.7	ft
r =	0.12	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	3.3E-04	cm/s

Zone 3

Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =	3.3E-02	ft^3/s
h1 =	4.3	ft
h2 =	230.7	ft
H =	235.0	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	3.2E-04	cm/s

Q= flow rate

H = h1+h2 = effective head

Cs = conductivity coefficient

h1 = distance between gage and water table

r = radius of test hole

h2 = applied pressure at gage

A = length of test section

Reference

US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No.	MW-1808	Contractor	AEP	Page	1 of 1
Project	Amos FAP	Project No.	WV015976.0005	Arcadis Staff	Allan Gillespie
Site Location	Winfield, WV			Date	4/23/2018

Base of Top Packer (ft bgs/ft amsl)	215.0	642.52	Surface Elevation (ft amsl)	857.52
Top of Bottom Packer (ft bgs/ft amsl)	225.0	632.52	Distance from Gauge to Ground Surface (ft)	1.8
Depth to Water Prior to Install (ft bgs/ft amsl)	82.0	775.52	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	82.0	775.52		

Test 1
Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	10090	0.0	N/A
1	10091	1.0	N/A
2	10093	1.5	N/A
3	10095	1.7	N/A
4	10097	1.8	N/A
5	10101	2.2	N/A
10	10128	3.8	N/A
15	10156	4.4	N/A
20	10189	5.0	N/A
25	10228	5.5	N/A
30	10259	5.6	N/A

Test 2
Constant Pressure (psi)

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0			
1			
2			
3			
4			
5			
10			
15			
20			
25			
30			

Test 1

Q =	1.3E-02	ft^3/s
h1 =	83.8	ft
h2 =	138.42	ft
H =	222.2	ft
r =	0.12	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	1.3E-04	cm/s

Zone 3
Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =		cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

Pre-Test 1
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

BEDROCK INJECTION PACKER TESTING LOG

Boring No.	MW-1810	Contractor	AEP	Page	1 of 1
Project	Amos FAP	Project No.	WV015976.0005	Arcadis Staff	Allan Gillespie
Site Location	Winfield, WV			Date	2/28/2018

Base of Top Packer (ft bgs/ft amsl)	70.0	665.26	Surface Elevation (ft amsl)	735.26
Top of Bottom Packer (ft bgs/ft amsl)	80.0	655.26	Distance from Gauge to Ground Surface (ft)	6.2
Depth to Water Prior to Install (ft bgs/ft amsl)	10.0	725.26	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	10.0	725.26		

Test 1
Constant Pressure (psi) 30

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	21.0	0.0	N/A
1	25.0	4.0	N/A
2	29.0	4.0	N/A
3	33.0	4.0	N/A
4	37.0	4.0	N/A
5	41.5	4.1	N/A
10	64.0	4.3	N/A
15	81.0	4.0	N/A
20	103.0	4.1	N/A
25	120.0	4.0	N/A
30	139.5	4.0	N/A

Test 2
Constant Pressure (psi)

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0			
1			
2			
3			
4			
5			
10			
15			
20			
25			
30			

Pre-Test 1
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =	8.8E-03	ft^3/s
h1 =	16.2	ft
h2 =	69.21	ft
H =	85.4	ft
r =	0.12	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	2.3E-04	cm/s

Zone 3
Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

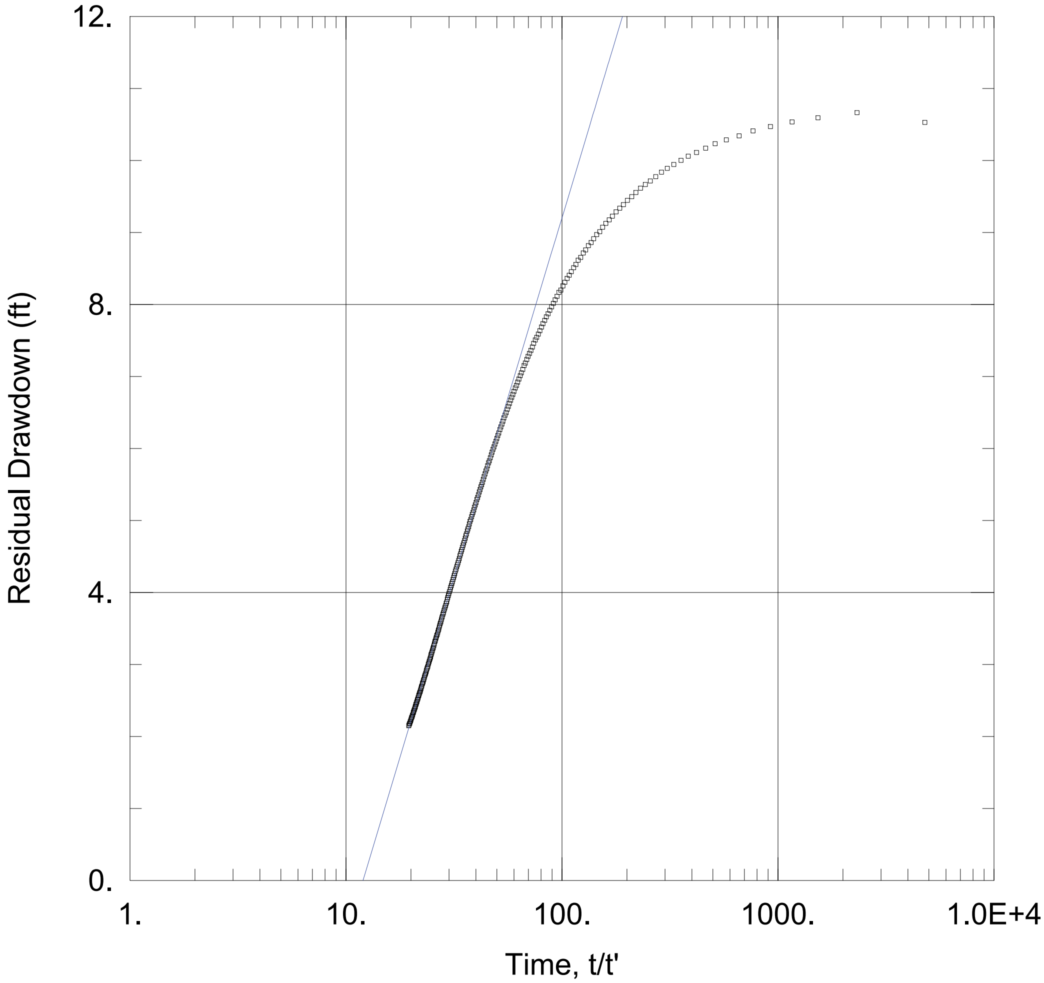
Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =		cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

Well Yield Tests

AQTESOLV Plots



MW-1 RECOVERY

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1
Test Date: 4-5-2018

AQUIFER DATA

Saturated Thickness: 8.9 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ MW-1	0	0

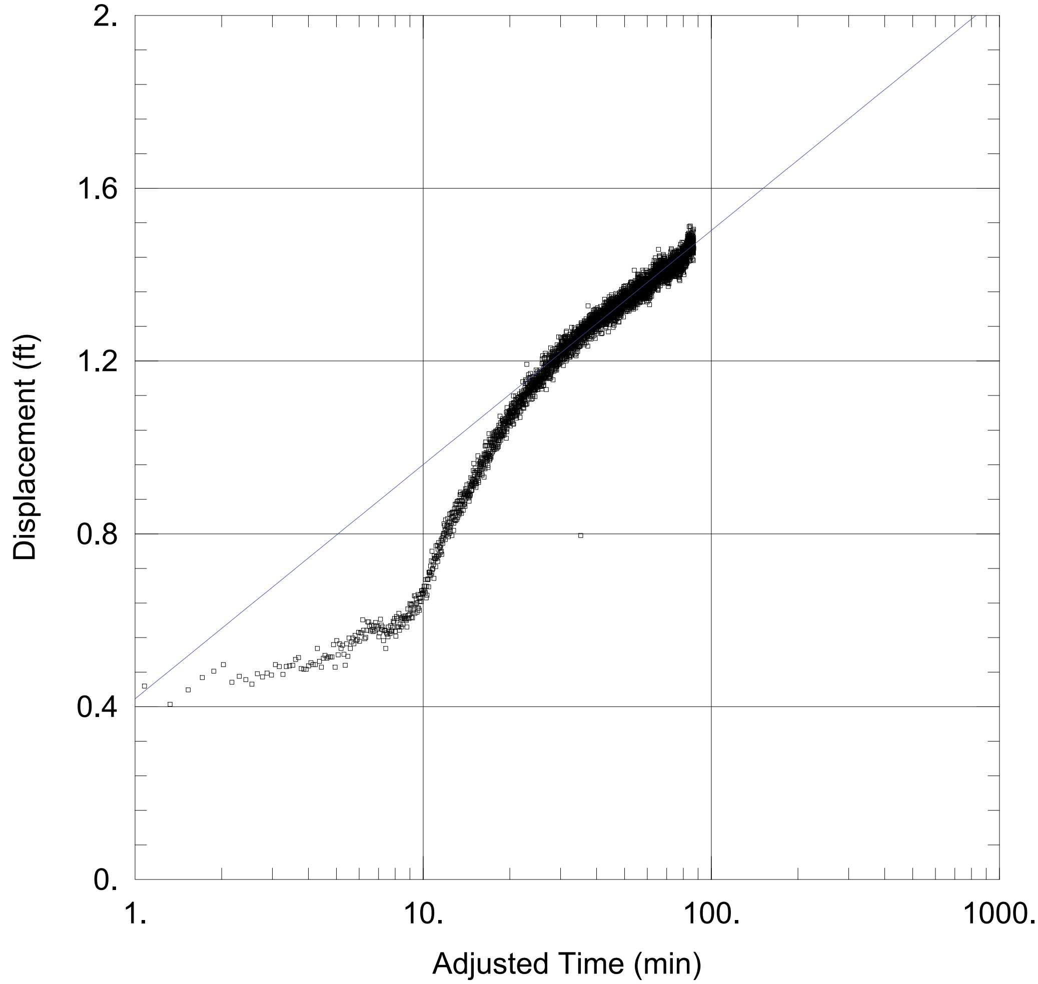
SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 2.8 ft^2/day

S/S' = 12.



MW-2

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-2
Test Date: 3-23-2018

AQUIFER DATA

Saturated Thickness: 8.9 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-2	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ MW-2	0	0

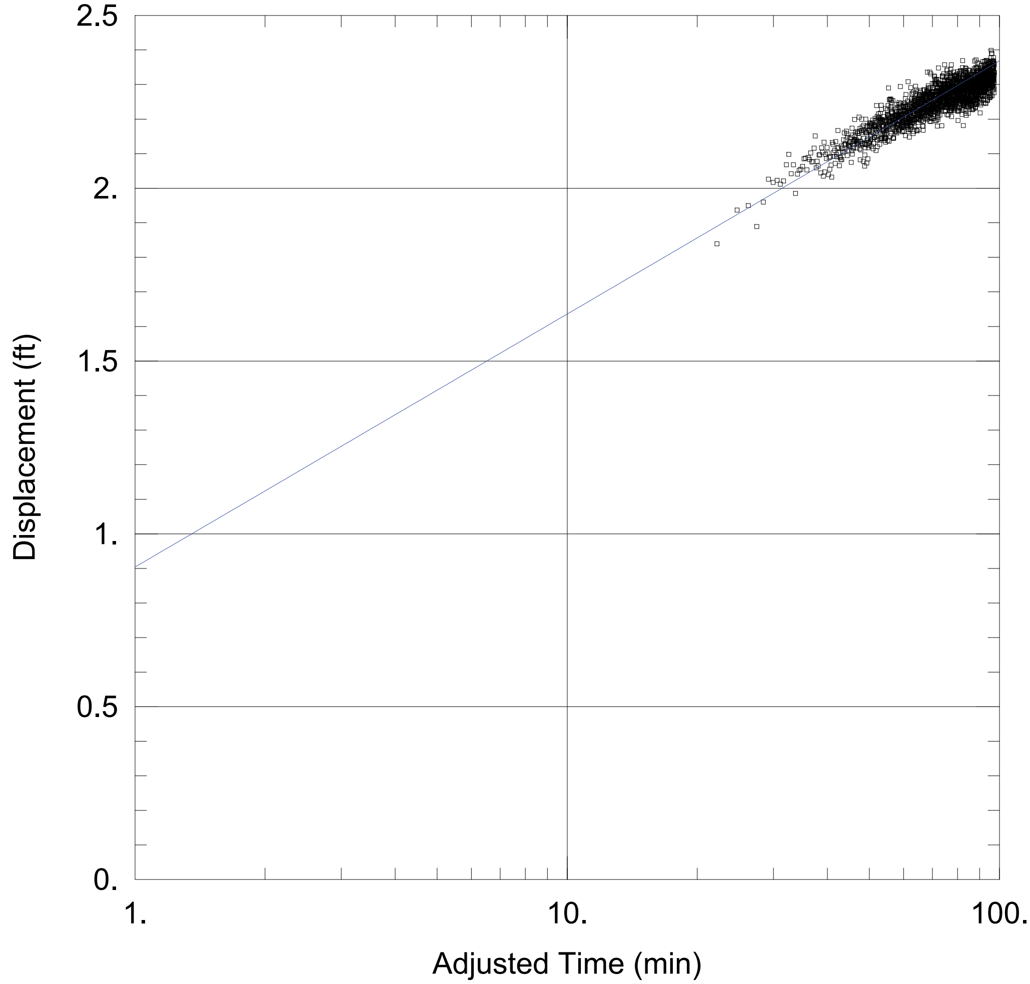
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 51.6 ft^2/day

S = 1.964



MW-6 STEP 7

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-6
Test Date: 4-6-2018

AQUIFER DATA

Saturated Thickness: 5. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-6	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ MW-6	0	0

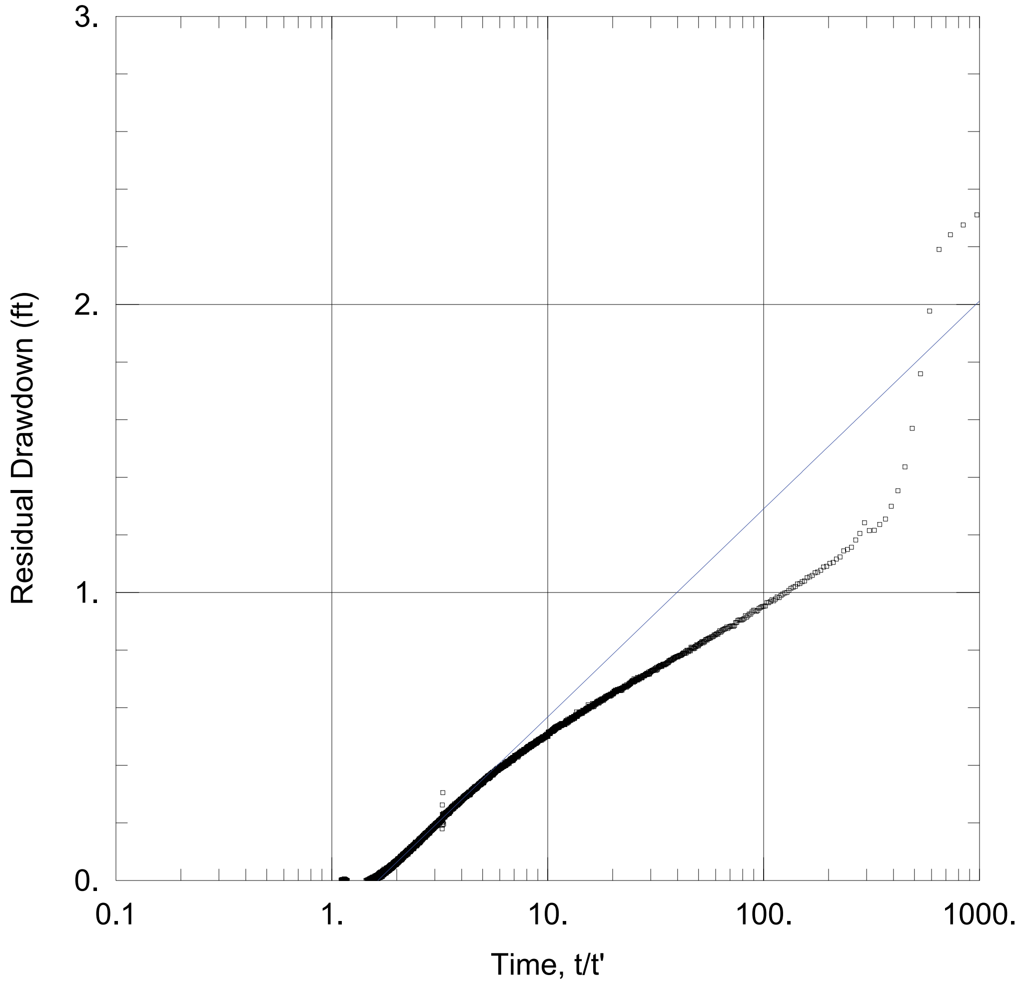
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 180.7 ft^2/day

S = 2.367



MW-6 RECOVERY

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-6
Test Date: 4-6-2018

AQUIFER DATA

Saturated Thickness: 5. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-6	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ MW-6	0	0

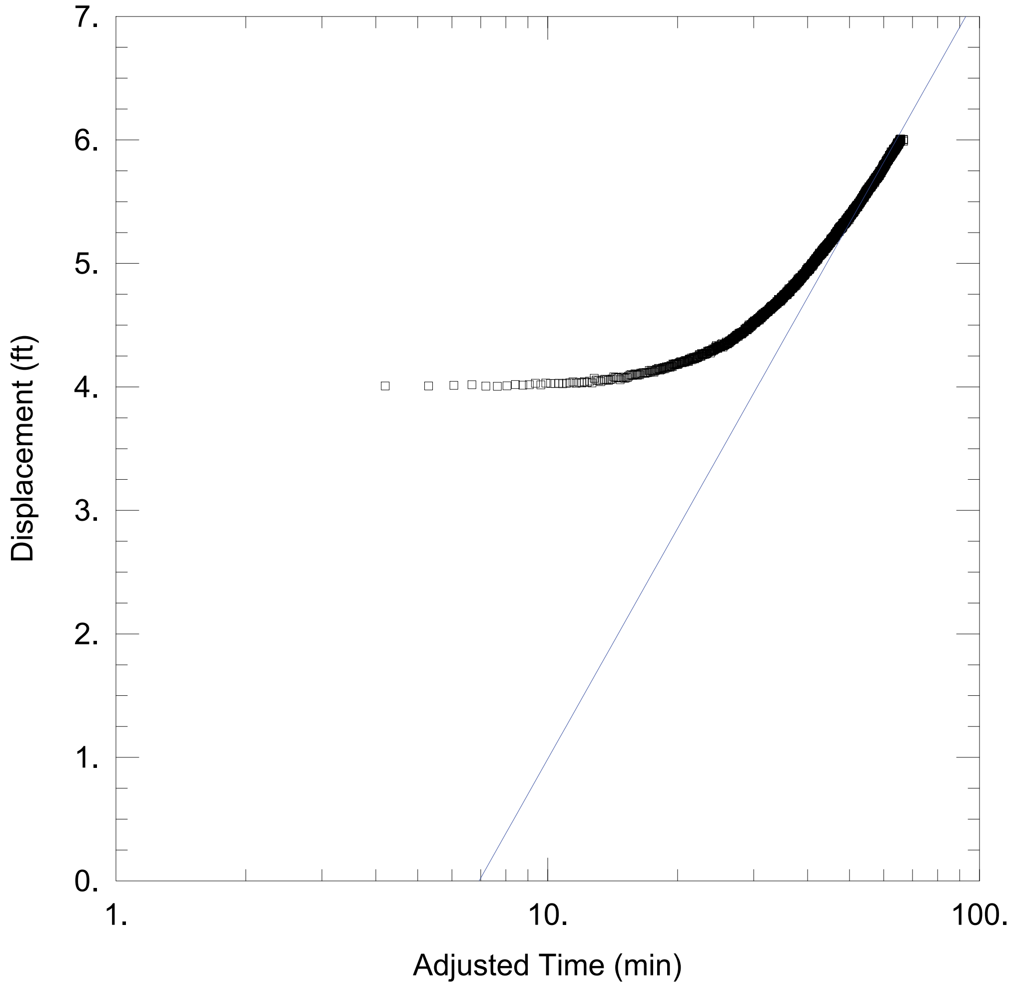
SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 183.2 ft^2/day

S/S' = 1.636



MW-1801A

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1801A
Test Date: 7-4-2018

AQUIFER DATA

Saturated Thickness: 20. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1801A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-1801A	0	0

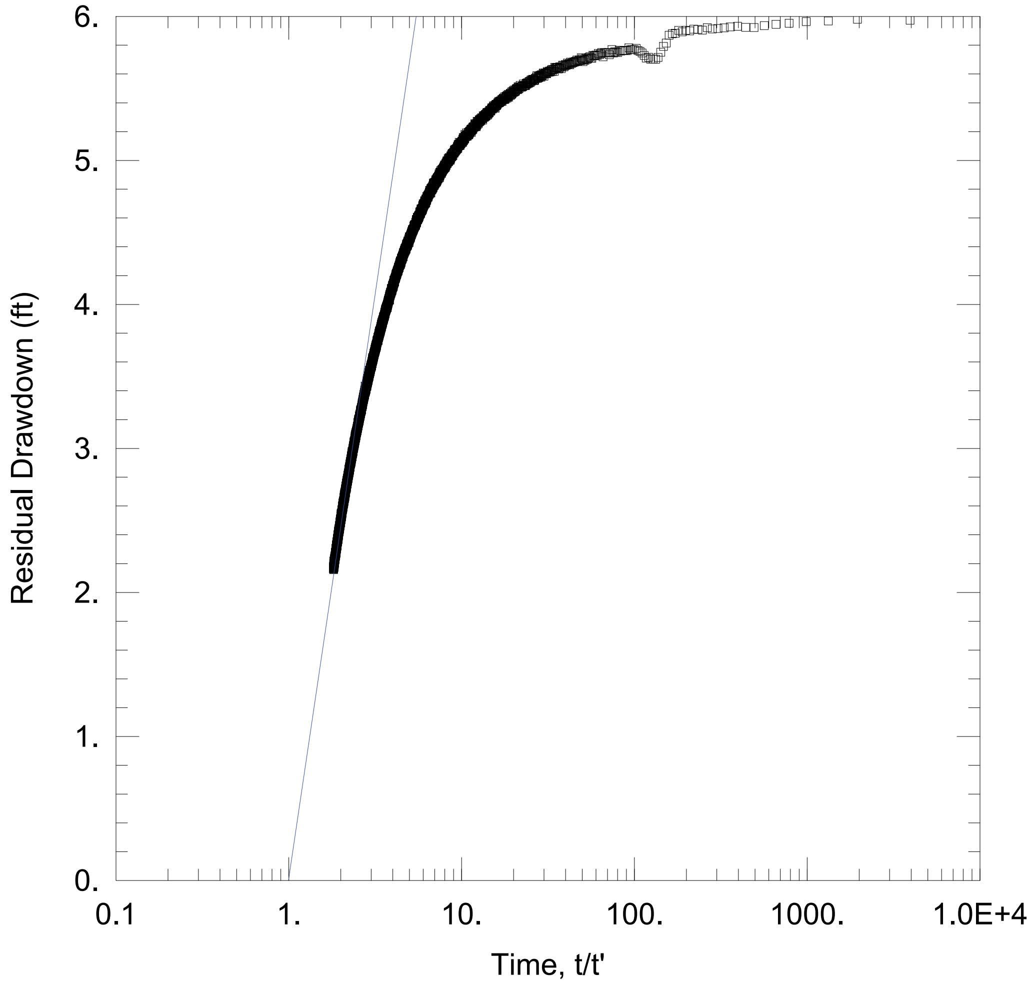
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 2.249 ft^2/day

S = 3.505



MW-1801A RECOVERY

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1801A
Test Date: 7-4-2018

AQUIFER DATA

Saturated Thickness: 20. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1801A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-1801A	0	0

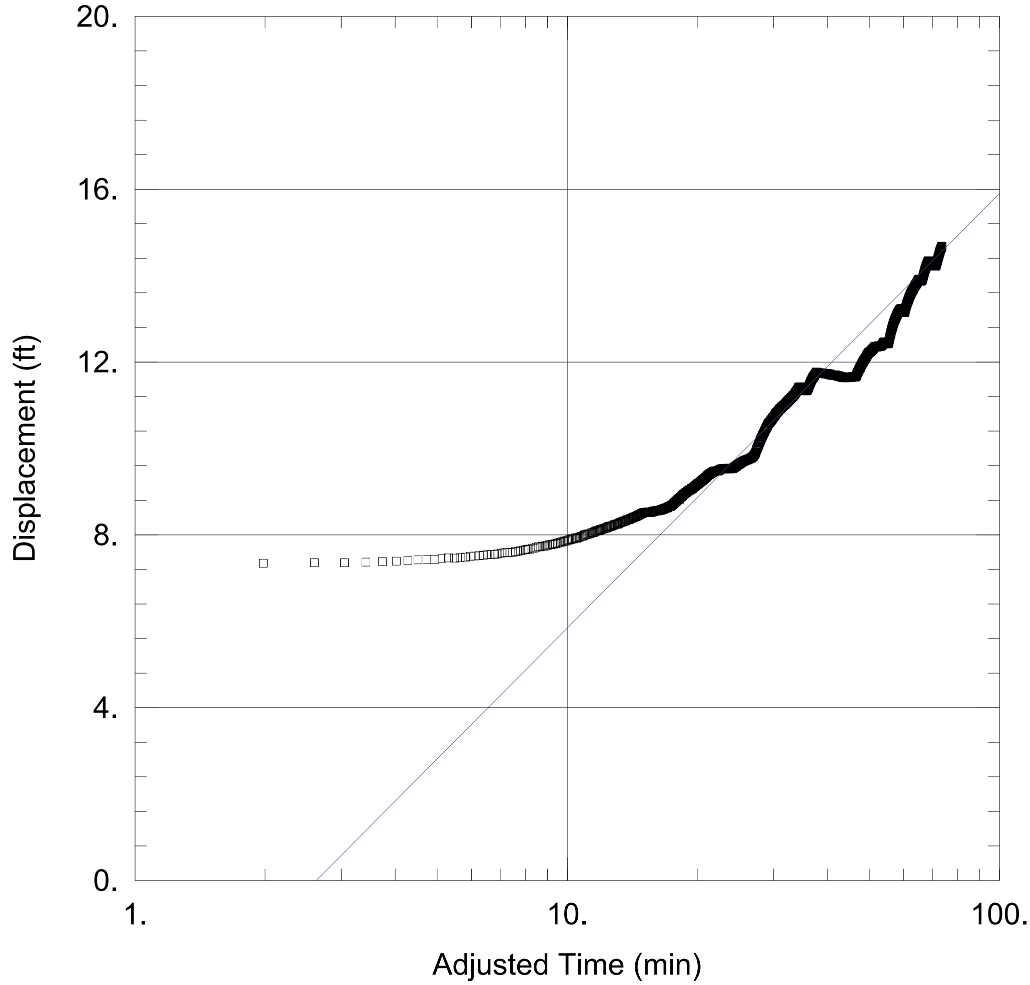
SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 1.722 ft^2/day

S/S' = 0.9966



MW-1806A

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1806A
Test Date: 7-19-2018

AQUIFER DATA

Saturated Thickness: 20. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
1806A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ 1806A	0	0

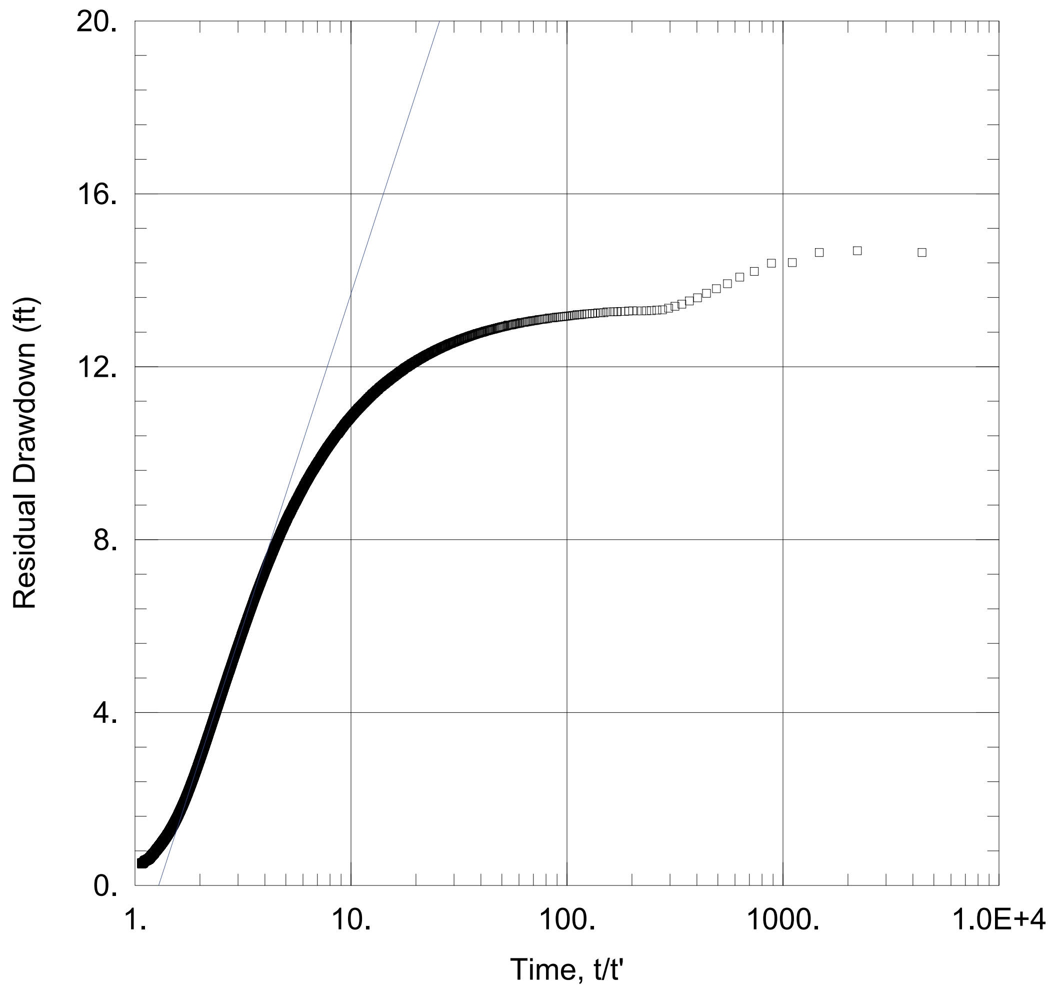
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 0.4629 ft^2/day

S = 0.2753



MW-1806A RECOVERY

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1806A
Test Date: 7-19-2018

AQUIFER DATA

Saturated Thickness: 20. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
1806A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ 1806A	0	0

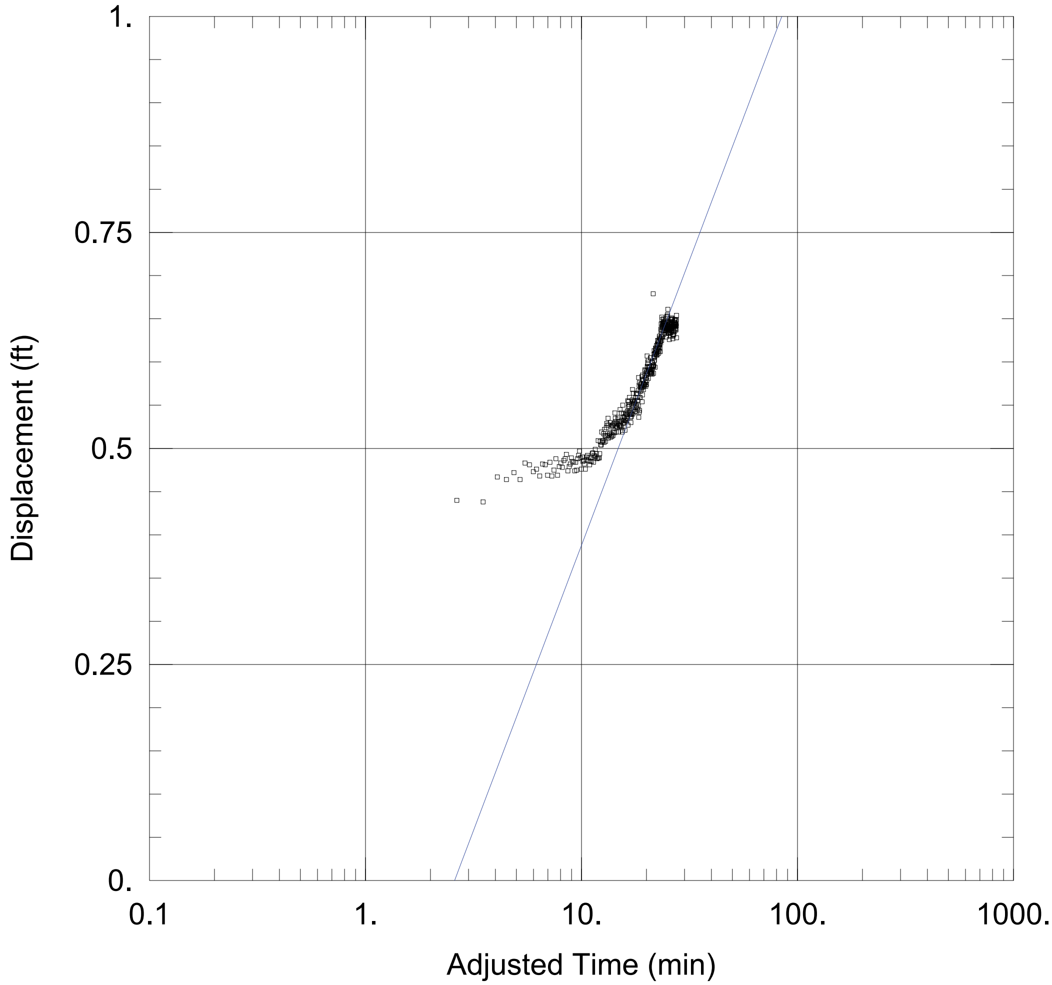
SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 0.3028 ft^2/day

S/S' = 1.289



MW-1808A

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1808A
Test Date: 7-20-2018

AQUIFER DATA

Saturated Thickness: 25. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW1808A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW1808A	0	0

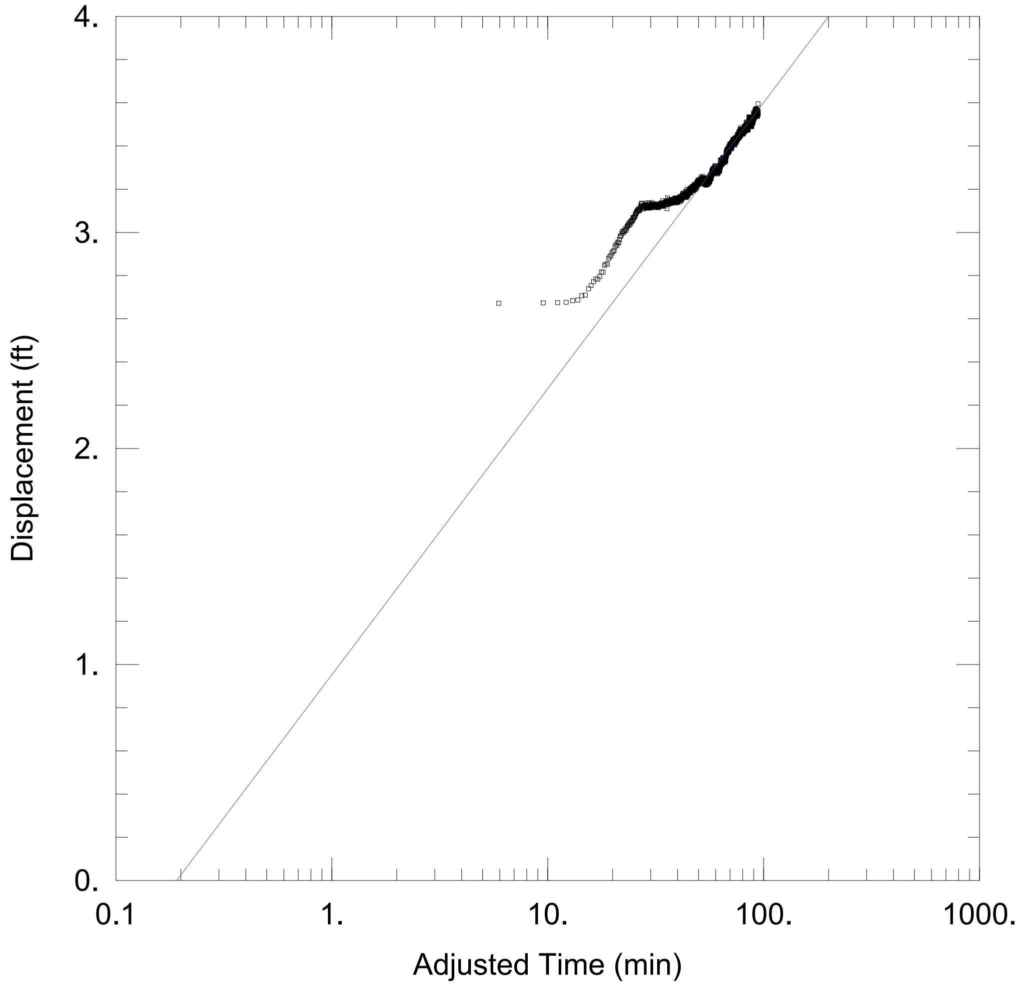
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 42.36 ft^2/day

S = 24.64



MW-1809A

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1809A
Test Date: 6-28-2018

AQUIFER DATA

Saturated Thickness: 15. ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1809A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
▫ MW-1809A	0	0

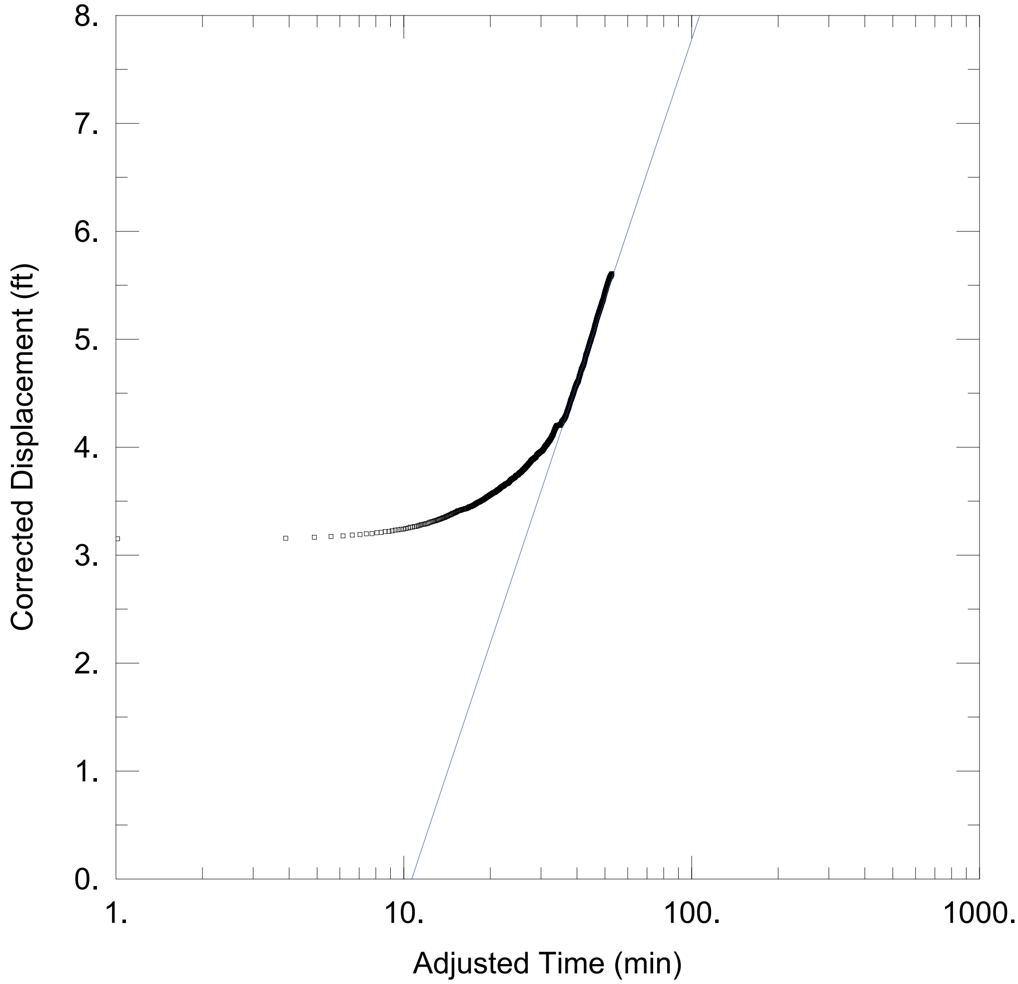
SOLUTION

Aquifer Model: Confined

Solution Method: Cooper-Jacob

T = 28.14 ft^2/day

S = 1.21



MW-1810A

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1810A
Test Date: 6-18-2018

AQUIFER DATA

Saturated Thickness: 15.22 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1810A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
MW-1810A	0	0

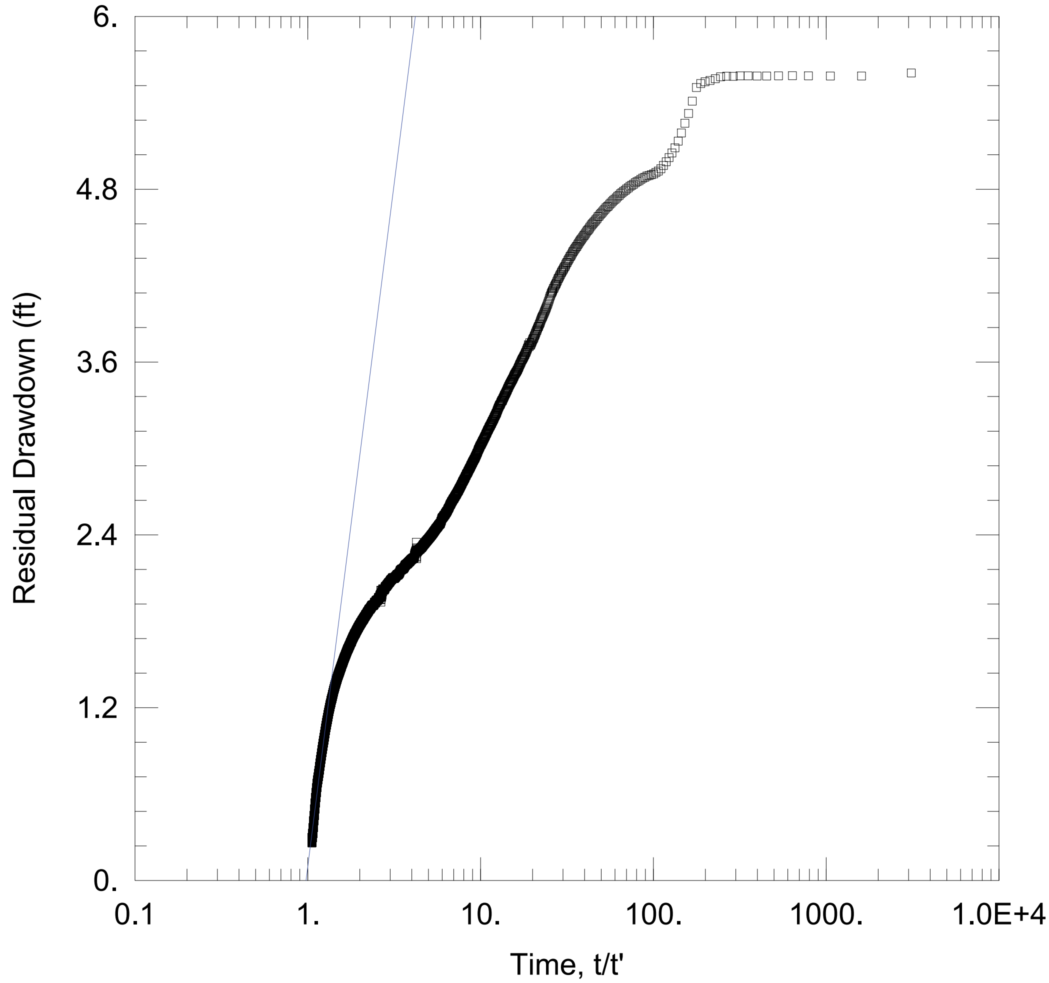
SOLUTION

Aquifer Model: Unconfined

Solution Method: Cooper-Jacob

T = 1.746 ft^2/day

S = 4.184



MW-1810A RECOVERY

Data Set: G:\...\Theis_Rec.aqt
Date: 11/08/18 Time: 14:11:41

PROJECT INFORMATION

Company: Arcadis
Client: AEP
Project: WV015976.0005
Location: Amos Fly Ash Pond
Test Well: MW-1810A
Test Date: 6-18-2018

AQUIFER DATA

Saturated Thickness: 15.22 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1810A	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-1810A	0	0

SOLUTION

Aquifer Model: Confined Solution Method: Theis (Recovery)

T = 1.473 ft^2/day S/S' = 0.9774

ARCADIS

Well Yield Tests

Field Logs

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1 | Date 4/5/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather NR

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 12.76 | Total Depth (ft-bmp) 53.05 | Water Column 40.29

Gallons in Well 6.45

MP Elevation NA | Pump Intake (ft-bmp) NR

Purge Method: Pump

Pump On/Off NR | Volumes Purged 8 | Centrifugal ___

Submersible x

Transducer SN NR | Observation Wells None | Other ___

Transducer Depth NR | Completed by J. Wanner

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
12:25	0:00	600	N/A	13.50	8.32	0.603	417.00	5.31	12.49	-42	90 HZ
12:31	0:06	600	NM	13.68	8.09	0.742	69.50	1.53	14.47	-69	90 HZ
12:36	0:11	600	NM	13.75	7.89	0.733	15.60	1.01	14.61	-89	90 HZ
12:40	0:15	600	2.64	13.78	7.83	0.729	10.70	0.77	14.68	-111	90 HZ
12:46	0:21	500	3.17	13.76	7.81	0.726	9.01	0.74	14.75	-132	91 HZ
12:50	0:25	500	3.70	13.78	7.80	0.724	6.62	0.62	14.76	-140	91 HZ
12:53	0:28	500	4.23	13.61	7.80	0.578	4.96	0.60	14.58	-145	92 HZ
12:57	0:32	500	4.76	13.67	7.79	0.722	4.74	0.58	14.58	-153	94 HZ
13:01	0:36	NR	5.28	13.68	7.78	0.727	4.31	0.51	14.79	-161	94 HZ
13:06	0:41	500	5.81	13.68	7.79	0.719	3.58	0.52	14.77	-164	94 HZ
13:10	0:45	NR	6.34	13.68	7.79	0.720	3.44	0.48	14.91	-166	94 HZ
13:11	0:46	Increase discharge/purge rate									
13:14	0:49	2000	7.40	16.24	7.79	0.721	6.89	0.63	15.17	-169	113 HZ
13:17	0:52	2000	9.25	16.70	7.78	0.720	4.40	0.72	15.12	-159	113 HZ
13:21	0:56	1900	10.57	17.13	7.78	0.720	3.46	0.36	15.04	-167	118 HZ
13:27	1:02	2000	11.89	17.29	7.77	0.720	4.19	0.30	15.04	-173	118 HZ
13:31	1:06	NR	14.53	17.39	7.76	0.720	4.17	0.25	15.05	-177	118 HZ
13:41	1:16	2000	16.11	17.35	7.76	0.582	3.35	0.20	15.04	-184	118 HZ
13:46	1:21	NR	18.49	17.28	7.77	0.584	3.22	0.18	15.12	-184	118 HZ
13:51	1:26	2000	21.13	17.13	7.76	0.584	3.05	0.18	15.10	-186	118 HZ
13:52	1:27	Increase discharge/purge rate									
13:55	1:30	2900	23.78	NM	7.75	0.721	6.20	0.70	15.16	-179	145 HZ
14:03	1:38	2800	29.06	20.78	7.75	0.720	6.45	0.24	15.15	-176	145 HZ
14:10	1:45	3400	31.70	21.96	7.75	0.721	NM	0.50	15.16	-176	145 HZ
14:17	1:52	3000	36.98	22.90	7.75	0.721	6.77	0.17	15.14	-178	145 HZ

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 Well ID MW-1 Date 4/5/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond Weather NR

Measuring Pt. Description TOC Screen Setting (ft-bmp) NR Casing Diameter (in.) 2 Well Material X PVC ___ SS

Static Water Level (ft-bmp) 12.76 Total Depth (ft-bmp) 53.05 Water Column 40.29

Gallons in Well 6.45

MP Elevation NA Pump Intake (ft-bmp) NR

Purge Method: Pump

Pump On/Off NR Volumes Purged 8 Centrifugal ___

Submersible x

Transducer SN NR Observation Wells None Other ___

Transducer Depth NR Completed by J. Wanner

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
14:24	1:59	NR	42.27	23.30	7.74	0.721	NM	0.18	15.15	-182	145 HZ
14:31	2:06	3200	48.87	NM	7.74	0.721	6.31	0.17	15.17	-183	145 HZ
14:39	2:14	3000	NM	NM	7.75	0.722	5.91	0.16	15.17	-185	145 HZ
14:43	2:18	Pump stopped									145 HZ
14:47	2:22	3100	NM	NM	7.71	0.722	5.70	0.19	15.08	-188	
14:54	2:29	3000	NM	NM	7.73	0.586	5.88	0.19	15.14	-185	
14:55	2:30	Increase discharge/purge rate									
14:58	2:33	6500	NM	NM	7.71	0.590	14.80	1.43	15.35	-168	
15:05	2:40	Test discontinued when DTW = 43.0 ft									

Well Casing Volumes (gallon/feet)

1-¼" = 0.06 2" = 0.16 3" = 0.37 4" = 0.65
1-½" = 0.09 2-½" = 0.26 3-½" = 0.50 6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-2 | Date 3/22/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather 32°F, cold, cloudy

Measuring Pt. Description TOC | Screen Setting (ft-bmp) 96.1-105.0 | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 55.38 | Total Depth (ft-bmp) 108 | Water Column 52.62

Gallons in Well 8.42

MP Elevation NA | Pump Intake (ft-bmp) 100

Purge Method: Pump

Pump On/Off NR | Volumes Purged 6 | Centrifugal ___

Submersible x

Transducer SN NR | Observation Wells None | Other ___

Transducer Depth 95 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
12:15	0:00	1000	N/A	55.38	NM	NM	NM	NM	NM	NM	
12:20	0:05	1000	NM	55.73	8.49	1.771	27.80	1.09	13.50	-140	
12:25	0:10	1000	NM	55.74	8.59	1.811	11.00	0.80	13.70	-159	
12:30	0:15	1000	NM	NM	8.65	1.829	4.78	0.76	13.26	-158	
12:40	0:25	1000	NM	55.85	8.73	1.823	3.88	0.63	13.66	-192	
12:50	0:35	1000	11	55.88	8.73	1.812	3.48	0.60	13.76	-210	
13:00	0:45	2000	NM	55.90	8.74	1.803	3.10	0.61	13.75	-213	
13:05	0:50	2000	NM	56.16	8.75	1.791	1.45	0.73	13.78	-221	
13:10	0:55	2000	NM	56.19	8.74	1.780	1.12	0.59	13.75	-213	
13:20	1:05	2000	26	56.23	8.74	1.768	0.95	0.55	13.78	-223	
13:30	1:15	2000	31	56.23	8.75	1.760	0.72	0.62	13.76	-224	
13:40	1:25	2000	41	56.23	8.76	1.755	0.69	0.69	13.77	-239	
13:50	1:35	2000	51	56.23	8.75	1.752	0.47	0.56	13.82	NR	
13:55	1:40	3000	Increase pumping rate								
14:00	1:45	3000	NM	56.61	8.73	1.747	0.48	0.55	13.73	-237	
14:05	1:50	3000	NM	56.71	8.75	1.751	0.42	0.55	13.83	-240	
14:15	2:00	3000	NM	56.79	8.75	1.747	0.55	0.46	13.82	-234	
14:25	2:10	3000	NM	56.82	8.75	1.752	0.49	0.47	13.81	-246	
14:35	2:20	3000	NM	56.84	8.75	1.750	0.40	0.50	13.72	-247	
14:40	2:25	4000	NM	57.09	8.74	1.751	0.39	0.46	13.78	-244	
14:50	2:35	4000	NM	57.20	8.74	1.755	0.48	0.37	13.80	-214	
15:00	2:45	4000	NM	57.26	8.74	1.756	0.48	0.39	13.77	-253	
15:10	2:55	4000	NM	57.31	8.75	1.739	0.48	0.39	13.80	-242	
15:15	3:00	Stop pumping, allow to recover									

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-2 | Date 3/23/2018

Project Name/Location: AEP Amos Plant - Fly Ash Pond | Weather: 22°F, sunny

Measuring Pt. Description: TOC
Screen Setting (ft-bmp): 96.1-105.0
Casing Diameter (in.): 2
Well Material: X PVC; SS

Static Water Level (ft-bmp): 55.50
Total Depth (ft-bmp): 108
Water Column: 52.5
Gallons in Well: 8.40

MP Elevation: NA
Pump Intake (ft-bmp): 100
Purge Method: Pump
- Centrifugal:
- Submersible: x
- Other:

Pump On/Off: NR
Volumes Purged: NM

Transducer SN: NR
Observation Wells: None

Transducer Depth: 95 ft
Completed by: A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
10:40	0:00	1000	NM	55.50	NM	NM	NM	NM	NM	NM	
10:45	0:05	1000	NM	55.83	8.58	1.747	2.03	12.60	13.43	-111	
10:50	0:10	1000	NM	55.85	8.70	1.756	0.82	1.00	13.56	-136	
11:00	0:20	1000	NM	55.85	8.76	1.754	0.71	0.69	13.64	-173	Transducer running
11:10	0:30	1000	NM	55.76	8.77	1.757	0.82	0.58	13.82	-177	
11:15	0:35	2000	Increase pumping rate								
11:20	0:40	2000	NM	56.12	8.78	1.771	0.53	0.45	14.02	-205	
11:25	0:45	2000	NM	56.25	8.78	1.771	0.52	0.43	14.00	-211	
11:30	0:50	2000	NM	56.30	8.78	1.776	0.32	0.42	13.91	219	
11:40	1:00	2000	NM	56.36	8.77	1.766	0.30	0.35	14.03	-237	
11:55	1:15	2000	NM	56.41	8.77	1.769	0.30	0.31	14.08	-241	
12:05	1:25	2000	NM	56.44	8.77	1.768	0.32	0.29	14.02	-247	
12:20	1:40	2000	NM	56.46	8.77	1.767	0.16	0.24	14.02	-250	
12:25	1:45	3000	Increase pumping rate								
12:30	1:50	3000	NM	56.72	8.77	1.761	0.28	0.24	13.93	-252	
12:35	1:55	3000	NM	56.83	8.76	1.763	0.25	0.23	13.97	-255	
12:45	2:05	3000	NM	56.92	8.76	1.764	0.28	0.24	13.98	-258	
12:55	2:15	3000	Shut down pumping, battery low								
13:00	2:20	N/A	NM	56.26	NM	NM	NM	NM	NM	NM	
13:15	2:35	N/A	NM	55.84	NM	NM	NM	NM	NM	NM	
13:25	2:45	N/A	NM	55.80	NM	NM	NM	NM	NM	NM	
13:35	2:55	N/A	NM	55.77	NM	NM	NM	NM	NM	NM	
13:45	3:05	N/A	NM	55.75	NM	NM	NM	NM	NM	NM	
13:47	3:07	Stop transducer recording									

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-2 | Date 3/26/2018

Project Name/Location: AEP Amos Plant - Fly Ash Pond | Weather: NR

Measuring Pt. Description: TOC
Screen Setting (ft-bmp): 96.1-105.0
Casing Diameter (in.): 2
Well Material: X PVC; ___ SS

Static Water Level (ft-bmp): 55.54
Total Depth (ft-bmp): 108
Water Column: 52.46
Gallons in Well: 8.39

MP Elevation: NA
Pump Intake (ft-bmp): 100
Purge Method: Pump
Centrifugal: ___
Submersible: x
Other: ___

Pump On/Off: NR
Volumes Purged: NM

Transducer SN: NR
Observation Wells: None

Transducer Depth: 95 ft
Completed by: A. Gillespie

Pumping Stress Test

Time	Min Elapsed	Rate (gpm)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (^oC)	Redox (mV)	Comments
10:50	0:00	N/A	NM	55.54	NM	NM	NM	NM	NM	NM	
10:55	0:05	1.50	NM	56.71	8.70	1.765	2.22	1.63	13.87	-200	
11:00	0:10	1.25	NM	57.00	8.76	1.758	1.07	1.15	13.88	-212	
11:15	0:25	1.25	NM	57.32	8.79	1.756	0.62	0.62	13.92	-242	
11:35	0:45	1.25	NM	57.52	8.79	1.752	0.42	0.38	13.95	-255	
11:45	0:55	0.75	NM	Decrease pumping rate							
11:50	1:00	N/A	NM	57.05	Stop pumping, allow to recover						

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-6 | Date 4/6/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather NR

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 12.50 | Total Depth (ft-bmp) NR | Water Column NA

Gallons in Well NA

MP Elevation NA | Pump Intake (ft-bmp) 32

Purge Method: Pump

Pump On/Off NR | Volumes Purged NM | Centrifugal ___

Submersible x

Transducer SN NR | Observation Wells MW-1, MW-5 | Other ___

Transducer Depth 29 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Observation Wells DTW MW-1	Observation Wells DTW MW-5	Comments
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12.78	32.88	
8:15	0:00	NR	N/A	NM	7.78	0.484	283.00	13.00	11.27	33	NM	NM	85 HZ
8:20	0:05	1100	NM	12.59	6.97	0.583	108.00	2.19	15.01	-80	NM	NM	90 HZ
8:28	0:13	Pump stopped due to error											
8:33	0:18	NR	3.70	12.60	6.30	0.561	12.90	0.96	14.99	-115	12.8	32.85	90 HZ
8:35	0:20	Pump stopped due to error											
8:42	0:27	NR	5.81	12.61	6.14	0.551	3.50	0.66	15.19	-117	NM	NM	90 HZ
8:51	0:36	1000	8.19	12.61	6.05	0.540	1.45	0.48	15.19	-116	NM	NM	90 HZ
8:59	0:44	NR	10.57	12.61	6.00	0.536	2.08	0.42	15.14	-115	12.82	32.84	90 HZ
9:02	0:47	Pump discharge/purge rate increased											
9:09	0:54	2000	14.53	12.71	5.97	0.531	11.60	0.31	15.25	-117	NM	NM	125 HZ
9:16	1:01	2000	NM	12.72	5.98	0.523	3.11	0.28	15.25	-119	12.88	32.86	125 HZ
9:24	1:09	2000	NM	12.73	6.03	0.508	1.38	0.25	15.29	-124	NM	NM	125 HZ
9:30	1:15	NR	NM	12.74	6.06	0.502	1.35	0.25	15.33	-127	NM	NM	125 HZ
9:35	1:20	NR	NM	12.74	6.08	0.500	1.10	0.23	15.32	-128	12.89	32.85	125 HZ
9:40	1:25	2000	NM	12.72	6.08	0.498	0.92	0.23	15.26	-127	NM	NM	125 HZ
9:45	1:30	NR	NM	12.75	6.08	0.500	1.17	0.20	15.36	-128	NM	NM	125 HZ
9:50	1:35	2000	NM	12.75	6.08	0.500	0.78	0.20	15.42	-128	NM	NM	125 HZ
9:52	1:37	Pump discharge/purge rate increased											
9:57	1:42	NR	NM	12.85	6.11	0.490	4.74	0.18	15.20	-131	NM	NM	125 HZ
10:02	1:47	3250	NM	12.85	6.10	0.488	3.75	0.17	15.14	-132	12.93	32.83	125 HZ
10:07	1:52	3250	NM	12.83	6.11	0.488	2.86	0.17	15.14	-131	NM	NM	125 HZ
10:12	1:57	NR	NM	12.85	6.12	0.487	1.24	0.16	15.19	-133	NM	NM	125 HZ
10:17	2:02	NR	NM	12.85	6.13	0.486	0.91	0.17	15.20	-134	12.95	32.84	125 HZ
10:22	2:07	NR	NM	12.87	6.15	0.485	0.73	0.16	15.18	-135	NM	NM	125 HZ

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-6 | Date 4/6/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather NR

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 12.50 | Total Depth (ft-bmp) NR | Water Column NA

Gallons in Well NA

MP Elevation NA | Pump Intake (ft-bmp) 32

Purge Method: Pump
Centrifugal ___
Submersible x
Other ___

Pump On/Off NR | Volumes Purged NM

Transducer SN NR | Observation Wells MW-1, MW-5

Transducer Depth 29 ft | Completed by J. Wanner

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (^oC)	Redox (mV)	Comments
10:27	2:12	3000	NM	12.89	6.15	0.485	1.12	0.17	15.17	-136	125 HZ
10:32	2:17	NR	NM	12.87	6.15	0.485	0.54	0.15	15.18	-137	125 HZ
10:37	2:22	3000	NM	12.88	6.15	0.486	0.98	0.14	15.17	-136	125 HZ
10:40	2:25	NR	NM	12.88	6.15	0.486	NM	0.15	15.21	-137	125 HZ
10:41	2:26	Pump discharge/purge rate increased									
10:44	2:29	3500	NM	12.92	6.15	0.488	1.41	0.14	15.31	-137	150 HZ
10:47	2:32	4400	NM	12.97	6.16	0.486	2.67	0.14	15.16	-137	150 HZ
10:52	2:37	4000	NM	13.01	6.16	0.487	1.90	0.14	15.19	-138	150 HZ
10:57	2:42	NR	NM	13.00	6.16	0.487	1.60	0.13	15.20	-138	150 HZ; MW-1 DTW = 13.03
11:02	2:47	4300	NM	13.03	6.16	0.487	2.15	0.13	15.15	-138	150 HZ
11:07	2:52	NR	NM	13.01	6.16	0.488	1.12	0.13	15.20	-138	150 HZ
11:12	2:57	NR	NM	12.99	6.15	0.488	1.86	0.13	15.17	-136	150 HZ
11:17	3:02	NR	NM	13.00	6.14	0.489	1.09	0.13	15.24	-136	150 HZ
11:18	3:03	Pump discharge/purge rate increased									
11:20	3:05	7500	NM	13.28	NM	NM	NM	NM	NM	NM	225 HZ
11:22	3:07	8000	NM	13.36	6.16	0.490	13.00	0.11	15.36	-138	225 HZ
11:25	3:10	NR	NM	13.37	6.16	0.489	5.85	0.11	15.36	-138	225 HZ
11:30	3:15	8000	NM	13.43	6.15	0.493	4.07	0.11	15.33	-138	225 HZ
11:40	3:25	8000	NM	13.45	6.14	0.493	2.97	0.10	15.31	-139	225 HZ
11:45	3:30	NR	NM	13.46	6.14	0.493	NM	0.11	15.31	-139	225 HZ
11:47	3:32	Pump discharge/purge rate increased									
11:49	3:34	12000	NM	13.82	6.11	0.495	35.40	0.11	15.44	-137	300 HZ
11:53	3:38	11000	NM	13.92	NM	NM	19.20	NM	NM	NM	
11:56	3:41	11000	NM	NM	NM	NM	NM	NM	NM	NM	

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-6 | Date 4/6/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather NR

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC, SS

Static Water Level (ft-bmp) 12.50 | Total Depth (ft-bmp) NR | Water Column NA

Gallons in Well NA

MP Elevation NA | Pump Intake (ft-bmp) 32

Purge Method: Pump — Centrifugal ___ Submersible x Other ___

Pump On/Off NR | Volumes Purged NM

Transducer SN NR | Observation Wells MW-1, MW-5

Transducer Depth 29 ft | Completed by J. Wanner

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (^oC)	Redox (mV)	Comments
12:00	3:45	12000	NM	14.15	6.12	0.496	19.20	0.1	15.42	-139	320 HZ
12:05	3:50	NR	NM	14.23	NM	NM	NM	NM	NM	NM	320 HZ
12:08	3:53	NR	NM	14.25	NM	NM	NM	NM	NM	NM	320 HZ
12:11	3:56	12000	NM	14.28	NM	NM	NM	NM	NM	NM	320 HZ
12:14	3:59	NR	NM	14.30	NM	NM	NM	NM	NM	NM	320 HZ
12:17	4:02	12000	NM	14.31	NM	NM	NM	NM	NM	NM	320 HZ
12:20	4:05	NR	NM	14.33	NM	NM	NM	NM	NM	NM	320 HZ
12:23	4:08	12000	NM	14.34	NM	NM	NM	NM	NM	NM	320 HZ
12:26	4:11	NR	NM	14.37	NM	NM	NM	NM	NM	NM	320 HZ
12:29	4:14	12000	NM	14.36	NM	NM	NM	NM	NM	NM	320 HZ
12:31	4:16	14500	NM	14.66	NM	NM	NM	NM	NM	NM	400 HZ
12:34	4:19	NR	NM	14.70	NM	NM	NM	NM	NM	NM	400 HZ
12:37	4:22	14000	NM	14.73	6.10	0.500	13.50	0.09	15.60	-141	400 HZ
12:40	4:25	NR	NM	14.76	NM	NM	NM	NM	NM	NM	400 HZ
12:43	4:28	13500	NM	14.78	6.10	0.501	10.90	0.09	15.58	-141	400 HZ
12:46	4:31	NR	NM	14.80	NM	NM	NM	NM	NM	NM	400 HZ
12:49	4:34	14200	NM	14.80	6.09	0.500	8.11	0.09	15.56	-141	400 HZ
12:52	4:37	NR	NM	14.81	NM	NM	NM	NM	NM	NM	400 HZ
13:01	4:46	NR	NM	14.84	6.09	0.501	10.60	0.07	15.54	-141	400 HZ
13:02	4:47	NR	NM	14.85	NM	NM	NM	NM	NM	NM	400 HZ
13:03	4:48	End of test, begin recovery									

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1801A | Date 7/4/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather Sunny, hot, humid, 82-94°F

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 49.78 | Total Depth (ft-bmp) 78.5 | Water Column 28.72

Gallons in Well 4.60

MP Elevation NA | Pump Intake (ft-bmp) 75

Purge Method: Pump
Centrifugal ___
Submersible x
Other ___

Pump On/Off NR | Volumes Purged 7

Transducer SN NR | Observation Wells 1801B, 1801C

Transducer Depth 73 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
10:30	0:00	500	N/A	49.78	NM	NM	NM	NM	NM	NM	
10:40	0:10	500	NM	50.39	7.27	0.708	68.70	3.12	15.34	88.2	Clear, no odors
10:50	0:20	500	NM	50.74	7.38	0.612	18.90	2.23	15.51	77.9	
11:00	0:30	500	3.96	50.87	7.38	0.570	18.10	1.84	16.14	78.8	
11:10	0:40	750	NM	51.44	7.39	0.572	16.10	2.23	14.74	73.7	Clear, no turbidity, no odors
11:20	0:50	750	NM	52.10	7.37	0.515	10.30	2.13	14.75	75.1	
11:30	1:00	750	9.91	52.38	7.37	0.514	7.42	2.11	14.92	74.1	Clear, no odors
11:40	1:10	1000	12.55	52.81	7.36	0.508	4.77	2.12	14.55	74.2	Clear, no odors
11:50	1:20	1000	NM	53.35	7.35	0.507	5.04	2.05	14.51	74.1	
12:00	1:30	1000	17.83	53.74	7.35	0.506	6.05	1.98	14.55	76.5	
12:05	1:35	1500	NM	NM	NM	NM	NM	1.98	14.55	76.5	
12:10	1:40	1500	NM	54.14	7.34	0.503	5.01	2.01	14.19	75.0	Clear, no odors
12:20	1:50	1500	25.1	55.06	7.35	0.504	3.22	1.92	14.10	73.3	
12:30	2:00	1500	NM	55.55	7.35	0.506	2.71	1.90	14.13	74.1	Clear, no odors
12:35	2:05	1500	31.04	55.73	Terminated pumping, allow to recover						
Well Recovery Data:											
12:52	2:22	N/A	N/A	54.30	NM	NM	NM	NM	NM	NM	
13:00	2:30	N/A	N/A	53.82	NM	NM	NM	NM	NM	NM	
13:15	2:45	N/A	N/A	53.14	NM	NM	NM	NM	NM	NM	
13:30	3:00	N/A	N/A	52.72	NM	NM	NM	NM	NM	NM	
13:45	3:15	N/A	N/A	52.33	NM	NM	NM	NM	NM	NM	
14:00	3:30	N/A	N/A	52.01	NM	NM	NM	NM	NM	NM	

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1806A | Date 7/19/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather Sunny, hot, 65-92^{o}F

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 25.25 | Total Depth (ft-bmp) 83.5 | Water Column 58.25

Gallons in Well 9.32

MP Elevation NA | Pump Intake (ft-bmp) 80

Purge Method: Pump

Pump On/Off NR | Volumes Purged NM | Centrifugal ___

Submersible x

Transducer SN NR | Observation Wells MW-1806B, MW-1806C | Other ___

Transducer Depth 75 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (^{o}C)	Redox (mV)	Observation Wells DTW MW-1806B	Observation Wells DTW MW-1806C	Comments
11:30	0:00	300	N/A	25.25	NM	NM	NM	NM	NM	NM	210.47	257.68	
11:35	0:05	300	NM	NM	NM	NM	NM	NM	NM	NM			Voltage output = 10
11:40	0:10	300	NM	28.52	8.04	0.659	242.00	2.19	15.73	51.1			Cloudy, no odors
11:45	0:15	300	NM	29.70	8.19	0.638	107.00	1.89	15.53	26.9	>200	257.68	
11:50	0:20	300	NM	30.12	8.21	0.635	69.80	0.56	15.96	20.7			Difficult to maintain constant pumping rate
11:55	0:25	300	NM	31.06	8.17	0.629	73.70	0.53	15.36	18.1			
12:05	0:35	300	NM	32.24	8.11	0.621	51.10	0.61	15.30	11.2	>200	257.68	Clearing, no odors
12:10	0:40	300	NM	32.91	8.06	0.621	18.70	0.69	15.51	18.3			
12:15	0:45	300	NM	32.85	8.06	0.620	16.60	0.75	15.86	18.1			
12:20	0:50	500	NM	34.37	8.07	0.623	23.60	0.91	14.84	17.2	>200	257.68	Clear, no odors
12:25	0:55	500	NM	35.84	8.04	0.623	14.60	1.12	14.84	14.1			Clear, no odors
12:30	1:00	500	NM	36.88	8.02	0.625	10.30	0.96	15.09	10.8			
12:40	1:10	500	NM	37.40	8.02	0.637	11.40	1.09	15.06	0.0	>200	257.68	Clear, no odors
12:50	1:20	500	NM	38.66	8.04	0.643	10.90	0.95	15.27	-16.0			
13:00	1:30	500	NM	39.52	8.05	0.647	7.79	0.82	15.07	-51.7			Voltage output = 12.7
13:05	1:35	Stop pumping, allow to recover w/transducer running											
Well Recovery Data:													
13:10	1:40	N/A	N/A	37.11	NM	NM	NM	NM	NM	NM			
13:15	1:45	N/A	N/A	35.9	NM	NM	NM	NM	NM	NM			
13:20	1:50	N/A	N/A	34.73	NM	NM	NM	NM	NM	NM			
13:25	1:55	N/A	N/A	33.77	NM	NM	NM	NM	NM	NM			

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 Well ID MW-1808A Date 7/20/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond Weather Sunny, 82°F

Measuring Pt. Description TOC Screen Setting (ft-bmp) NR Casing Diameter (in.) 2 Well Material X PVC ___ SS

Static Water Level (ft-bmp) 83.11 Total Depth (ft-bmp) 112.7 Water Column 29.59

Gallons in Well 4.73

MP Elevation NA Pump Intake (ft-bmp) 109

Purge Method: Pump

Pump On/Off NR Volumes Purged NM Centrifugal ___

Submersible x

Transducer SN NR Observation Wells None Other ___

Transducer Depth 105 ft

1808B/A recently developed dry on 7/19/18. Pumps removed morning of 7/20/18.

Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
10:40	0:00	NR	N/A	83.11	NM	NM	NM	NM	NM	NM	
10:50	0:10	300	NM	83.19	7.54	1.261	369.00	3.38	15.29	-174	Slightly turbid, sulfur odor
10:55	0:15	400	NM	83.19	7.60	1.221	243.00	1.99	15.07	-165	Voltage output = 20.1
11:00	0:20	400	NM	83.22	7.61	1.203	174.00	1.54	14.89	-180	Voltage output fluctuating
11:05	0:25	500	NM	NM	7.60	1.188	181.00	1.52	15.20	-166	Controller moved to shade
11:10	0:30	500	NM	83.22	7.60	1.187	215.00	1.52	15.39	-165	Cloudy, no odors; voltage output = 17.6
11:20	0:40	600	NM	83.24	7.60	1.15	209.00	1.15	15.45	-171	Cloudy, no odors
11:25	0:45	600	NM	83.26	7.61	1.102	203.00	0.97	15.45	-179	Rate increased without adjusting controller; voltage output = 18.4
11:30	0:50	500	NM	83.26	7.64	1.053	172.00	0.69	15.55	-181	
11:35	0:55	500	NM	83.27	7.65	1.031	134.00	0.50	15.61	-191	Voltage output =16.9 w/o adjusting
11:40	1:00	800	NM	83.31	7.67	0.965	112.00	0.48	15.32	-182	Clearing, no odors; voltage output = 17.8
11:45	1:05	800	NM	83.32	7.68	0.939	74.30	0.53	15.29	-174	
11:55	1:15	800	NM	83.36	7.66	0.923	55.40	0.38	15.07	-178	Clearing, no odors; voltage output = 18.0
12:05	1:25	800	NM	83.39	7.63	0.937	53.20	0.40	14.98	-175	
12:15	1:35	800	NM	83.41	7.59	0.966	49.70	0.35	14.93	-170	Clear, no odors; voltage output = 17.9
12:25	1:45	800	NM	83.41	7.59	0.968	45.30	0.33	14.94	-169	
12:30	1:50	800	NM	83.40	7.58	0.969	43.40	0.37	15.17	-165	
12:35	1:55	1300	NM	83.46	7.57	0.974	25.30	0.31	14.72	-174	Clear, no odors; voltage output = 18.7
12:40	2:00	1300	NM	83.48	7.58	0.974	27.20	0.29	14.68	-177	
12:50	2:10	1300	NM	83.48	7.56	0.976	38.20	0.29	14.85	-178	Clear, no odors
13:00	2:20	1300	NM	83.49	7.57	0.978	56.40	0.26	14.79	-182	
13:05	2:25	1300	NM	Increase pumping rate							
13:10	2:30	2000	NM	83.59	7.55	0.979	46.30	0.21	14.62	-187	
13:15	2:35	2000	NM	83.61	7.56	0.978	45.60	0.21	14.45	-189	Rain approaching
13:20	2:40	3000	NM	83.75	7.55	0.975	NM	0.19	14.21	-193	
13:25	2:45	NR	NM	Stop work due to lightning and slight to moderate rain, stopped pump; heavy rain approaching; transducer running until 11:00 p.m.							

Notes: MW-1808M depth to water measurements: 11:45 = 197.54 ft, 12:05 = 197.13 ft, 12:25 = 196.56 ft
Stopped collecting water level measurements on MW-1808M: depth to water decreasing from well development on 7/19/18 and removal of pump the morning of 7/20/18. Well is recovering from development.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1809A | Date 6/28/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather Sunny, hot, 81°F

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 48.39 | Total Depth (ft-bmp) 75.12 | Water Column 26.73

Gallons in Well 4.28

MP Elevation NA | Pump Intake (ft-bmp) 73

Purge Method: Pump

Pump On/Off NR | Volumes Purged 28 | Centrifugal ___ | Submersible x

Transducer SN NR | Observation Wells MW-1807A, MW-1807B | Other ___

Transducer Depth 71 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
13:05	0:00	NR	N/A	48.39	NM	NM	NM	NM	NM	NM	
13:15	0:10	NR	NM	48.39	NM	NM	NM	NM	NM	NM	
13:20	0:15	500	1.06	48.54	6.97	1.370	30.10	12.35	19.06	-52.1	Clearing, no odors
13:30	0:25	500	NM	48.59	6.93	1.361	18.00	6.26	20.45	-56.4	Air bubbles in flow thru cell
13:45	0:40	500	NM	48.58	6.95	1.353	12.70	5.48	20.95	-58.1	Clear, no odors
13:55	0:50	500	5.68	48.66	7.01	1.353	5.59	5.19	19.19	-81.9	
14:00	0:55	750	Increase pumping rate								
14:05	1:00	750	NM	48.80	7.03	1.334	4.53	4.55	18.40	-83.1	Air bubbles in flow thru cell
14:15	1:10	750	NM	48.84	7.04	1.334	5.59	4.18	18.71	-76.3	Clear, no odors
14:30	1:25	750	11.62	48.88	7.07	1.332	3.96	4.01	18.54	-96.1	Clear, no odors
14:45	1:40	750	14.61	48.90	7.08	1.329	3.53	3.89	18.61	-92.0	
14:50	1:45	1000	NM	49.08	7.08	1.326	3.46	3.63	17.33	-78.6	Clear, no odors
15:00	1:55	1000	18.57	49.13	7.09	1.323	2.12	3.20	17.86	-71.4	
15:10	2:05	1000	21.21	49.12	7.09	1.313	2.81	2.84	17.54	-81.5	
15:20	2:15	NR	23.85	49.16	7.09	1.313	3.32	2.68	17.44	-82.1	
15:30	2:25	1000	26.50	49.17	7.10	1.309	4.18	2.40	17.36	-84.4	
15:35	2:30	1500	NM	49.38	7.10	1.304	3.83	2.28	16.77	-83.9	Clear, no odors
15:45	2:40	1500	32.44	49.43	7.09	1.301	3.14	2.24	16.83	-74.8	
15:55	2:50	1500	36.40	49.48	7.10	1.304	3.82	2.01	16.16	-97.6	
16:05	3:00	1500	40.37	49.51	7.10	1.302	0.85	1.84	16.59	-101.8	
16:10	3:05	2000	43.00	49.75	7.10	1.303	1.21	1.86	16.02	-103.2	Clear, no odors
16:20	3:15	2000	48.29	49.84	7.10	1.304	1.13	1.63	15.99	-105.8	
16:30	3:25	2000	53.57	49.93	7.10	1.303	3.18	1.41	16.01	-108.5	Clear, no odors
16:40	3:35	2000	58.86	49.99	7.10	1.302	3.24	1.12	15.88	-109.9	

Note: >4 inch rain event last night (4 inches in approximately 1 hour).

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1809A | Date 6/28/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather Sunny, hot, 83°F

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC / SS

Static Water Level (ft-bmp) 48.39 | Total Depth (ft-bmp) 75.12 | Water Column 26.73

Gallons in Well 4.28

MP Elevation NA | Pump Intake (ft-bmp) 73

Purge Method: Pump

Pump On/Off NR | Volumes Purged 28 | Centrifugal ___ | Submersible x

Transducer SN NR | Observation Wells MW-1807A, MW-1807B | Other ___

Transducer Depth 71 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
16:48	3:43	3000	NM	50.80	7.08	1.298	2.16	0.95	15.26	-112.3	Clear, no odors
16:55	3:50	3000	70.75	50.92	7.10	1.295	1.02	0.82	15.15	-114.2	
17:05	4:00	3000	78.67	51.06	7.11	1.293	0.77	0.68	15.20	-115.3	
17:10	4:05	4000	82.63	Increase pumping rate							
17:15	4:10	4000	87.92	51.62	7.11	1.291	1.21	0.63	15.00	-111.6	Clear, no odors
17:25	4:20	4000	98.48	51.70	7.12	1.288	1.61	0.60	14.99	-114.0	
17:35	4:30	4000	109.05	51.89	7.13	1.294	2.80	0.54	15.02	-116.9	
17:45	4:40	4000	119.62	51.95	7.14	1.294	1.10	0.48	15.09	-117.3	
17:50	4:45	Stop pumping, allow to recover with transducers running/on overnight; depth to water = 51.98; no water back-flow from tubing, crimped several times and zip tied									
Well Recovery Data:											
18:00	4:55	N/A	N/A	49.88	NM	NM	NM	NM	NM	NM	
18:07	5:02	N/A	N/A	49.80	NM	NM	NM	NM	NM	NM	

Note: Turned off transducers in well 1809, 1807SRF, and 1807C on 6/29/18 from 7:40 to 8:30.

Well Casing Volumes (gallon/feet)

1-¼" = 0.06 | 2" = 0.16 | 3" = 0.37 | 4" = 0.65
1-½" = 0.09 | 2-½" = 0.26 | 3-½" = 0.50 | 6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1810A | Date 6/15/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather Mostly cloudy, humid, 72°F

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 68.10 | Total Depth (ft-bmp) 83.71 | Water Column 15.61

Gallons in Well 2.50

MP Elevation NA | Pump Intake (ft-bmp) 80

Purge Method: Pump
Centrifugal ___
Submersible x
Other ___

Pump On/Off NR | Volumes Purged 10

Transducer SN NR | Observation Wells None (nearest wells 1807/1808 being developed by DLZ)

Transducer Depth 75 ft | Completed by A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
9:30	0:00	NR	NM	68.24	Pump malfunction, low voltage, changed power cords						
9:35	0:05	2000	NM	68.24	NM	NM	NM	NM	NM	NM	
9:45	0:15	NR	NM	71.51	NM	NM	32.60	NM	NM	NM	Calibrating Horiba meter
9:50	0:20	2000	NM	71.79	7.42	1.080	14.20	1.33	17.90	45	Clear
10:00	0:30	2000	NM	72.71	7.67	0.897	14.00	0.35	15.76	-71	Clear
10:10	0:40	2000	NM	73.40	7.78	0.845	3.11	0.17	15.75	-82	
10:20	0:50	2000	23.78	80.00	Pumped dry, turn off pump, allow to recover; crimped hose-no back-flow						
Well Recovery Data:											
10:25	0:55	NR	NM	74.73	NM	NM	NM	NM	NM	NM	
10:35	1:05	NR	NM	69.91	NM	NM	NM	NM	NM	NM	
10:45	1:15	NR	NM	69.45	NM	NM	NM	NM	NM	NM	
11:25	1:55	NR	NM	69.39	NM	NM	NM	NM	NM	NM	
12:15	2:45	NR	NM	69.30	NM	NM	NM	NM	NM	NM	
12:20	2:50	Turn off transducer in well									

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	milliliter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976 | Well ID MW-1810A | Date 6/18/2018

Project Name/Location AEP Amos Plant - Fly Ash Pond | Weather Sunny, humid, 92°F

Measuring Pt. Description: TOC
Screen Setting (ft-bmp): NR
Casing Diameter (in.): 2
Well Material: X PVC; SS

Static Water Level (ft-bmp): 68.49
Total Depth (ft-bmp): 83.71
Water Column: 15.22
Gallons in Well: 2.44

MP Elevation: NA
Pump Intake (ft-bmp): 80
Purge Method: Pump
- Centrifugal:
- Submersible: x
- Other:

Pump On/Off: NR
Volumes Purged: 8

Transducer SN: NR
Observation Wells: None (DLZ developing wells 1808A/B/C)

Transducer Depth: 75 ft
Completed by: A. Gillespie

Time	Min Elapsed	Rate (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C)	Redox (mV)	Comments
12:45	0:00	NR	NM	68.49	NM	NM	NM	NM	NM	NM	
12:50	0:05	500	NM	NM	NM	NM	NM	NM	NM	NM	
13:00	0:15	500	NM	69.62	7.54	1.040	5.90	9.27	22.28	77	Clear, no turbidity
13:10	0:25	500	NM	69.86	7.56	0.957	2.90	2.40	21.49	12	Tubing in sun, increasing temp.
13:20	0:35	500	3.96	70.04	7.69	0.885	1.30	1.58	21.54	-7	
13:30	0:45	500	5.28	70.14	7.76	0.845	0.73	1.25	21.99	-22	
13:40	0:55	1000	7.93	71.25	7.83	0.783	0.21	1.28	19.29	-49	16.2 mV setting/controller
13:50	1:05	1000	10.57	71.56	7.81	0.771	0.11	1.31	19.98	-65	
14:00	1:15	1000	13.21	71.79	7.91	0.738	0.10	1.20	20.42	-67	
14:10	1:25	NR	15.85	72.02	7.95	0.727	0.10	1.28	20.24	-73	
14:20	1:35	NR	19.81	73.60	7.98	0.708	3.20	1.39	19.21	-95	
14:35	1:50	NR	NM	75.91	7.79	0.715	1.30	1.22	18.88	-47	
Stopped pumping, depth to water near transducer depth, allow to recover; crimp/sealed tubing, back-flow into well											
Well Recovery Data:											
14:40	1:55	NR	NM	72.35	NM	NM	NM	NM	NM	NM	
14:50	2:05	NR	NM	70.99	NM	NM	NM	NM	NM	NM	
15:10	2:25	NR	NM	70.68	NM	NM	NM	NM	NM	NM	Water from tubing running into well

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds	HZ	hertz

APPENDIX G

Geophysical Logs

ARCADIS

Marshal Miller & Associates, 2018

Geophysical Logs

MW-1801, MW-1802, MW-1805, MW-1806, and MW-1808

GEOLOGICAL LOGGING SYSTEMS

CO AEP
WELL 1801
FLD Amos Plant
CTY Kanawha
STE WV
FILING No

COMPANY	AEP		
WELL ID	1801		
FIELD	Amos Plant		
COUNTRY	USA	STATE	WEST VIRGINIA
LOCATION FAP			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.

DATE	02/22/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER		MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	N. PAINTER		
WITNESSED BY			

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

CO AEP
WELL 1801
FLD Amos Plant
CTY Kanawha
STE WV
FILING No

GEOLOGICAL LOGGING SYSTEMS

COMPANY	AEP		
WELL ID	1801		
FIELD	Amos Plant		
COUNTRY	USA	STATE	WEST VIRGINIA
LOCATION FAP			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	GL	ELEVATION	K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM	GL		G.L.
DATE	02/22/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER		MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	N. PAINTER		
WITNESSED BY			

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

GAM(NAT)	Depth	Apparent Dip	True Dip	STEREONET
0 CPS 300	1ft:24ft	0° 90° 180° 270° 0° / Centralized AMPL / 0° 90° 180° 270° 0°	0 90	Wulff Plot - LH - Type / ROSE DIAGRAM / Azimuth - Absolute (Count)

Azimuth - Absolute (Count)
Depth: 46.25 [ft] to 295.35 [ft]

Components:	Azimuth
Counts:	70.00
Mean (2D):	293.87
Std.Dev.:	112.51
Min:	0.00
Max:	358.54

Wulff Plot - LH - Type
Depth: 63.88 [ft] to 303.43 [ft]

Acoustic Televiewer Interpretation

Well: 1801 AEP Amos Plant

Depth Feet	Dip Direction Degrees	DIP Angle Degrees	APERTURE mm	Feature Category
64.36	9.23	81.87	0	1
68.22	174.41	22.2	0	1
80.87	16.06	6.16	0	2
87.12	253.6	23.36	0	2
96.31	283.24	43.83	0	1
97.65	286.3	52.6	0	2
100.79	98.27	60.28	0	2
101.77	247.77	47.2	0	2
102.84	195.94	41.61	0	2
103.77	190.93	38.38	0	2
104.49	187.04	57.54	0	2
105.14	202.48	54.07	0	2
105.83	212.79	65.28	0	2
106.61	269.64	37.52	0	2
114.26	357.57	77.82	0	1
117.07	348.34	75.14	0	1
119.67	89.39	60.11	0	2
120.48	10.2	75.95	0	1
121.45	81.43	44.54	16.8	1
121.61	255.92	40.03	0	1
123.05	233.86	17.95	0	2
123.76	177.33	30.96	0	2
124.13	181.21	39.62	0	2
124.89	180.24	56.31	0	2
125.94	154.98	60.28	0	2
135.1	325.02	1.37	0	5
135.77	317.25	0	0	5
137.94	357.57	0	283.94	0
145.84	94.25	34.84	0	2
147.4	111.74	52.35	0	1
147.96	127.29	61.42	0	1
148.68	106.88	48.14	0	1
148.76	358.54	9.54	384.84	0
149.11	92.79	45.23	0	1
155.37	283.24	23.94	0	2
160.25	295.87	46.88	0	1
161.11	18.46	60.62	0	1
161.92	355.63	2.75	275.12	0
165.33	128.5	63.62	0	2
165.72	4.86	1.37	199.33	0
166.17	177.17	51.03	0	2
174.18	320.16	52.6	0	2

Feature Category Legend

Color	Label	Description
Black	0	Broken Zone / Undifferentiated
Red	1	Major Open Joint/Fracture
Magenta	2	Minor Open Joint/Fracture
Orange	3	Partially Open Joint/Fracture
Gray	4	Filled Fracture/ Joint
Green	5	Bedding/Banding/Foliation

177.63	4.86	1.37	499.7	0				
185.7	350.28	82.21	0	1				
189.5	350.77	80.95	0	1				
195.77	271.58	0	22.2	1				
198.34	135.06	54.07	0	1				
198.71	136.03	47.83	0	1				
198.94	130.2	39.21	0	1				
200.91	243.89	56.31	0	1				
207.89	346.88	0	2560.63	0				
219.18	232.23	32.94	0	1				
220.32	333.07	53.59	0	2				
220.59	236.6	63.89	0	1				
221.09	253.6	61.89	0	1				
221.52	279.35	55	0	1				
223	245.67	6.17	0	5				
235.02	273.52	2.75	0	5				
235.21	270.61	4.12	0	5				
254.61	343	1.38	60.93	0				
254.88	355.63	0	0	0				
258.64	77.25	0	11.34	1				
262.24	195.79	13.5	0	2				
267.82	0.97	1.37	677.28	0				
284.9	341.05	1.38	0	5				
290.36	179.06	7.52	0	5				
290.84	177.17	2.75	0	5				
291.98	351.02	5.48	0	5				
292.73	0	0	0	5				
294.91	6.14	2.75	0	5				

GEOLOGICAL
LOGGING
SYSTEMS

CO AEP AMOS FAP	COMPANY AEP AMOS FAP
WELL MW-1802	WELL ID MW-1802
FLD	FIELD
CTY PUTNAM	COUNTRY USA
STE WV	STATE WEST VIRGINIA
FILING No	LOCATION
	OTHER SERVICES
	SEC TWP RGE

PERMANENT DATUM		ELEVATION		K.B.
LOG MEAS. FROM	GL	ABOVE PERM. DATUM		D.F.
DRILLING MEAS. FROM	GL			G.L.

DATE	04/26/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER	315	LEVEL	
DEPTH-LOGGER	313.90	MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	PJ WATERS		
WITNESSED BY	ALAN G		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
	6						

GEOLOGICAL LOGGING SYSTEMS

CO	AEP AMOS FAP
WELL	MW-1802
FLD	
CTY	PUTNAM
STE	WV
FILING No	

COMPANY	AEP AMOS FAP		
WELL ID	MW-1802		
FIELD			
COUNTRY	USA	STATE	WEST VIRGINIA
LOCATION		OTHER SERVICES	
SEC	TWP	RGE	
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.

DATE	04/26/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER	315	LEVEL	
DEPTH-LOGGER	258.02	MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	PJ WATERS		
WITNESSED BY	ALAN G		

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

		Acoustic Televiewer Interpretation					
MW 1802					**AEP AMOS FAP**		
Depth Feet	**Dip Direction Degrees**	**DIP Angle Degrees**	**APERTURE mm**	**Feature Category**	**Feature Category Legend**		
15.41	232.94	57.94	0	3	**Color**	**Label**	**Description**
17.18	161.28	73.54	0	3	Black	0	Broken Zone / Undifferentiated
19.58	88.49	4.21	0	2	Red	1	Major Open Joint/Fracture
22.73	75.04	79.2	0	3	Magenta	2	Minor Open Joint/Fracture
23.68	69	70.69	0	3	Orange	3	Partially Open Joint/Fracture
24.37	62.97	68.03	0	3	Gray	4	Filled Fracture/ Joint
24.84	77.82	49.56	0	3	Green	5	Bedding/Banding/Foliation
27.02	30.12	48.4	0	3	Teal	6	Induced Fracture
27.8	49.66	25.71	0	3	Dk Green	7	Top of Coal
28.38	35.71	40.76	0	3	Dk Blue	8	Bottom of Coal
29.21	99.47	3.31	14.02	1	Purple	9	Cleat
29.63	280.74	38.5	0	2			
29.99	267.33	12.68	0	2			
31.69	247.16	4.79	0	2			
34.1	236.63	10.27	0	3			
36.85	318.03	12.88	0	2			
37.33	60.09	5.11	0	2			
38.3	126.86	65.86	0	3			
50.82	143.14	44.38	0	3			
59.41	104.21	81.32	0	3			
61.44	62.82	9.96	0	2			
62.76	279.41	10.62	0	2			
74.52	102.4	3.07	0	2			
75.9	291.33	17.12	0	3			
76.28	207.39	28.59	0	3			
76.55	94.71	24.73	0	3			
77.33	82.24	42.72	0	3			
78.09	334.94	39.98	0	3			
78.47	208.86	13.85	0	3			
81.91	287.96	13.17	0	3			
85.76	203.54	78.75	0	3			
87.13	21.77	51.71	0	3			
88.86	32.51	81.85	0	3			
89.64	184.35	20.7	0	3			
94.59	274.28	7.25	0	2			
96.63	199.02	59.71	0	3			
97.42	316.28	23.76	0	3			
98.15	62.02	11.38	0	3			
99.48	282.59	39.15	0	2			
102.01	86.15	66.25	0	3			
102.06	265.66	42.52	0	3			

104.66	122.78	10.12	0	3				
105.72	35.27	5.46	0	1				
106.39	253.28	42.33	0	3				
107.07	217.55	18.15	0	3				
108.32	280.55	76.86	0	3				
110.92	113.84	39.57	0	3				
111.74	197.27	68.97	0	3				
113.25	248.85	9.88	0	2				
114.1	24.81	10.09	0	2				
125.74	217.45	33.07	0	3				
126.05	15.27	11.09	0	3				
126.74	15.2	17.02	0	3				
128.94	194.37	32.82	0	3				
129.41	291.36	33.2	0	3				
130.22	41.15	48.35	0	3				
134.02	25.87	66.33	0	3				
135.06	54.51	2.59	0	3				
136.01	132.29	59.46	0	3				
137.53	354.91	81.96	0	3				
140.69	30.33	3.14	0	2				
141.73	84.51	8.02	0	2				
142.96	46.45	31.44	0	3				
146.1	174.96	55.94	0	2				
151.11	292.35	49.43	0	2				
154.81	158.73	13.91	0	2				
157.21	219.14	76.14	0	3				
159.56	130.65	16.68	0	2				
162.39	40.49	67.2	0	3				
164.98	136.68	9.24	0	2				
166.21	113.03	4.51	0	2				
169.27	159.17	7.54	0	3				
170	260.64	6.92	0	2				
171.15	53.73	3.18	0	2				
174.15	225.3	7.82	0	2				
174.83	267.52	7.3	0	3				
175.13	284.86	5.53	0	3				
177.86	33.37	11.29	3.75	1				
181.48	270.92	57.36	0	3				
183.22	124.14	67.15	0	3				
196.73	269.54	68.29	0	3				
200.81	286.76	31.43	0	2				
202.73	223.17	11.94	0	2				
218.22	318.05	62	0	3				
219.81	171.06	27.82	0	2				
221.33	81.06	30.45	0	2				
224.45	104.12	42.78	0	2				
224.51	84.2	61.17	0	3				

225.26	48.02	30.01	0	2				
226.7	112.88	16.13	0	2				
226.99	184.23	41.34	0	3				
227.39	73.48	41.87	0	2				
232.44	13.56	5.45	0	2				
250.39	24.69	13.59	0	3				
268.87	165.83	50.85	0	3				
281.54	123.31	52.25	0	3				
283.01	120.47	65.13	0	3				
284.43	121.89	59.55	0	3				
286.51	70.16	17.48	0	2				
289.72	218.98	68.1	0	3				
292.29	51.73	79.11	0	3				
293.9	287.01	74.82	0	3				
296.52	59.53	52.58	0	3				
302.78	358.58	59.55	0	2				
307.91	265.04	46.11	0	3				
308.5	31.89	48.59	0	1				

GEOLOGICAL LOGGING SYSTEMS

CO	AEP
WELL	1805
FLD	Amos Plant
CTY	Kanawaha
STE	WV
FILING No	

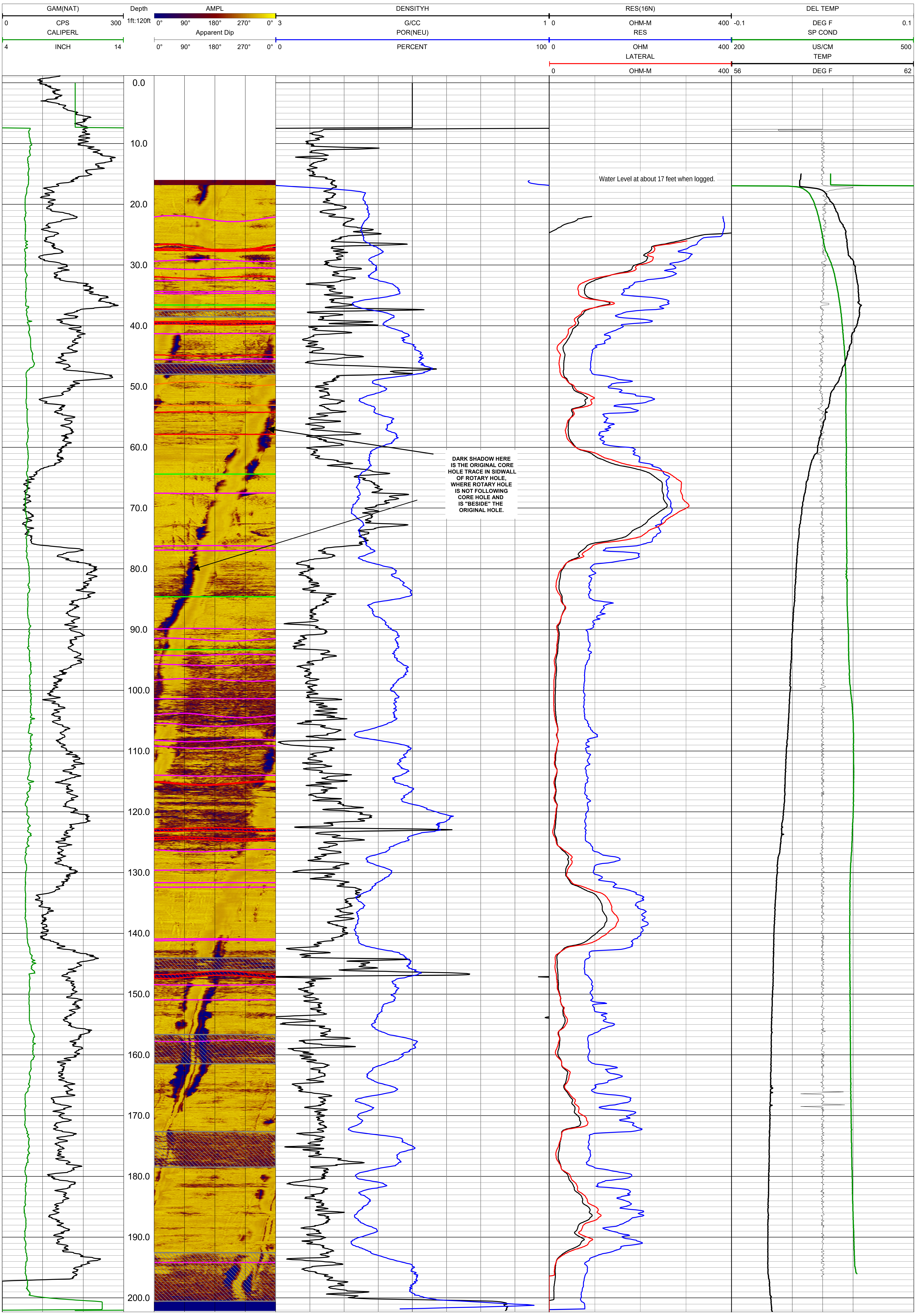
COMPANY	AEP
WELL ID	1805
FIELD	Amos Power Plant
COUNTRY	
STATE	WEST VIRGINIA
LOCATION	FAP
OTHER SERVICES	

SEC TWP RGE

PERMANENT DATUM	- ELEVATION	K.B.
LOG MEAS FROM	ABOVE PERM. DATUM	D.F.
DRILLING MEAS FROM		G.L.

DATE	02/22/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG	Composite	DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER		MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	N. PAINTER		
WITNESSED BY			

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO



CO AEP
WELL 1805
FLD Amos Power Plant
CTY Kanawha
STE WV
FILING No

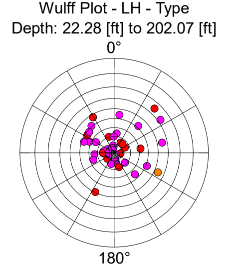
GEOLOGICAL LOGGING SYSTEMS

COMPANY	AEP		
WELL ID	1805		
FIELD	Amos Power Plant		
COUNTRY		STATE	WEST VIRGINIA
LOCATION FAP			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM	-	ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM			G.L.
DATE	02/22/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG	Acoustic Televiewer	DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER		MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	N. PAINTER		
WITNESSED BY			

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

GAM(NAT)	Depth	AMPL	True Dip	Rose Diagram
0 CPS 300	1ft:24ft	0° 90° 180° 270° 0°	0 90	Azimuth - Absolute (Count)
		Apparent Dip		Stereonet
		0° 90° 180° 270° 0°		Wulff Plot - LH - Type

Azimuth - Absolute (Count)
Depth: 7.52 [ft] to 196.71 [ft]



Components:	Azimuth
Counts:	59.00
Mean (2D):	38.08
Std.Dev.:	107.44
Min:	3.11
Max:	358.04

Wulff Plot - LH - Type
Depth: 22.28 [ft] to 202.07 [ft]

MARSHALL MILLER & ASSOCIATES

GEOLOGICAL LOGGING SYSTEMS
A DIVISION OF MARSHALL MILLER & ASSOCIATES

Acoustic Televiewer Interpretation

Well: 1805 AEP Amos Plant

Depth Feet	Dip Direction Degrees	DIP Angle Degrees	APERTURE mm	Feature Category
22.33	234.67	62.37	0	2
27.1	222.29	64.97	3.71	1
27.36	244.32	14.89	0	1
27.65	212.06	14.71	4.55	1
29.25	316.19	35.31	0	2
30.59	114.37	32.13	0	2
32	123.64	38.05	0	1
32.48	348.44	12.41	0	2
34.35	98.61	13.09	0	2
34.66	86.22	13.7	0	2
36.55	41.1	2.62	0	5
37.31	90.61	13.53	26.9	1
38.01	18.58	0.88	125.99	0
39.24	47.79	11.42	0	1
39.61	223.52	15.01	42.23	1
41.28	76.7	6.91	0	2
44.86	160.74	20.47	0	1
45.54	120.25	25.56	0	2
47.08	345.22	0.91	210.24	0
47.96	347.5	0.88	0	0
49.51	294.45	54.12	0	3
53.11	119.72	8.01	0	3
54.18	277.73	8.08	0	1
57.84	356.8	0.23	0	1
64.37	60.93	2.49	0	5
67.55	119.56	9.46	0	2
76.21	350.04	6.43	0	2
76.97	170.04	8.97	0	2
84.58	14.91	3.17	0	5
89.88	311.68	17.82	0	2
91.61	222.3	42.15	0	2
93.3	20.75	1.16	0	5
94.16	85.04	23.87	0	2
95.81	188.11	23.36	0	2
98.24	292.36	41.45	0	2
101.36	340.09	5.05	0	2
104.11	257.8	55.08	0	2
105.66	188.38	44.18	0	2
108.23	110.23	38	0	2
109.3	139.6	41	0	2
114.05	177.82	19.64	0	2
115.27	149.19	47.64	11.34	1

Feature Category Legend

Color	Label	Description
Black	0	Broken Zone / Undifferentiated
Red	1	Major Open Joint/Fracture
Magenta	2	Minor Open Joint/Fracture
Orange	3	Partially Open Joint/Fracture
Gray	4	Filled Fracture/ Joint
Green	5	Bedding/Banding/Foliation

122.93	340.38	18.8	52.93	1				
124.45	260.86	31.93	34.93	1				
126.37	129.89	38.12	0	2				
129.54	350.51	9.09	0	2				
131.64	337.56	4.27	0	2				
132.39	26.89	3.82	0	2				
140.87	350.75	6.98	0	2				
141.13	15.54	14.4	0	2				
145.03	51.73	1.1	235.04	0				
146.8	25.67	49.83	53.45	1				
148.48	156.87	6.06	0	2				
150.94	160.84	3.55	0	2				
157.68	70.87	26.64	0	2				
159.05	30.37	1.27	576.38	0				
175.54	3.11	1.38	700.39	0				
194.14	316.71	3.6	0	2				
196.53	358.04	2.72	956.16	0				

GEOLOGICAL LOGGING SYSTEMS

CO AEP
WELL 1806
FLD Amos Plant
CTY Kanawha
STE WV
FILING No

COMPANY	AEP
WELL ID	1806
FIELD	Amos Plant
COUNTRY	USA
STATE	West Virginia
LOCATION	
OTHER SERVICES	
SEC	TWP	RGE
PERMANENT DATUM	ELEVATION
LOG MEAS. FROM	ABOVE PERM. DATUM
DRILLING MEAS. FROM	
K.B.	
D.F.	
G.L.	

DATE	
RUN No	
TYPE LOG	
DEPTH-DRILLER	
DEPTH-LOGGER	
BTM LOGGED INTERVAL	
TOP LOGGED INTERVAL	
OPERATING RIG TIME	
RECORDED BY	
WITNESSED BY	
TYPE FLUID IN HOLE	
SALINITY	
DENSITY	
LEVEL	
MAX. REC. TEMP	

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

GEOLOGICAL LOGGING SYSTEMS

CO AEP
WELL 1806
FLD Amos Plant
CTY Kanawha
STE WV
FILING No

COMPANY AEP
WELL ID 1806
FIELD Amos Plant
COUNTRY USA
STATE West Virginia
LOCATION
OTHER SERVICES

SEC TWP RGE

PERMANENT DATUM — ELEVATION — K.B.
LOG MEAS. FROM — ABOVE PERM. DATUM — D.F.
DRILLING MEAS. FROM — G.L.

DATE	04/17/2018	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER		MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	N. Painter		
WITNESSED BY			

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO

GAM(NAT)	Depth	AMPL	True Dip	Stereonet
0 CPS 300	1ft:24ft	0° 90° 180° 270° 0°	0 90	Wulff Plot - LH - Type
		Apparent Dip 0° 90° 180° 270° 0°		Rose Diagram
				Azimuth - Absolute (Count)

Azimuth - Absolute (Count)
Depth: -2.46 [ft] to 275.63 [ft]

Components:	Azimuth
Counts:	111.00
Mean (3D):	259.89
Min:	16.29
Max:	356.05

Wulff Plot - LH - Type
Depth: 22.34 [ft] to 284.68 [ft]

		Acoustic Televiewer Interpretation						
Hole ID 1806			**AEP - Amos Plant**					
Depth Feet	**Dip Direction Degrees**	**DIP Angle Degrees**	**APERTURE mm**	**Feature Category**	**Feature Category Legend**			
26.49	250.87	23.04	0	2	**Color**	**Label**	**Description**	
33.99	291.26	74.82	0	3	Black	0	Broken Zone / Undifferentiated	
34.51	301.89	74.44	0	2	Red	1	Major Open Joint/Fracture	
36.37	353.62	28.17	0	2	Magenta	2	Minor Open Joint/Fracture	
37.71	72.99	22.27	0	2	Orange	3	Partially Open Joint/Fracture	
37.73	22.68	15.83	0	2	Gray	4	Filled Fracture/ Joint	
39.3	72.99	7.18	12.06	1	Green	5	Bedding/Banding/Foliation	
39.69	34.02	38.22	0	3				
42.13	291.97	62.88	0	3				
43.06	118.35	11.57	0	2				
43.42	111.26	7.18	0	3				
44.93	172.91	44.32	0	2				
45.4	274.25	44.32	0	3				
46.21	87.87	37.66	0	2				
46.23	270.71	34.72	0	2				
46.84	296.22	32.21	0	2				
47.36	0	0	0	3				
47.78	68.74	52.25	0	2				
47.85	248.03	38.22	0	2				
48.27	102.05	4.5	0	2				
53.04	161.57	18.3	51.47	0				
57.09	0	0	0	2				
62	133.94	54.79	0	3				
67.82	289.84	78.64	0	1				
76.7	288.43	82.21	0	1				
76.84	289.13	70.16	0	3				
78.85	300.47	72.3	0	1				
82.27	13.46	29.55	0	3				
84.12	342.99	45.22	0	3				
86.43	286.3	34.72	0	3				
86.79	0	0	0	3				
87.32	0	0	0	3				
92.06	0	0	0	3				
92.43	123.31	57.58	0	3				
93.51	314.65	23.79	0	3				
98.11	310.39	26.75	0	3				
98.17	0	0	0	3				
100.15	206.93	28.17	0	3				
100.48	184.96	40.38	0	3				
100.85	234.57	35.92	0	3				
100.96	119.76	62.88	0	3				
102.2	231.73	37.09	0	3				

102.81	23.39	40.38	0	3				
103.21	255.83	39.31	0	3				
104.07	272.13	26.75	0	3				
104.25	254.41	52.25	0	3				
104.96	186.38	50.12	0	3				
105.5	229.61	45.22	0	3				
106.06	208.35	47.38	0	2				
106.53	218.98	48.59	0	3				
107.3	149.53	41.41	0	3				
107.39	97.8	46.96	0	3				
107.86	82.2	48.59	0	3				
108.11	276.38	50.85	0	3				
108.79	240.94	43.38	0	3				
109.63	194.17	42.41	0	2				
109.77	189.21	45.67	0	3				
112.1	131.81	49.75	0	3				
113.83	199.13	38.77	0	1				
114.35	108.43	62.11	0	3				
115.66	325.98	39.31	0	2				
117.98	46.06	12.43	0	3				
121.26	284.88	84.21	0	3				
125.06	16.3	23.79	36.86	0				
125.25	174.33	18.3	0	3				
125.74	26.22	36.51	0	3				
125.9	80.79	30.9	0	3				
126.39	16.3	34.72	0	3				
126.73	281.34	27.46	0	3				
127.01	50.31	26.75	0	3				
127.03	192.76	47.79	0	3				
127.71	162.99	23.04	0	3				
127.9	290.55	55.39	0	3				
144.26	195.59	15.83	0	3				
145.67	245.2	12.43	0	2				
146.35	41.81	19.91	0	2				
146.61	69.45	32.21	0	2				
147.08	77.95	32.21	0	2				
147.74	231.73	26.75	0	3				
148.17	45.35	50.12	0	3				
149.26	280.63	19.11	0	3				
158.03	0	0	0	3				
158.6	352.2	30.23	0	3				
159.32	338.74	20.7	0	3				
159.41	342.99	30.9	0	3				
160.36	76.54	26.02	0	3				
169.72	191.34	41.91	0	3				
180.17	103.46	30.23	0	3				
185.4	133.23	6.29	0	3				

195.54	0	0	0	2				
199.51	166.54	34.72	0	3				
200.01	279.92	67.06	0	3				
200.9	216.85	35.32	0	2				
201.44	74.41	41.91	0	2				
213.56	258.66	57.06	0	3				
215.15	258.66	43.38	0	2				
217.08	216.85	39.31	0	2				
217.91	107.01	40.9	0	2				
218.91	143.86	33.48	0	2				
220.56	306.85	50.49	0	2				
221	24.8	51.56	0	3				
221.47	347.95	46.54	0	2				
222.23	17.01	33.48	0	2				
223.15	341.57	26.02	0	2				
238.25	294.8	63.61	0	3				
239.34	102.05	74.69	0	3				
240.29	279.21	75.64	0	3				
241.01	114.09	82.37	0	3				
259.8	314.65	36.51	0	3				
267.48	270	9.83	0	2				
273.64	140.31	78.91	0	3				

GEOLOGICAL
LOGGING
SYSTEMS

CO AEP AMOS FAP
WELL MW-1808
FLD
CTY PUTNAM
STE WV
FILING No

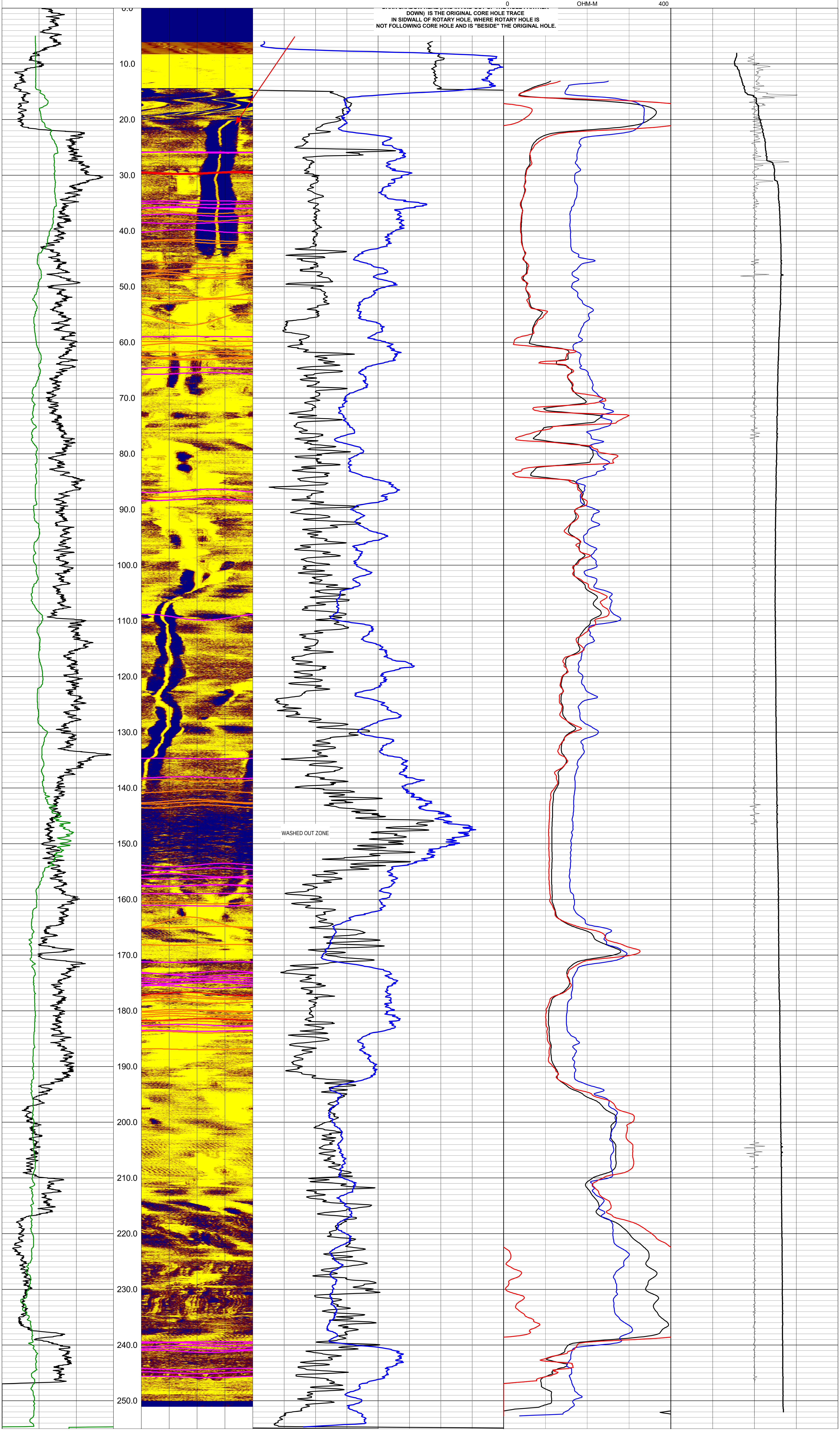
COMPANY AEP AMOS FAP
WELL ID MW-1808
FIELD
COUNTRY USA STATE WEST VIRGINIA
LOCATION OTHER SERVICES
SEC TWP RGE

PERMANENT DATUM ELEVATION K.B.
LOG MEAS. FROM ABOVE PERM. DATUM D.F.
DRILLING MEAS. FROM GL G.L.

DATE	05/01/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER	255.04	MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	PJ WATERS		
WITNESSED BY	ALAN G		

RUN	BOREHOLE RECORD			CASING RECORD			
NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
	6						

GAM(NAT)	Depth	AMPL	DENSITYH	RES(16N)	DEL TEMP
0 CPS 300	1ft:120ft	0° 90° 180° 270° 0°	3 G/CC 1	0 OHM-M 400	-0.1 DEG F 0.1
CALIPERL		Apparent Dip	POR(NEU)	RES	TEMP
4 INCH 14		0° 90° 180° 270° 0°	0 PERCENT 100	0 OHM 400	54 DEG F 58
				LATERAL	
				0 OHM-M 400	



CO AEP AMOS FAP
WELL MW-1808
FLD
CTY PUTNAM
STE WV
FILING No

GEOLOGICAL LOGGING SYSTEMS

COMPANY	AEP AMOS FAP		
WELL ID	MW-1808		
FIELD			
COUNTRY	USA	STATE	WEST VIRGINIA
LOCATION			OTHER SERVICES
SEC	TWP	RGE	
PERMANENT DATUM		ELEVATION	K.B.
LOG MEAS. FROM		ABOVE PERM. DATUM	D.F.
DRILLING MEAS. FROM GL			G.L.
DATE	05/01/18	TYPE FLUID IN HOLE	
RUN No	1	SALINITY	
TYPE LOG		DENSITY	
DEPTH-DRILLER		LEVEL	
DEPTH-LOGGER	251.06	MAX. REC. TEMP.	
BTM LOGGED INTERVAL			
TOP LOGGED INTERVAL			
OPERATING RIG TIME			
RECORDED BY	PJ WATERS		
WITNESSED BY	ALAN G		

BOREHOLE RECORD				CASING RECORD			
RUN NO.	BIT	FROM	TO	SIZE	WGT.	FROM	TO
	6						

MARSHALL MILLER & ASSOCIATES

Acoustic Televiewer Interpretation

MW 1808 — AEP AMOS FAP

Depth Feet	Dip Direction Degrees	DIP Angle Degrees	APERTURE mm	Feature Category
25.81	319.33	9.32	0	2
25.9	266.21	20.24	0	2
29.58	132.26	33.36	17.97	1
34.6	344.14	8.4	0	2
35.11	228.55	25.47	0	2
35.84	321.23	16.19	0	2
35.84	287.66	37.84	0	2
36.65	233.19	40.93	0	3
37.17	272.16	42.86	0	2
37.96	229.37	48.91	0	3
38.55	124.5	26.86	0	2
40.01	318.61	51.08	0	2
41.7	314.54	39.94	0	3
42	268.04	45.15	0	3
45.8	268.62	40.81	0	3
46.81	52.48	40.45	0	3
47.58	219.23	50.71	0	3
48.19	258.51	57.45	0	3
48.38	138.61	51.66	0	3
51.62	215.38	62.47	0	3
52.42	88.98	35.72	0	3
55.86	153.4	76.15	0	3
58.94	319.75	7.64	0	2
59.84	144.03	4.84	0	3
60.43	294.37	52.27	0	3
61.66	117.73	5.82	0	3
62.38	65.06	54.21	0	3
62.9	152.88	44.48	0	3
62.91	208.94	25.03	0	3
64.51	325.78	21.94	0	2
65.53	35.55	35.4	0	2
86.66	47.18	51.61	0	2
87.63	63.38	33.97	0	3
88.21	25.02	37.31	0	2
109.34	201.43	63.4	0	2
134.68	243.96	12.44	0	2
138.1	316.36	32.82	0	2
138.69	241.36	43.89	0	3
140.55	12.39	46.2	0	3
142.36	352.44	47.26	0	3
142.64	23.42	42.12	0	3
143.32	32.36	47.67	0	3

Feature Category Legend

Color	Label	Description
Black	0	Broken Zone / Undifferentiated
Red	1	Major Open Joint/Fracture
Magenta	2	Minor Open Joint/Fracture
Orange	3	Partially Open Joint/Fracture
Gray	4	Filled Fracture/ Joint
Green	5	Bedding/Banding/Foliation
Teal	6	Induced Fracture
Dk Green	7	Top of Coal
Dk Blue	8	Bottom of Coal
Purple	9	Cleat

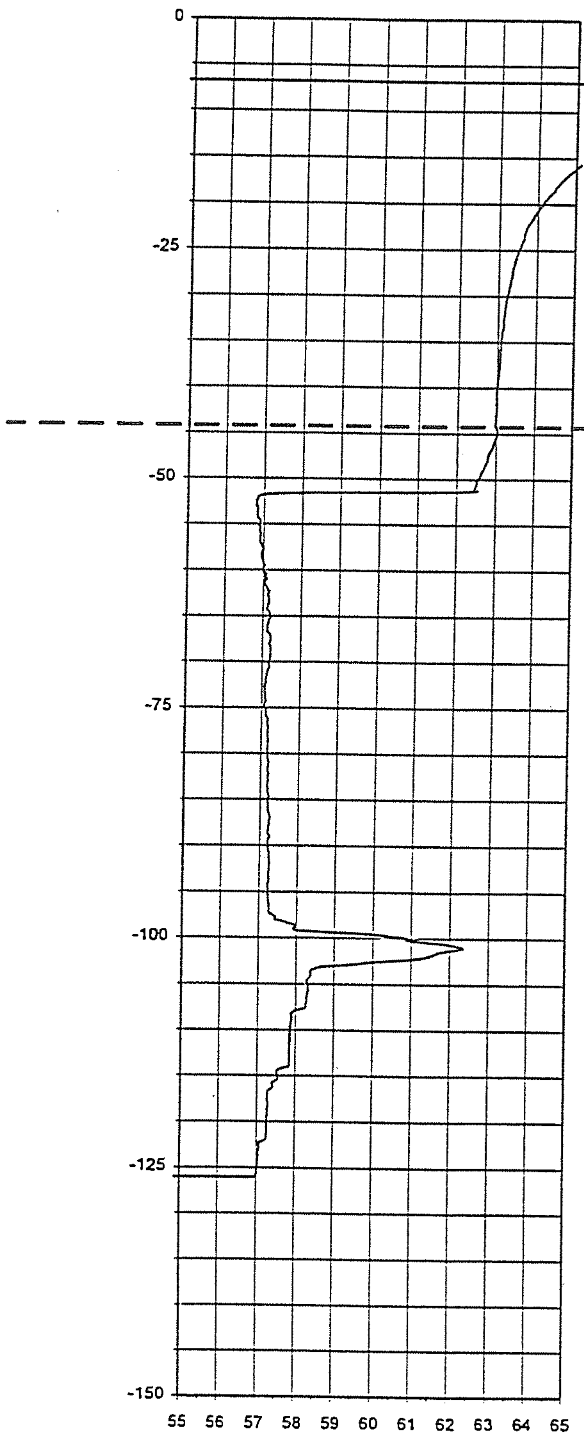
153.82	88.85	52.82	0	2				
154.58	71.66	44.52	0	2				
155.66	268.92	48.93	0	2				
156.23	104	31.87	0	2				
157.48	98.22	24.47	0	2				
157.5	51.46	36.47	0	2				
158.95	106.74	9.22	0	2				
160.6	231.99	37.61	0	3				
161.1	228.74	20.58	0	2				
164.15	334.01	75.13	0	3				
164.98	67.85	26.34	0	3				
168.15	111.72	17.59	0	3				
171.2	88.22	10.79	0	2				
173.12	97.96	52.26	0	2				
173.51	185.71	48.89	0	2				
174.12	111.35	38.61	0	2				
174.45	92.7	31.98	0	2				
174.89	105.73	37.38	0	2				
175.06	45.52	42.93	0	2				
175.71	226.85	45.51	0	2				
176.91	319.25	46.36	0	1				
177.45	277.84	46.1	0	3				
177.77	279.46	38.06	0	3				
178.43	252.55	40.5	0	3				
179.96	308.1	41.97	0	3				
180.09	36.19	33.35	0	3				
180.66	298.21	39.74	0	3				
181.12	276.68	37.27	0	3				
181.58	22.39	34.5	0	1				
181.91	294.84	19.97	0	3				
182.58	312.48	30.48	0	2				
182.93	251.93	32.84	0	3				
183.57	195.7	18.23	0	2				
183.81	213.54	29.11	0	3				
186.89	192.94	20.6	0	3				
239.42	79.14	9.24	0	2				
239.69	260.62	32.84	0	2				
240.21	324.89	34.35	0	2				
240.72	269.82	36.73	0	2				
241.12	215.84	40.6	0	2				
244.28	137.84	24.75	0	2				
244.96	181.62	31.4	0	2				
245.71	222.77	26.46	0	2				

Electric Power Research Institute, 1999; Geological Logging Systems, 2002; H.C. Nutting Company, 2008; Cardno GLS, 2014

Geophysical Logs

MW-2, MW-4, & MW-5; MW-9 & MW-10; 2008-17; B-1401 & B-1402

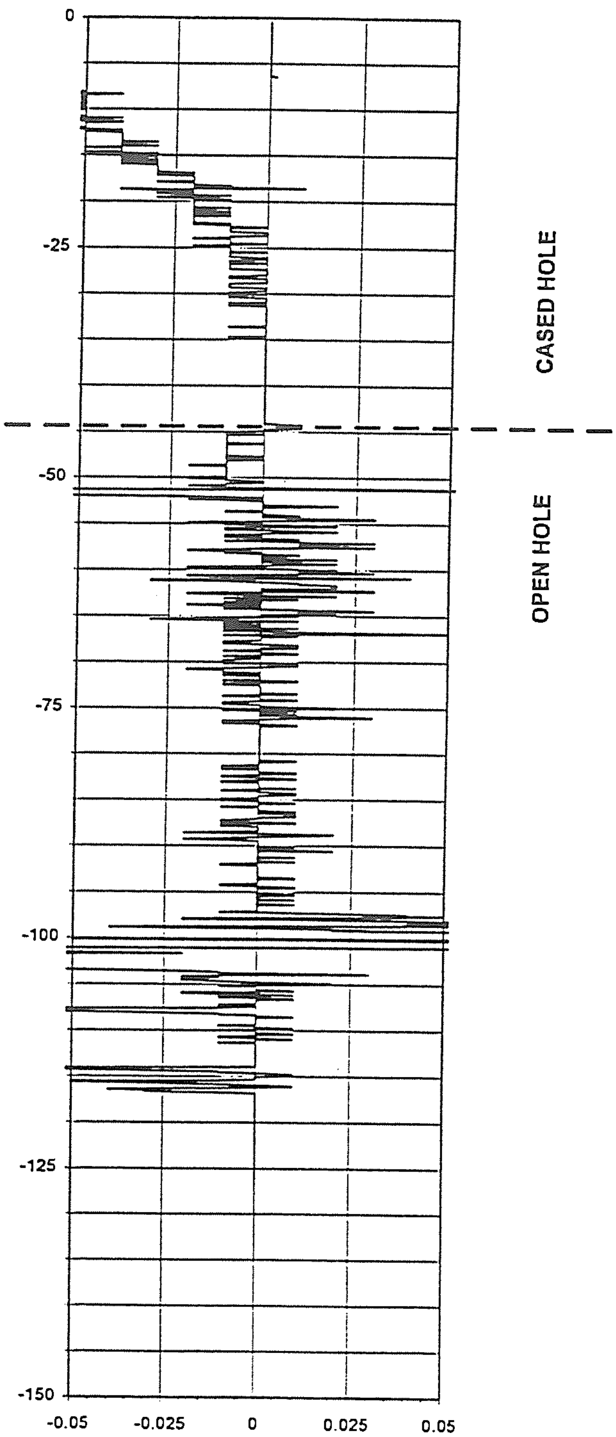
MW2 TEMPERATURE
LOG



TEMPERATURE

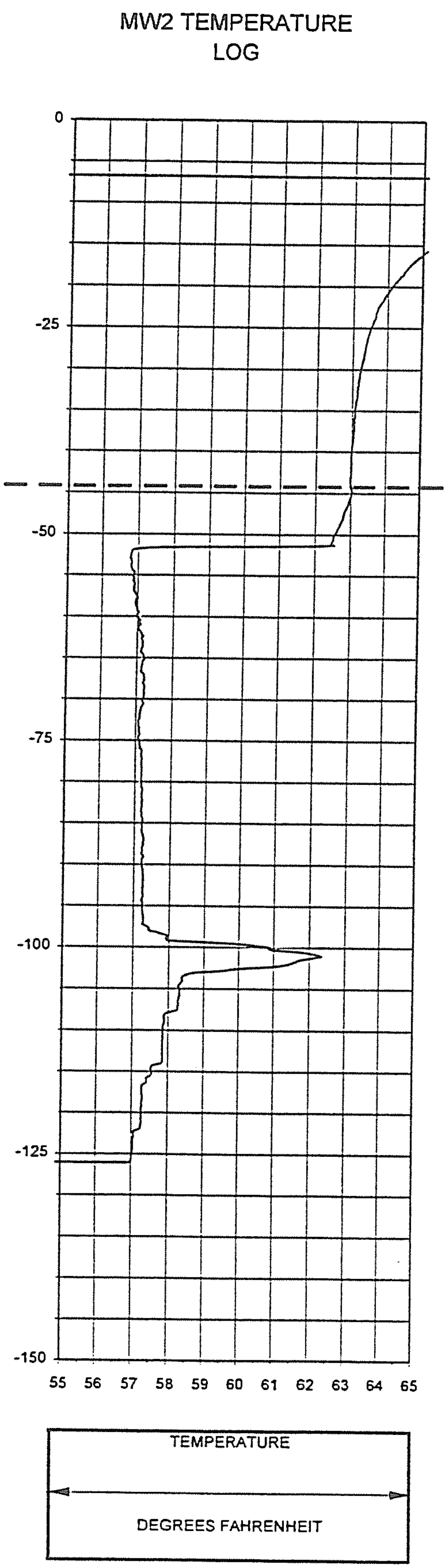
DEGREES FAHRENHEIT

MW2 TEMPERATURE
GRADIENT LOG

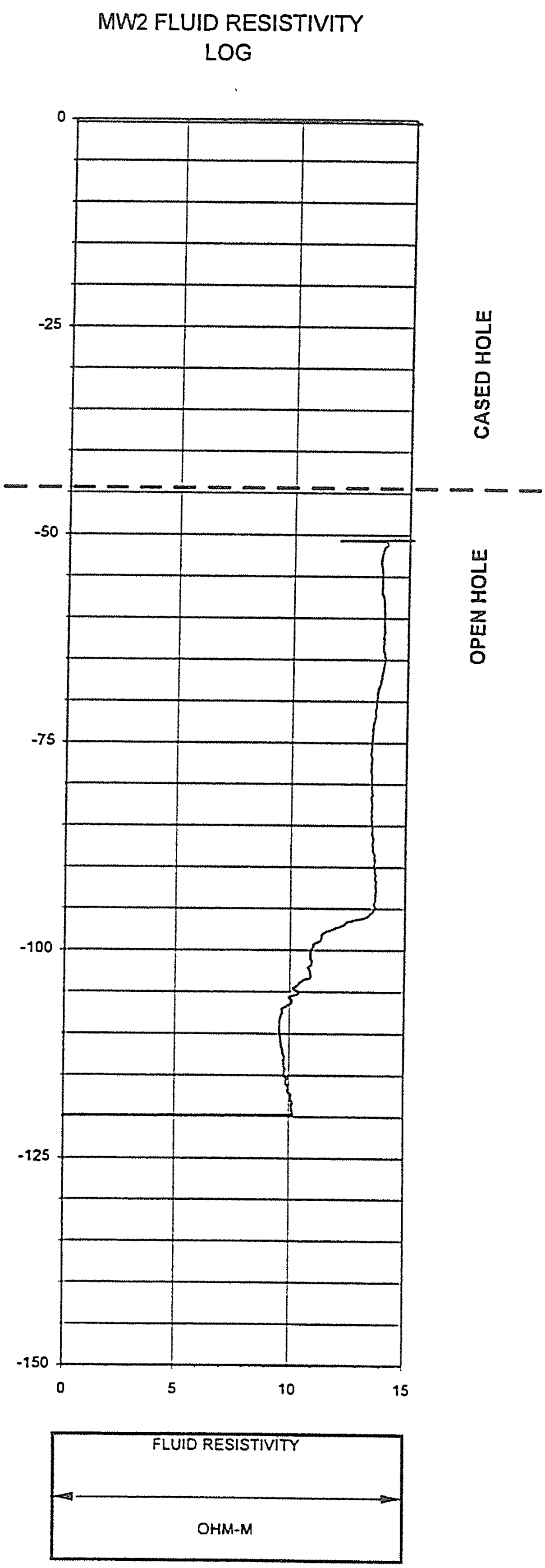


DELTA TEMPERATURE

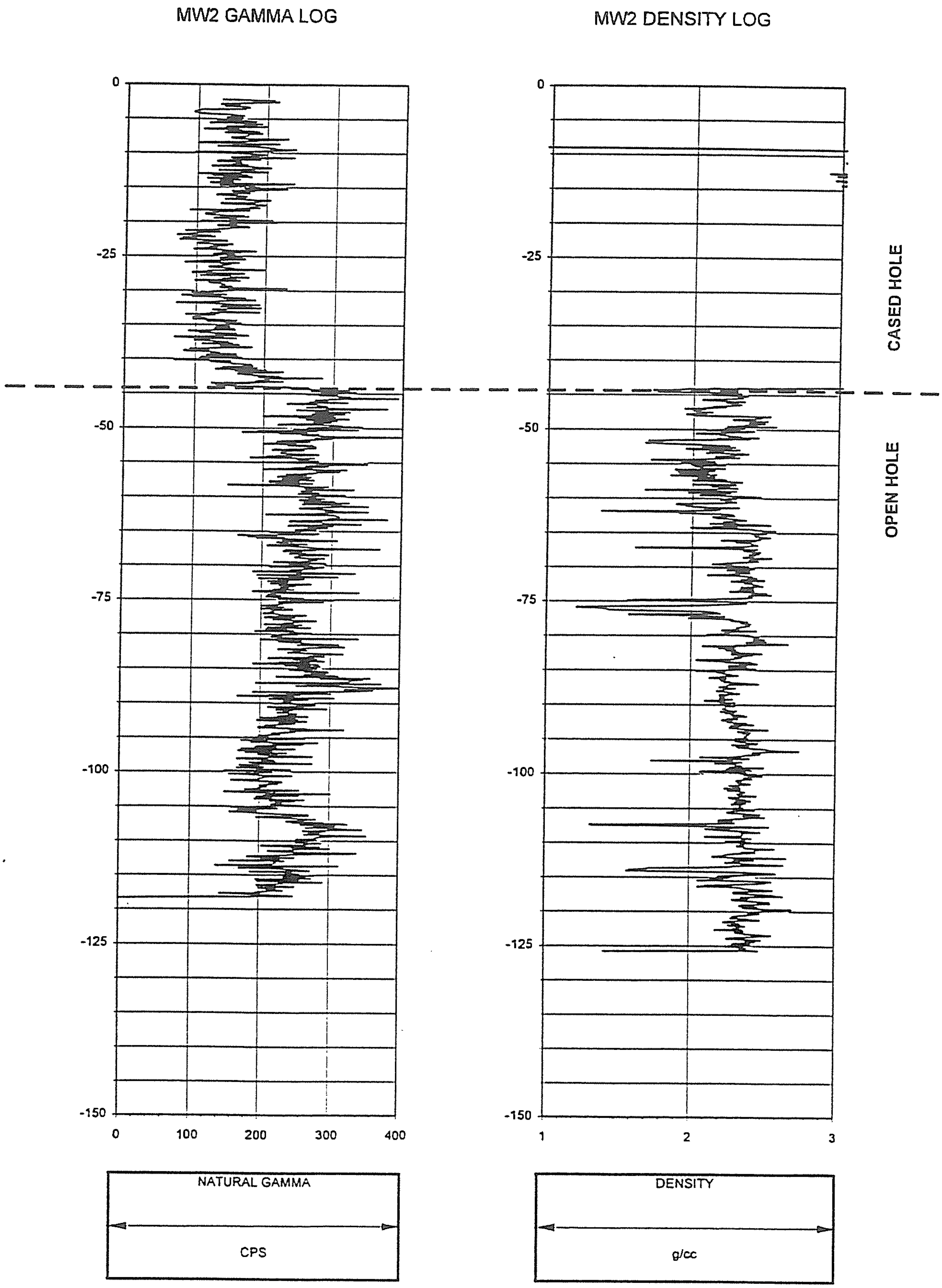
DEGREES FAHRENHEIT

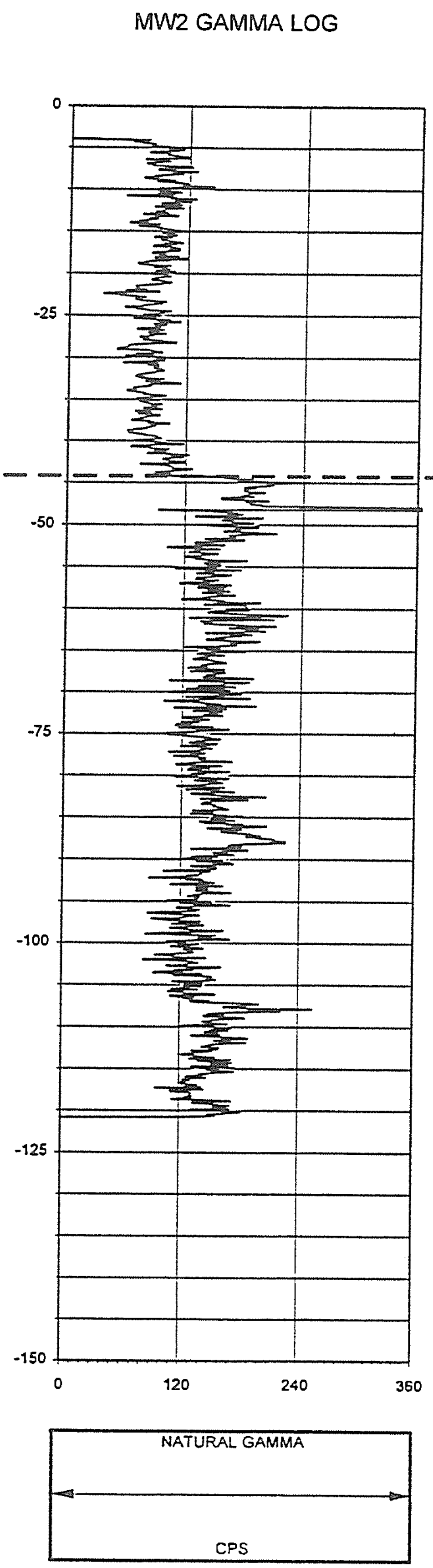


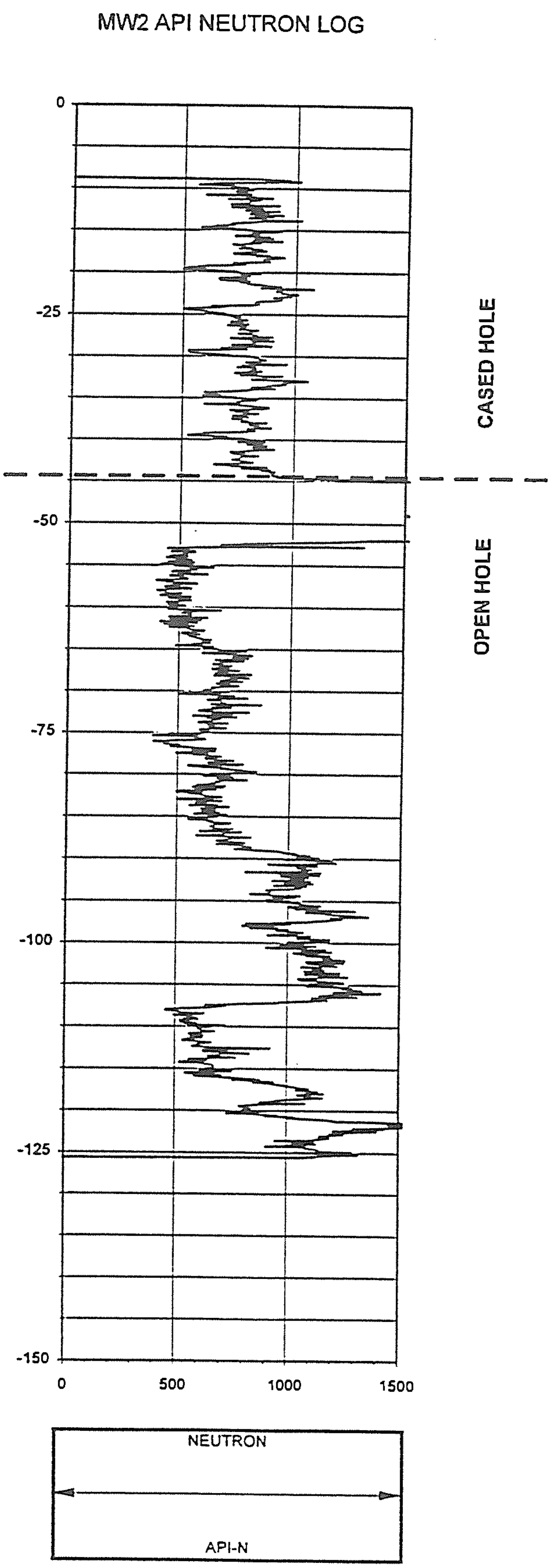
MW2 TEMPERATURE LOG
0
-25
-50
-75
-100
-125
-150
55 56 57 58 59 60 61 62 63 64 65
TEMPERATURE
DEGREES FAHRENHEIT

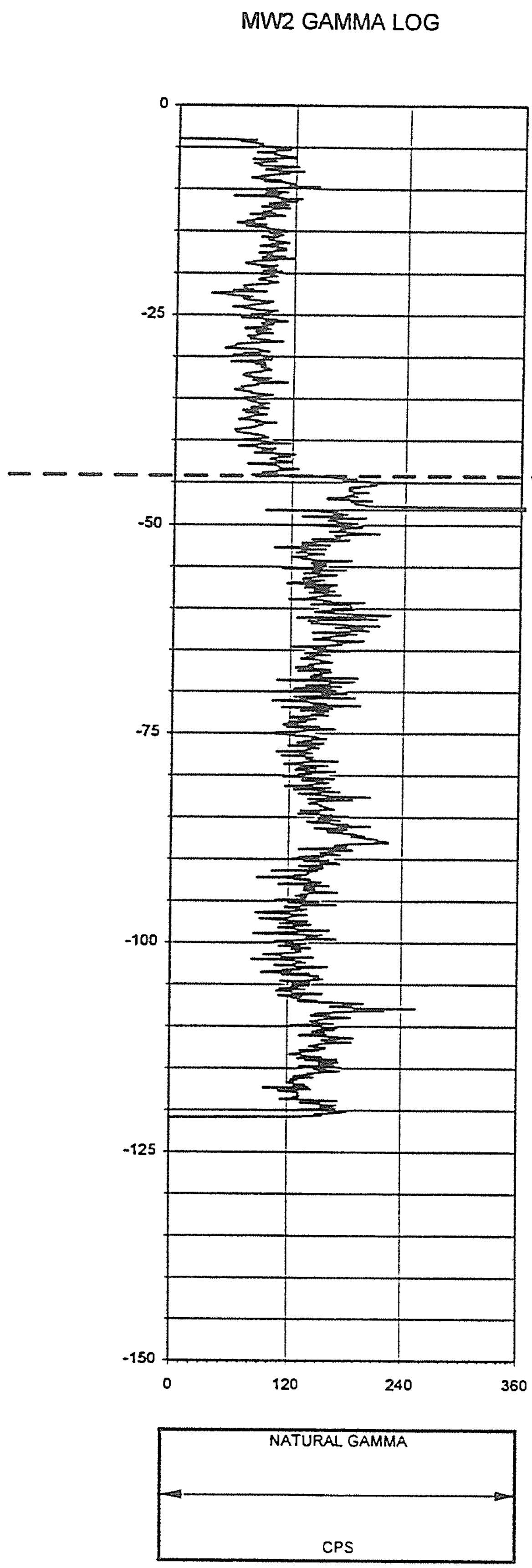


MW2 FLUID RESISTIVITY LOG
0
-25
-50
-75
-100
-125
-150
0 5 10 15
CASED HOLE
OPEN HOLE
FLUID RESISTIVITY
OHM-M

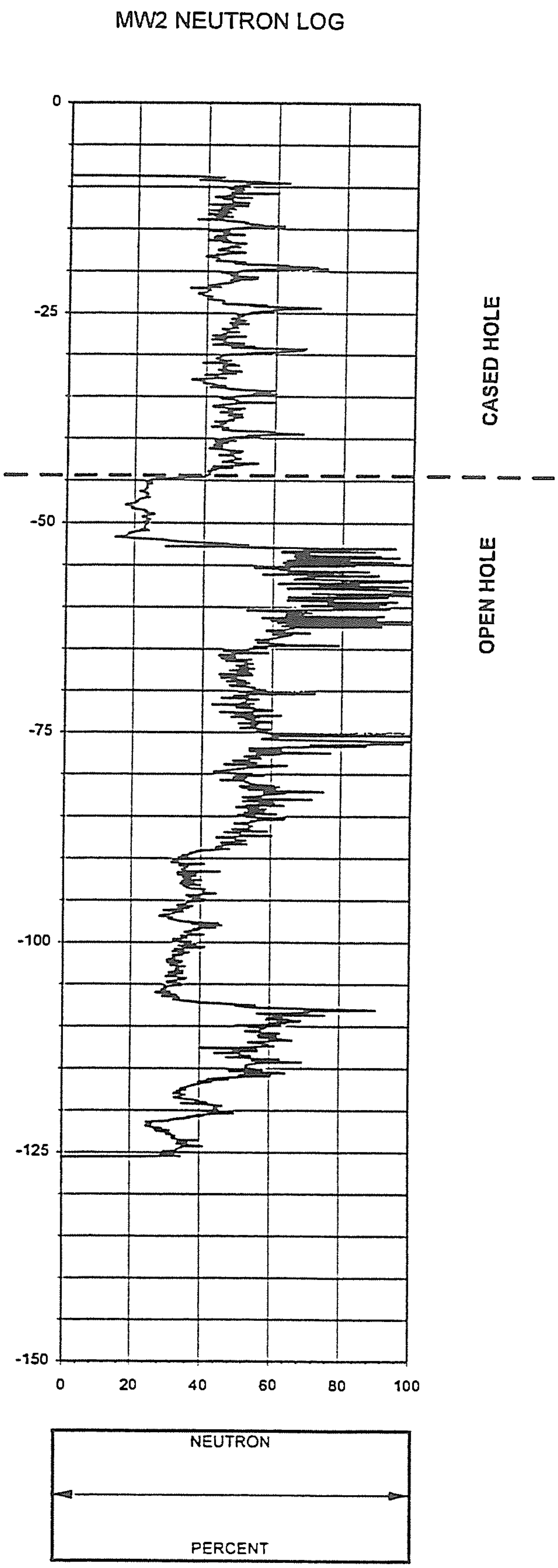

MW2 GAMMA LOG
MW2 DENSITY LOG
CASED HOLE
OPEN HOLE
0
-25
-50
-75
-100
-125
-150
0
100
200
300
400
1
2
3
NATURAL GAMMA
CPS
DENSITY
g/cc


MW2 GAMMA LOG
0
-25
-50
-75
-100
-125
-150
0
120
240
360
NATURAL GAMMA
CPS

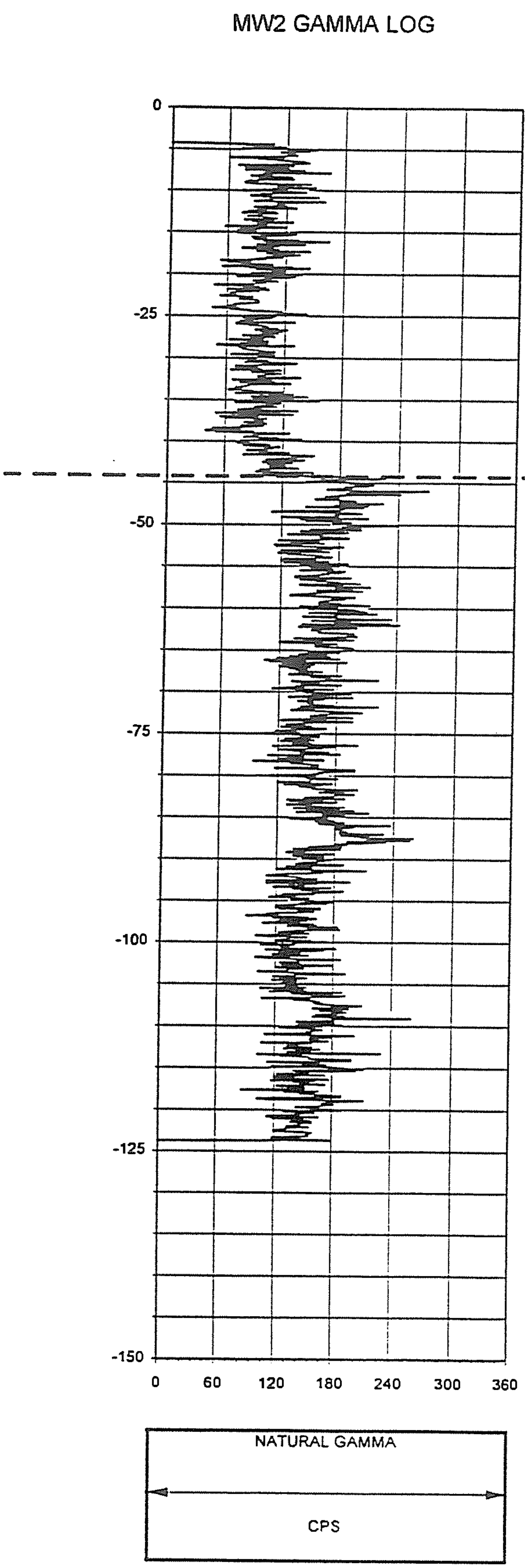

MW2 API NEUTRON LOG
0
-25
-50
-75
-100
-125
-150
0
500
1000
1500
NEUTRON
API-N
CASED HOLE
OPEN HOLE

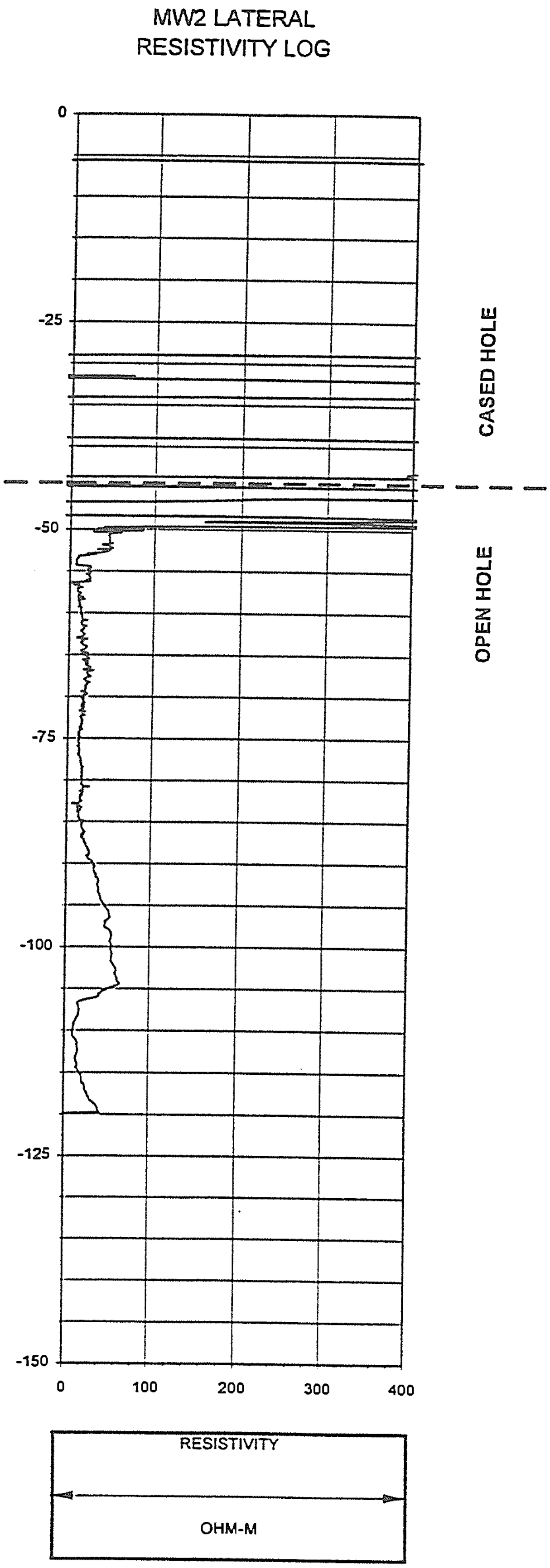


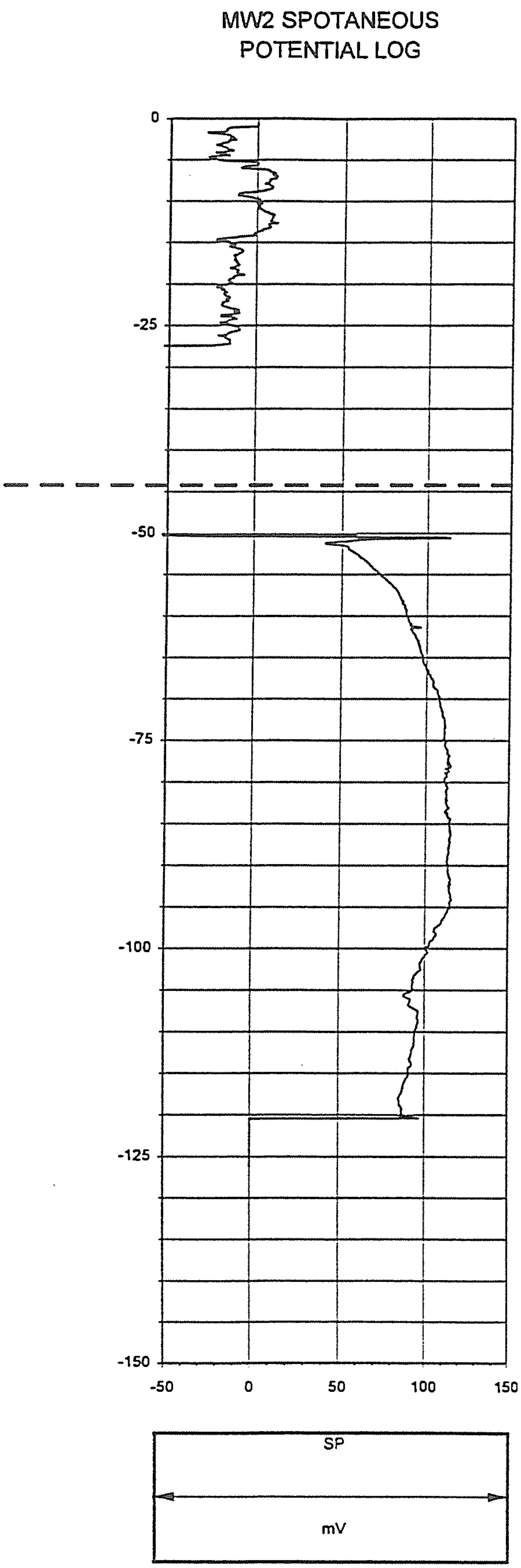
MW2 GAMMA LOG
0
-25
-50
-75
-100
-125
-150
0
120
240
360
NATURAL GAMMA
CPS

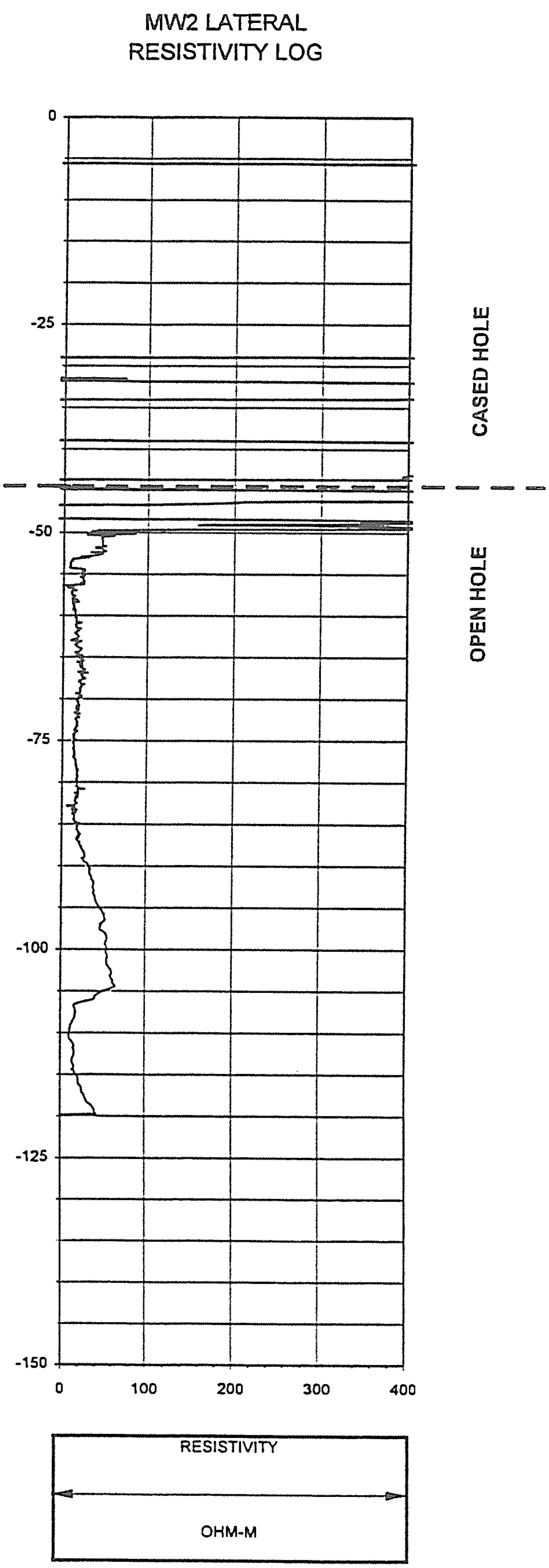


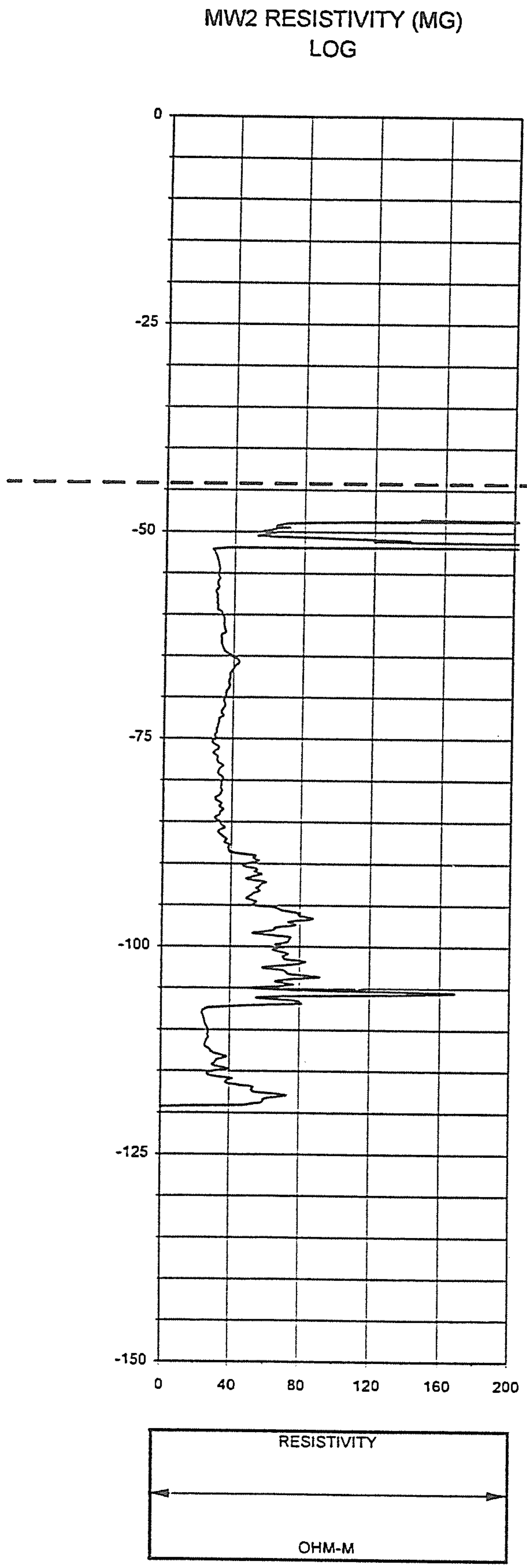
MW2 NEUTRON LOG
0
-25
-50
-75
-100
-125
-150
0
20
40
60
80
100
NEUTRON
PERCENT
CASED HOLE
OPEN HOLE

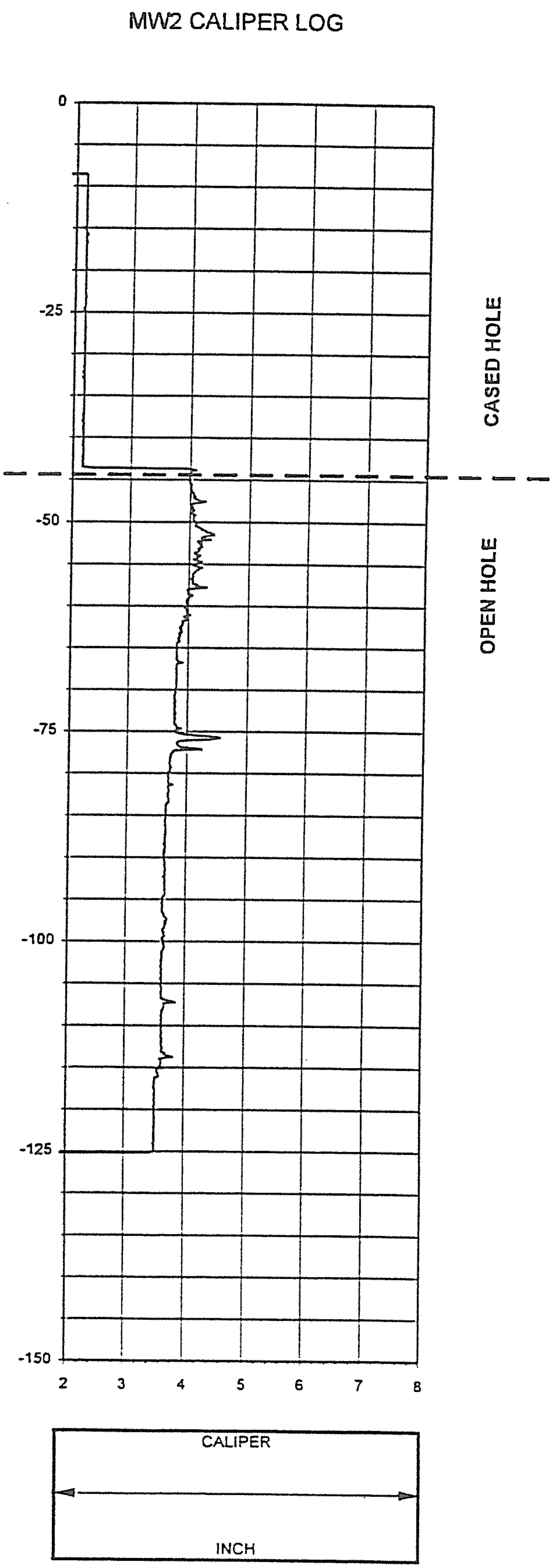

MW2 GAMMA LOG
0
-25
-50
-75
-100
-125
-150
0
60
120
180
240
300
360
NATURAL GAMMA
CPS


MW2 LATERAL
RESISTIVITY LOG
0
-25
-50
-75
-100
-125
-150
0
100
200
300
400
RESISTIVITY
OHM-M
CASED HOLE
OPEN HOLE

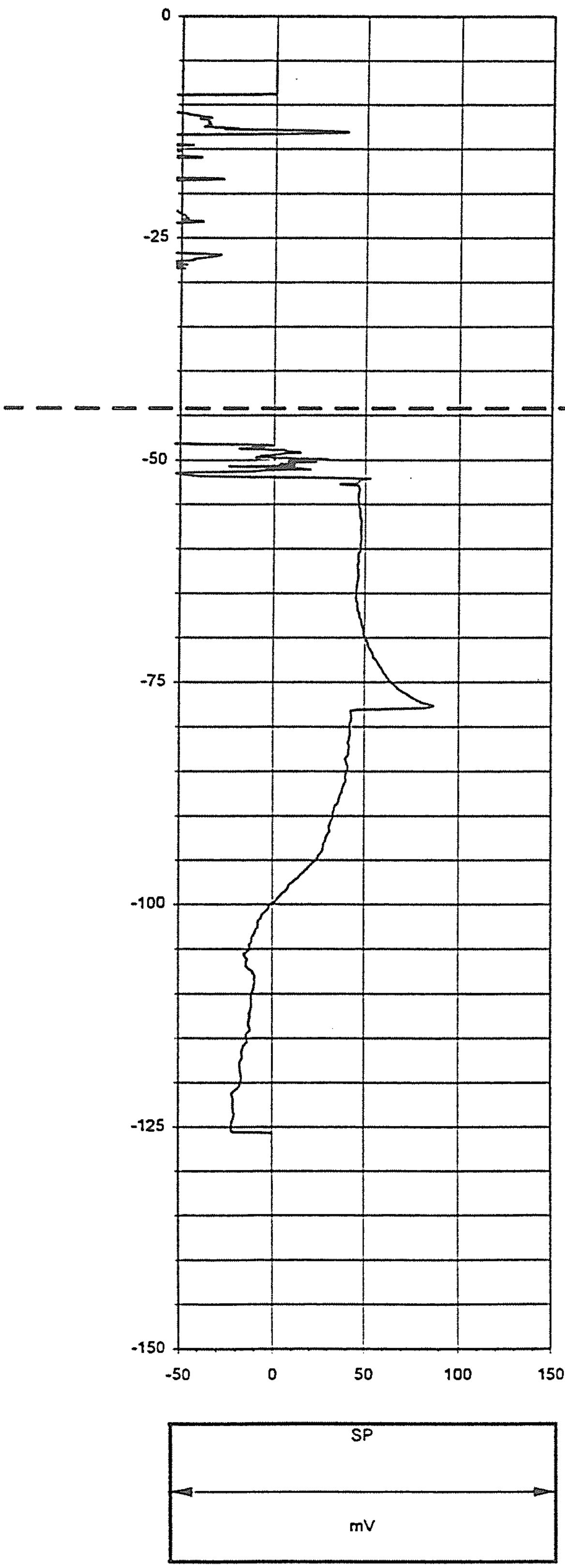

MW2 SPOTANEOUS
POTENTIAL LOG
0
-25
-50
-75
-100
-125
-150
-50
0
50
100
150
SP
mV


MW2 LATERAL
RESISTIVITY LOG
0
-25
-50
-75
-100
-125
-150
0
100
200
300
400
RESISTIVITY
OHM-M
CASED HOLE
OPEN HOLE

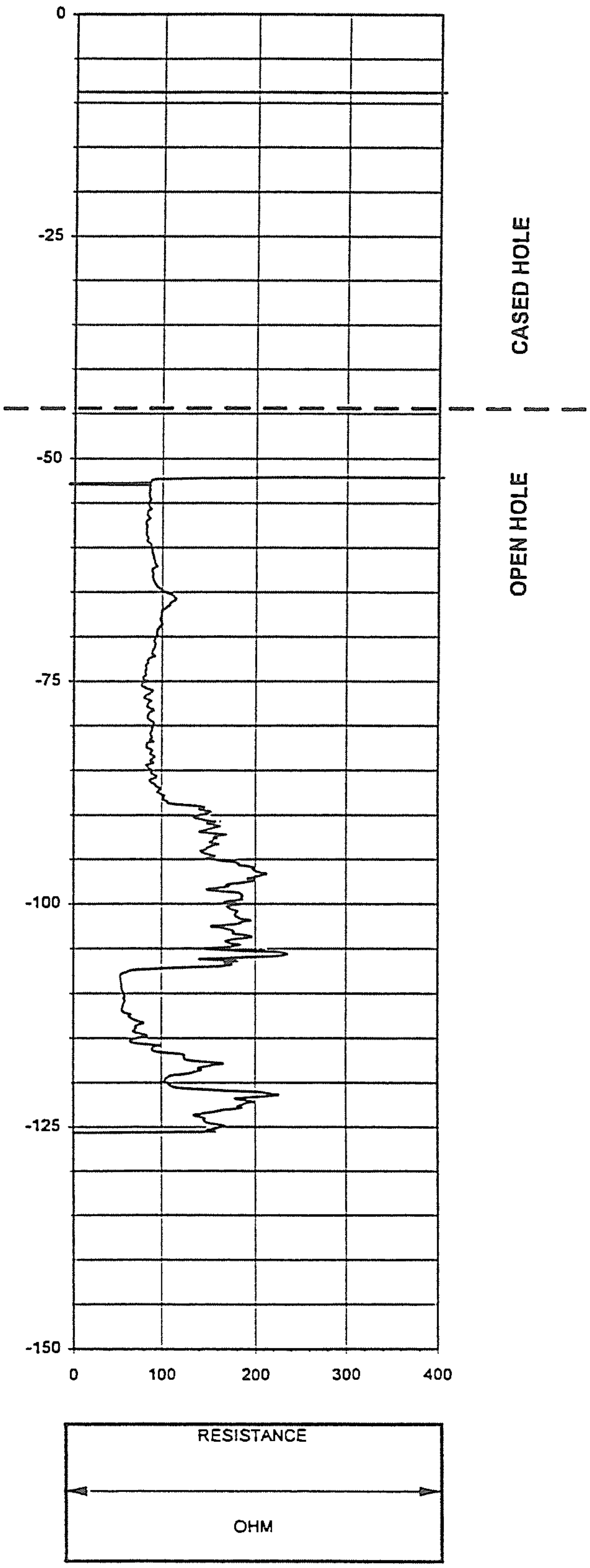

MW2 RESISTIVITY (MG)
LOG
0
-25
-50
-75
-100
-125
-150
0
40
80
120
160
200
RESISTIVITY
OHM-M

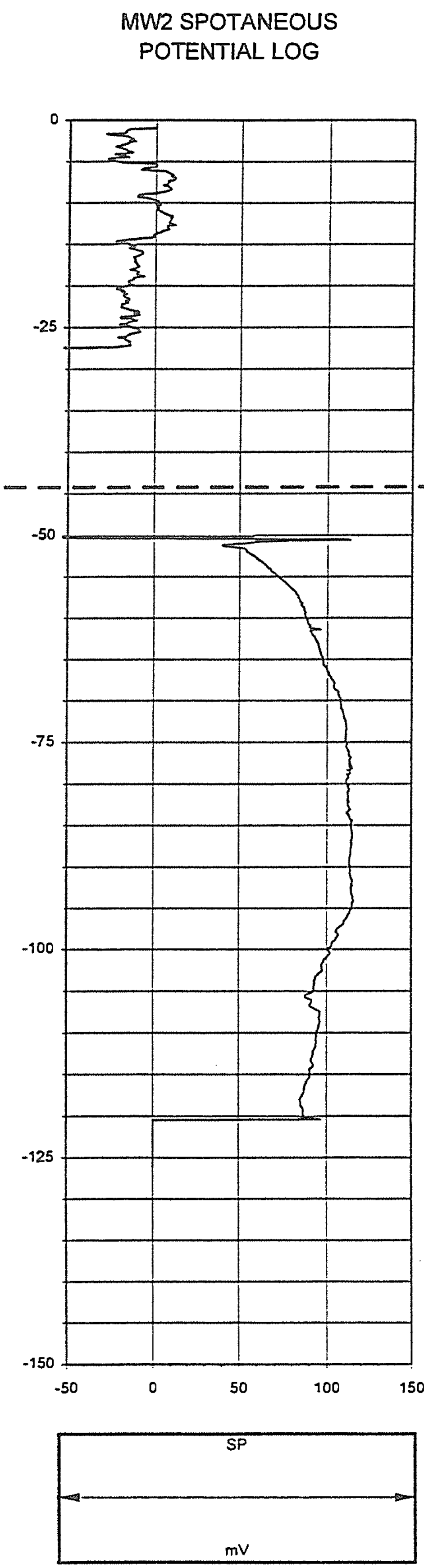

MW2 CALIPER LOG
0
-25
-50
-75
-100
-125
-150
2
3
4
5
6
7
8
CASED HOLE
OPEN HOLE
CALIPER
INCH

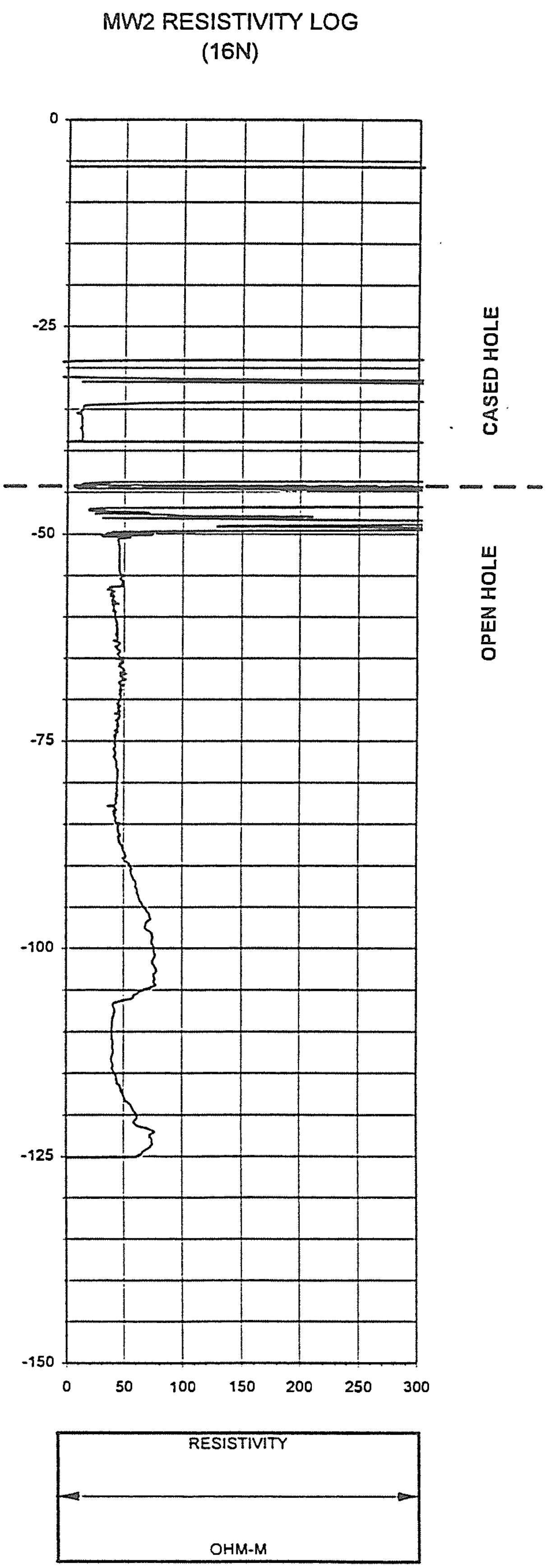
MW2 SPOTANEOUS
POTENTIAL LOG

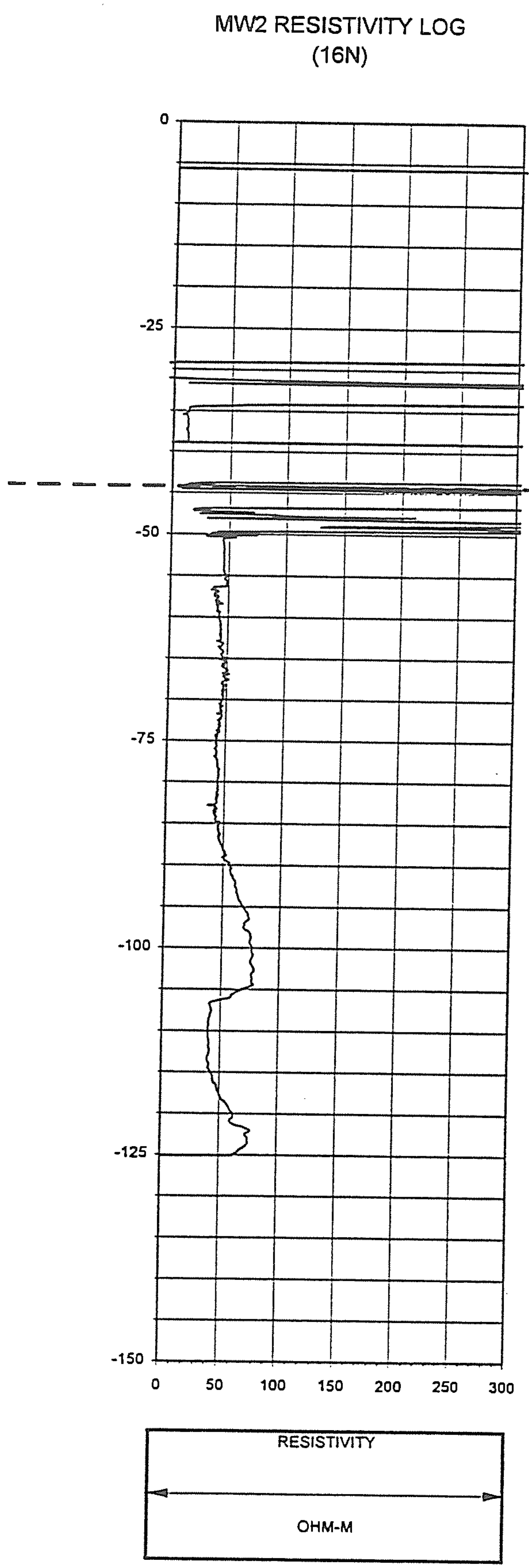


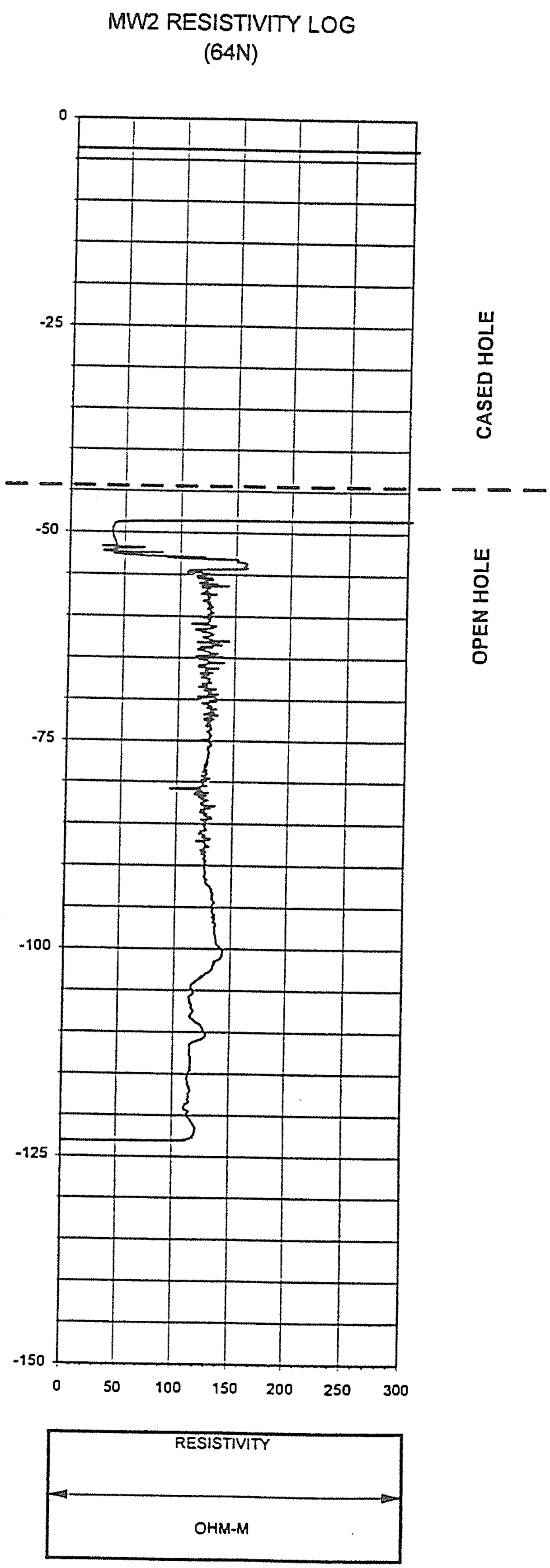
MW2 SINGLE POINT
RESISTANCE LOG

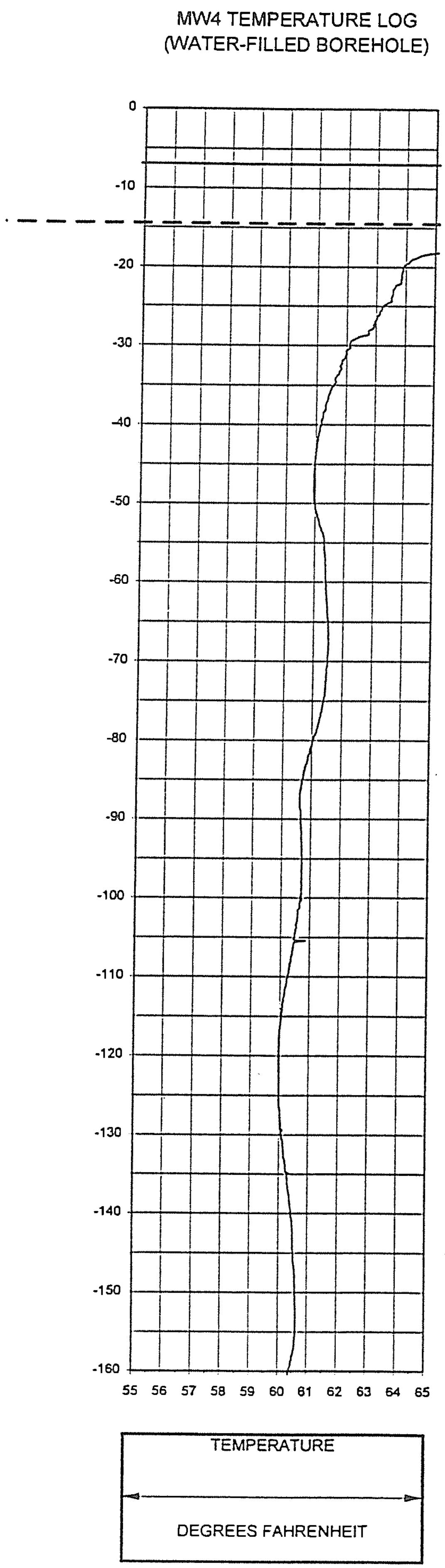


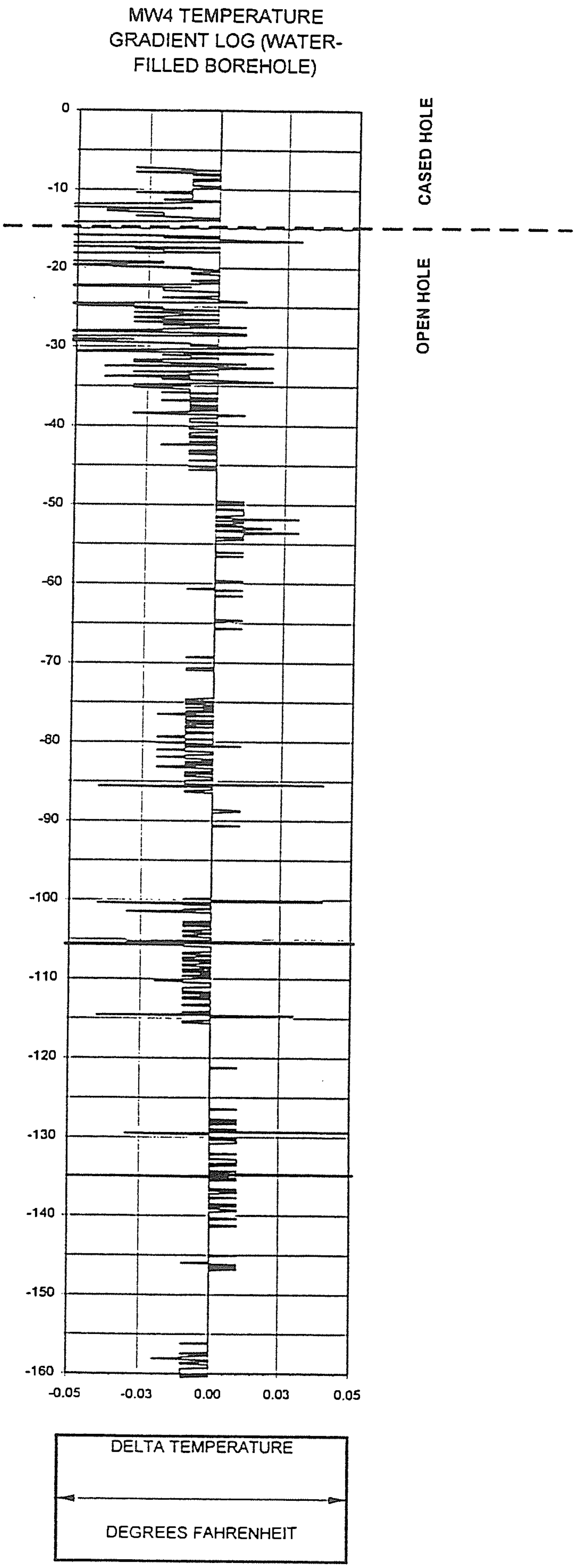

MW2 SPOTANEOUS
POTENTIAL LOG
0
-25
-50
-75
-100
-125
-150
-50
0
50
100
150
SP
mV


MW2 RESISTIVITY LOG
(16N)
0
-25
-50
-75
-100
-125
-150
0
50
100
150
200
250
300
RESISTIVITY
OHM-M
CASED HOLE
OPEN HOLE


MW2 RESISTIVITY LOG
(16N)
0
-25
-50
-75
-100
-125
-150
0 50 100 150 200 250 300
RESISTIVITY
OHM-M

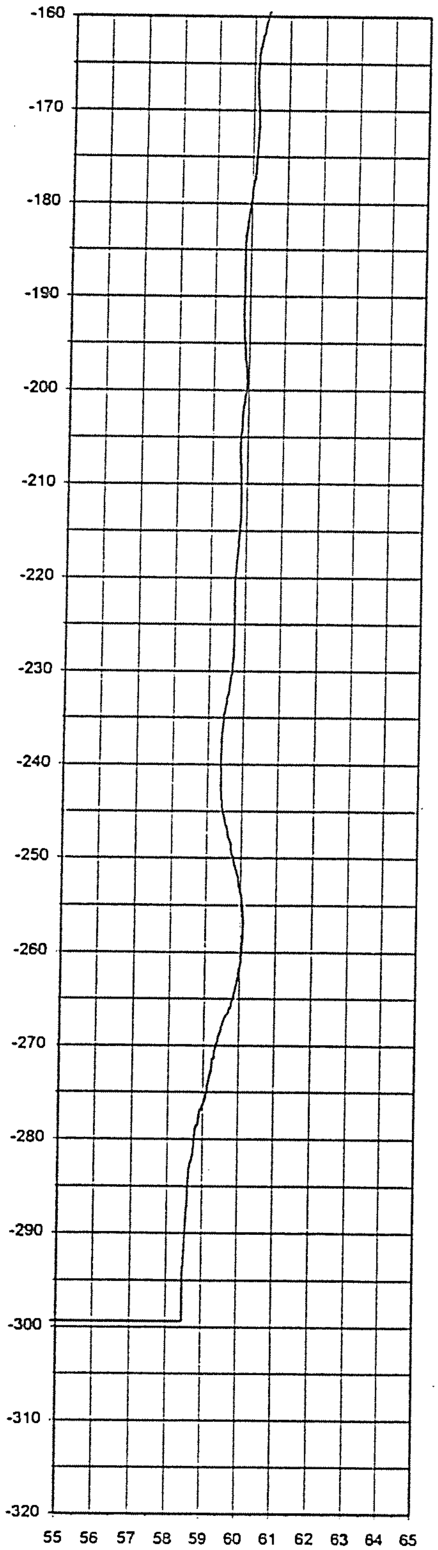

MW2 RESISTIVITY LOG
(64N)
0
-25
-50
-75
-100
-125
-150
0 50 100 150 200 250 300
CASED HOLE
OPEN HOLE
RESISTIVITY
OHM-M


MW4 TEMPERATURE LOG (WATER-FILLED BOREHOLE)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
55 56 57 58 59 60 61 62 63 64 65
TEMPERATURE
DEGREES FAHRENHEIT


MW4 TEMPERATURE GRADIENT LOG (WATER-FILLED BOREHOLE)
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
-0.05 -0.03 0.00 0.03 0.05
DELTA TEMPERATURE
DEGREES FAHRENHEIT

MW4 TEMPERATURE LOG (WATER-FILLED BOREHOLE)

(Continued)

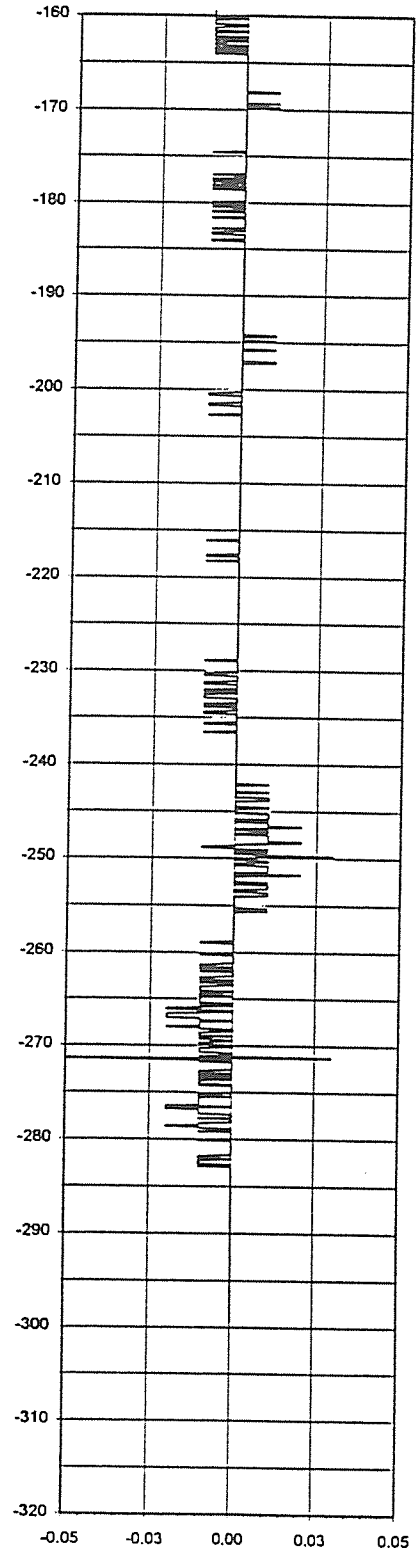


TEMPERATURE

DEGREES FAHRENHEIT

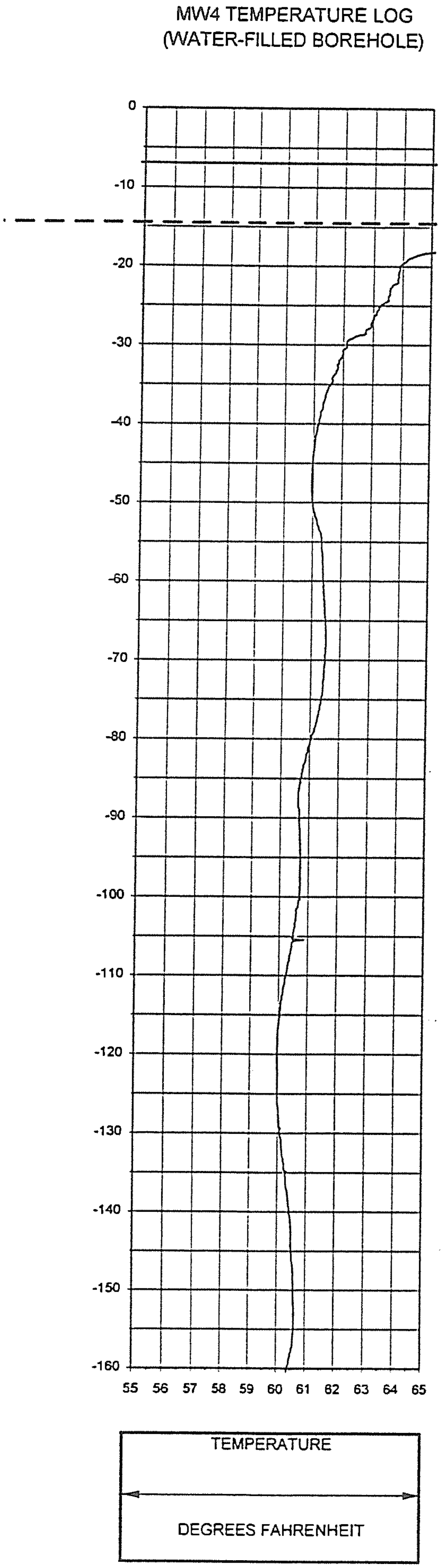
MW4 TEMPERATURE GRADIENT LOG (WATER-FILLED BOREHOLE)

(Continued)

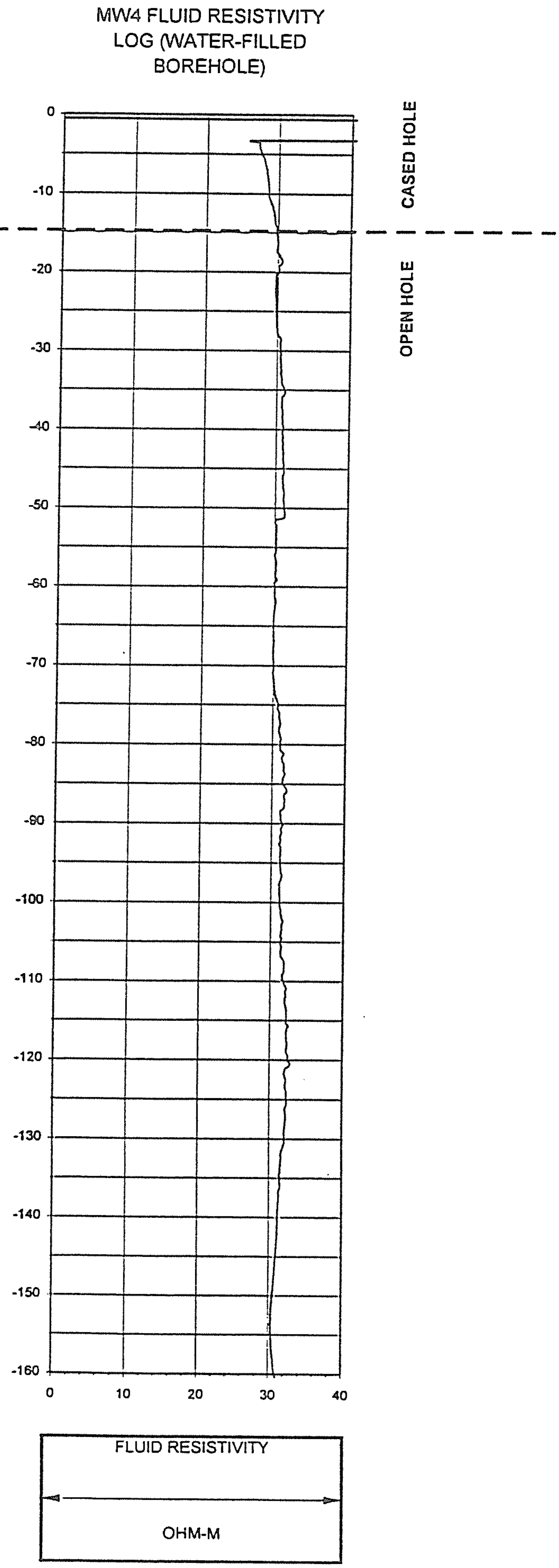


DELTA TEMPERATURE

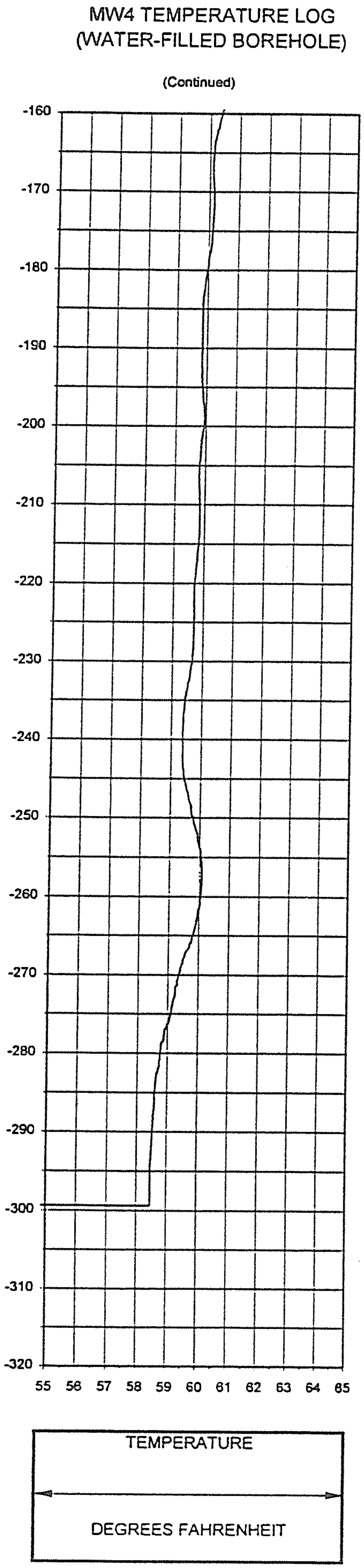
DEGREES FAHRENHEIT

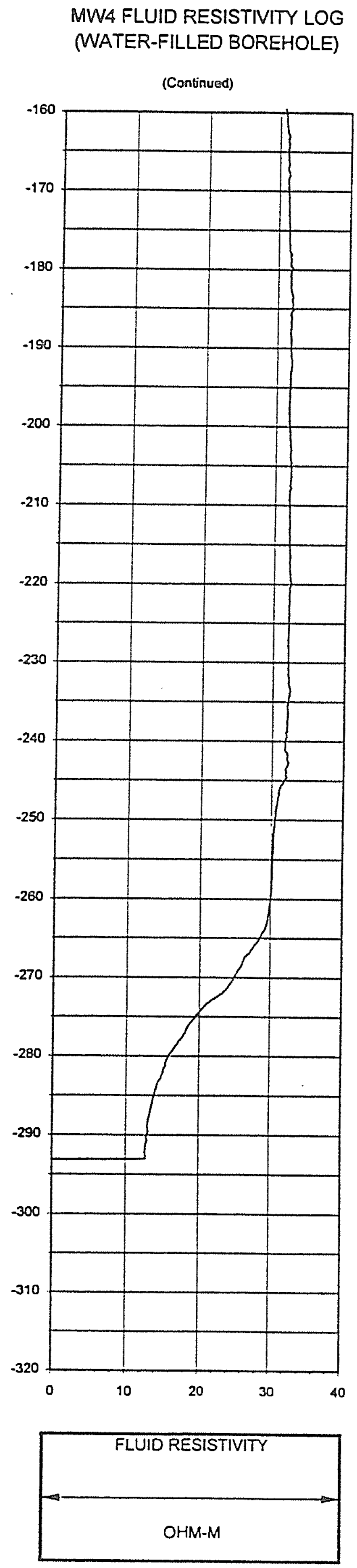


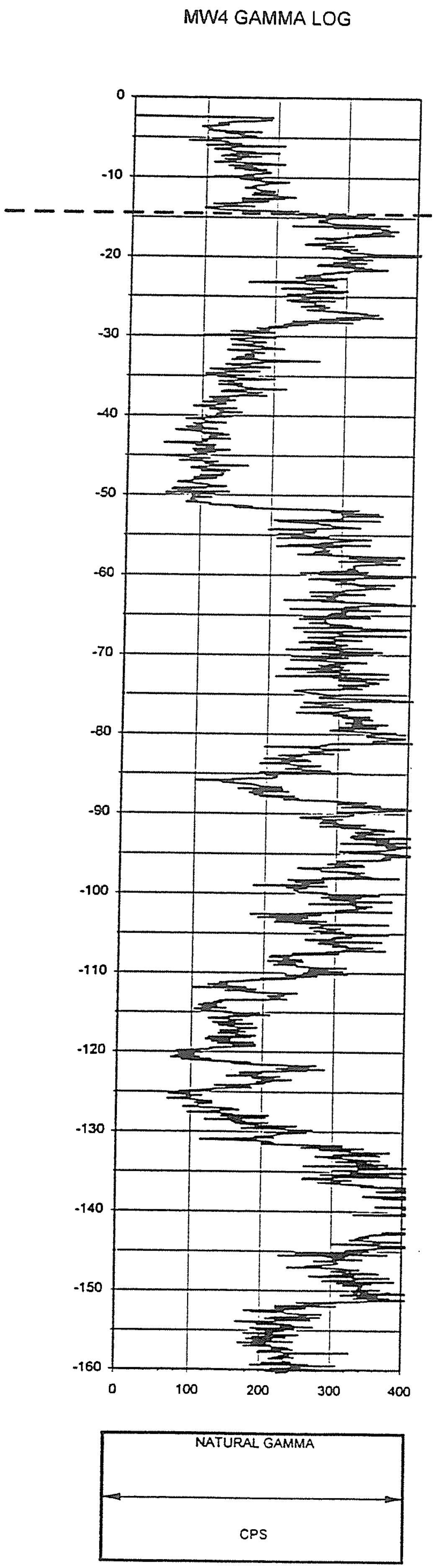
MW4 TEMPERATURE LOG
(WATER-FILLED BOREHOLE)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
55 56 57 58 59 60 61 62 63 64 65
TEMPERATURE
DEGREES FAHRENHEIT

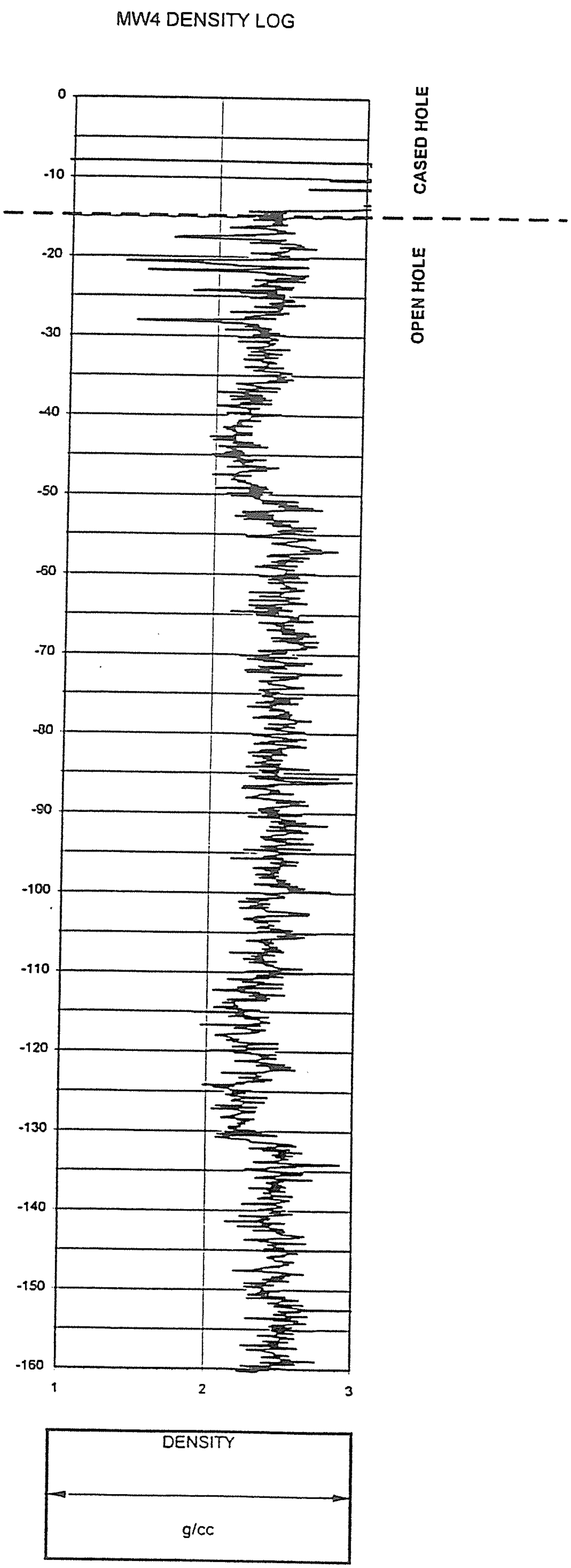


MW4 FLUID RESISTIVITY
LOG (WATER-FILLED
BOREHOLE)
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0 10 20 30 40
FLUID RESISTIVITY
OHM-M


MW4 TEMPERATURE LOG
(WATER-FILLED BOREHOLE)
(Continued)
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
-310
-320
55 56 57 58 59 60 61 62 63 64 65
TEMPERATURE
DEGREES FAHRENHEIT

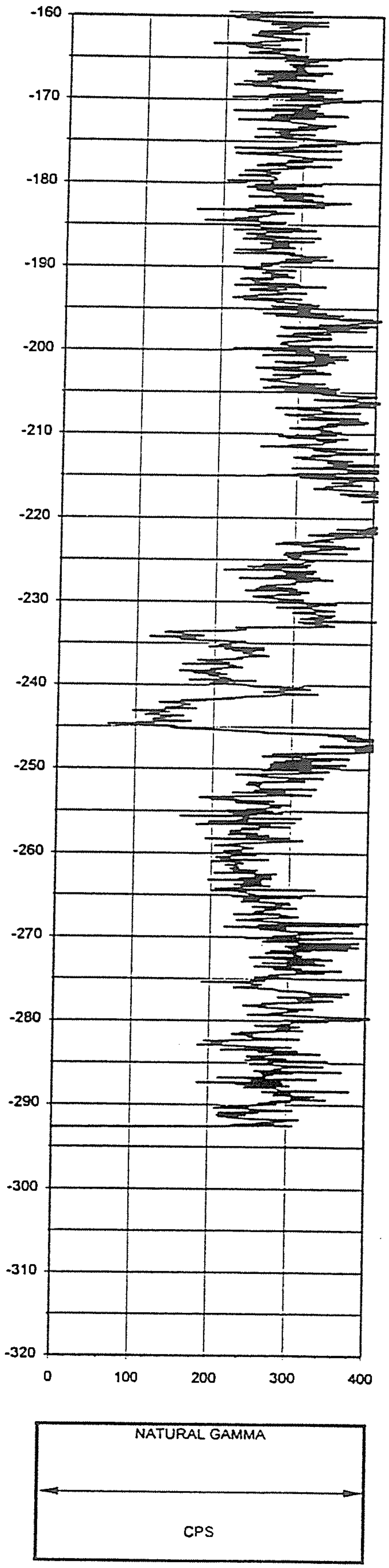

MW4 FLUID RESISTIVITY LOG
(WATER-FILLED BOREHOLE)
(Continued)
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
-310
-320
0 10 20 30 40
FLUID RESISTIVITY
OHM-M


MW4 GAMMA LOG
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
100
200
300
400
NATURAL GAMMA
CPS


MW4 DENSITY LOG
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
1
2
3
DENSITY
g/cc

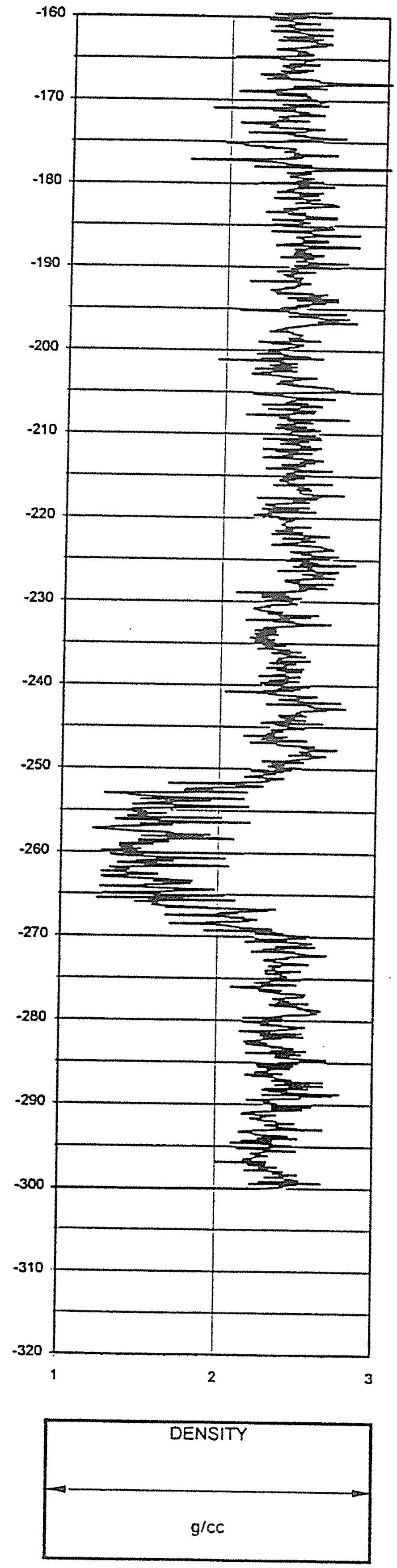
MW4 GAMMA LOG

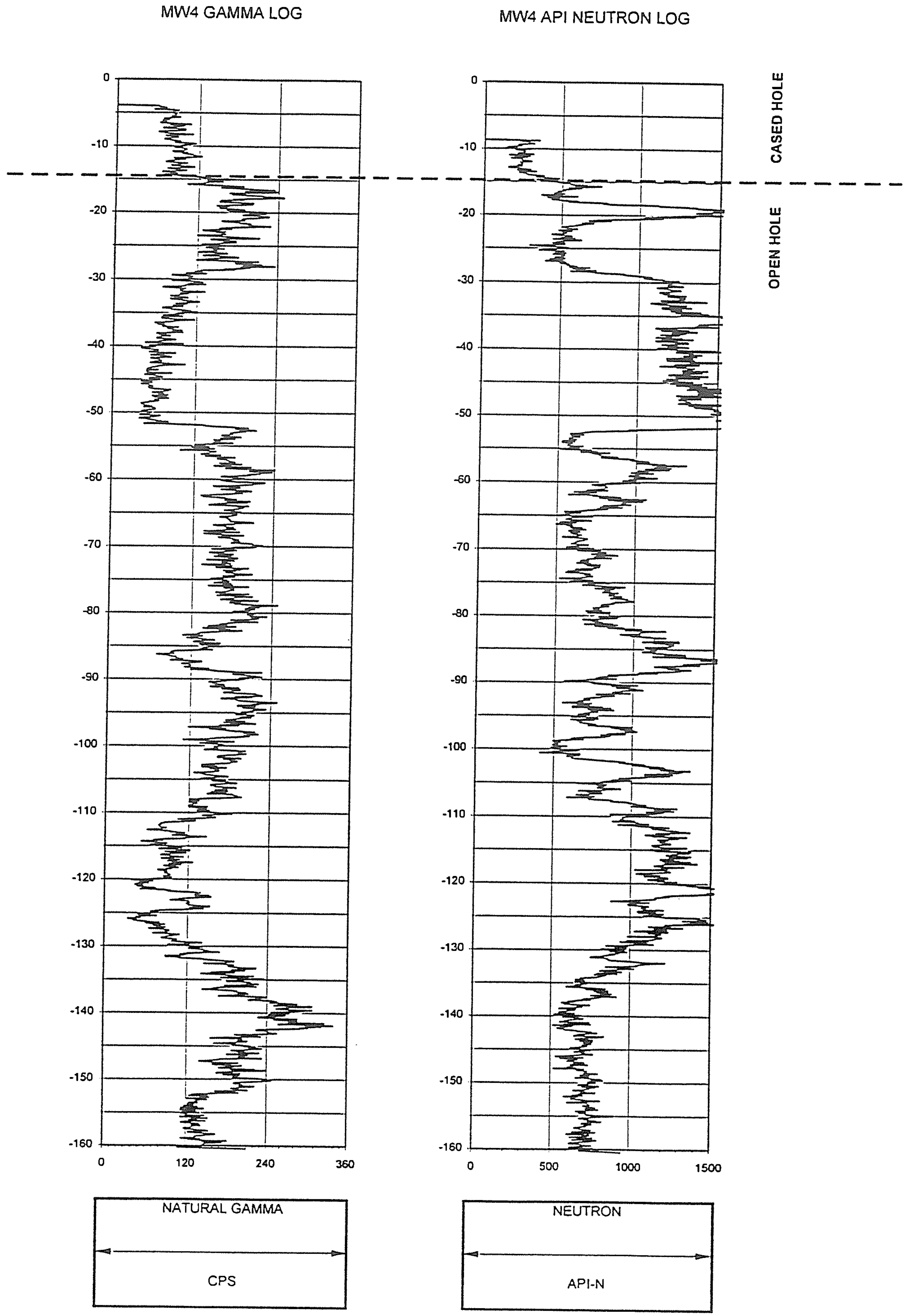
(Continued)



MW4 DENSITY LOG

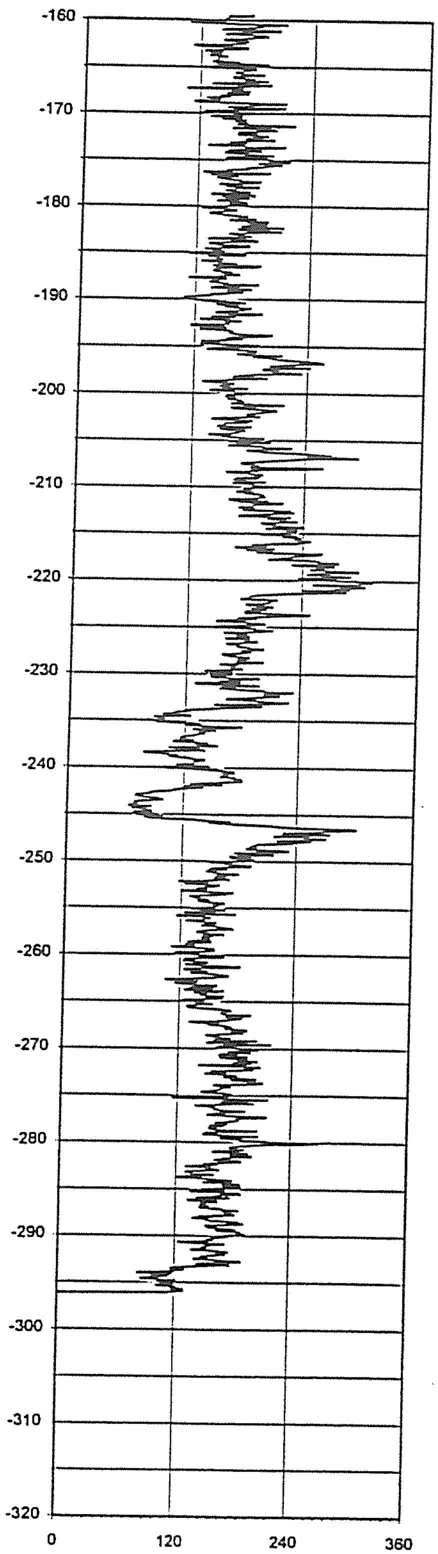
(Continued)




MW4 GAMMA LOG
MW4 API NEUTRON LOG
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
120
240
360
0
500
1000
1500
NATURAL GAMMA
CPS
NEUTRON
API-N

MW4 GAMMA LOG

(Continued)

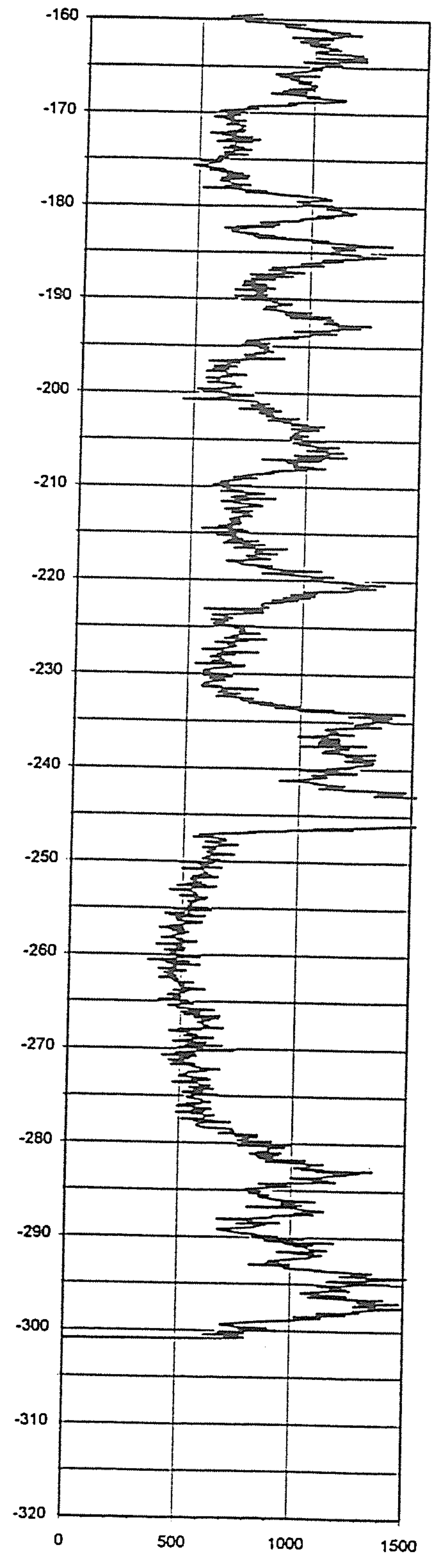


NATURAL GAMMA

CPS

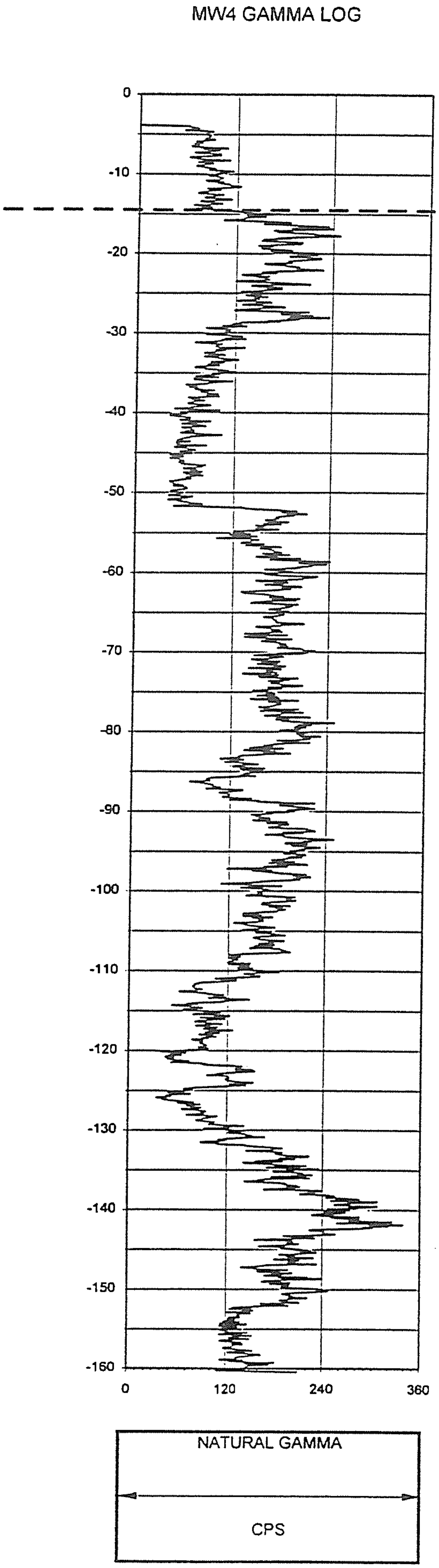
MW4 API NEUTRON LOG

(Continued)

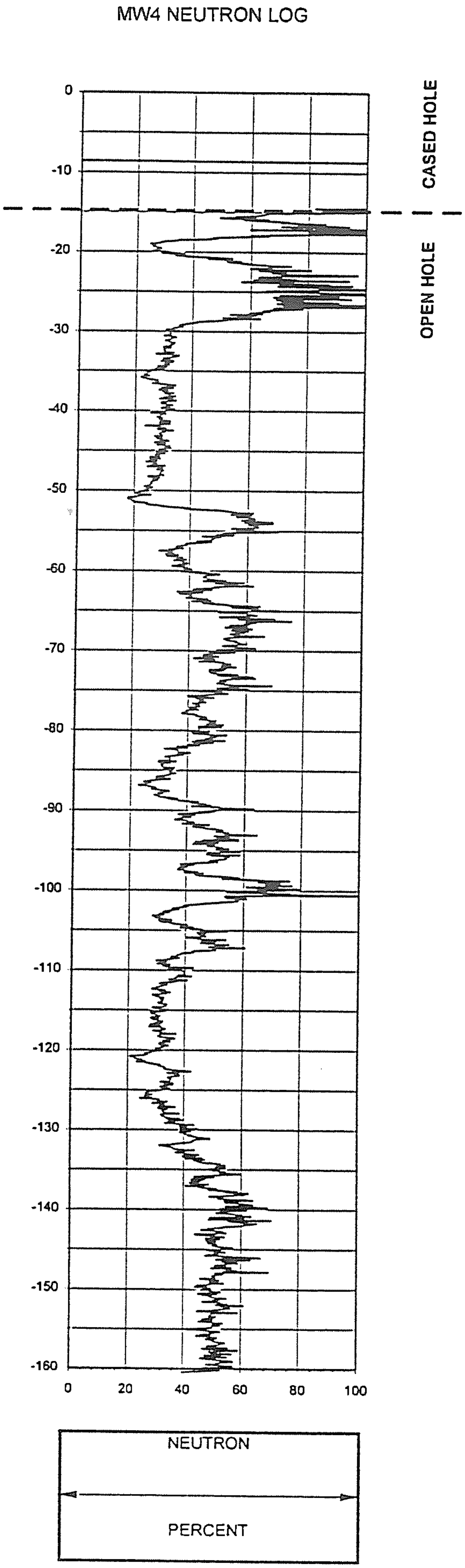


NEUTRON

API-N



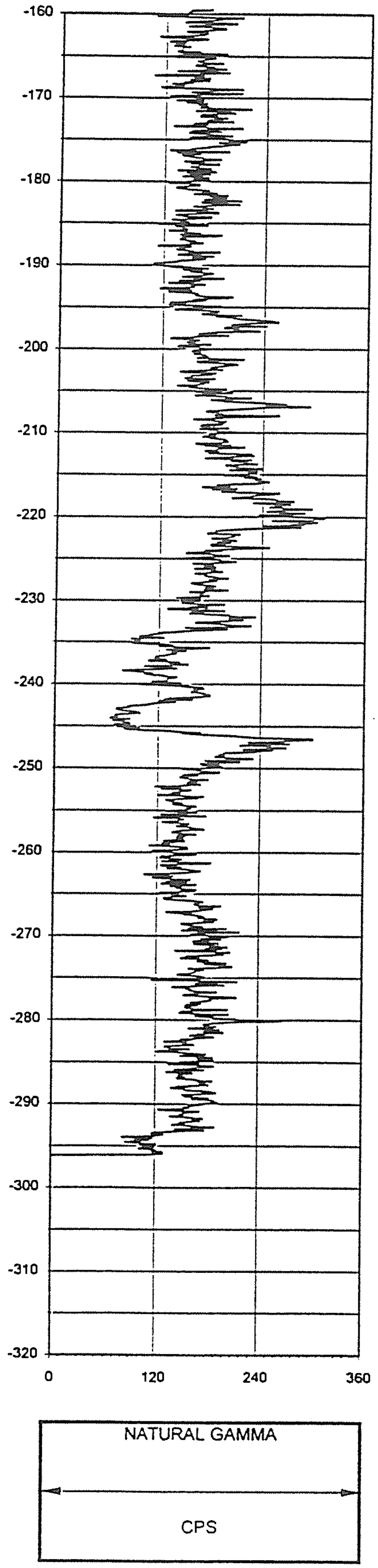
MW4 GAMMA LOG
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
120
240
360
NATURAL GAMMA
CPS



MW4 NEUTRON LOG
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
20
40
60
80
100
NEUTRON
PERCENT
CASED HOLE
OPEN HOLE

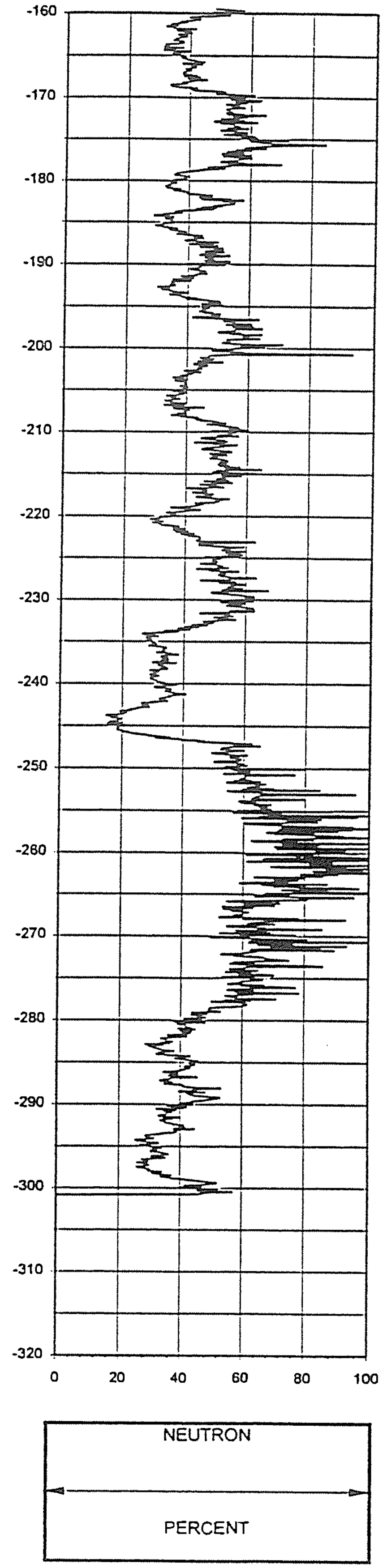
MW4 GAMMA LOG

(Continued)



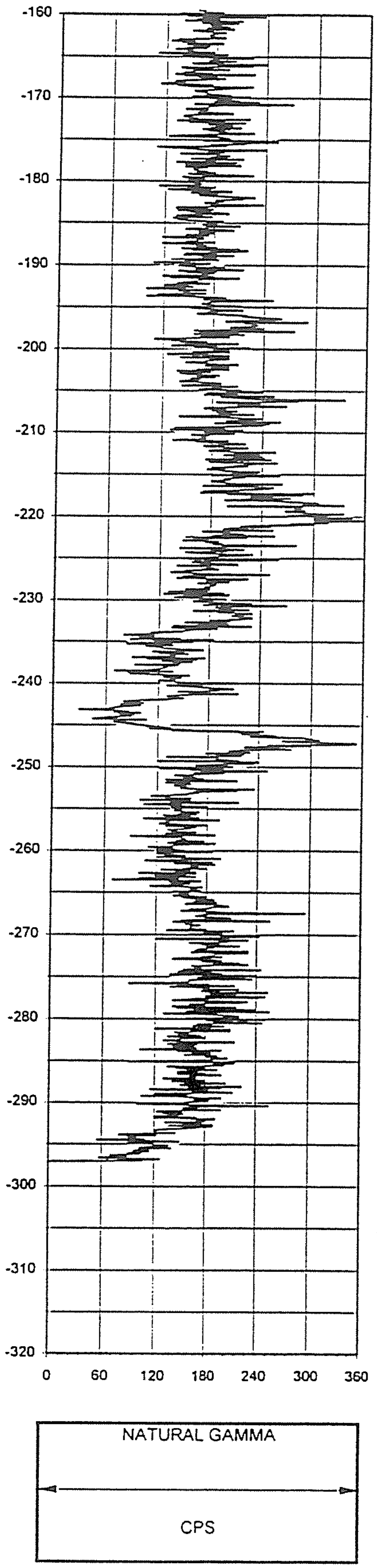
MW4 NEUTRON LOG

(Continued)



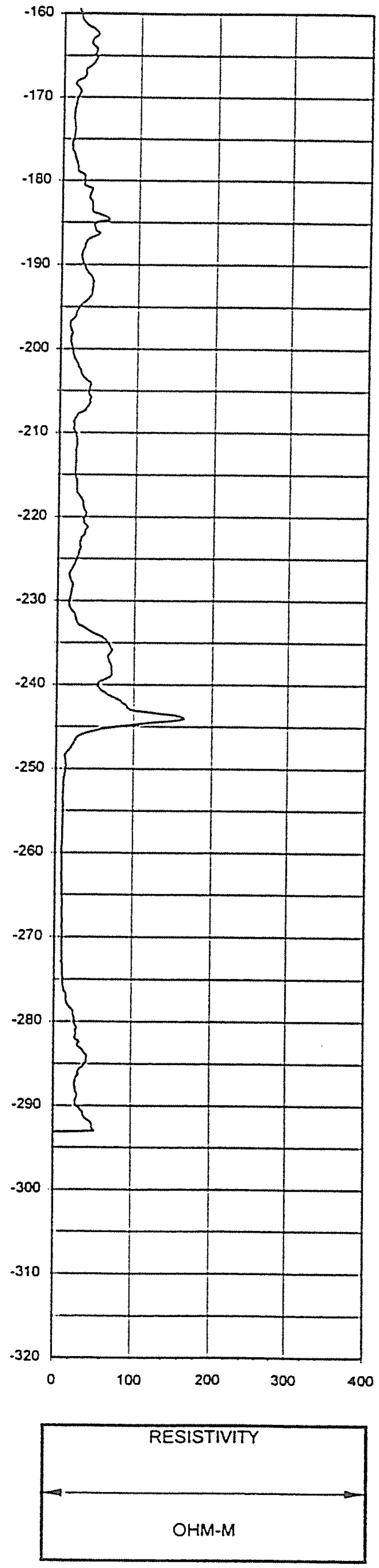
MW4 GAMMA LOG

(Continued)



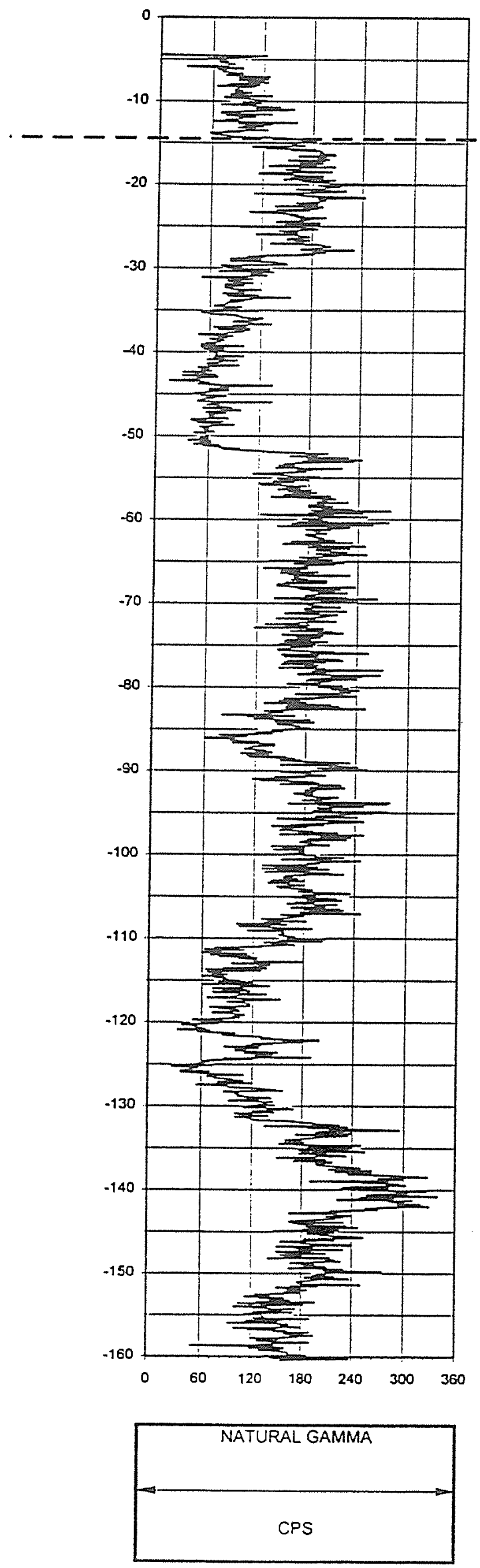
MW4 LATERAL RESISTIVITY LOG

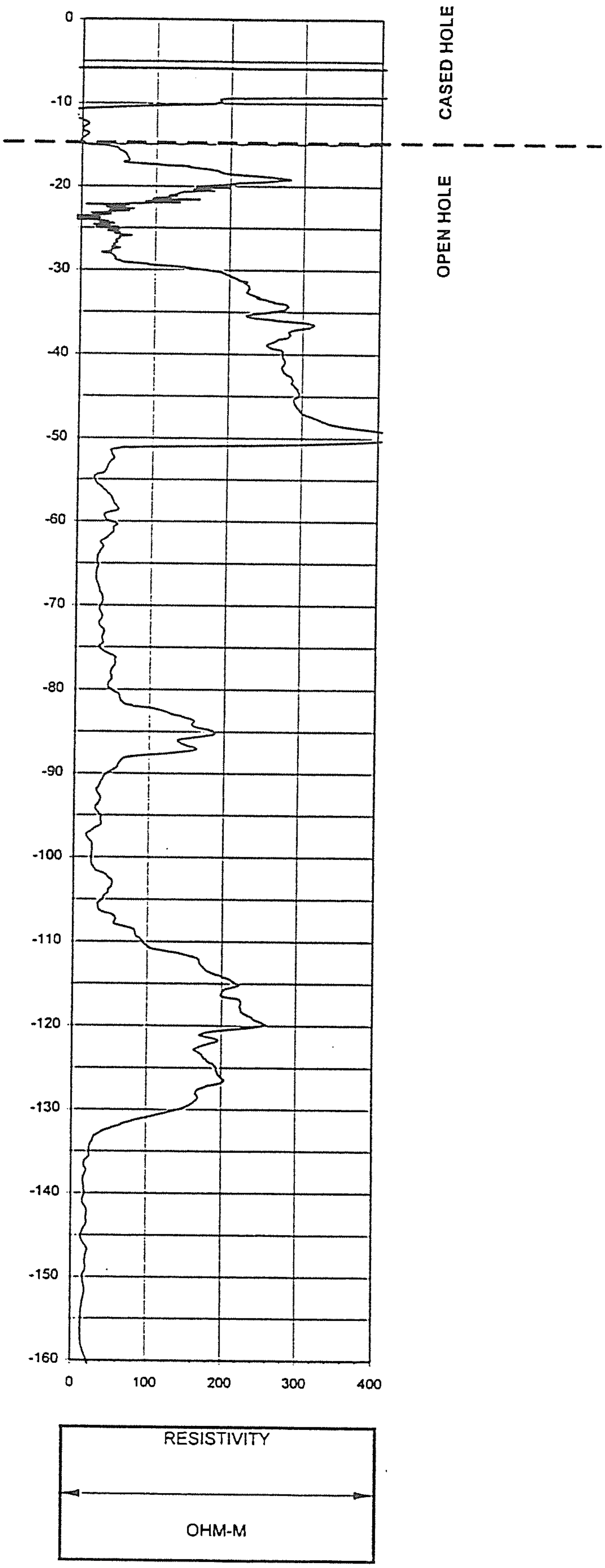
(Continued)



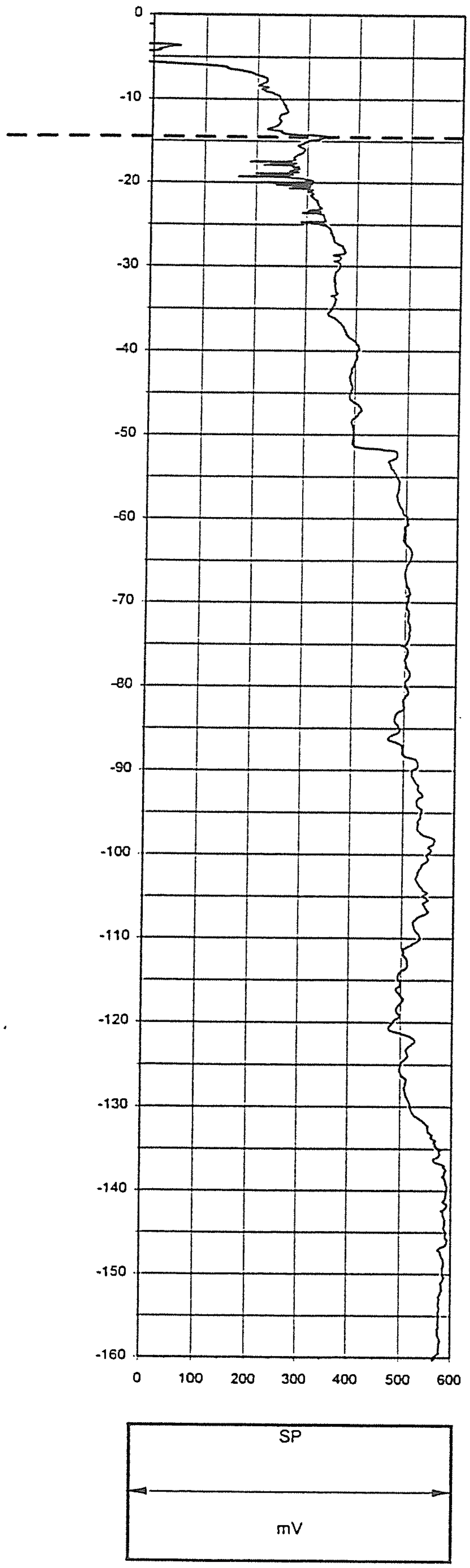
MW4 GAMMA LOG

MW4 LATERAL RESISTIVITY LOG

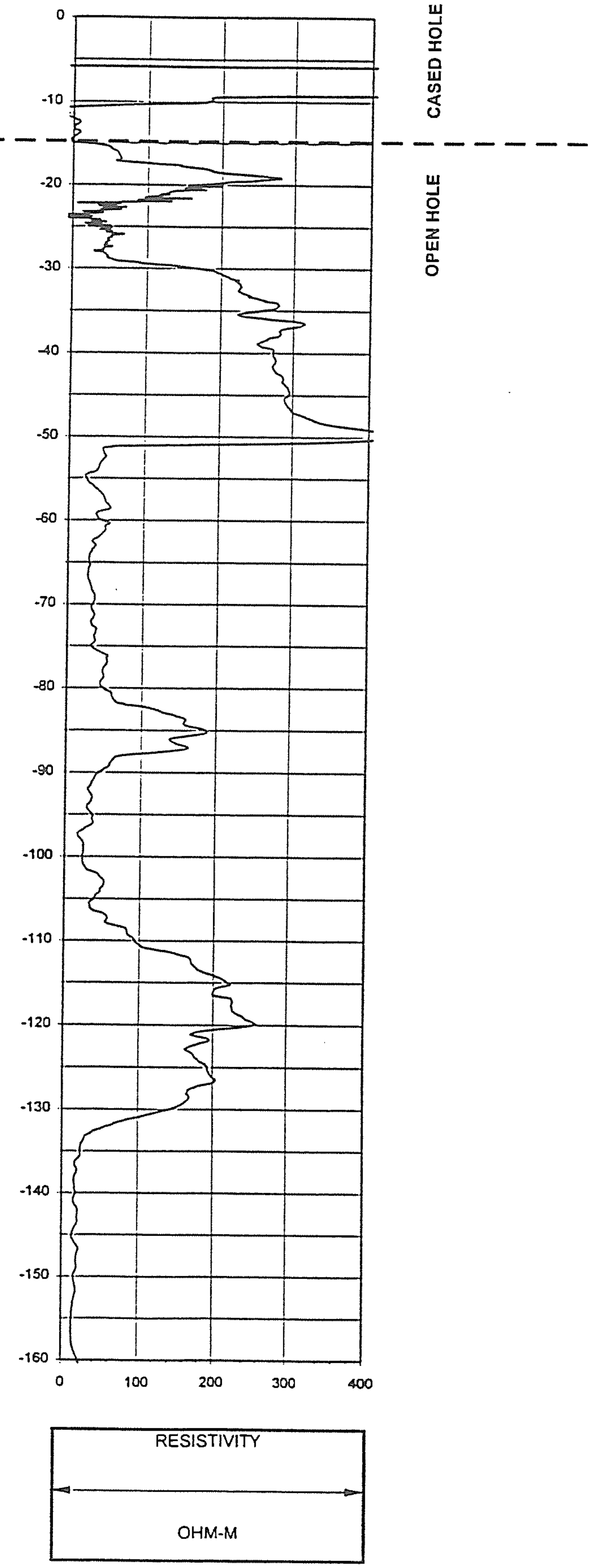




MW4 SPOTANEOUS
POTENTIAL LOG

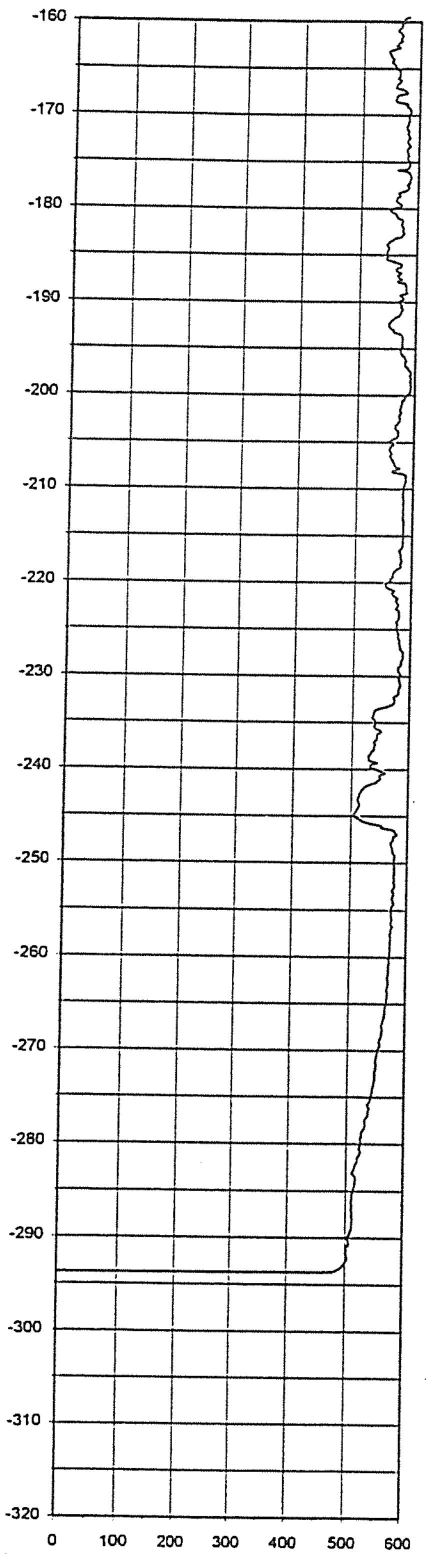


MW4 LATERAL
RESISTIVITY LOG



MW4 SPOTANEOUS
POTENTIAL LOG

(Continued)

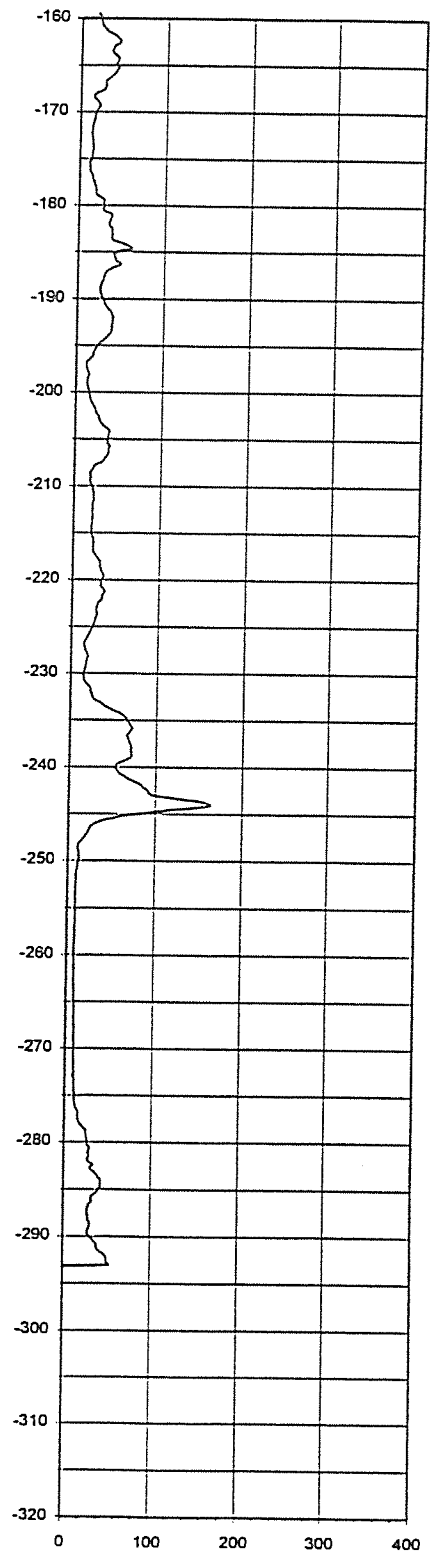


SP

mV

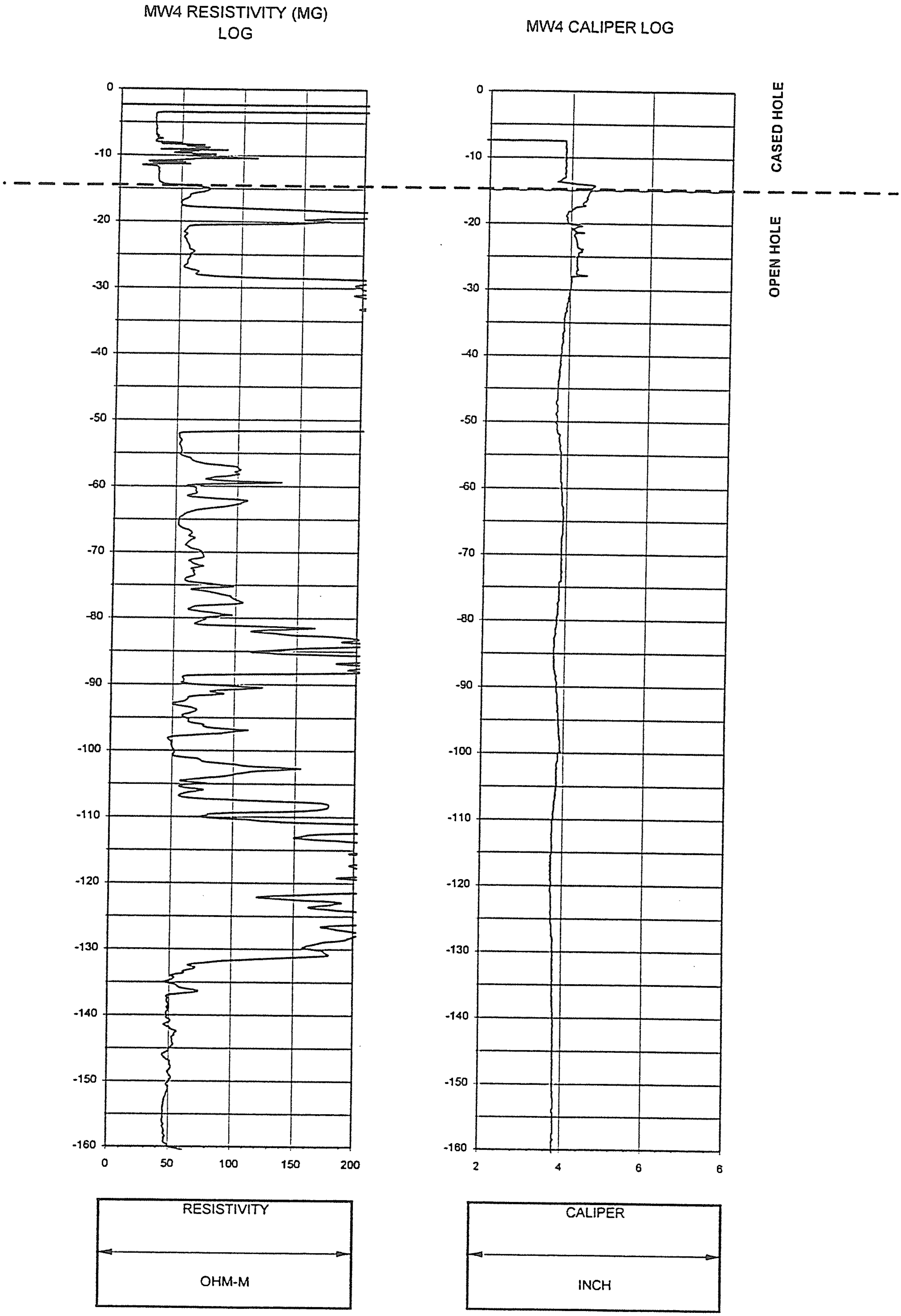
MW4 LATERAL
RESISTIVITY LOG

(Continued)



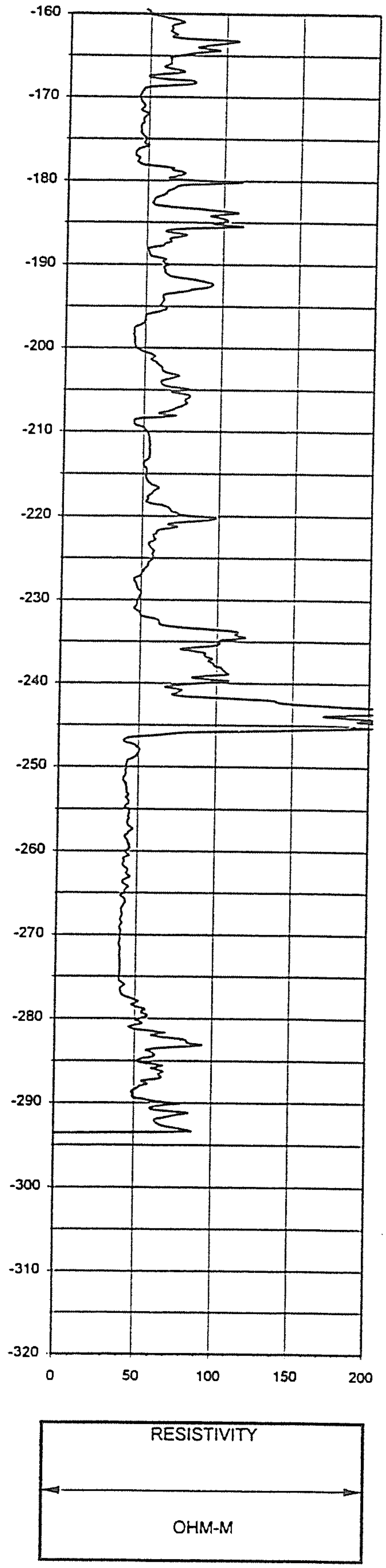
RESISTIVITY

OHM-M


MW4 RESISTIVITY (MG)
LOG
MW4 CALIPER LOG
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
50
100
150
200
2
4
6
6
RESISTIVITY
OHM-M
CALIPER
INCH

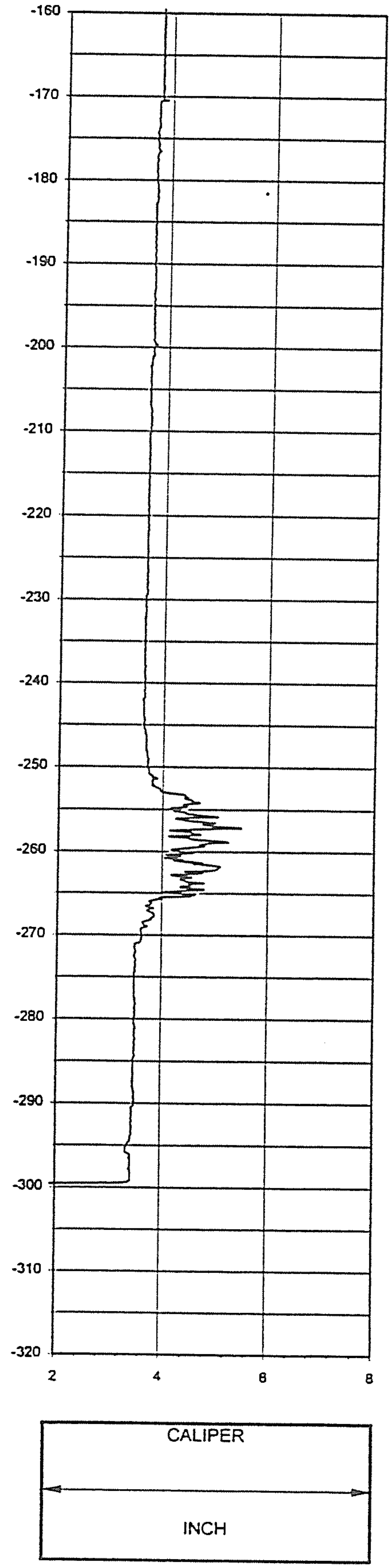
MW4 RESISTIVITY (MG) LOG

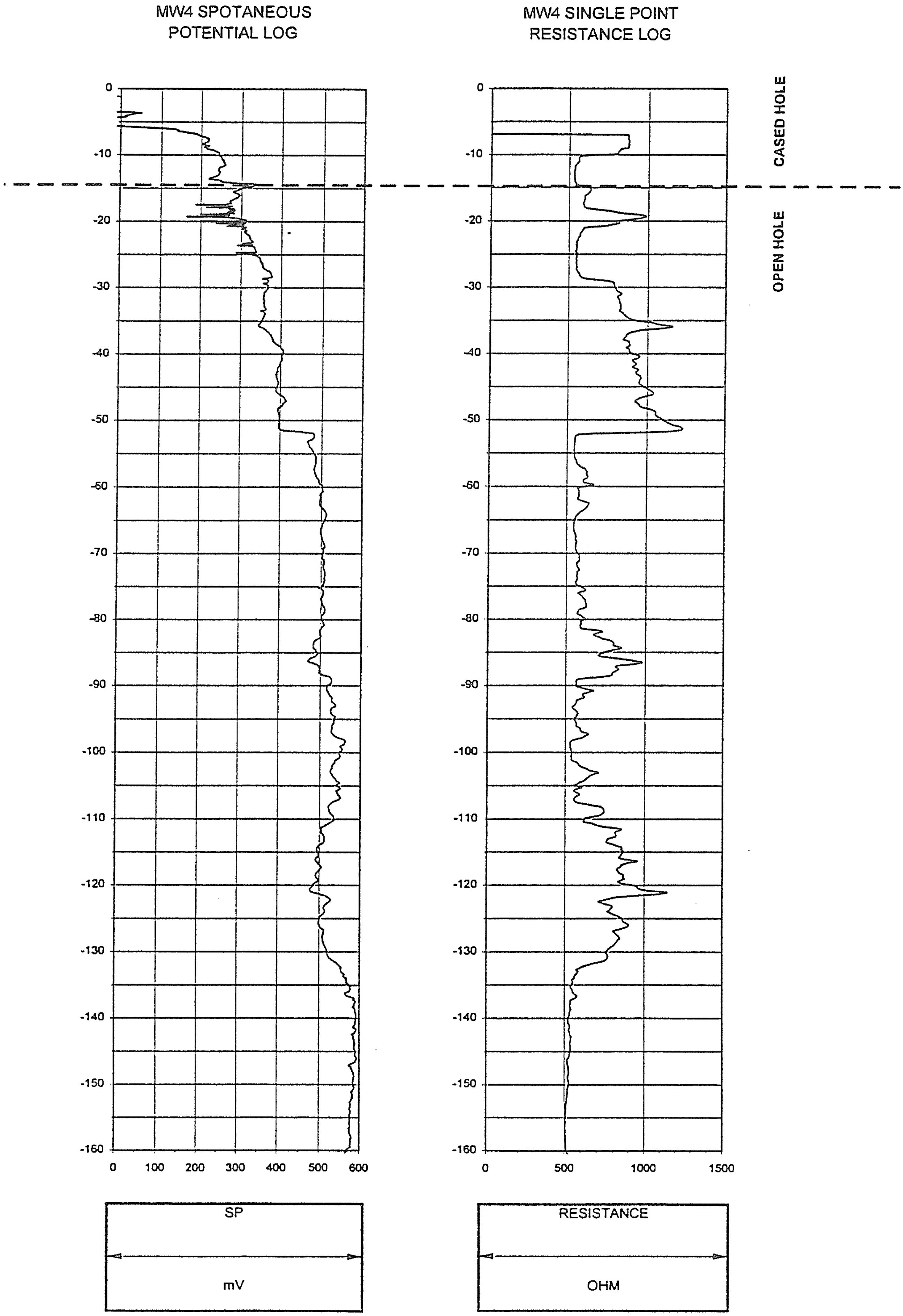
(Continued)



MW4 CALIPER LOG

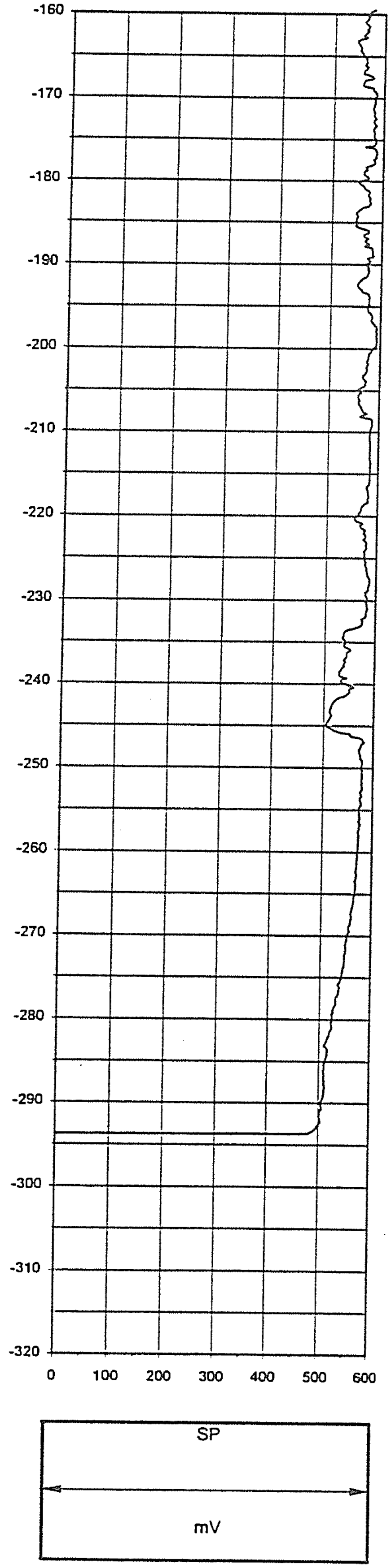
(Continued)




MW4 SPOTANEOUS
POTENTIAL LOG
MW4 SINGLE POINT
RESISTANCE LOG
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
100
200
300
400
500
600
0
500
1000
1500
SP
mV
RESISTANCE
OHM

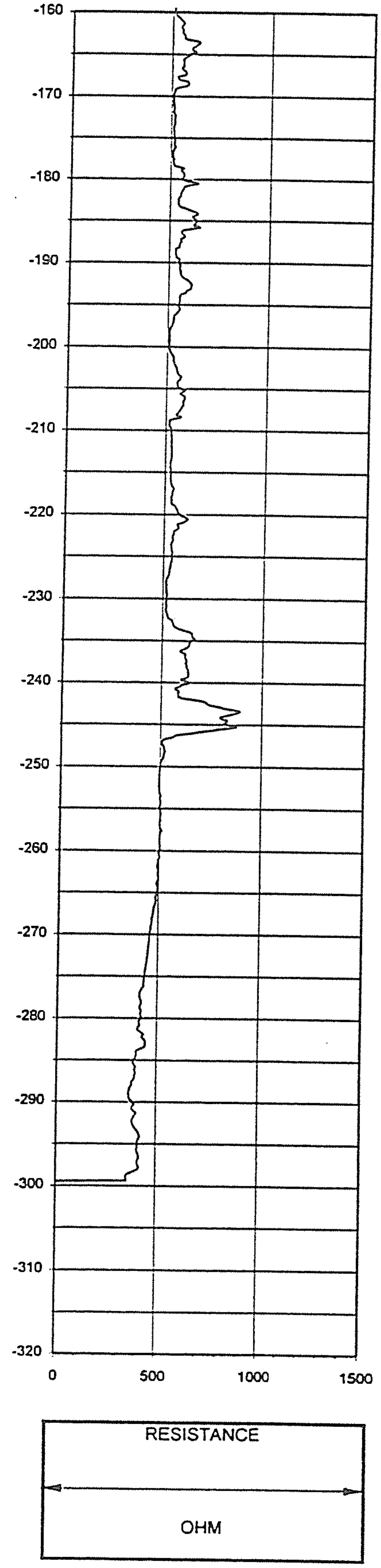
MW4 SPOTANEOUS POTENTIAL LOG

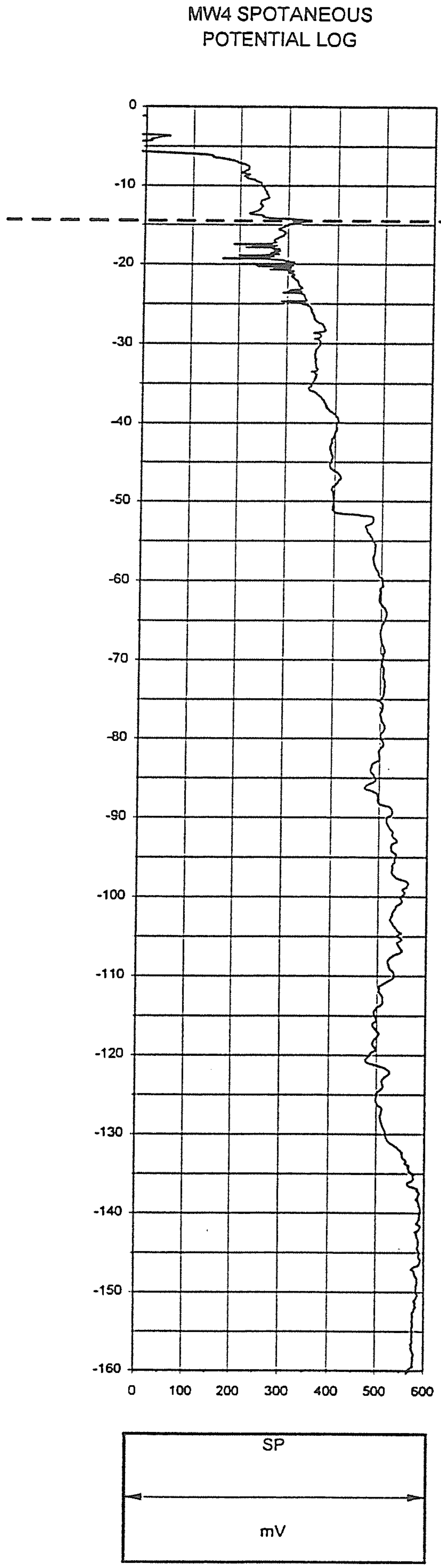
(Continued)

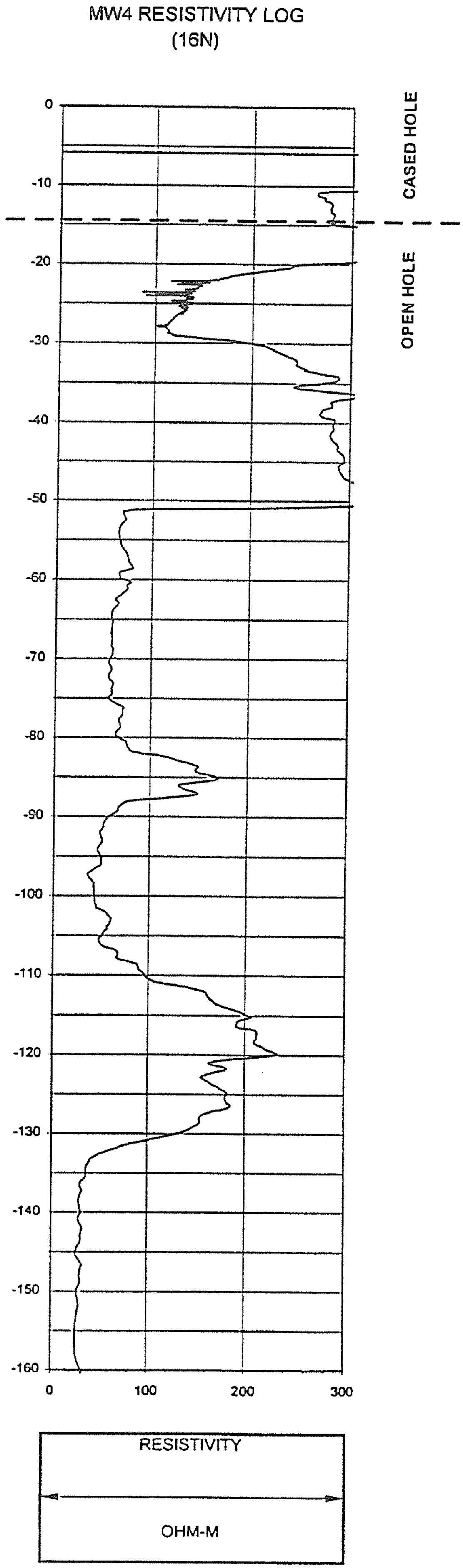


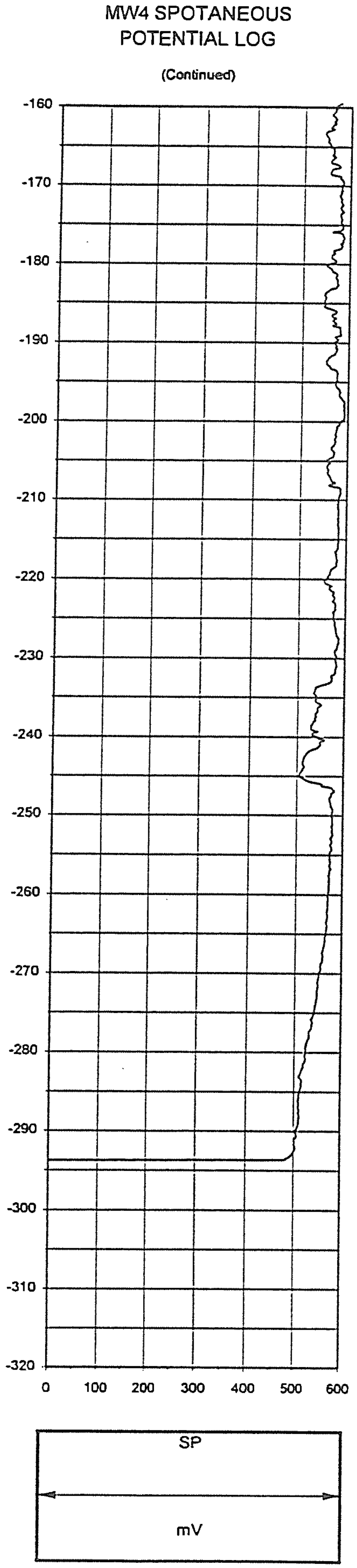
MW4 SINGLE POINT RESISTANCE LOG

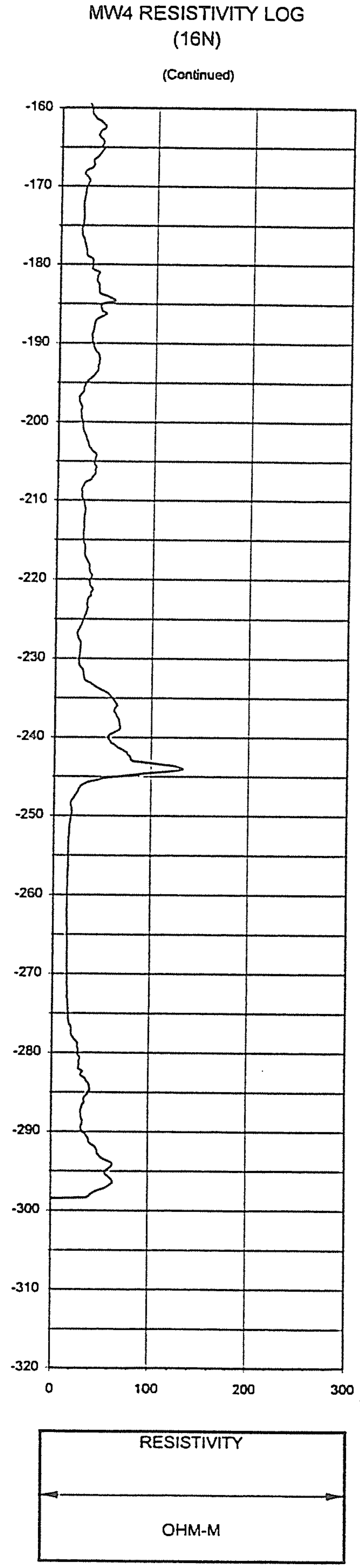
(Continued)

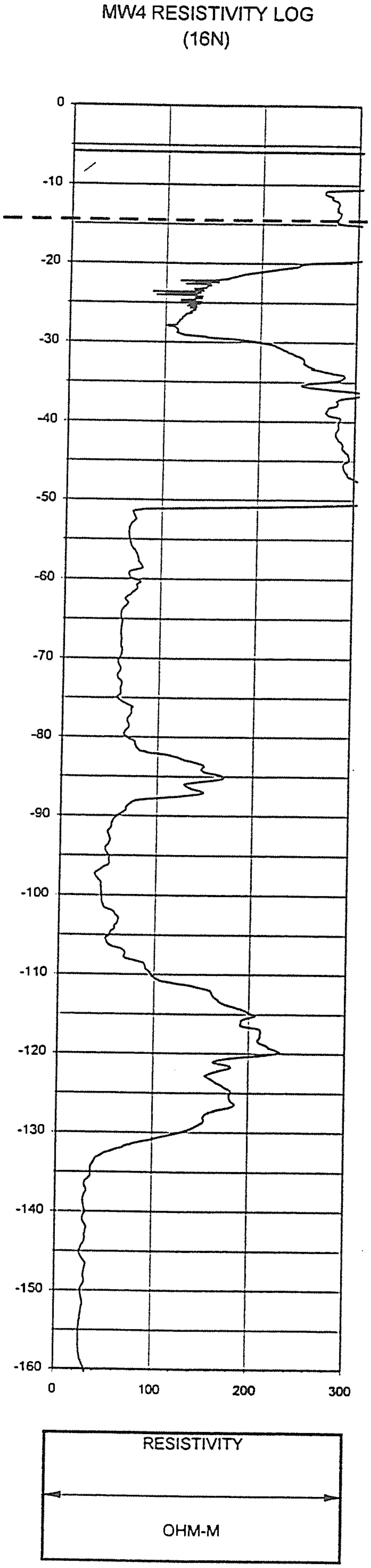


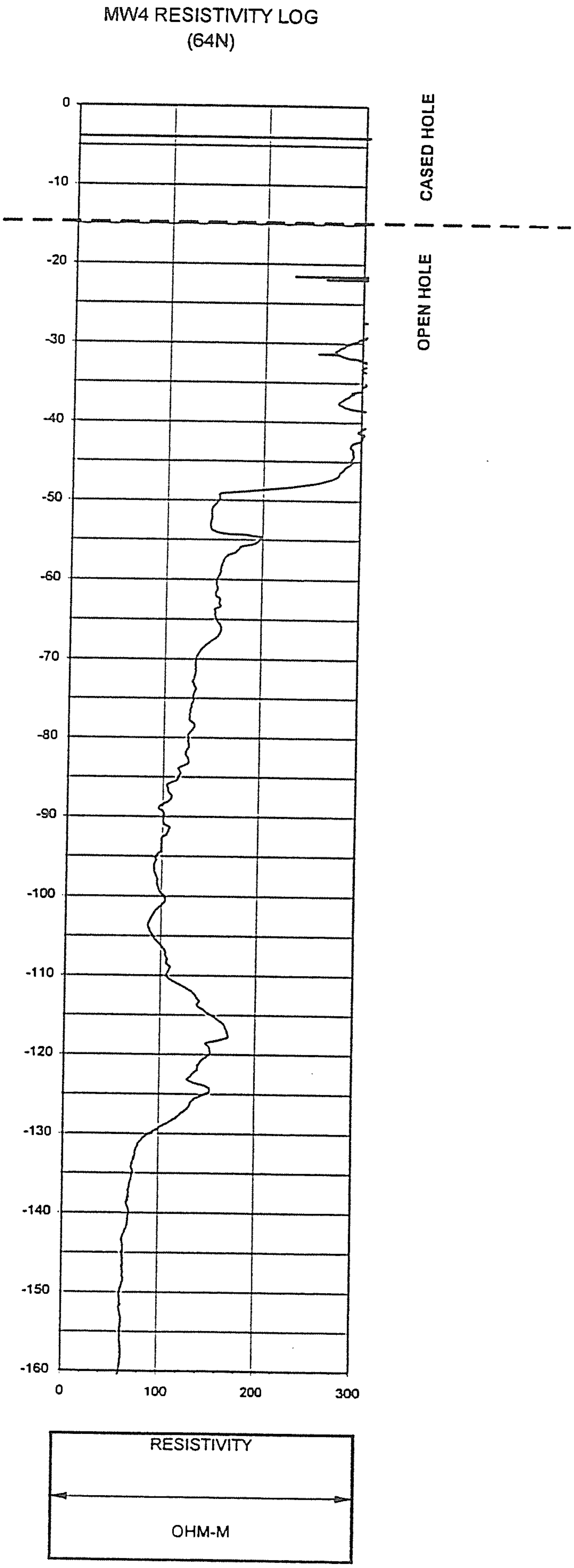

MW4 SPOTANEOUS
POTENTIAL LOG
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
100
200
300
400
500
600
SP
mV


MW4 RESISTIVITY LOG
(16N)
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
100
200
300
RESISTIVITY
OHM-M


MW4 SPOTANEOUS
POTENTIAL LOG
(Continued)
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
-310
-320
0
100
200
300
400
500
600
SP
mV

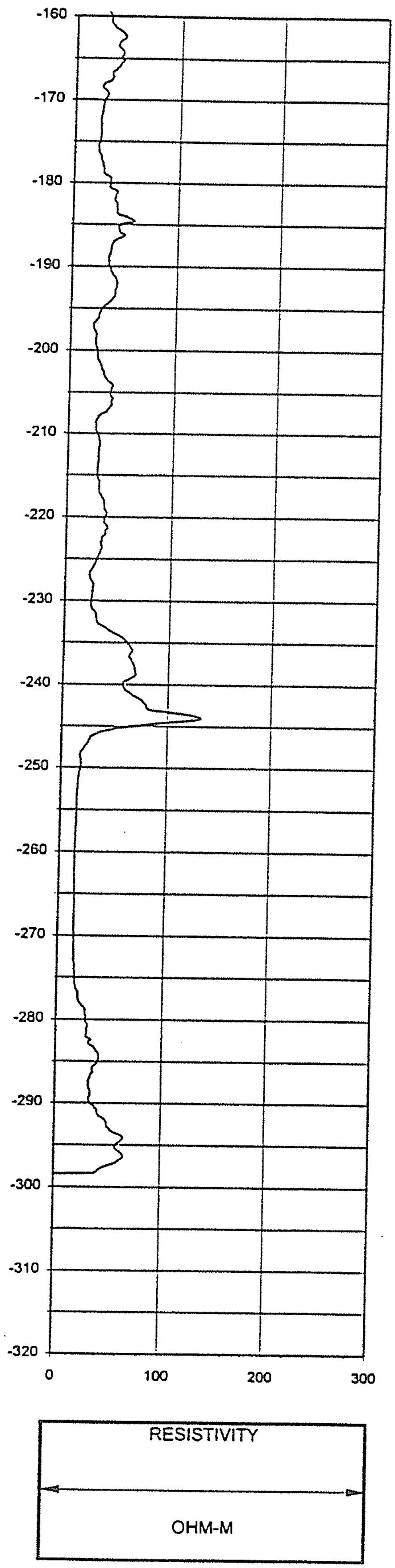

MW4 RESISTIVITY LOG
(16N)
(Continued)
-160
-170
-180
-190
-200
-210
-220
-230
-240
-250
-260
-270
-280
-290
-300
-310
-320
0
100
200
300
RESISTIVITY
OHM-M


MW4 RESISTIVITY LOG
(16N)
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
100
200
300
RESISTIVITY
OHM-M


MW4 RESISTIVITY LOG
(64N)
CASED HOLE
OPEN HOLE
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
-160
0
100
200
300
RESISTIVITY
OHM-M

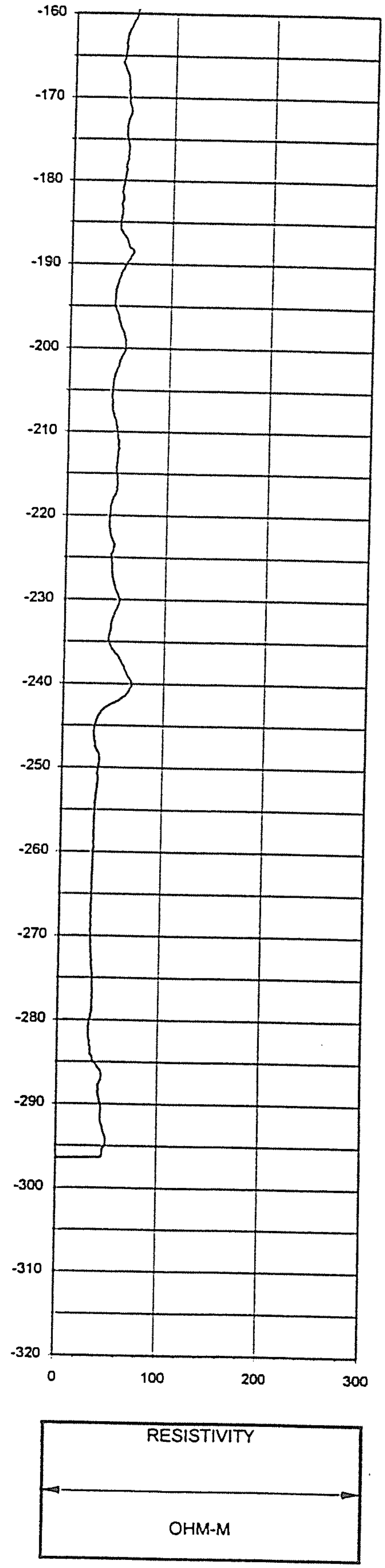
MW4 RESISTIVITY LOG
(16N)

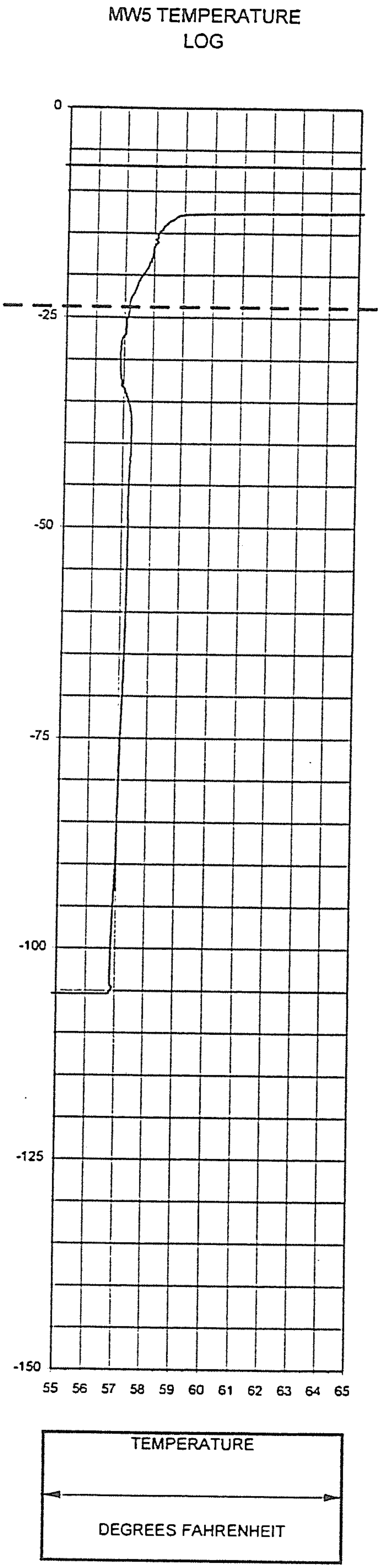
(Continued)



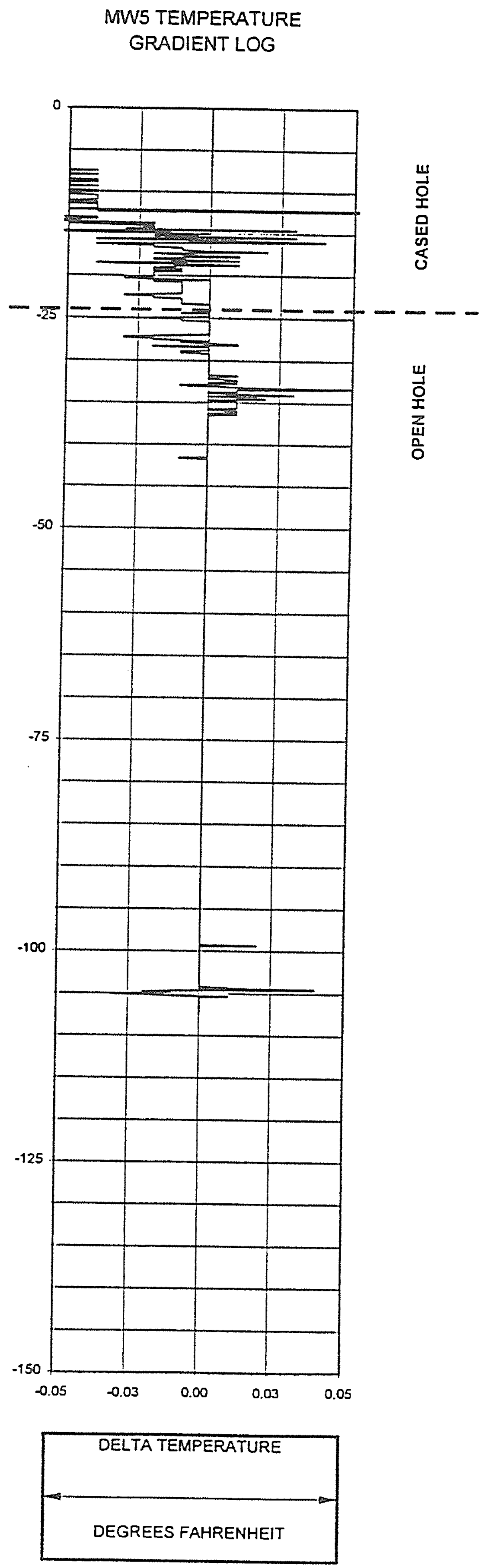
MW4 RESISTIVITY LOG
(64N)

(Continued)

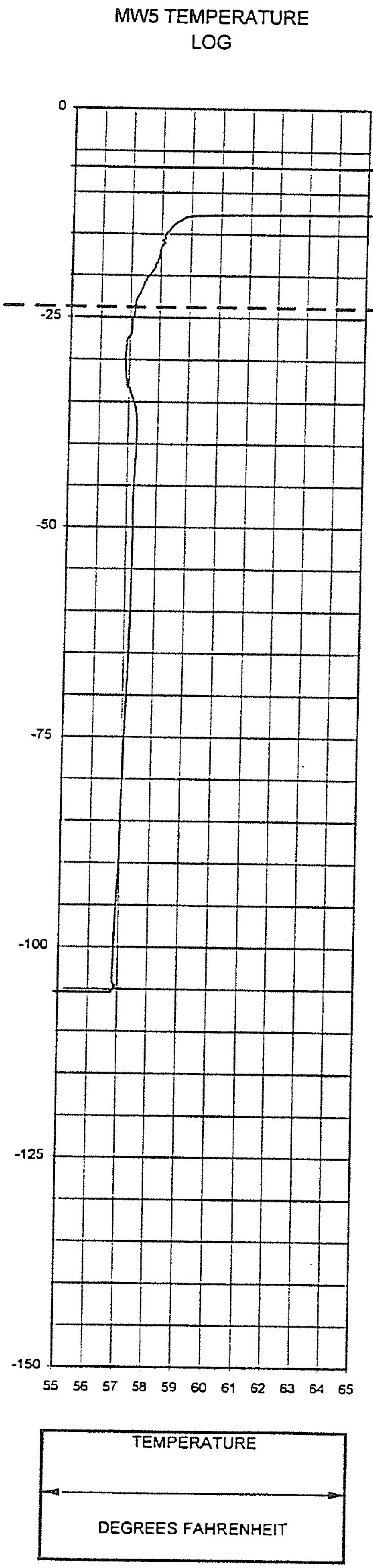


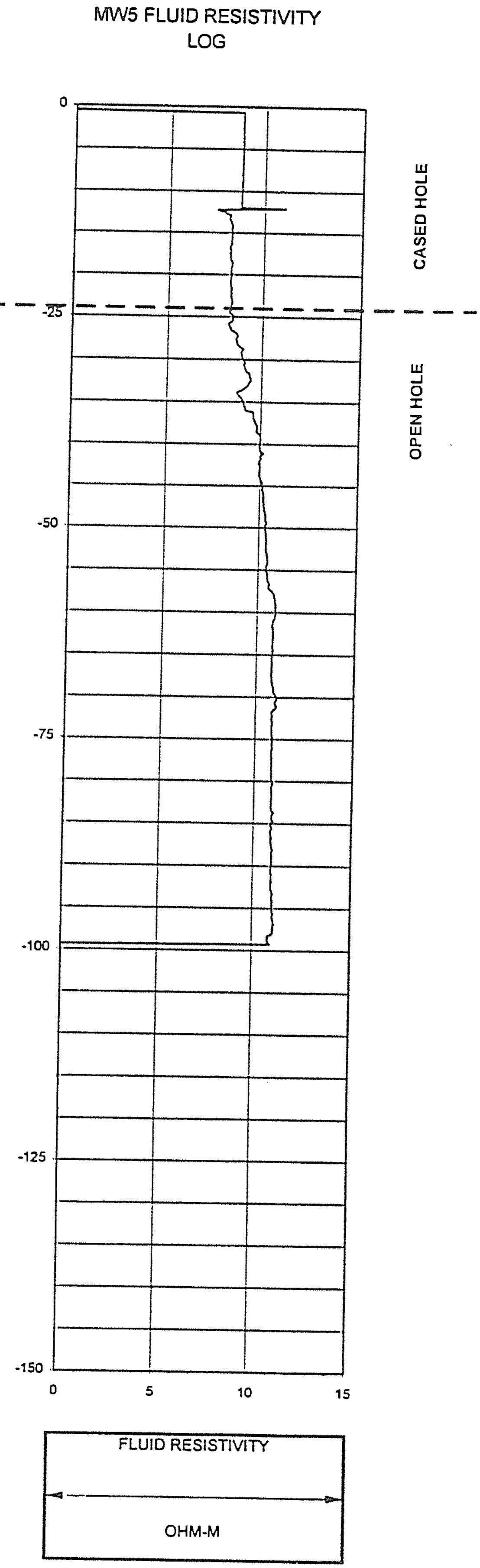


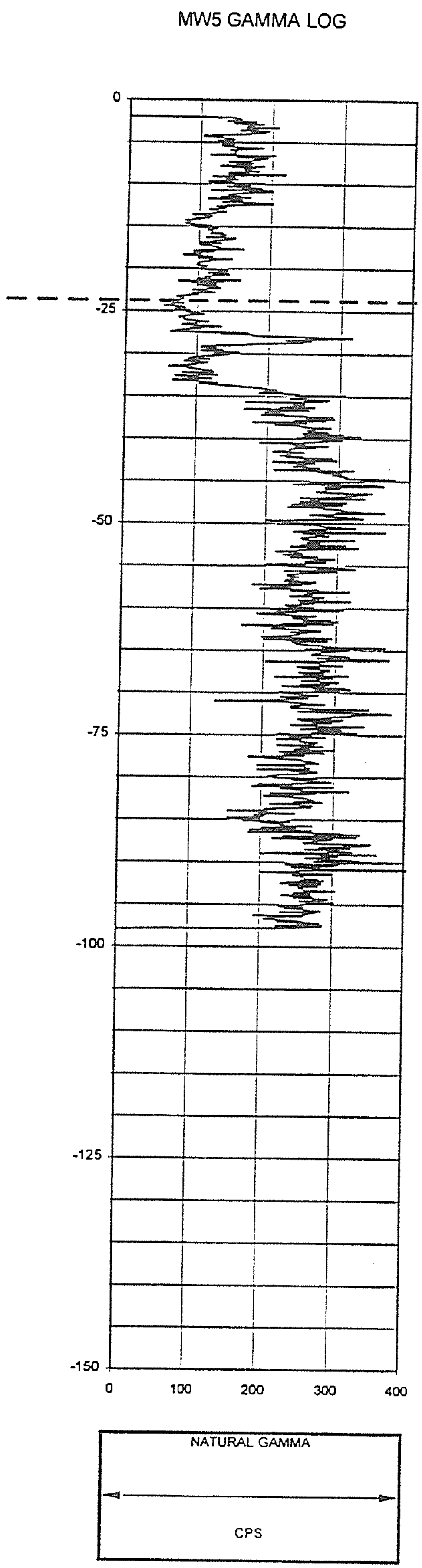
MW5 TEMPERATURE
LOG
0
-25
-50
-75
-100
-125
-150
55 56 57 58 59 60 61 62 63 64 65
TEMPERATURE
DEGREES FAHRENHEIT

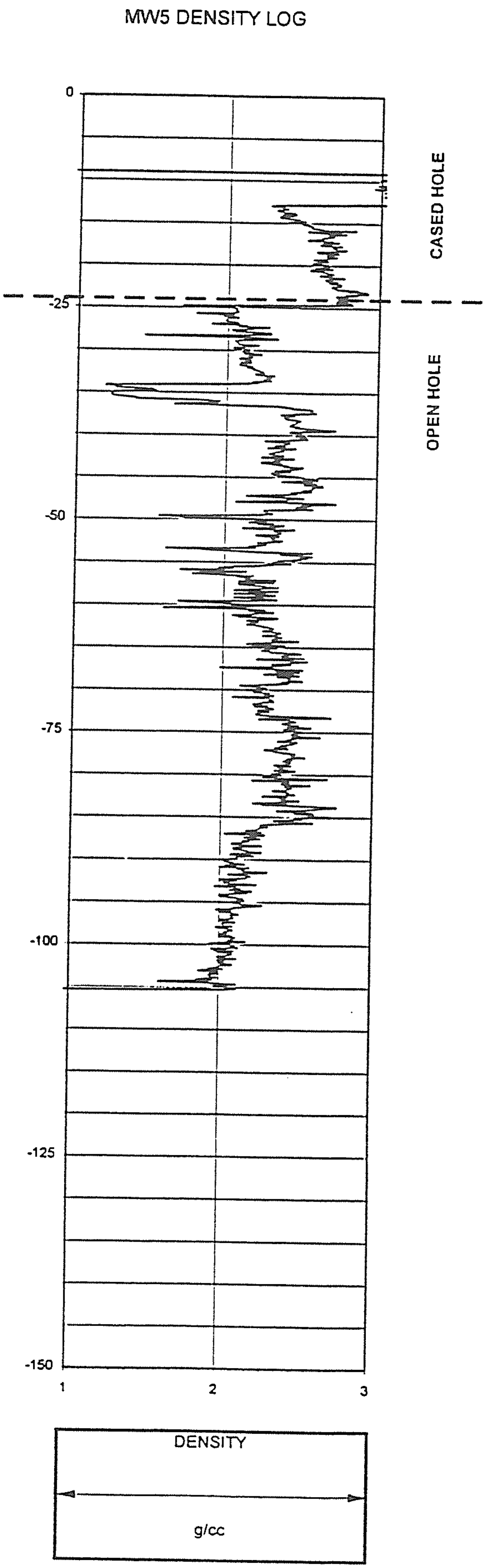


MW5 TEMPERATURE
GRADIENT LOG
0
-25
-50
-75
-100
-125
-150
-0.05 -0.03 0.00 0.03 0.05
DELTA TEMPERATURE
DEGREES FAHRENHEIT
CASED HOLE
OPEN HOLE


MW5 TEMPERATURE
LOG
0
-25
-50
-75
-100
-125
-150
55 56 57 58 59 60 61 62 63 64 65
TEMPERATURE
DEGREES FAHRENHEIT

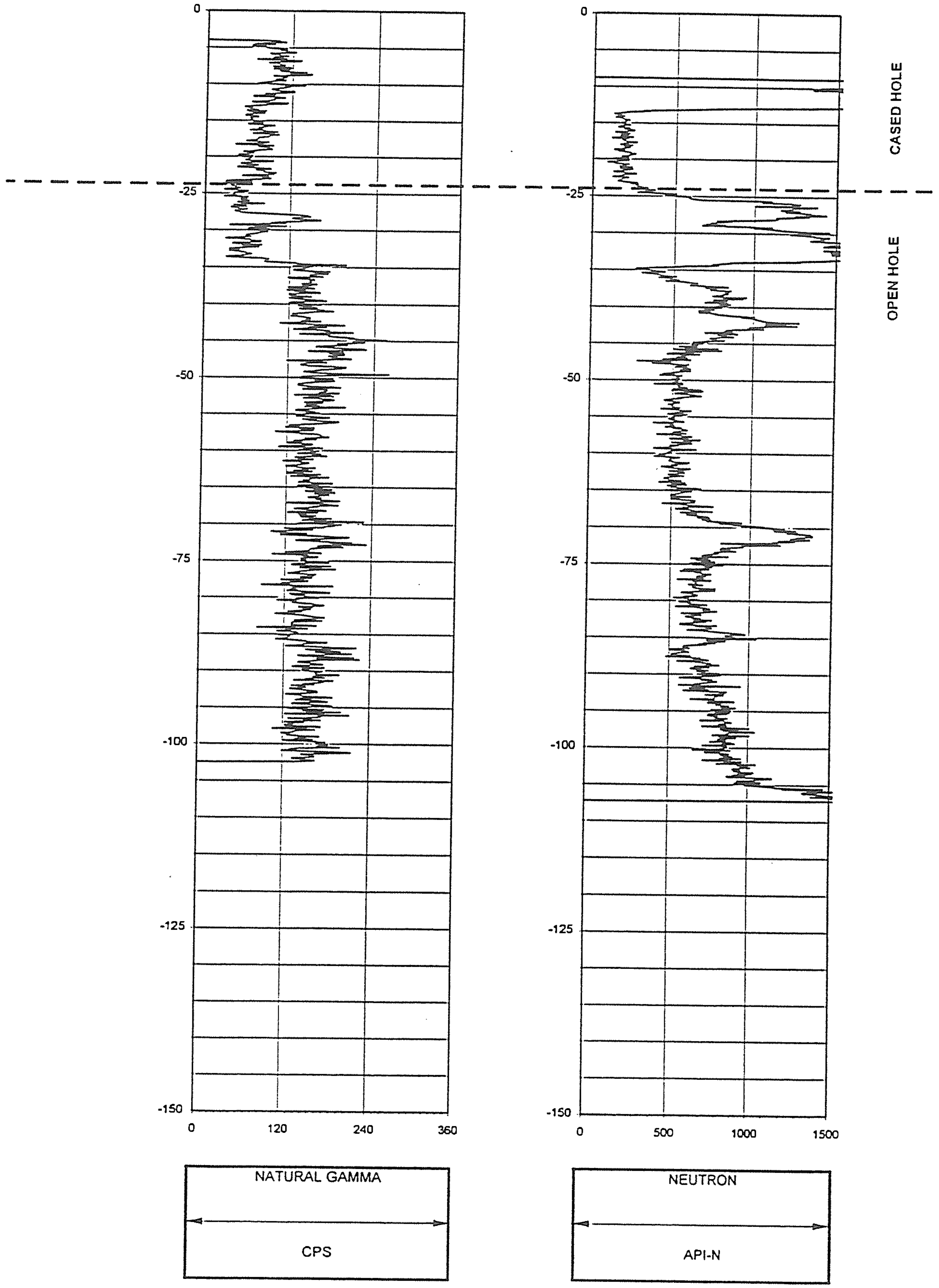

MW5 FLUID RESISTIVITY
LOG
0
-25
-50
-75
-100
-125
-150
0 5 10 15
CASED HOLE
OPEN HOLE
FLUID RESISTIVITY
OHM-M


MW5 GAMMA LOG
0
-25
-50
-75
-100
-125
-150
0
100
200
300
400
NATURAL GAMMA
CPS


MW5 DENSITY LOG
0
-25
-50
-75
-100
-125
-150
1
2
3
CASED HOLE
OPEN HOLE
DENSITY
g/cc

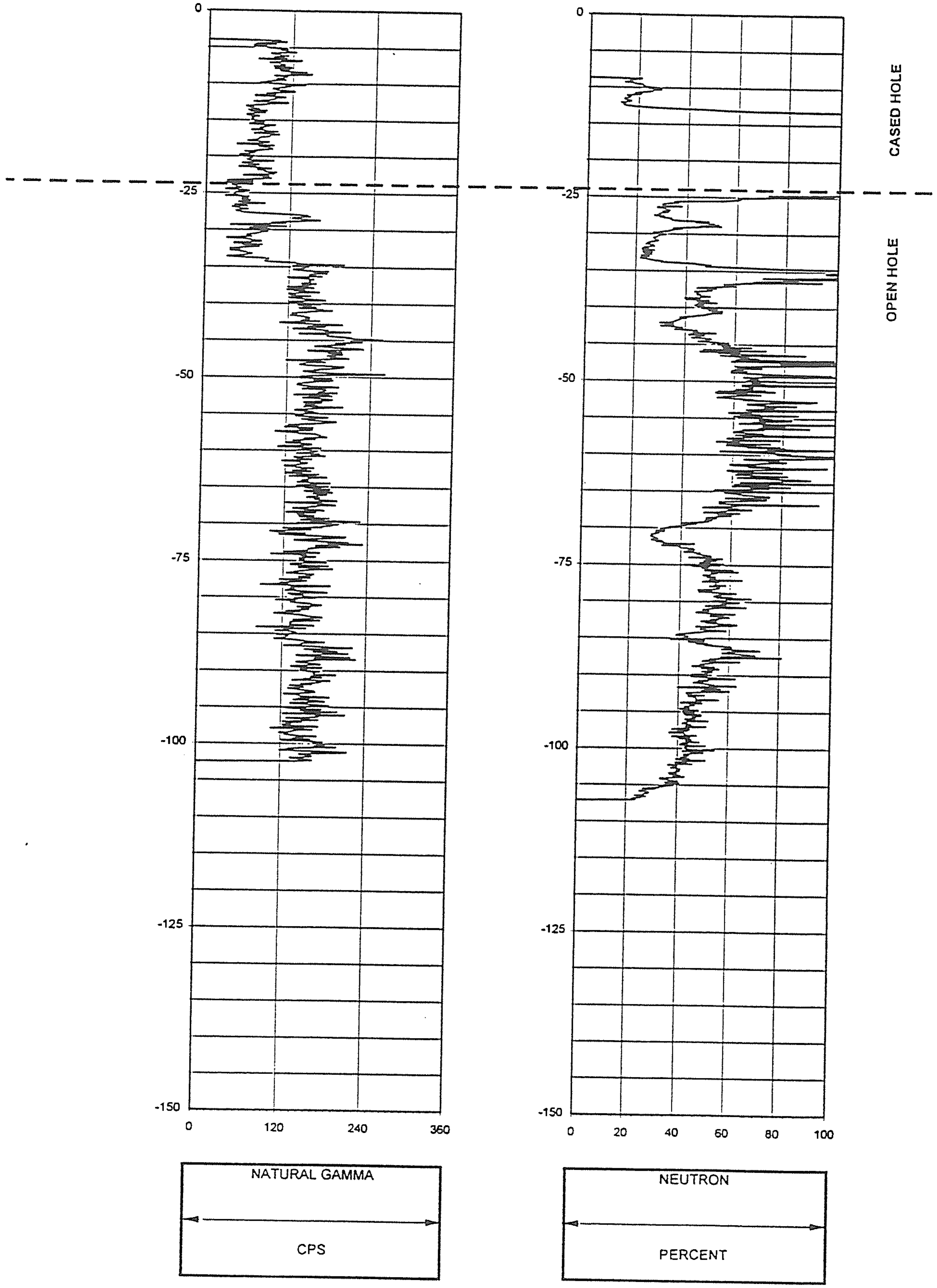
MW5 GAMMA LOG

MW5 API NEUTRON LOG

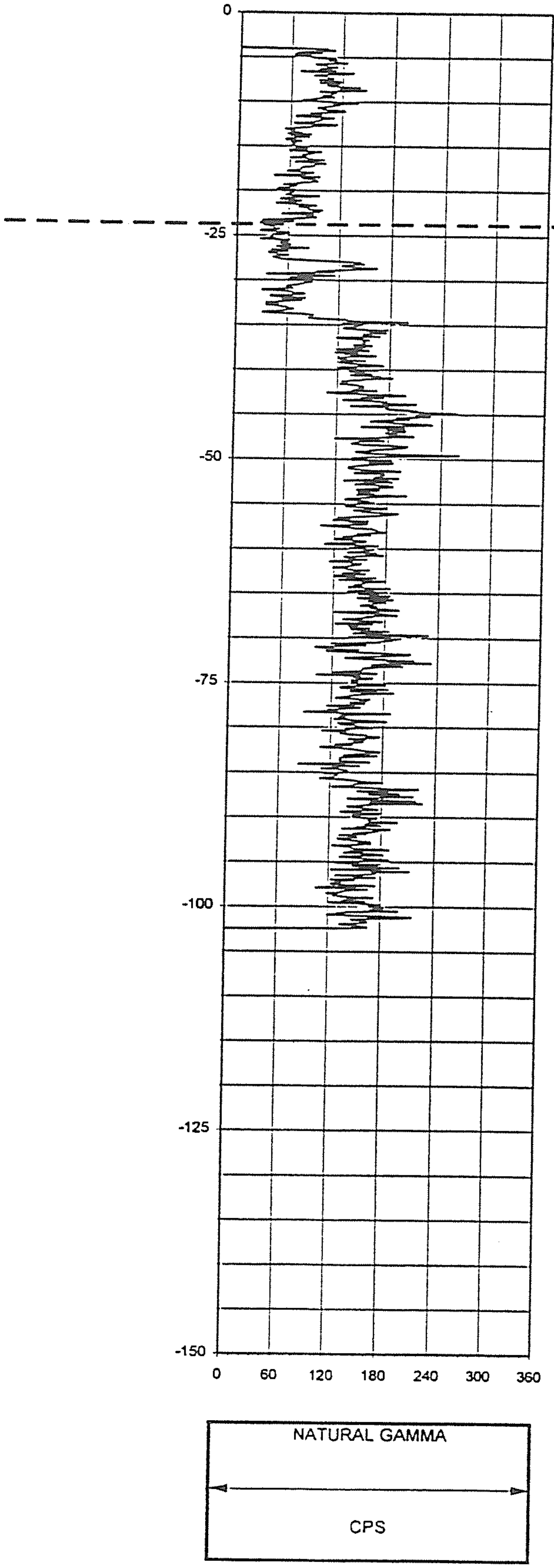


MW5 GAMMA LOG

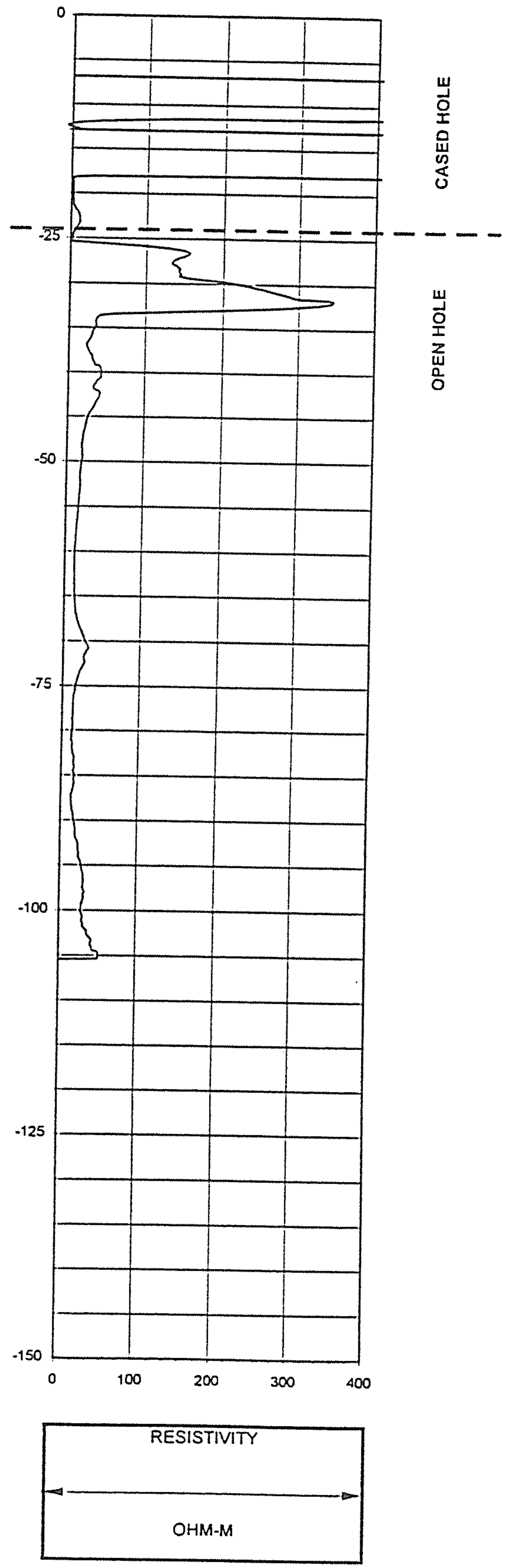
MW5 NEUTRON LOG

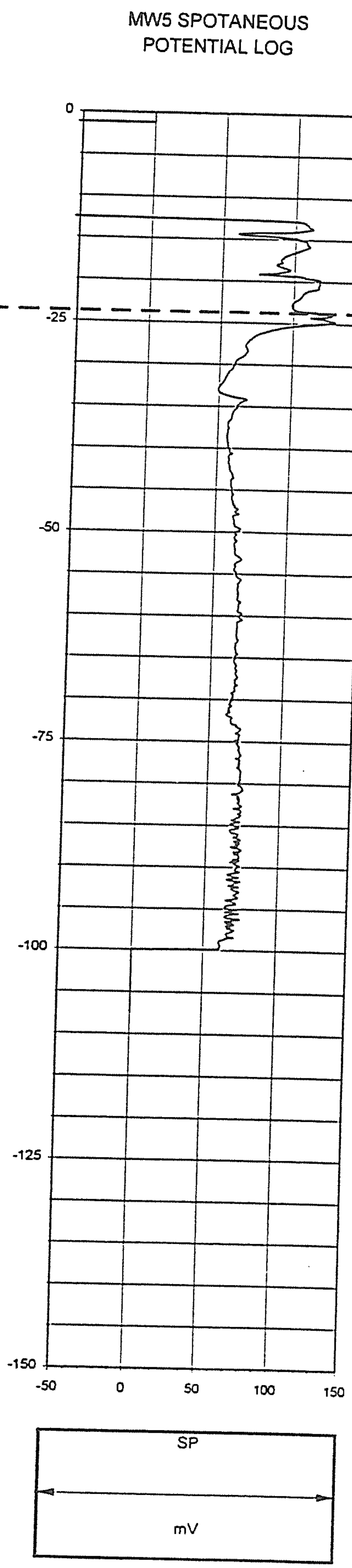


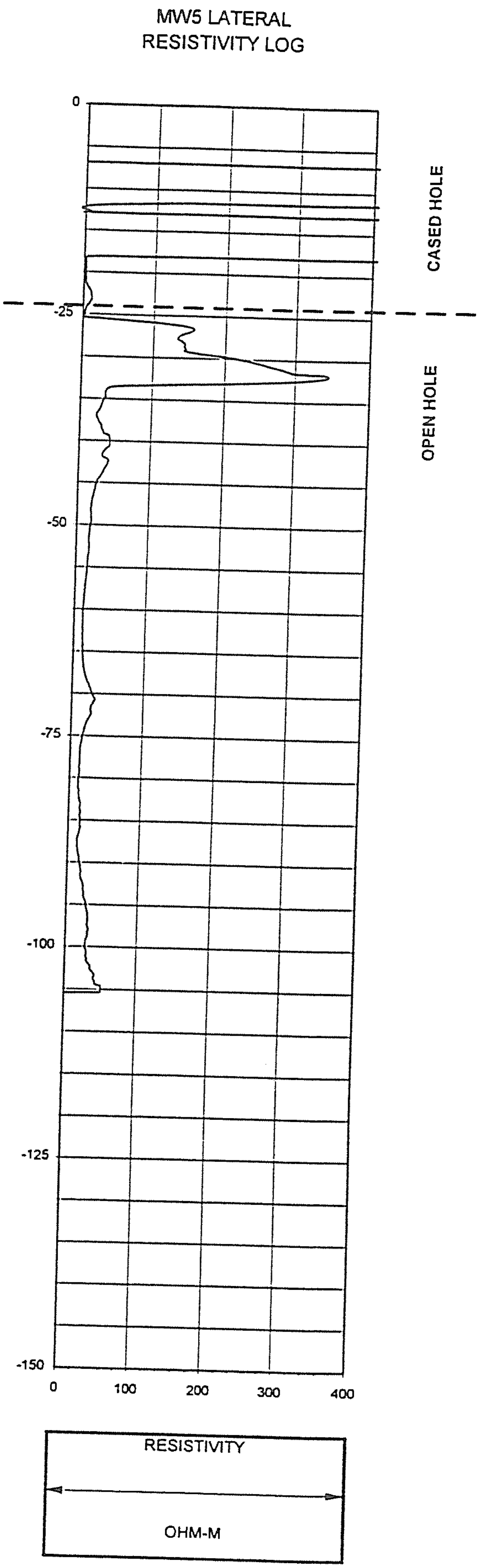
MW5 GAMMA LOG



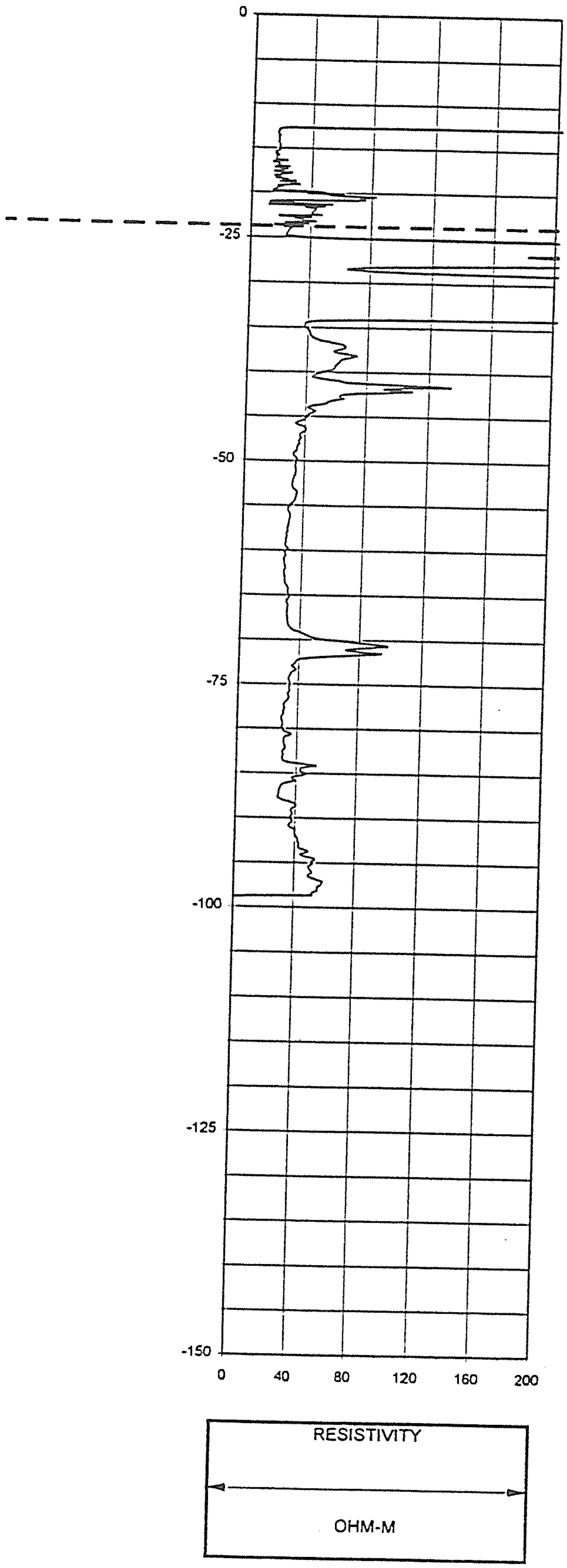
MW5 LATERAL RESISTIVITY LOG



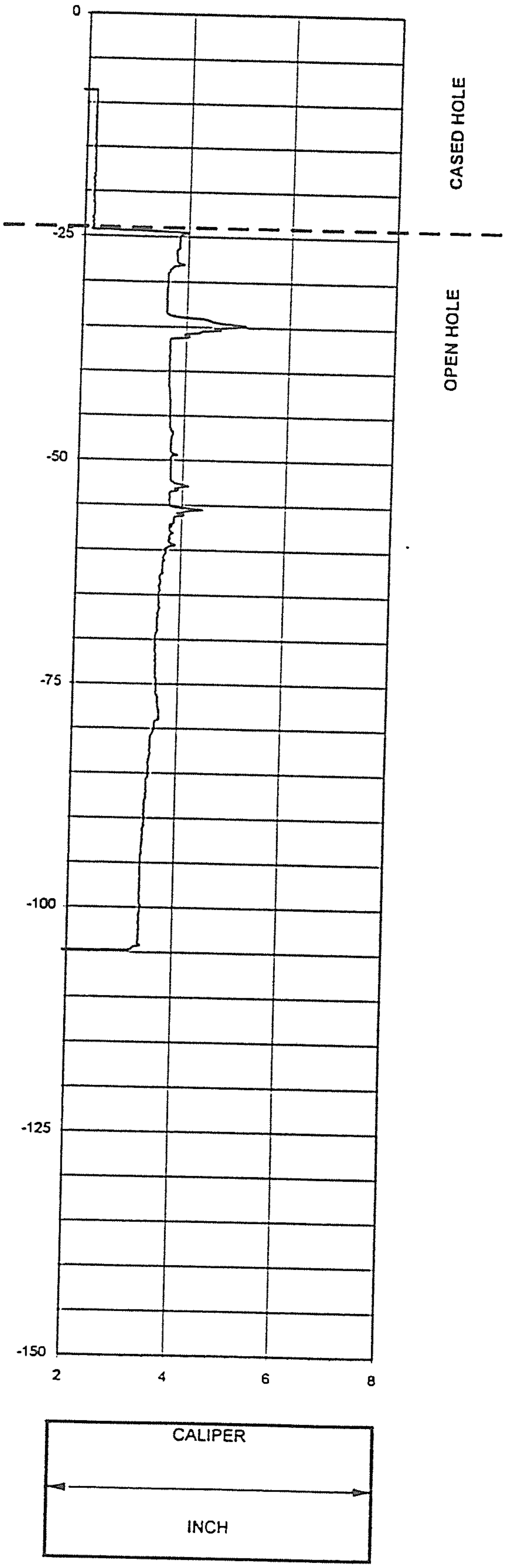

MW5 SPOTANEOUS
POTENTIAL LOG
0
-25
-50
-75
-100
-125
-150
-50
0
50
100
150
SP
mV

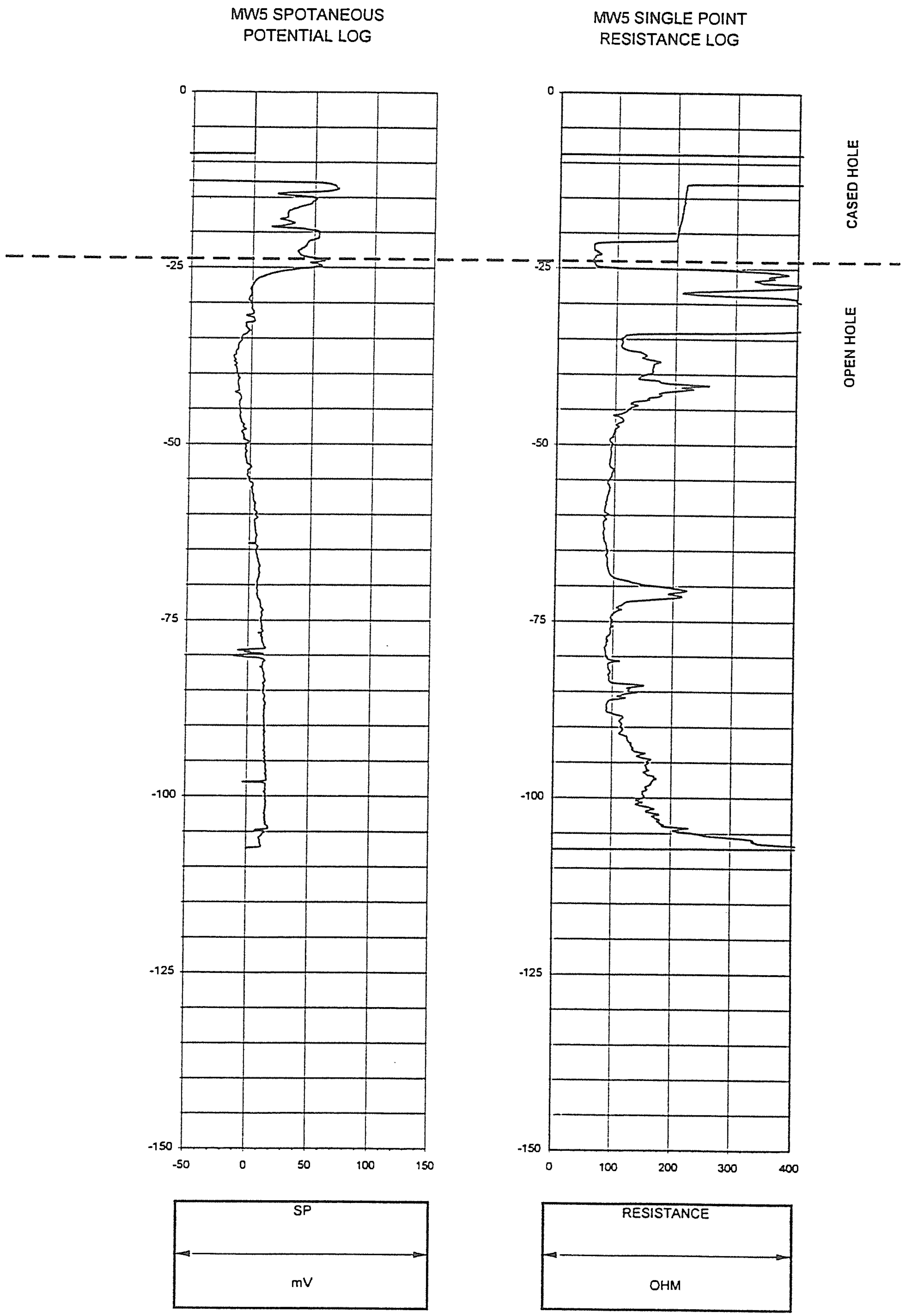

MW5 LATERAL
RESISTIVITY LOG
0
-25
-50
-75
-100
-125
-150
0
100
200
300
400
CASED HOLE
OPEN HOLE
RESISTIVITY
OHM-M

MW5 RESISTIVITY (MG) LOG

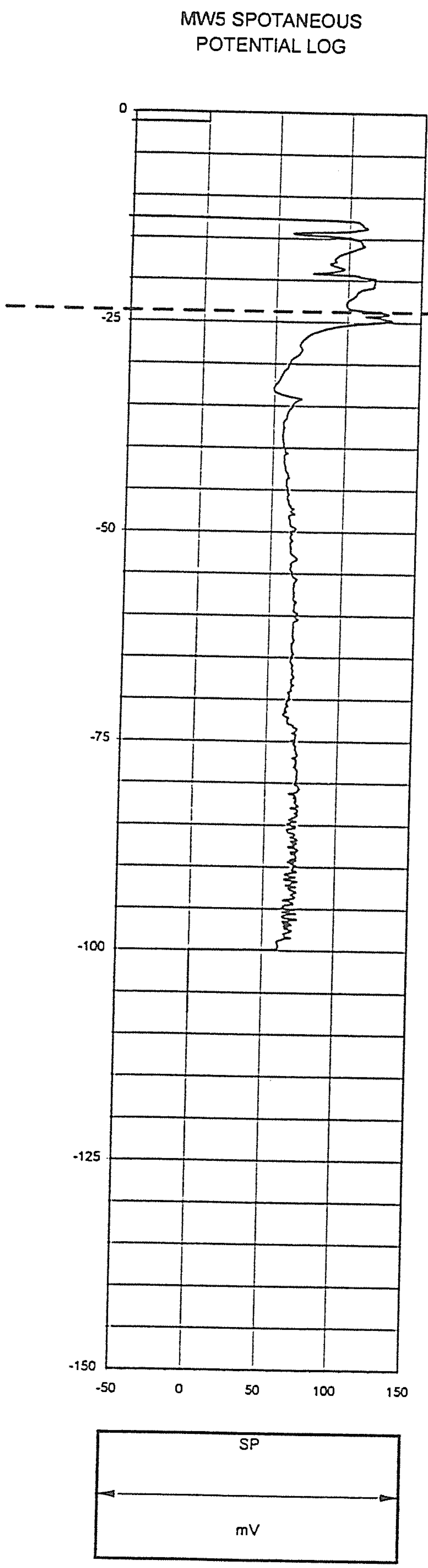


MW5 CALIPER LOG

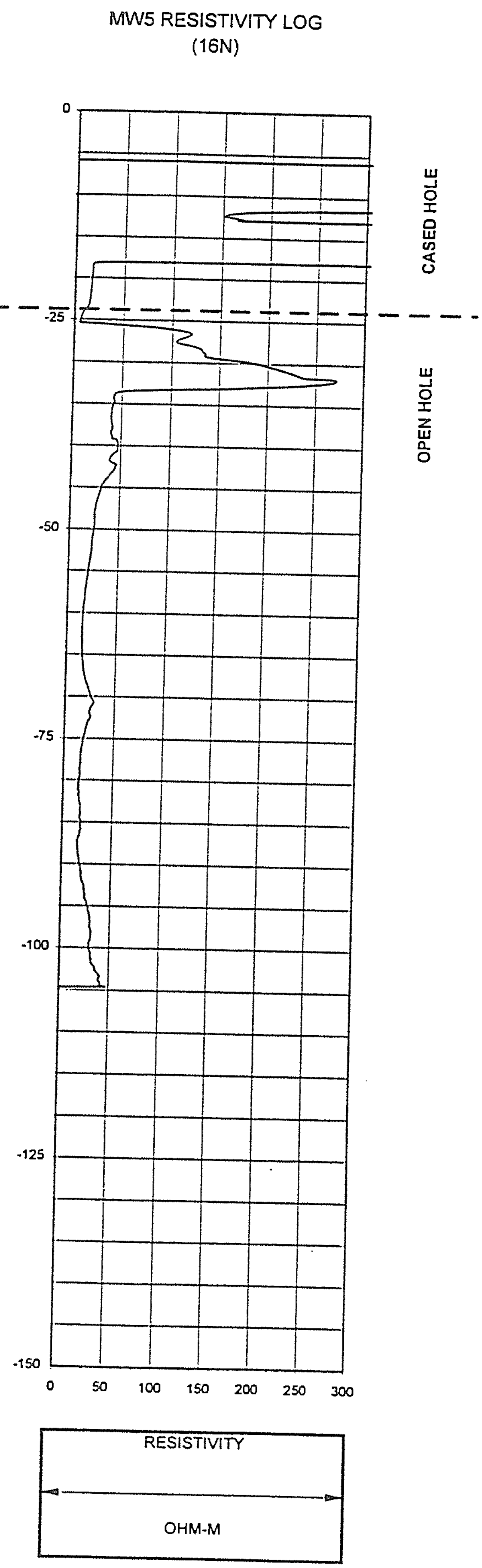




MW5 SPOTANEOUS POTENTIAL LOG
MW5 SINGLE POINT RESISTANCE LOG
CASED HOLE
OPEN HOLE
0
-25
-50
-75
-100
-125
-150
-50
0
50
100
150
0
100
200
300
400
SP
mV
RESISTANCE
OHM



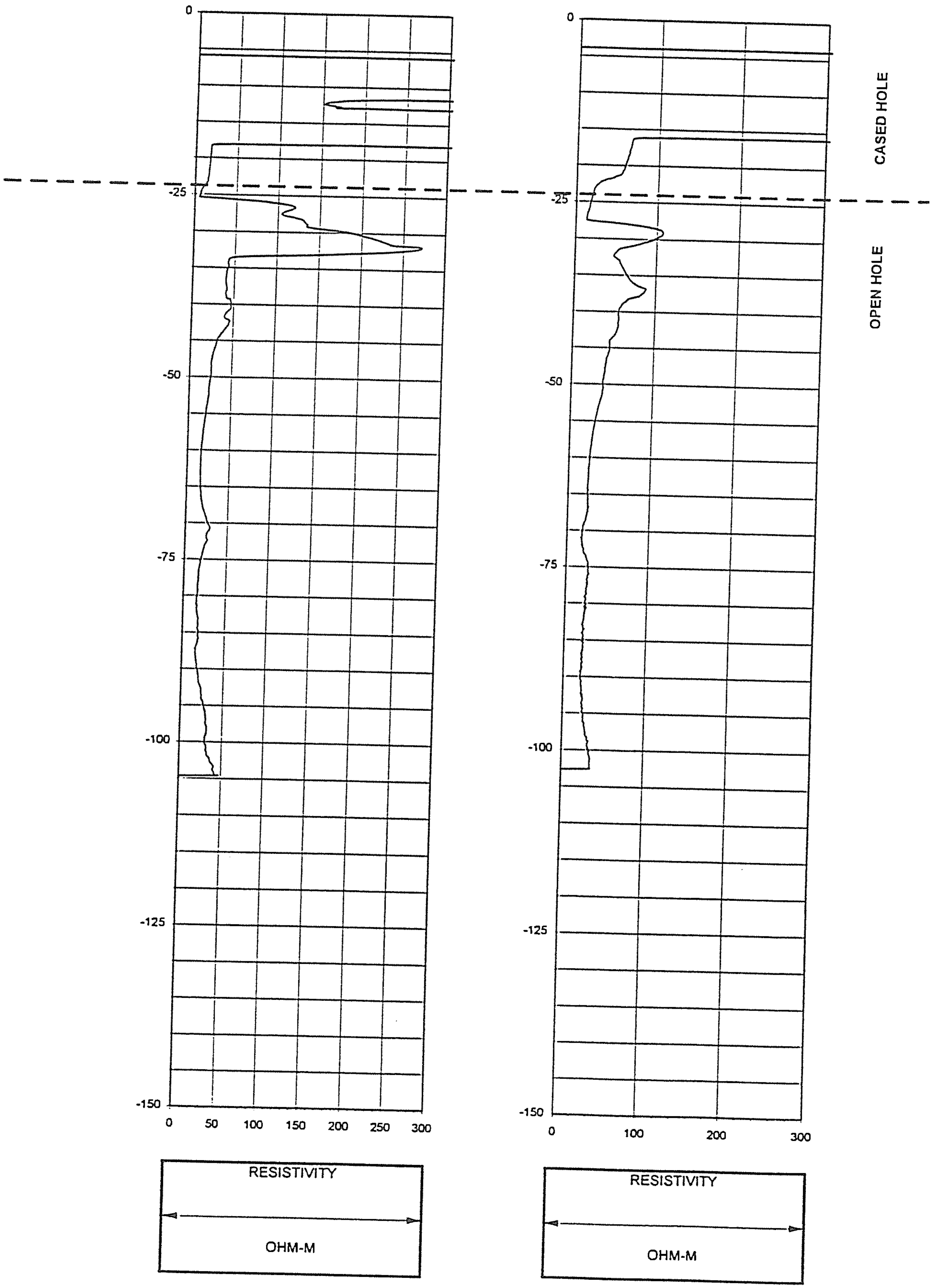
MW5 SPOTANEOUS
POTENTIAL LOG
0
-25
-50
-75
-100
-125
-150
-50
0
50
100
150
SP
mV



MW5 RESISTIVITY LOG
(16N)
0
-25
-50
-75
-100
-125
-150
0
50
100
150
200
250
300
CASED HOLE
OPEN HOLE
RESISTIVITY
OHM-M

MW5 RESISTIVITY LOG
(16N)

MW5 RESISTIVITY LOG
(64N)



GEOLOGICAL LOGGING SYSTEMS

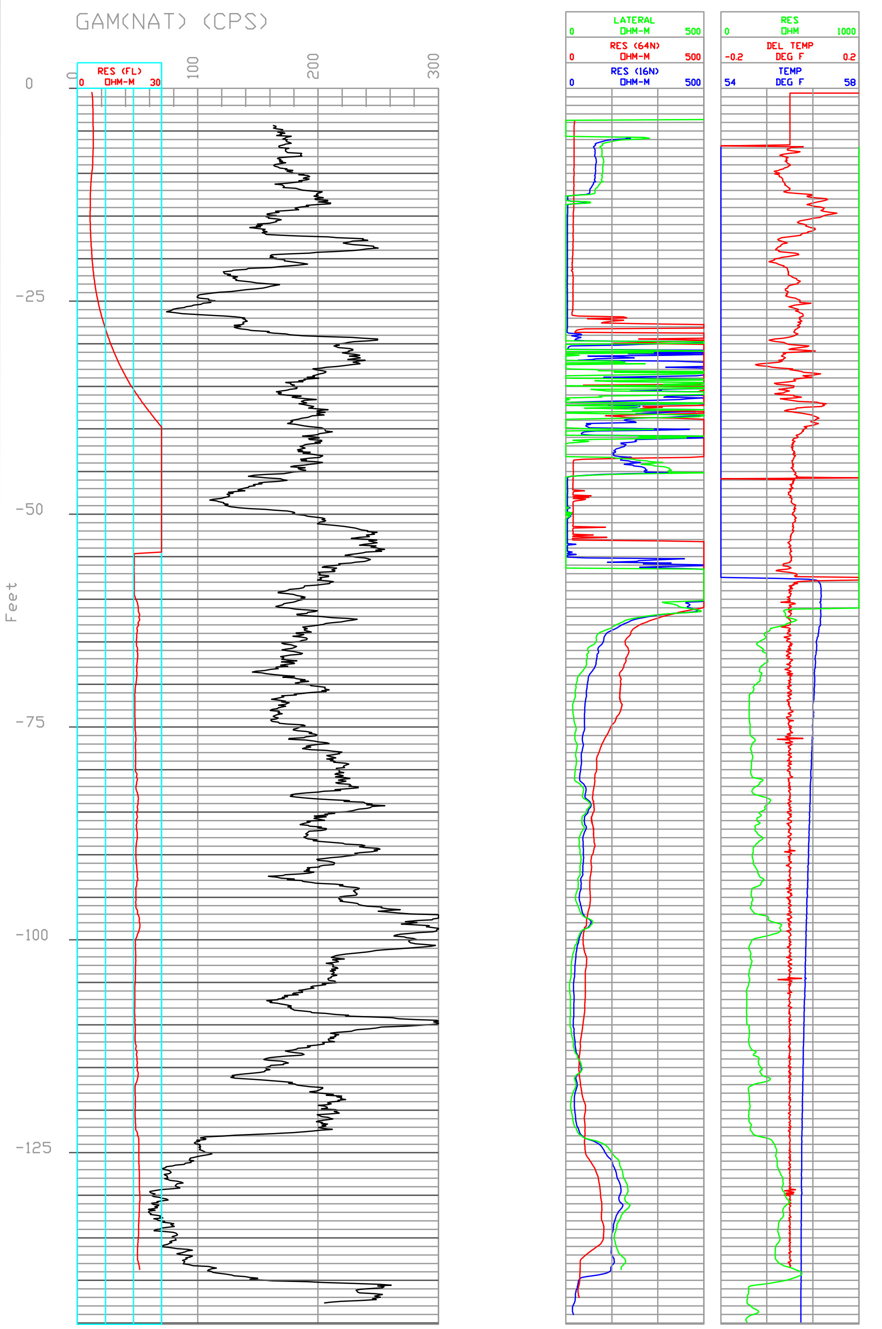
P.O. Box 848, Industrial Park, Bluefield VA 24605 276-322-5467

DIGITAL LOG

Company	: AEP					**Other Services:**	CORE 9041 -
Well	: MW 9						
Location/Field	: AMOS FLY ASH POND						
County	: PUTNAM						
State	: WEST VIRGINIA						
Section	: -	**Township**	:			**Range**	:
Date	: 02/04/02	**Permanent Datum**	: -			**Elevations**	
Depth Driller	: 148	**Elev. Perm. Datum**	: -			**KB**	:
Log Bottom	: 145.10	**Log Measured From**	: GL			**DF**	:
Log Top	: 0.40	**Drl Measured From**	: GL			**GL**	:
Casing Driller	: 3	**Logging Unit**	: 10				
Casing Type	: PVC	**Field Office**	: BLFD.,VA				
Casing Thickness	: .25	**Recorded By**	: M. CASSADY				
Bit Size	: 2.85	**Borehole Fluid**	: 0			**File**	: ORIGINAL
Magnetic Decl.	: -6.9	**RM**	: 0			**Type**	: 9041C
Matrix Density	: 2.71	**RM Temperature**	: 0			**Log**	: 1"=10'
Fluid Density	: -	**Matrix Delta T**	: 140			**Plot**	:
Neutron Matrix	: SANDSTONE	**Fluid Delta T**	:			**Thresh**	: 20000
Remarks	:						

Electric Log Interpretation Is Empirical In Nature. Extreme Hole Conditions Will Make Completely Accurate Interpretations Difficult.

All Services Provided Subject To Standard Terms And Conditions.



GEOLOGICAL
LOGGING
SYSTEMS

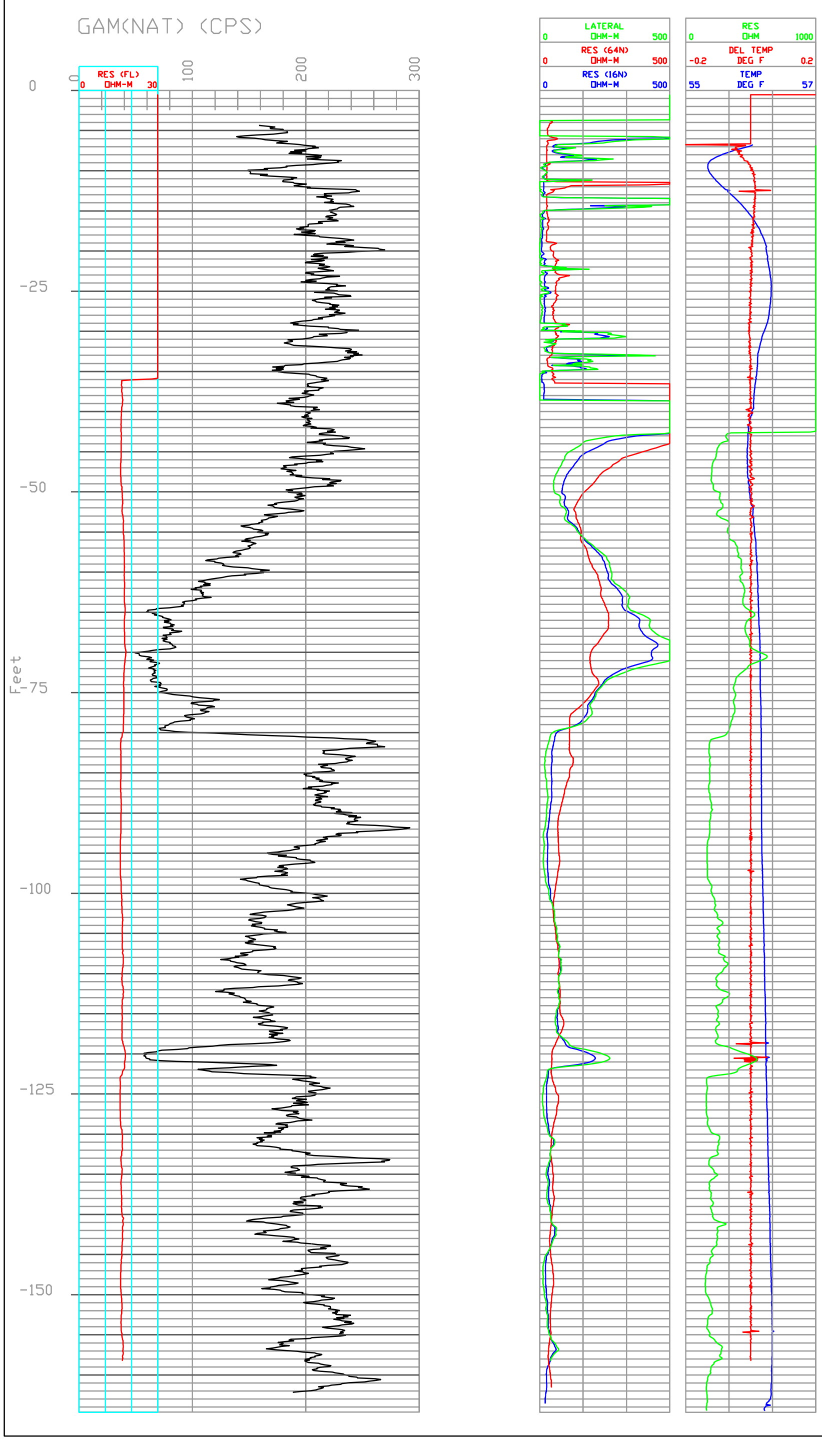
P.O. Box 848, Industrial Park, Bluefield VA 24605 276-322-5467

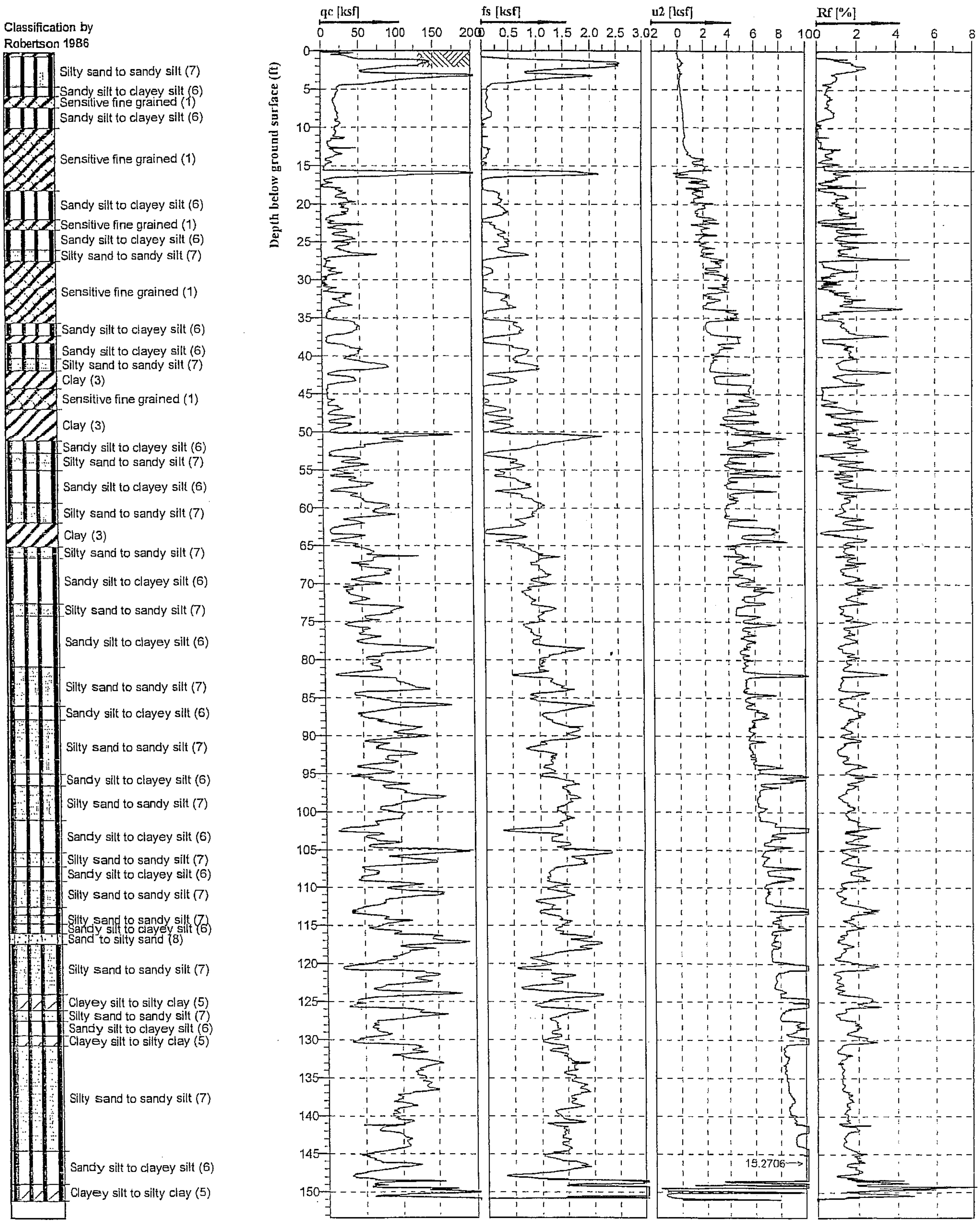
DIGITAL LOG

Company	: AEP			**Other Services:** CORE 9041 -	
Well	: MW 10				
Location/Field	: AMOS FLY ASH POND				
County	: PUTNAM				
State	: WEST VIRGINIA				
Section	: -	**Township**	:	**Range**	:
Date	: 02/04/02	**Permanent Datum**	: -	**Elevations**	
Depth Driller	: 165	**Elev. Perm. Datum**	: -	**KB**	:
Log Bottom	: 164.60	**Log Measured From**	: GL	**DF**	:
Log Top	: 0.40	**Drl Measured From**	: GL	**GL**	:
Casing Driller	: 3	**Logging Unit**	: 10		
Casing Type	: PVC	**Field Office**	: BLFD.,VA		
Casing Thickness	: .25	**Recorded By**	: M. CASSADY		
Bit Size	: 2.85	**Borehole Fluid**	: 0	**File**	: ORIGINAL
Magnetic Decl.	: -6.9	**RM**	: 0	**Type**	: 9041C
Matrix Density	: 2.71	**RM Temperature**	: 0	**Log**	: 1"=10'
Fluid Density	: -	**Matrix Delta T**	: 140	**Plot**	:
Neutron Matrix	: SANDSTONE	**Fluid Delta T**	:	**Thresh**	: 20000
Remarks	:				

Electric Log Interpretation Is Empirical In Nature. Extreme Hole Conditions Will Make Completely Accurate Interpretations Difficult.

All Services Provided Subject To Standard Terms And Conditions.

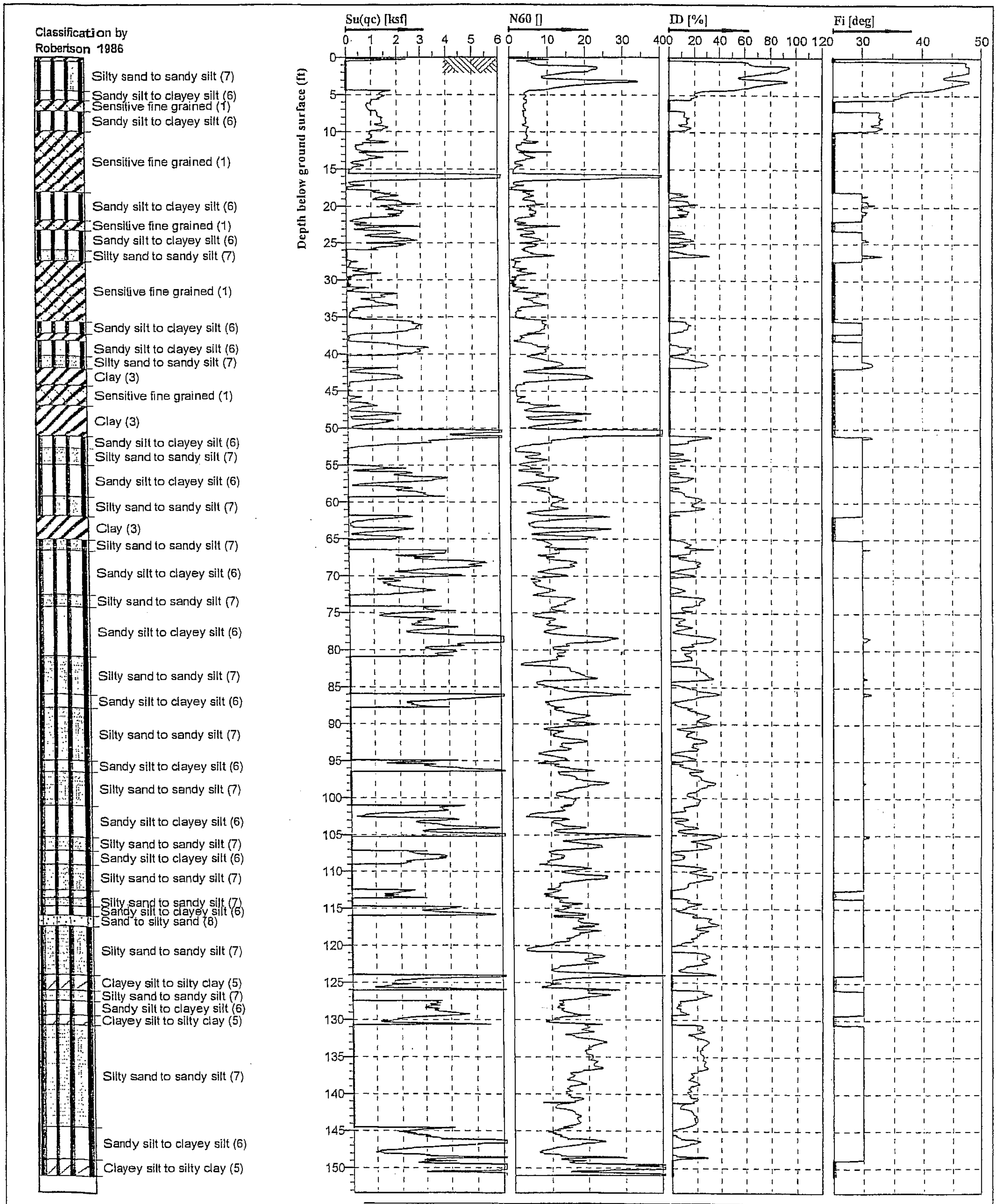




U2

Cone No: 4202
Tip area [cm2]: 10
Sleeve area [cm2]: 150

Location: Scary, Putnam County, WV	Position: X: 1726856.99 ft, Y: 532112.99 ft	Ground level: 875.00	Test no: B-17
Project ID: 90979.100	Client: American Electric Power	Date: 12/6/2007	Scale: 1 : 215
Project: Amos U3 Flyash Dam Raising		Page: 1/1	Fig:
LOG OF CONE PENETRATION TEST		File: B-17.cpd	



H. C. NUTTING CO.
P.O. BOX C
CINCINNATI, OH

U2

Cone No: 4202
Tip area [cm2]: 10
Sleeve area [cm2]: 150

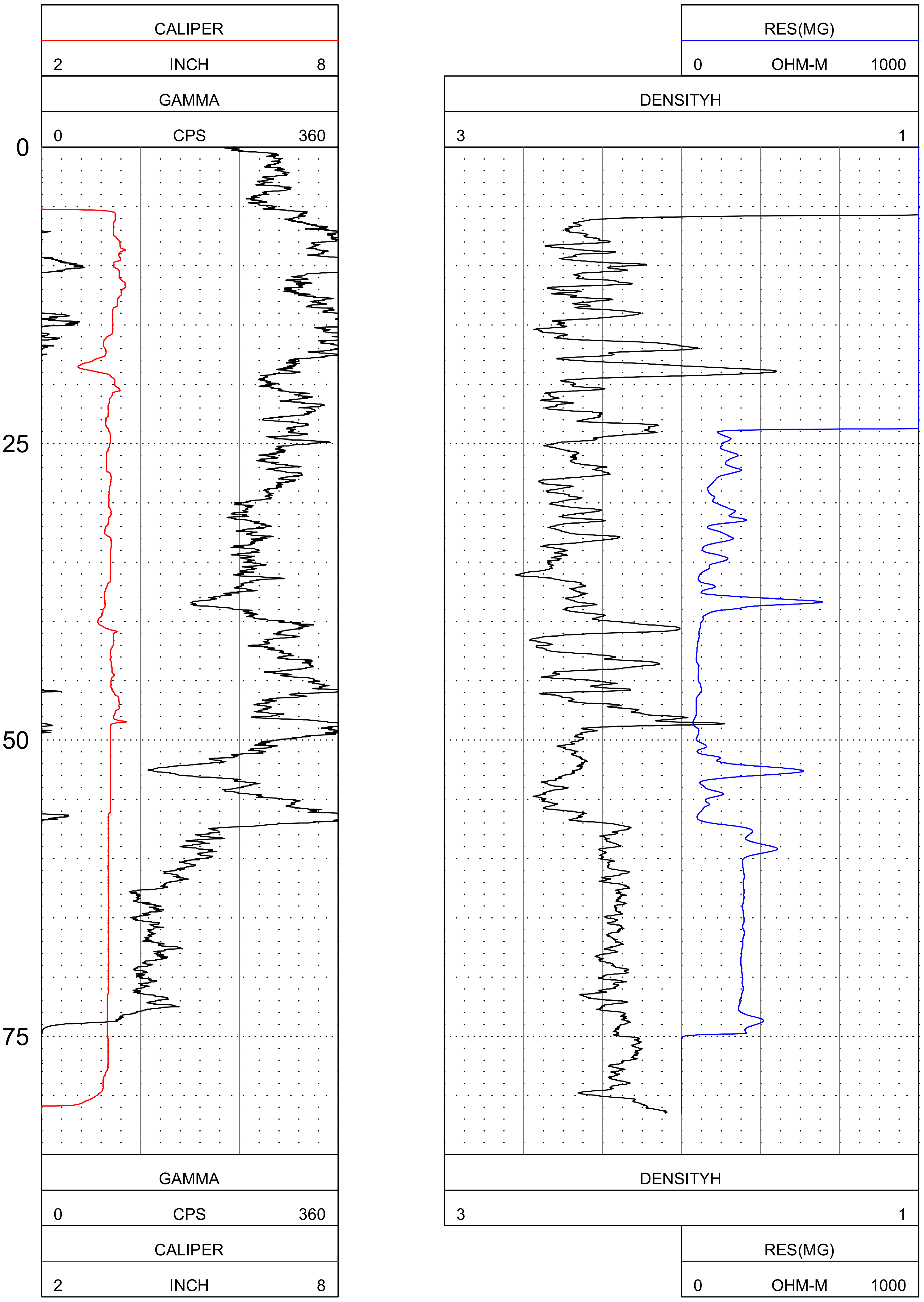
Location: Scary, Putnam County, WV	Position: X: 1726856.99 ft, Y: 532112.99 ft	Ground level: 875.00	Test no: B-17
Project ID: 90979.100	Client: American Electric Power	Date: 12/6/2007	Scale: 1 : 215
Project: Amos U3 Flyash Dam Raising		Page: 1/1	Fig:
LOG OF CONE PENETRATION TEST		File: B-17.cpd	

B-1401
Gamma-Density Log

Cardno GLS
Shaping the Future
534 Industrial Park Road, Bluefield VA 24605 276-322-5467

Company	: APCO			Other Services: OPEN ROTARY 0033CH			
Well	: B-1401						
Location/Field	: -						
County	: PUTNAM						
State	: WEST VIRGINIA						
Section	: -	Township	: -			Range	: -
Date	: 11/04/14	Permanent Datum	: -			Elevations	
Depth Driller	: 90.0	Elev. Perm. Datum	: -			KB	: -
Log Bottom	: 81.480	Log Measured From	: GL			DF	: -
Log Top	: 0.000	Drl Measured From	: GL			GL	: -
Casing Diameter	: -	Logging Unit	: 5			Latitude	-
Casing Bottom	: -	Field Office	: BLUEFIELD			Longitude	-
Casing Type	: -	Recorded By	: A. HUDAK				
Bit Size	: 3.0	Borehole Fluid	: WATER			File	: PROCESSED
Magnetic Decl.	: -8.29		: -			Type	: 0033CH
Matrix Density	: 2.65	RM Temperature	: -			Log	: 1"= 10'
Fluid Density	: -	Matrix Delta T	: 54			Plot	: -
Neutron Matrix	: SANDSTONE	Fluid Delta T	: -			Thresh	: 99999
Remarks	: -						

Electric Log Interpretation Is Empirical In Nature. Extreme Hole Conditions Will Make Completely Accurate Interpretations Difficult.



Cardno GLS

Shaping the Future

534 Industrial Park Road, Bluefield VA 24605 276-322-5467

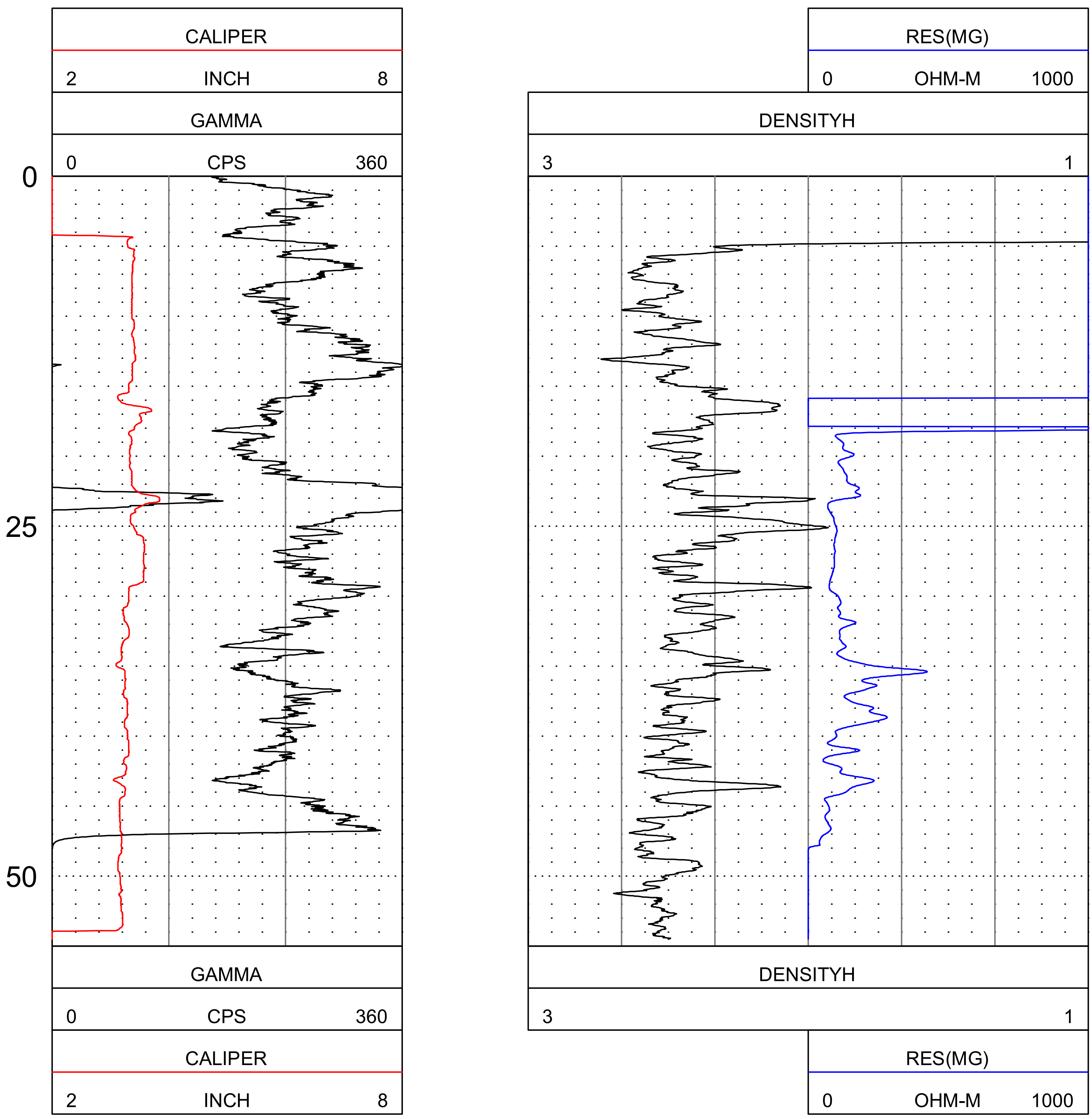
B-1402
Gamma-Density Log

Other Services:
OPEN
ROTARY
9321C2

Company	: APCO				
Well	: B-1402				
Location/Field	: -				
County	: PUTNAM				
State	: WEST VIRGINIA				
Section	: -	Township	: -	Range	: -
Date	: 11/04/14	Permanent Datum	: -	Elevations	
Depth Driller	: 90.0	Elev. Perm. Datum	: -	KB	: -
Log Bottom	: 54.500	Log Measured From	: GL	DF	: -
Log Top	: 0.000	Drl Measured From	: GL	GL	: -
Casing Diameter	: -	Logging Unit	: 5		
Casing Bottom	: -	Field Office	: BLUEFIELD	Latitude	-
Casing Type	: -	Recorded By	: A. HUDAK	Longitude	-
Bit Size	: 3.0	Borehole Fluid	: WATER	File	: PROCESSED
Magnetic Decl.	: -8.29		: -	Type	: 0033CH
Matrix Density	: 2.65	RM Temperature	: -	Log	: 1"= 10'
Fluid Density	: -	Matrix Delta T	: 54	Plot	: -
Neutron Matrix	: SANDSTONE	Fluid Delta T	: -	Thresh	: 99999
Remarks	: -				

Electric Log Interpretation Is Empirical In Nature. Extreme Hole Conditions Will Make Completely Accurate Interpretations Difficult.

All Services Provided Subject To Standard Terms And Conditions.



FGD LANDFILL-CCR REVISED GROUNDWATER MONITORING WELL NETWORK EVALUATION

Amos Plant

Winfield Road

Putnam County

Winfield, West Virginia

May 27, 2020

FGD LANDFILL-CCR REVISED GROUNDWATER MONITORING WELL NETWORK EVALUATION

Amos Plant
Winfield Road
Putnam County
Winfield, West Virginia

Prepared for:

American Electric Power Service Corporation

Everett Fortner III, PG
Senior Geologist

Matthew J. Lamb
Project Manager

Todd Minehardt, PE
Principal Engineer

Prepared by:

Arcadis U.S., Inc.

100 E Campus View Boulevard

Suite 230

Columbus

Ohio 43235-1447

Tel 614 985 9100

Fax 614 985 9170

Our Ref.:

30015982

Date:

May 27, 2020

CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power Service Corporation
amsl	above mean sea level
Arcadis	Arcadis U.S., Inc.
ASD	alternative source demonstration
bgs	below ground surface
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
CSM	Conceptual Site Model
FGD	flue gas desulfurization
ft	feet
LCS	Leachate Collection System
PVC	polyvinyl chloride

1 INTRODUCTION

This report was prepared by Arcadis U.S., Inc. (Arcadis) for American Electric Power Service Corporation (AEP) to assess the adequacy of the groundwater monitoring well network included in the Coal Combustion Residual (CCR) requirements, as specified in Code of Federal Regulations (CFR) 40 CFR 257.91, for the offsite flue gas desulfurization (FGD) landfill (CCR Unit) located approximately 2 miles northwest of the AEP Generating Plant (Plant) located on Winfield Road in Winfield, West Virginia (**Figure 1**). Specifically, this Groundwater Monitoring Well Network Evaluation report is intended to address the requirements of 40 CFR 257.91 excluding paragraphs (d) and (g) regarding the adequacy of the groundwater monitoring system. The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit in the uppermost aquifer. The objective of this report is to present an evaluation of the adequacy of the groundwater monitoring well network in the uppermost aquifer at the offsite FGD Landfill (Site).

Two other regulated CCR units associated with the Plant were identified for review, which include the bottom ash pond (BAP) system and the fly ash pond (FAP) (**Figure 2**). The evaluations of the onsite BAP system and FAP are not included in this report and were completed under separate cover.

An initial evaluation of the FGD Landfill monitoring well network was completed in November 2015 and included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the FGD Landfill, as well as publicly available geologic and hydrogeologic data. Based on the initial evaluation, the monitoring well network included wells and piezometers that already existed at the Site. Additional analyses and understanding of the uppermost aquifer have provided information that supports re-evaluation of the previous monitoring well network that included shallow monitoring wells. To supplement the network, two additional deeper down gradient monitoring wells (MW-1801, MW-1802) screened in the uppermost aquifer were drilled and installed in August 2018. Drilling activities were performed by a West Virginia-licensed driller (AEP) with Arcadis personnel completing borehole logging and well installation oversight. These monitoring wells have been effectively added to the federal CCR Rule Groundwater Monitoring Network as of the date of this report.

The following report presents the current Conceptual Site Model (CSM) based on a combination of historic site data, regional data for the Site and surrounding vicinity, site-specific investigations completed through 2018, and permit documentation. This report also includes a description of the uppermost aquifer and the revised monitoring well network. The revised monitoring well network was determined to adequately monitor up gradient and down gradient areas of the Site in the uppermost aquifer; therefore, the report objective has been met.

2 BACKGROUND INFORMATION

The following section provides background information for the AEP Amos Generating Plant FGD landfill that was used to support the groundwater monitoring well network evaluation.

2.1 Facility Location Description

The AEP Amos Generating Plant is located in Putnam County, bounded by State Route 817 (Old U.S. Route 35) to the west and the Kanawha River to the east. The FGD Landfill is located approximately 2 miles northwest of the Plant and approximately three-quarters of a mile west of Winfield Road (WV 817) (**Figures 1** and **2**). The CCR Unit occupies approximately 258 total acres, located in an isolated area, with surrounding land use predominantly residential or undeveloped, with some agriculture (**Figure 3**).

2.2 Description of FGD Landfill CCR Unit

The following section will discuss the landfill configuration, area, volume, construction and operational history, and surface water control associated with the FGD Landfill.

2.2.1 Landfill Configuration

The landfill consists of a northern and southern valley surrounded on all sides by ridges with the northern and southern valleys separated by a topographic high point. The surface of the waste is designed to be covered with a minimum of 6-inches of soil overlying CCR, a 50-mil High Density Polyethylene (HDPE) Integrated Drainage System (IDS) geomembrane or equivalent, and covered with at least 18-inches of protective and vegetative cover soil (in the upper 6-inches of the protective cover) and vegetated with grass cover as closure construction at each landfill area is completed. Currently, final cover has been placed on the south valley cell 3 section of the landfill. General construction of the landfill final cover is further detailed in the *Design Report: Landfill Final Cover System* (GAI Consultants, Inc. [GAI] 2016).

The topography surrounding the FGD Landfill consists of steep ridges greater than 200 ft on most sides (**Figure 3**). The highest point at the Site is greater than 1,000 ft above mean sea level (amsl), while the river valley elevations range from less than 600 ft amsl (Kanawha River valley) to less than 700 ft amsl (Lick Run). The Kanawha River is located east of the FGD Landfill and ranges in elevation from approximately 565 to 583 ft amsl (United States Geological Survey [USGS] 2019).

2.2.2 Area/Volume

The total area of the Site is approximately 258 acres which includes both disposal and non-disposal use. The current permitted area for disposal is 192 acres, with a permitted waste capacity of approximately 36.7 million cubic yards (**Figure 3**).

2.2.3 Construction and Operational History

In March 2006, AEP submitted the *Class F Industrial Landfill Facility Application* (GAI 2006) to West Virginia Department of Environmental Protection. The application was approved and landfill activities began in April 2009. Subsequent permit modifications and renewals have been submitted and approved for the Site, most recently in 2016 at the time of this report (GAI 2016). Landfill construction is planned for 9 individual sequences (i.e. cells), and the designed disposal rate is 2 million cubic yards per year. With a maximum design capacity of 36.7 million cubic yards, the landfill design life is approximately through the middle of year 2035 (GAI 2016). As of April 2019, the landfill is being filled within cells 1, 2 and 3 in the southern valley. Northern valley construction began in 2013 with installation of the groundwater interceptor drainage system, as well as the sedimentation and leachate ponds, and followed by the cell 4 bottom liner construction in 2018-2019.

During landfill construction, a liner is placed at the base of each cell. This liner is described in detail in the *Solid Waste/NPDES Permit Renewal Application* (GAI 2006). In general, the landfill liner consists of the following layers:

- Groundwater interceptor drainage system
- 12-inches of compacted or in-place clayey-silt subbase
- 24-inches of compacted clay liner (North Valley); 18-inches of compacted clay liner (South Valley)
- 30-mil polyvinyl chloride (PVC) geomembrane
- Leachate Collection System (LCS)
- 18-inches of protective cover (typically bottom ash, potentially West Virginia Department of Transportation mortar sand or gypsum)

The CCR byproducts from the three coal-fired generating units at the Plant (Unit 1 through Unit 3) are placed in the landfill. These waste products include fly ash, bottom ash, FGD (synthetic gypsum), and FGD purge stream treatment solids (limestone inert solids). Fly ash and bottom ash are trucked from the Amos Plant to the landfill active cell area. FGD is sluiced from the Amos Plant to the Chloride Purge Stream (CPS) WWTP directly adjacent to the Landfill via pipelines. FGD products are dried and caked at this facility before being trucked to the landfill for disposal. Fly ash and bottom ash are trucked directly from the Amos Plant to the landfill via a private haul road for direct disposal. The landfill was also permitted to receive CCR byproducts from the AEP Plants at Big Sandy, Clinch River, Conesville, Gavin, Glen Lyn, Mitchell, Mountaineer, Muskingum River, Sporn, Tanners Creek, and Kanawha River (GAI 2006; GAI 2016).

2.2.4 Surface Water Control

Surface water control at the CCR Unit is discussed in detail in *Class F Industrial Landfill Facility Application* (GAI 2006) and consists of surface runoff and infiltration of surface runoff. Surface runoff is managed through a series of collection channels, sediment traps, and pipe culverts that channel flow to 4 sediment collection ponds around the perimeter of the site. Leachate and surface flow in active landfill areas are directed to the leachate pond at the mouth of the southern or northern valley, respective to the active portion of the landfill containing the contact water. This is accomplished with vertical chimney drains that divert water to the LCS component of the landfill liner, which is a geo-composite drainage net consisting of a high-density polyethylene geo-net with needle-punched nonwoven geotextiles heat-bonded to its upper and lower surfaces draining to a network of perforated PVC pipes. The LCS channels leachate and surface flow in active landfilling areas to the leachate ponds (GAI 2006). Sedimentation ponds are located in the northwest, southwest, and southeast portions of the landfill. A sedimentation pond is located along the eastern side of the landfill near the divide between the north and south valleys.

2.3 Previous Investigations

Prior to submission of the *Class F Industrial Landfill Facility Application* in March 2006, GAI Consultants, Inc., in coordination with AEP, performed a site investigation to characterize the conditions at the proposed landfill facility. These investigations included drilling through soil and into rock, split barrel soil sampling and standard penetration testing, undisturbed soil sampling (Shelby tubes), continuous rock coring (where appropriate), and pump or packer testing of select rock units (GAI 2006).

Soil samples were analyzed for geotechnical parameters to assist with general site characterization and stability analyses. These parameters include grain size distribution, Atterberg limits, specific gravity, moisture content, compaction, permeability, cation exchange capacity, and X-Ray Diffraction characteristics. Additionally, soil samples were analyzed for physical properties at a proposed onsite borrow site for liner quality determination (GAI 2006).

During the site investigation, piezometers were installed in 23 of 25 soil borings advanced in the projected landfill footprint. Ten 2-inch PVC monitoring wells were also installed, generally around the perimeter of the proposed extent of fill. Groundwater samples were collected from monitoring wells in an effort to characterize background water quality.

Since 2016, background and detection groundwater monitoring has been performed in accordance with 40 CFR 257.90 through 40 CFR 257.94. This monitoring includes statistical evaluation of concentrations of Appendix III and Appendix IV parameters as defined in 40 CFR 257. Analysis of groundwater chemistry data has been successful in demonstrating alternate sources. Specifically, two alternate source demonstrations (ASDs) have been completed for observed statistically significant increases (SSIs) in Appendix III parameters (AEP 2019):

- November 2017/January 2018 monitoring events: Boron (MW-2), Chloride (MW-5), and Fluoride (MW-2 and MW-4)
- May/June 2018 monitoring events: Boron (MW-2 and MW-5), and Chloride (MW-5)

These ASDs suggested that concentration trends may be the result of Type IV (natural variability) and/or Type V (alternative source) causes. In particular, it was noted that construction activities and/or road salting may represent an anthropogenic Type V factor contributing to concentration variability in several wells at the Site. Furthermore, the ASD indicated groundwater types can be divided into two groups, with MW-2, MW-4, and MW-10 exhibiting a tight sodium-carbonate cluster, and the remaining wells (MW-1, MW-5, MW-6, MW-7R, MW-8, and MW-9) falling outside of this range (AEP 2019). Down gradient wells within the uppermost aquifer (MW-2 and MW-4) that fall within a differing groundwater type than shallow perched zone wells (MW-1 and MW-5) is evidence of separation of these two zones.

In 2018, Arcadis completed site investigation activities including high-resolution water level monitoring, hydraulic testing, and well installation. Pressure transducers were installed in seven monitoring wells (MW-1, MW-2, MW-4, MW-5, MW-8, MW-9, and MW-10) to collect continuous water level data from May through August 2018 in order to better characterize hydrogeologic conditions. Monitoring well installation was designed to augment the CCR monitoring well network at the Site with two additional down gradient wells installed in the stress relief fracture system. Boreholes were continuously logged and advanced to depths ranging from approximately 105 ft below ground surface (bgs) to 115 ft bgs at MW-1801 (south valley) and MW-1802 (north valley), respectively. After completion of the boreholes, straddle packer tests were completed to quantify hydraulic parameters and to assist in final placement of well screen intervals. Well yield testing was completed at the new monitoring wells to further quantify aquifer parameters. A complete description of well installation field methodology is provided in **Appendix A**. Results of hydraulic testing and water level monitoring are discussed in Section 3.1.3 of this report.

2.4 Hydrogeologic Setting

The geologic setting surrounding the Site consists of ridges formed by the Pennsylvanian age Monongahela and Conemaugh Formations. The Monongahela and Conemaugh Formations consist of sandstones, shales, limestones, and coal. These rocks have been fractured in response to a decline in stress and erosion. This decline in stress expands the rock and a system of fractures form throughout the bedrock over time. This process, which is characteristic of Appalachian valleys, is called stress relief fracturing (SRF) and is more prevalent in shallow bedrock (USGS 1981, 2000). Groundwater is present at the Site within these fracture systems (secondary porosity), while groundwater within primary porosity components (i.e., pore spaces) is less significant. A generalized cross section illustrating the features of an Appalachian SRF system is provided on **Figure 4**. Fractures observed at the Site in the SRF system are nearly vertical with attitude angles ranging from 75˚ to near 90˚. These fractures occur in sets that are oriented roughly parallel and perpendicular to one another, but not necessarily to the valley walls. Borings installed in both the south valley and north valley have moderate to highly fractured bedrock at depths greater than 100 ft below ground surface (bgs). Bedrock groundwater flow generally follows surface topography and is generally downslope of the ridge towards the valley floors. The SRF is known to be regionally prevalent and is considered the regional uppermost aquifer system outside of primary unconsolidated fluvial valleys (e.g. Kanawha River Valley and Teays Valley) surrounding the Site.

Unconsolidated deposits on top of the bedrock consist primarily of weathered bedrock and residuum, with some colluvial/alluvial deposits consisting of weathered rock, sand, silt, and clay. In valley bottoms, the unconsolidated sediments can be saturated with localized areas of shallow perched groundwater at the soil-rock interface. These localized areas of shallow groundwater generally flow down-valley and have limited connection with the SRF system. This is further discussed in Section 3.1.3.4.

These features are further illustrated on three lines of cross section through the FGD Landfill. Two lines trend from southwest to northeast through the south valley (A-A') and north valley (B-B'). The other line trends from northwest to southeast through both the north and south valleys. A cross section location map is provided on **Figure 5**. Cross sections A-A', B-B', and C-C' are provided on **Figures 6A**, **6B**, and **6C**, respectively. Detailed boring logs and well construction diagrams are included in **Appendix B**.

2.4.1 Climate and Water Budget

The climate of Winfield, West Virginia is characterized as humid continental with an average rainfall of approximately 40 inches annually. The average maximum temperature is 66 degrees Fahrenheit and the average minimum temperature is 44 degrees Fahrenheit based on information from Southeast Regional Climate Center (SERCC 2017).

The results of a numerical water budget analysis performed as part of the March 2006 *Class F Industrial Landfill Facility Application* is described in detail in Appendix I of that application (GAI 2006). The primary objective of the analysis was to estimate the average annual leachate production and estimate the maximum leachate head within the landfill liner system. Using site-specific climate, slope, and soil characteristics, it was determined that maximum average daily heads, maximum daily peak heads, and average annual leachate heads were all within acceptable ranges (GAI 2006).

2.4.2 Regional and Local Geologic Setting

2.4.2.1 Unconsolidated

The Site is located in the Appalachian Plateau physiographic province, and unconsolidated soils are limited in extent and are residual and colluvial in origin. Soils in lower topographic areas (i.e. valleys) consist of sand, silt, or clay with increasing rock fragments with depth (colluvium), and grade to weathered bedrock (residuum) with depth. Further up the ridges, soils are composed mainly of residuum. Unconsolidated material is thickest in the valley floors, and average soil thickness is approximately 11 ft (GAI 2006).

2.4.2.2 Bedrock

The primary regional bedrock units encountered are Pennsylvanian age sedimentary rocks of the Monongahela Formation and Conemaugh Formation, in descending order from youngest to oldest. The depositional environment for these formations is characterized by a gradually subsiding shallow sea with alternating marine and freshwater strata. The sedimentary package associated with the Monongahela and Conemaugh Formations consists of alternating shale and sandstone units, with occasional thin limestone and coal beds. Several coal horizons are present in the region and often serve as marker beds for unit identification. The principal marker bed in the region is the Pittsburg Coal (i.e. No. 8 Coal), which marks the transition from the Monongahela and Conemaugh Formations. However, the Pittsburg Coal is not represented in Site borings (GAI 2006). The Pittsburgh Limestone has been identified in two borings at the nearby FAP, MW-3 and 2008-26, and is used to mark the local Monongahela-Conemaugh transition. Additionally, the Little Clarksburg Coal has been identified at FAP boring B-0608 and is used to mark the base of the Connellsville sandstone deposition (Latimer, W.J., et al. 1911).

The Monongahela Formation is found capping the hills surrounding the Site. It consists of claystones and sandstones, and to a lesser extent silt shales and siltstones, which have varying degrees of thickness laterally, making correlation difficult (GAI 2006). Stratigraphy and landfill construction details are illustrated on cross sections A-A’ (south valley-southwest to northeast), B-B’ (north valley-southwest to northeast), and C-C’ (north and south valleys-northwest to southeast) (**Figures 6A**, **6B**, and **6C**, respectively).

Interpretations regarding shallow geologic structures are based on mapping of the Pittsburg Coal. The Parkersburg Syncline and the Byrnside Anticline appears to dip to the north-northwest through the site. Bedding planes at the site have a strike to the east-northeast and dip to the north-northwest at approximately 20 ft per mile (GAI 2006).

Deeper bedrock units produce oil and gas. Six (6) active oil and gas wells are located in the vicinity of the FGD Landfill along with former wells that were located within the landfill footprint (079-00611 and 079-00722) that were closed in 2007 and 2006, respectively. The location of these wells is shown on **Figure 3**. Available information on the closure is provided in **Appendix B**.

2.4.3 Surface Water and Surface Water Groundwater Interactions

There are intermittent streams in both the northern and southern area of the Site, Lick Run, and Little Hurricane Creek (**Figure 3**). Groundwater flows following topographic relief and is generally in the direction of each of these creeks. However, sedimentation, leachate, and stormwater ponds have been constructed around the perimeter of the landfill. The design specifications of these ponds are described in detail in the Class F Industrial Landfill Facility Application (GAI 2006). Groundwater flow, as well as surface water runoff that contacts active landfill areas, is directed to the leachate ponds via the Leachate Collection System component of the landfill liner. Non-contact runoff that contacts covered landfill areas, disturbed borrow areas, or undisturbed areas is contained in the sediment collection ponds which ultimately discharge to either Little Hurricane Creek or Lick Run via principal or emergency spillways (GAI 2006).

2.4.4 Water Users

There are no active groundwater production wells at the Site or within a half-mile radius of the site, based on available information. In 2017, a water well inventory for the Amos Plant indicated no information regarding the use of wells located in the vicinity of the Site was available (Banks Environmental Data, Inc., 2017). The report identified one well registered with the United States Geological Survey within a half-mile of the Site. This well is located approximately 1,700 ft west of the FGD Landfill north valley, on the west side of Lick Run, and appears to be used for groundwater monitoring (**Appendix C**).

There is at least one confirmed private water well located within 0.5 miles of the FGD Landfill. This private well is located east of the Site at 6881 Winfield Road but is not in use because the residence is connected to public water supply.

Public water wells within 0.5 mile of the Site are unlikely. Land use is comprised of residential or undeveloped properties, with some agriculture and industry. Most, if not all, developed parcels in the vicinity of the Site are connected to Putnam Public Service District public water supply. The Putnam Public Service District source water is from the Poplar Fork Creek water shed located over 4 miles to the northwest of the Site. The water is pumped to a reservoir and subsequently treated at the water treatment plant before being distributed to public users (Putnam Public Service District 2017). Additional potable water in the area is supplied by West Virginia American Water, which operates several water systems that pull water from the Elk River, a tributary to the Kanawha River (West Virginia American Water 2015). The Lower Kanawha River is not used as a source for potable water.

3 MONITORING WELL NETWORK EVALUATION

An initial evaluation of the monitoring well network present at the Site was performed in November 2015 to determine if any of the wells were viable for continued use as part of the federal CCR Rule groundwater quality monitoring well network or retained for the purpose of water level measurement as part of a larger groundwater hydraulic monitoring well network. As part of this review, hydrogeologic conditions were evaluated to determine if the defined uppermost aquifer unit had an adequate monitoring well network. The evaluation was completed in accordance with 40 CFR 257.91 to have an established monitoring well network that effectively monitors the uppermost aquifer up gradient and down gradient of the Site. Following the initial evaluation, the network was augmented to include existing piezometers for the purpose of hydraulic monitoring. Additionally, existing wells MW-1 and MW-5 were removed from the groundwater quality monitoring well network and retained only for hydraulic monitoring. As a result, two new monitoring wells were installed in the uppermost aquifer down gradient of the FGD Landfill. Background groundwater quality is monitored at the wells that are hydraulically up gradient from the FGD Landfill. Down gradient wells are placed down gradient of the CCR unit boundary to monitor water quality.

3.1 Hydrostratigraphic Units

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

The uppermost aquifer is the first encountered aquifer that is horizontally continuous across the site. The uppermost aquifer at the Site is defined by the saturated portion of the SRF system, is independent of lithologic unit, and was examined to confirm hydraulic connection from ridge to valley using multiple lines of evidence that are discussed in Section 3.2.3. Stress relief fractures occur in both the Conemaugh and Monongahela Formations. Moderate to highly fractured bedrock was observed from the bedrock surface to depths greater than 100 ft bgs at wells MW-1801 and MW-1802, immediately west of the FGD Landfill in the south and north valleys, respectively. Stress relief fractures are also present along open horizontal bedding planes. In similar stress relief fracture systems, the aquifers are generally unconfined but water levels in wells can exhibit confined behavior in valley floors if low-transmissivity sediments (i.e. clay) are present (USGS 1981). The uppermost aquifer (i.e. saturated portion of the SRF system) is horizontally continuous across the entire site.

The upper limit of the uppermost aquifer is defined by the top of the potentiometric surface in the SRF system, generally located beneath the original bedrock surface prior to landfill construction. The potentiometric surface occurs at depths as shallow as 1 ft below the soil-rock interface (beneath valley walls) to greater than 90 ft below the soil-rock interface (beneath ridgetops, e.g. MW-10). This is illustrated on cross sections A to A’, B to B’, and C-C’ (**Figures 6A**, **6B**, and **6C**), as well as depth to water measurements summarized on **Table 1**.

There are localized areas of shallow perched groundwater at the soil-rock interface. These are limited in valley bottoms and have limited connection with the underlying SRF system. Monitoring wells MW-1 (southern valley), and MW-5 (northern valley) are screened in these shallow perched zones. These zones are not considered the uppermost aquifer as they are limited in extent and discontinuous. Within the limits of the landfill, underdrains located at various depths beneath the landfill liner prevent an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevation (GAI 2006).

3.1.2 Overall Flow Conditions

Groundwater flow at the Site occurs within the SRF system (i.e. uppermost aquifer), mainly moving along hydraulically connected fractures and other secondary porosity features. Groundwater within primary porosity components (i.e., pore spaces) is less significant. Fractures in this system are hydraulically connected via open bedding planes, and groundwater flow directions generally follow topography from ridges towards the valley floor and out the northern and southern valley mouths. Local areas of shallow perched groundwater in the valley flows horizontally along the soil-rock interface. As discussed in Section 3.1.3.4, vertical flow of perched groundwater is limited. Available groundwater elevations are summarized on **Table 1** for July 2005, November 2010, and January 2019 well gauging events. Potentiometric contours from the November 2010 event, which is the most recently available data that includes groundwater elevations beneath the landfilled material (e.g. MW-3R, 0512, 0513), are depicted on **Figure 7**. Groundwater levels and flow directions from the most recent gauging events, including levels from MW-1801 and MW-1802, are consistent with historical data.

3.1.3 Hydraulic Conductivity

The following subsection describes field implementation and data analysis of hydraulic testing conducted at the FGD Landfill (e.g., borehole packer tests, well yield tests). Historical hydraulic tests are briefly described and referenced. Hydraulic conductivity estimates derived from 2018 investigations are consistent with historical estimates and discussed in more detail below.

3.1.3.1 Historical Hydraulic Testing

Packer testing was completed during piezometer and well installations in 2005 in order to estimate hydraulic properties of the fractured bedrock. Additionally, slug tests were conducted at select bedrock monitoring wells. Reported hydraulic conductivity estimates from historic packer and slug tests in the SRF are provided in **Table 2** and ranged from 10^{-3} to 10^{-6} centimeters per second (cm/sec). No hydraulic testing data is available for perched groundwater in the valley floor (GAI 2006).

3.1.3.2 Packer Testing

Packer testing was conducted during installation of wells MW-1801 and MW-1802. The intent of injection packer testing is to estimate relative bedrock permeability for various borehole depth intervals to assist with water-bearing unit identification and monitoring well installation. Upon completion of each borehole, rock cuttings were flushed from the borehole with water in preparation for packer testing. Inflatable upper and lower rubber packers were then inserted to a specified 10-ft depth interval and inflated to create a seal. A riser pipe was attached to the top of the upper packer to provide a rigid, sealed standpipe with a pressure gauge at a known distance above the ground surface. Through this riser pipe, water was injected into the packer interval while measuring the gauge injection pressure, as well as injection volumes via a totalizing flowmeter. During the packer tests, flow rates and borehole pressure were monitored at regular intervals. Test data was analyzed using the method described in the U.S. Department of the Interior Ground Water Manual (1977).

Packer tests were designed to target the SRF system. Two depth intervals were tested at MW-1801 (55 to 65 and 65 to 75 ft bgs). The estimated hydraulic conductivity from 55 to 65 ft bgs was 7.9 x 10^{-5} cm/sec, and from 65 to 75 ft bgs was 3.2 x 10^{-6} cm/sec. Four depth intervals were tested at MW-1802 (48 to 58, 65 to 75, 89 to 99, and 99 to 109 ft bgs) and flow was only observed at two of those intervals. The estimated hydraulic conductivity from 48 to 58 ft bgs was 4.0 x 10^{-6} cm/sec, and from 89 to 99 ft bgs was 3.7 x 10^{-5} cm/sec. Packer test results are summarized on **Table 2** and packer testing logs are included in **Appendix D**.

3.1.3.3 Yield Testing

Well yield testing was conducted by Arcadis from August through September 2018 at wells MW-1801 and MW-1802, both of which are installed in the uppermost aquifer. Yield tests were completed by pumping each well at variable and steady state extraction rates and measuring the water level response in each well during and after pumping (recovery). Extraction rates were maintained using a submersible pump. High-resolution water level data were collected during both pumping and recovery phases via data-logging pressure transducers installed in each test well. Representative portions of recovery data were selected for analysis and analyzed using AQTESOLV® for Windows® Version 4.50 (Duffield 2007). Hydraulic parameter values were determined using the Theis analytical solution based on the observed response for a single (partially-penetrating) well. Drawdown data was corrected for unconfined conditions using an appropriate equation (Kruseman and DeRidder 1990).

The estimated hydraulic conductivity values at MW-1801 and MW-1802 were 2.5 x 10^{-6} and 1.2 x 10^{-5} cm/sec, respectively. A summary of yield testing results is provided on **Table 2** and solution reports with individual curve matches are provided in **Appendix D**.

3.1.3.4 High Resolution Water Level Monitoring

Continuous water level data in the SRF and shallow alluvial zone was collected in May through August 2018 in order to better characterize hydrogeologic conditions at the FGD Landfill. Resulting hydrographs from this data collection is presented in **Appendix D**.

Pressure transducers were installed at seven hydraulic monitoring locations that included three SRF monitoring wells located up gradient on ridges in the north valley (MW-8, MW-9 and MW-10), two down gradient SRF monitoring wells with one in the south valley (MW-2) and north valley (MW-4), and two down gradient shallow alluvium monitoring wells with one in the south valley (MW-1) and one north valley (MW-5).

The following external hydraulic influences were observed at the FGD Landfill during the monitoring period: precipitation events, barometric pressure fluctuations, and responses to groundwater sampling. Water-levels were post-processed that included barometric compensation, shift correction, water-level elevation, and barometric correction. Barometric efficiency was estimated for each monitoring well and varied from 0.05 to 0.2 and indicates a level of confinement for the SRF. In the north valley, shallow alluvium well MW-5 did not have a barometric effect reflecting unconfined shallow water table conditions. Shallow alluvium well MW-1 did have a barometric effect with a resulting barometric efficiency of 0.2, which is likely due to shallower finer grained material in the vadose zone compare to coarser deposits observed at MW-5. Additionally, the observed water level elevations confirm a vertical sequence separating the shallow alluvium and SRF indicating a level of hydraulic separation of the two zones (e.g. MW-1, MW-2 [south valley

Figures D-2 and **D-3**] and MW-4, MW-5 [north valley **Figures D-4** and **D-5**]). Vertical separation is evident at each of these two well pairs because the water level elevations in wells screened in the shallow alluvium (i.e., MW-1 and MW-5) are approximately 15 to 30 ft higher than at adjacent wells screened in the SRF (i.e., MW-2 and MW-4).

Several of the monitoring wells responded to precipitation events resulting in water level increases including MW-2, MW-4, MW-5 as well as MW-9, to a lesser extent. Sudden declines followed by recovery in water levels due to groundwater sampling were also observed in wells MW-5, MW-8, MW-9, and MW-10. Following groundwater sampling events and an anomalous decrease at MW-1, several wells showed a more rapid recharge such as MW-5, MW-8, and MW-9 (see **Figure D-7**) while other wells took several days or weeks to return to pre-pumping levels such as MW-10 (see **Figure D-8**). The more rapid recharge response is reflective of a higher permeability of the materials at the respective locations.

3.2 Uppermost Aquifer

3.2.1 CCR Rule Definition

Per 40 CFR 257.60(a), new CCR landfills, existing and new CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (5 ft) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high conditions).

The CCR rule definitions for an aquifer and the uppermost aquifer as specified in 40 CFR 257.53 indicates an aquifer is a geologic formation capable of yielding usable quantities of groundwater to wells or springs while an uppermost aquifer is defined as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers, that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural groundwater surface to which the aquifer rises during the wet season.

3.2.1.1 Common Definitions

An aquifer is commonly defined as a geologic unit that stores and transmits water (readily or at sufficient flow rates) to supply wells and springs (USGS 2015; Fetter 2001). The uppermost aquifer is considered the first encountered aquifer nearest to the CCR unit.

3.2.2 Identified Onsite Hydrostratigraphic Unit

The identified Site hydrostratigraphic unit is the saturated portion of the SRF system, which is considered the uppermost aquifer at the Site. The SRF is known to be regionally prevalent and is considered the regional uppermost aquifer system outside of primary unconsolidated fluvial valleys. The uppermost aquifer is not known to be used locally for groundwater supply or industrial water use.

3.2.3 Hydraulic Connection – Multiple Lines of Physical Evidence Approach

A multiple lines of evidence approach was used to understand the hydraulics related to horizontal and vertical groundwater flow at the Site. The main purpose for this demonstration was to help understand the dynamics and vertical connectivity of the SRF system, both from ridges to valleys, as well as perched groundwater in valleys to deeper bedrock fractures.

At the Site, the SRF system is determined to be the uppermost aquifer based on spatial occurrence and hydraulic testing. The following lines of physical evidence support the understanding that the SRF system is connected from the ridgetops down to the valleys and the shallow perched zones are hydraulically disconnected.

The physical lines of evidence that verify SRF hydraulics are:

- SRF occurring independent of bedrock units at depths greater than 100 feet (MW-1801 and MW-1802)
- Shallow shales are fractured on ridges according to boring logs
- Hydrographs indicate vertical separation from the local areas of shallow perched groundwater and deeper groundwater within the SRF system
- ASD evaluation concluded that there is a geochemical distinction between shallow perched groundwater wells MW-1 and MW-5 relative to other wells screened in the SRF system down gradient of the FGD Landfill at MW-2 and MW-4.

Based on this information and the positive correlation of these lines of evidence with the Appalachian conceptual site model for groundwater flow (USGS 1981), the SRF system is hydraulically connected from ridges to valleys. A generalized cross section illustrating the features of an Appalachian SRF system is provided on **Figure 4**.

3.3 Review of Existing Monitoring Well Network

3.3.1 Overview

The Site was visited by Arcadis and AEP personnel on August 11, 2015 to review existing well network conditions and locations. At that time, the monitoring well network was initially determined sufficient (Arcadis 2016). Since 2016, additional analyses discussed above in this report have resulted in a refined understanding of the uppermost aquifer and provided support for removal of shallow perched zone wells MW-1 and MW-5 from the federal well network. These wells were replaced with two deeper down gradient wells screened in the uppermost aquifer (i.e., SRF). A well construction table that summarizes the location, ground surface elevation, borehole depth, installation date, and associated well construction details of the monitoring well network is included as **Table 3**. As presented in **Table 3**, wells included in the monitoring network have been designated as up gradient or down gradient. Additionally, some monitoring wells and piezometers are designated for hydraulic monitoring only. The wells that are shaded on **Table 1** and **3** and **Figure 3** were abandoned. Available closure information is provided in **Appendix B** from the West Virginia Department of Environmental Protection (WVDEP). No closure information was available for monitoring wells MW-3 and MW-3RA and piezometers 0503, 0504, 0507 and 0514. These monitoring wells and piezometers are assumed to have been closed following WVDEP guidelines. Further details are provided in Section 4.1.

Spatially, the monitoring well network as illustrated on **Figure 8** is distributed around the entire Site and sufficiently monitors up gradient and down gradient locations as specified in 40 CFR 257.91. The well screen intervals are located in the SRF system and include both the Monongahela and Conemaugh Formations.

3.3.2 Gaps in Monitoring Network

As discussed in Section 3.3.1 of this report, gaps in the monitoring network were not identified upon initial Arcadis review in 2016. Upon additional data collection, modifications were made to the federal monitoring well network to add MW-1801 and MW-1802 as replacements for MW-1 and MW-5, respectively and as described previously in this report. Based on these modifications, there are no gaps in the monitoring network. The recommended monitoring well network is described in Section 4.

4 RECOMMENDED MONITORING NETWORK

The network meets specifications stated in 40 CFR 257.91. Recommended groundwater monitoring objectives utilizing existing wells are further discussed and will provide an adequate understanding of seasonal and temporal fluctuations in groundwater quality, hydraulics, and groundwater flow at the Site.

4.1 Monitoring Well Network Distribution

The groundwater quality monitoring network at the Site consists of 9 out of 11 wells as represented on **Table 3** and **Figure 8**. The remaining two wells at the Site (i.e., MW-1 and MW-5) will be gauged for the purpose of ongoing groundwater elevation data collection. Additionally, all available piezometers listed on **Table 3** along with the 9 groundwater water quality monitoring wells will be gauged.

4.1.1 Down Gradient Locations

Monitoring wells down gradient in the south valley (MW-2, MW-1801) and north valley (MW-4, MW-1802) constitute the down gradient groundwater quality monitoring locations (**Figure 8**).

4.1.2 Up Gradient Locations

Monitoring wells located along the western (MW-6), southern (MW-7R), eastern (MW-8), and northern (MW-9, MW-10) CCR boundary constitute the up gradient groundwater quality monitoring locations (**Figure 8**).

4.2 Well Construction

As discussed above in Section 3, gaps in the monitoring well network at the FGD Landfill were addressed by utilizing existing wells and by the installation of 2 monitoring wells in August 2018 (MW-1801, MW-1802). All new monitoring wells were constructed in general accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011 by a state licensed driller.

Installation details and field methods are provided in **Appendix A**. Well construction data for the monitoring well network is summarized on **Table 3**. Boring logs and the monitoring well completion diagrams are provided in **Appendix B**.

5 PROFESSIONAL ENGINEER'S CERTIFICATION

I, Todd A. Minehardt, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, the proposed groundwater monitoring system will be adequate to meet the requirements of 40 CFR Part 257.91 excluding paragraphs (d) and (g), which do not apply to this groundwater monitoring well network evaluation.

TODD A. MINEHARDT

Printed Name of Registered Professional Engineer

Signature

23518	WV	5/27/2020
Registration No.	Registration State	Date

TODD A. MINEHARDT REGISTERED 23518 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER 5/27/20

6 REFERENCES

AEP. 2019. Annual Groundwater Monitoring Report, Appalachian Power Company, John E. Amos Plant, Landfill CCR Management Unit, Winfield, West Virginia.

Arcadis. 2016. FGD Landfill CCR Groundwater Monitoring Well Network Evaluation. October 5.

Banks Environmental Data, Inc. 2017. Water Well Report, AEP Water Well Inventory, FGD Landfill, ES-124909.

Fetter, Charles Willard, and C. W. Fetter. 2001. Applied hydrogeology. Vol. 3. No. 3. Upper Saddle River: Prentice hall.

GAI Consultants, Inc. 2006. Class F Industrial Landfill Facility Application, John E. Amos Landfill, John E. Amos Plant, Winfield, West Virginia, GAI Project Number: C040384.40.

GAI Consultants, Inc. 2016. Design Report: Landfill Final Cover System, John E. Amos Landfill, John E. Amos Power Plant, Winfield, West Virginia

Latimer, W.J., et al. 1911. Jackson, Mason and Putnam Counties, Volume 1, County Reports and Maps. Wheeling News Litho. Company.

Putnam Public Service District. 2017. 2017 Water Quality Report. http://www.putnampsd.com/ccr.pdf

Southeast Regional Climate Center. 2017. Historical Climate Summaries, Winfield Locks, West Virginia, http://www.sercc.com, Query conducted by Mr. Josh Roberts of Arcadis on May 10, 2017.

U.S. Department of the Interior. 1977. Groundwater Manual. Bureau of Reclamation. Supt. of Documents, U.S. Govt. Printing Office, Washington, D.C.

USGS. 1981. Water-Supply Paper 2177, Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley.

USGS. 2001. Aquifer – Characteristics Data for West Virginia, Water Resources Investigation Report 01-4036.

USGS, Aquifers and Groundwater. 2015. Available online at www.usgs.gov.

USGS. 2019. USGS Water Data for the Nation. USGS 03198000 Kanawha River at Charleston, WV. https://waterdata.usgs.gov/usa/nwis/uv?03198000. Data range: January 2016 to May 2019. Query conducted by Mr. Josh Roberts of Arcadis on May 15, 2019.

TABLES

Table 1
Water Level Data
AEP Amos Generating Plant - FGD Landfill
Winfield, West Virginia

Well ID	Top of Casing Elevation	7/1/2005 Depth to Water ft TOC	7/1/2005 GW Elev ft amsl	11/22/2010 Depth to Water ft TOC	11/22/2010 GW Elev ft amsl	12/17/2018 Depth to Water ft TOC	12/17/2018 GW Elev ft amsl	1/24/2019 Depth to Water ft TOC	1/24/2019 GW Elev ft amsl	2/21/2019 Depth to Water ft TOC	2/21/2019 GW Elev ft amsl	3/13/2019 Depth to Water ft TOC	3/13/2019 GW Elev ft amsl	4/23/2019 Depth to Water ft TOC	4/23/2019 GW Elev ft amsl	6/10/2019 Depth to Water ft TOC	6/10/2019 GW Elev ft amsl	7/22/2019 Depth to Water ft TOC	7/22/2019 GW Elev ft amsl	11/4/2019 Depth to Water ft TOC	11/4/2019 GW Elev ft amsl
Monitor Wells																					
Downgradient																					
MW-1 [a]	711.57	6.30	705.27	9.76	701.81	13.07	698.50	13.08	698.49	NM	NM	NM	NM	NM	NM	13.02	698.55	12.34	699.23	12.24	699.33
MW-2 [a]	711.41	40.40	671.01	43.06	668.35	44.03	667.38	73.74	637.67	43.82	667.59	NM	NM	NM	NM	44.13	667.28	44.06	667.35	44.47	666.94
MW-3	NA	NA	806.80	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-3R [a]	NA	NM	NM	NA	779.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-3RA	NA	NM	NM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-4 [a]	676.76	19.70	657.06	20.51	656.25	NM	NM	18.43	658.33	NM	NM	NM	NM	NM	NM	19.11	657.65	19.22	657.54	19.19	657.57
MW-5 [a]	676.84	6.60	670.24	6.34	670.50	4.85	671.99	3.58	673.26	NM	NM	NM	NM	NM	NM	5.20	671.64	5.06	671.78	5.12	671.72
MW-1801	738.32	NA	NA	NA	NA	34.48	703.84	34.42	703.90	34.70	703.62	35.23	703.09	35.33	702.99	35.60	702.72	35.47	702.85	34.99	703.33
MW-1802	712.69	NA	NA	NA	NA	52.68	660.01	52.35	660.34	53.00	659.69	55.30	657.39	53.73	658.96	53.82	658.87	54.01	658.68	53.92	658.77
Upgradient																					
MW-6 [a]	929.29	66.00	863.29	65.75	863.54	NM	NM	61.10	868.19	NM	NM	NM	NM	NM	NM	63.79	865.50	64.71	864.58	65.56	863.73
MW-7	NA	NA	906.55	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-7R [a]	854.63	NM	NM	72.35	782.28	NM	NM	69.90	784.73	NM	NM	NM	NM	NM	NM	70.02	784.61	70.07	784.56	70.64	783.99
MW-8 [b]	937.68	25.80	921.21	31.81	915.20	NM	NM	26.53	920.48	NM	NM	NM	NM	NM	NM	27.44	919.57	28.49	918.52	16.88	920.80
MW-9 [a]	935.39	32.90	902.49	37.89	897.50	NM	NM	27.28	908.11	NM	NM	NM	NM	NM	NM	30.63	904.76	32.35	903.04	35.45	899.94
MW-10 [a]	911.43	119.70	791.73	101.28	810.15	NM	NM	99.64	811.79	NM	NM	NM	NM	NM	NM	103.18	808.25	100.81	810.62	98.40	813.03
Piezometers																					
0501	761.33	18.65	742.68	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0502	761.46	NM	NM	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0503	777.00	19.30	757.70	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0504	777.30	6.10	771.20	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0505	912.89	88.40	824.49	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0506 [a]	711.77	41.75	670.02	43.61	668.16	NM	NM	43.81	667.96	NM	NM	NM	NM	NM	NM	44.19	667.58	44.12	667.65	44.53	667.24
0507	712.49	14.60	697.89	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0508	980.97	139.15	841.82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0509	826.75	22.25	804.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0510	927.69	NM	NM	NM	NM	NM	NM	45.66	882.03	NM	NM	NM	NM	NM	NM	46.41	881.28	47.48	880.21	46.60	881.09
0511	826.67	20.90	805.77	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0512 [a]	786.29	5.40	780.89	5.22	781.07	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0513 [a]	786.49	5.70	780.79	5.25	781.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0514	950.65	25.85	924.80	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0515	935.49	62.85	872.64	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0517 [b]	937.68	51.20	896.15	52.67	894.68	NM	NM	42.09	905.26	NM	NM	NM	NM	NM	NM	41.92	905.43	42.34	905.01	31.26	906.42
0519 [a]	992.97	84.30	908.67	87.54	905.43	NM	NM	73.41	919.56	NM	NM	NM	NM	NM	NM	80.31	912.66	80.39	912.58	80.40	912.57
0520 [a]	681.38	24.47	656.91	NA	656.86	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0521 [a]	1006.48	56.33	950.15	58.05	948.43	NM	NM	54.10	952.38	NM	NM	NM	NM	NM	NM	56.31	950.17	56.33	950.15	56.38	950.10
0522 [a]	903.54	67.30	836.24	70.17	833.37	NM	NM	65.32	838.22	NM	NM	NM	NM	NM	NM	65.90	837.64	66.84	836.70	68.77	834.77
0523 [a]	972.30	296.90	675.40	304.13	668.17	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0524 [a]	699.14	5.33	693.81	5.61	693.53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
0525 [a]	681.48	6.55	674.93	6.47	675.01	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

NOTES:
Shaded = well not verified or closed
Elevation in feet above mean sea level.
a = Source: AEP DWG. No. 13-30500-12-E
b = Well was re-surveyed in September 2019. Ground surface was loweredto access stockpiled soil, and subsequently well casing was removed. Top of casing elevation changed from 947.01 to 937.68 at MW-8, and 947.35 to 937.68 at 0517.
amsl = above mean sea level
bls = below land surface
Elev = elevation
ft = feet
GW = groundwater

Table 2
Summary of Hydraulic Testing Results
AEP Amos Generating Plant - FGD Landfill
Winfield, West Virginia

ARCADIS Design & Consultancy for natural and built assets

Test Borehole/Well Identification	Test Date	Boring Diameter (inches)	Casing Diameter (inches)	Top of Interval/ Screen (ft-bgs)	Base of Interval/ Screen (ft-bgs)	Interval/ Screen Length (ft)	Water Level[4] (ft bgs)	Water Column (ft)	Test Pressure (psi)	Test Flow Rate (gpm)	Max Sustained Flow Rate (gpm)	T (ft^2/day)	K (ft/day)	K (cm/sec)
Borehole Packer Testing [1]														
MW-1801	8/9/2018	3.0	--	65	75	10	13.00	62.0	60	0.0	--	--	--	--
MW-1801	8/9/2018	3.0	--	65	75	10	13.00	62.0	100	0.2	--	9.1E-02	9.1E-03	3.2E-06
MW-1801	8/13/2018	3.0	--	55	65	10	17.10	47.9	60	2.6	--	2.2	0.2	7.9E-05
MW-1802	8/21/2018	3.0	--	48	58	10	35.10	22.9	60	0.1	--	0.1	1.1E-02	4.0E-06
MW-1802	8/21/2018	3.0	--	65	75	10	35.10	39.9	60	0.0	--	--	--	--
MW-1802	8/21/2018	3.0	--	65	75	10	35.10	39.9	100	0.0	--	--	--	--
MW-1802	8/21/2018	3.0	--	89	99	10	35.10	63.9	60	0.0	--	--	--	--
MW-1802	8/21/2018	3.0	--	89	99	10	35.10	63.9	100	2.0	--	1.0	0.1	3.7E-05
MW-1802	8/21/2018	3.0	--	99	109	10	35.10	73.9	60	0.0	--	--	--	--
MW-1802	8/21/2018	3.0	--	99	109	10	35.10	73.9	100	0.0	--	--	--	--
Yield Testing Recovery [2]														
MW-1801	9/12/2018	6.0	2	55	75	20	32.83	42.2	N/A	0.2	0.2	0.1	7.0E-03	2.5E-06
MW-1802	9/11/2018	6.0	2	50	70	20	51.84	18.2	N/A	0.3	0.3	0.7	3.5E-02	1.2E-05
Slug Testing [3]														
Unknown Location (high end range)	2006	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	2.8	1.0E-03
Unknown Location (low end range)	2006	NA	NA	NA	NA	NA	NA	NA	--	--	--	--	2.8E-03	1.0E-06
											Minimum	**9.1E-02**	**2.8E-03**	**1.0E-06**
											Maximum	**2.2**	**2.8**	**1.0E-03**
											Geometric Mean	**0.4**	**3.8E-02**	**1.4E-05**

NOTES:

[1] Packer testing analysis analyzed using U.S. Department of the Interior, Bureau of Reclamation, 1977. Ground Water Manual, A Water Resources Technical Publication, pp. 258-264

[2] Recovery results only using Theis solution; correction of drawdown data applied for unconfined conditions ($s'=s-s^2/2b$; where s is drawdown and b is aquifer thickness)

Kruseman, G.P. and Ridder, N.A., 1990. Analysis and evaluation of pumping test data. Analysis and evaluation of pumping test data., (47)

Theis, C.V., 1935. The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Am. Geophys. Union Trans., vol. 16, pp. 519-524

Birsoy, Y.K. and W.K. Summers, 1980. Determination of aquifer parameters from step tests and intermittent pumping, Ground Water, vol. 18, no. 2, pp. 137-146

[3] Slug testing results from GAI Consultants, Inc. 2006. Class F Industrial Landfill Facility Application, John E. Amos Landfill, John E. Amos Plant, Winfield, West Virginia, GAI Project Number: C040384.40

[4] Water level and total depth taken from data from individual respective test data

N/A = not available

-- = not applicable

T = transmissivity

K = hydraulic conductivity

ft = feet

gpm = gallons per minute

psi = pounds per square inch

cm/sec = centimeters per second

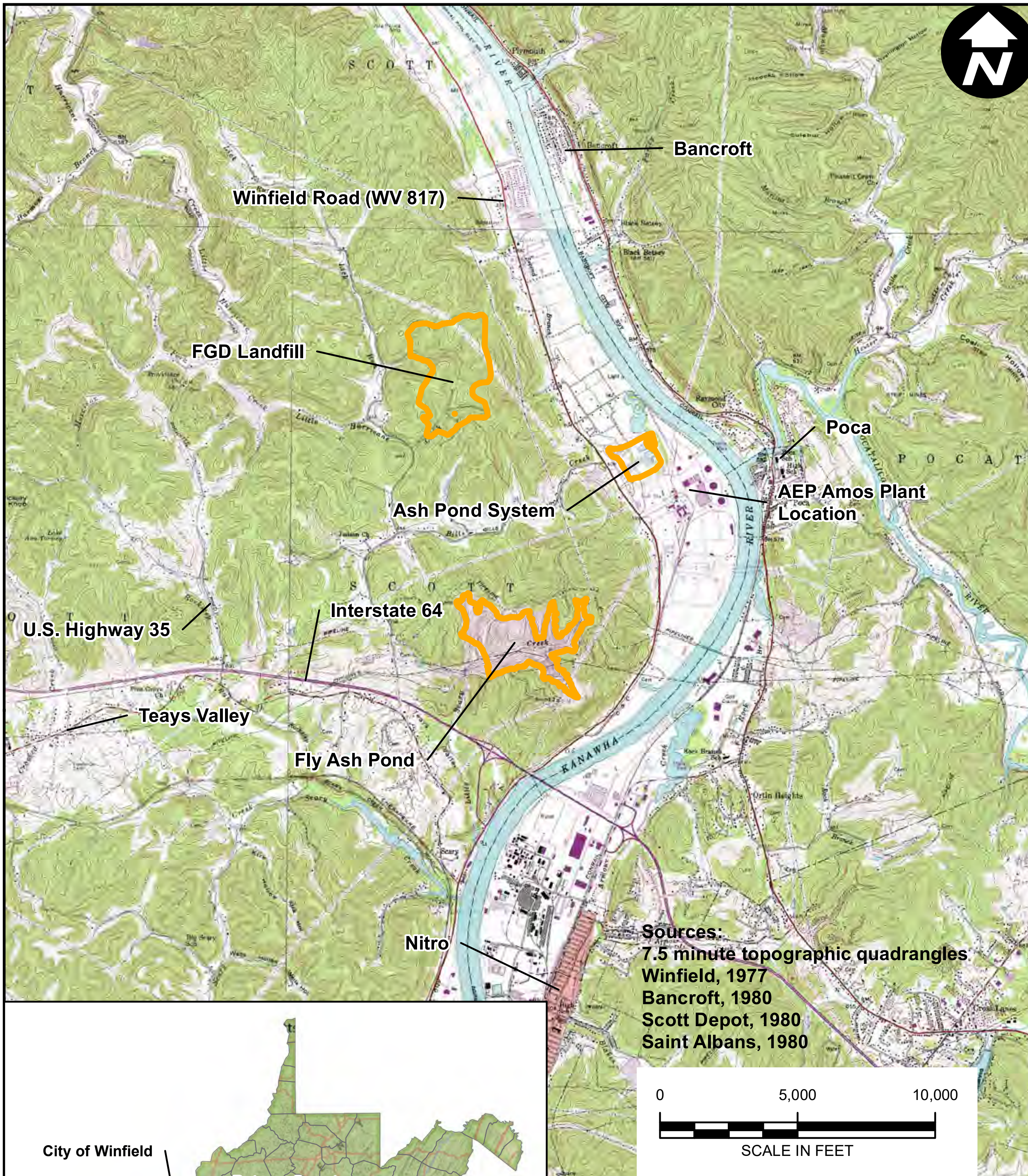
bgs = below ground surface

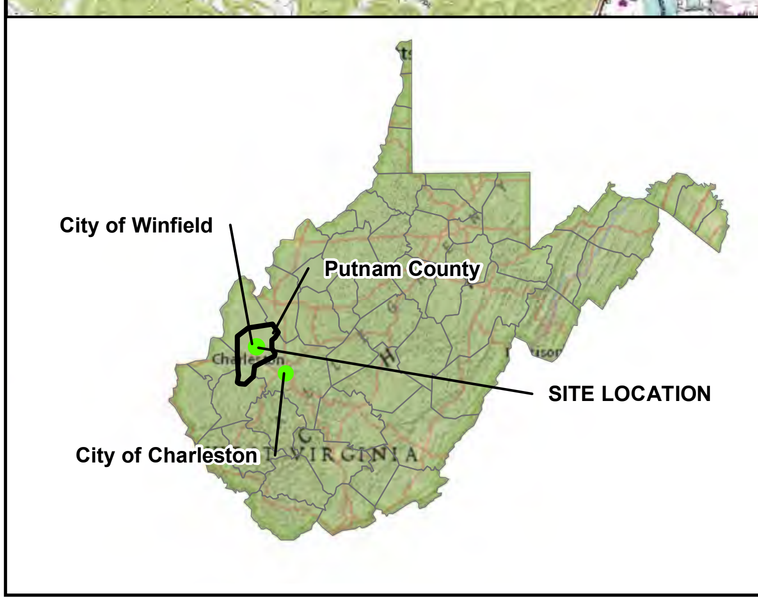
Table 3
Well Construction Details
AEP Amos Generating Plant - FGD Landfill
Winfield, West Virginia

Well ID	Hydraulic Monitoring Only	Location Description to CCR Unit	Northing [a]	Easting [a]	Ground Surface Elevation (ft amsl)	Top of Casing Elevation (ft amsl)	Borehole Depth ft bls	Date Installed	Screen Material	Well Diameter inches	Top of Filter Pack Depth ft bls	Top of Filter Pack Elevation ft amsl	Bottom of Filter Pack Depth ft bls	Bottom of Filter Pack Elevation ft amsl	Top of Screen Depth ft bls	Top of Screen Elevation ft amsl	Bottom of Screen Depth ft bls	Bottom of Screen Elevation ft amsl
Monitor Wells																		
Downgradient																		
MW-1 [b]	X	Southwest	539438.68	1722490.93	709.57	711.57	19.0	7/12/2005	screened PVC	2.00	6.00	703.57	19.00	690.57	8.00	701.57	18.00	691.57
MW-2 [b]		Southwest	539438.31	1722530.69	709.41	711.41	62.5	7/12/2005	screened PVC	2.00	37.00	672.41	62.50	646.91	42.00	667.41	62.00	647.41
MW-3 [b]		Central	541709.83	1724126.13	823.00	NA	32.5	6/27/2005	screened PVC	2.00	9.00	814.00	32.50	790.50	12.00	811.00	32.00	791.00
MW-3R [c]		Central	542088.19	1724096.18	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-3RA [c]		Central	542150.25	1724100.24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-4 [b]		West	542302.52	1721626.94	674.76	676.76	78.5	7/7/2005	screened PVC	2.00	53.00	621.76	78.50	596.26	58.00	616.76	78.00	596.76
MW-5 [b]	X	West	542299.18	1721658.72	674.84	676.84	10.2	7/7/2005	screened PVC	2.00	4.00	670.84	10.20	664.64	5.00	669.84	10.00	664.84
MW-1801		Southwest	539890.17	1722991.78	735.55	738.32	105.0	8/8/2018	screened PVC	2.00	52.00	683.55	76.00	659.55	55.00	680.55	75.00	660.55
MW-1802		West	542831.10	1722351.37	709.78	712.69	114.4	8/21/2018	screened PVC	2.00	45.00	664.78	71.00	638.78	50.00	659.78	70.00	639.78
Upgradient																		
MW-6 [b]		West	540882.81	1722758.78	927.29	929.29	91.0	6/23/2005	screened PVC	2.00	55.00	872.29	78.50	848.79	58.00	869.29	78.00	849.29
MW-7 [b]		South	539657.88	1723948.19	943.15	NA	55.5	6/28/2005	screened PVC	2.00	30.00	913.15	55.50	887.65	32.00	911.15	52.00	891.15
MW-7R [c]		South	539989.31	1723429.40	NA	854.63	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
MW-8 [d]		East	542177.39	1725392.13	935.14	937.68	50.6	7/11/2005	screened PVC	2.00	20.13	915.01	50.63	884.51	30.13	905.01	50.13	885.01
MW-9 [b]		Northeast	544204.89	1724522.80	933.39	935.39	62.5	6/30/2005	screened PVC	2.00	37.00	896.39	62.50	870.89	42.00	891.39	62.00	871.39
MW-10 [b]		Northwest	544079.05	1722812.23	909.43	911.43	157.0	7/6/2005	screened PVC	2.00	85.00	824.43	157.00	752.43	133.00	776.43	153.00	756.43
Piezometers																		
0501 [b]		Central	540588.50	1723508.13	759.08	761.33	80.0	4/21/2005	Slotted PVC	0.75	35.00	724.08	53.00	706.08	40.00	719.08	50.00	709.08
0502 [b]		Central	540563.24	1723508.03	759.46	761.46	22.0	4/21/2005	Slotted PVC	0.75	7.00	752.46	22.00	737.46	11.00	748.46	21.00	738.46
0503 [b]		Central	540843.81	1723858.56	773.00	777.00	50.0	4/20/2005	Slotted PVC	0.75	34.70	738.30	50.00	723.00	39.70	733.30	49.70	723.30
0504 [b]		Central	540840.05	1723859.84	775.40	777.30	24.0	4/20/2005	Slotted PVC	0.75	8.20	767.20	24.00	751.40	13.20	762.20	23.20	752.20
0505 [b]		Central	541325.35	1723551.34	910.89	912.89	200.0	4/27/2005	Slotted PVC	0.75	10.00	900.89	140.00	770.89	117.00	793.89	137.00	773.89
0506 [b]	X	Southwest	539424.97	1722578.68	709.52	711.77	80.0	4/28/2005	Slotted PVC	0.75	20.00	689.52	70.00	639.52	58.00	651.52	68.00	641.52
0507 [b]		Southwest	539428.81	1722523.77	709.99	712.49	18.0	4/22/2005	Slotted PVC	0.75	4.00	705.99	18.00	691.99	7.00	702.99	17.00	692.99
0508 [b]		Central	541996.98	1723377.34	979.22	980.97	200.9	5/3/2005	Slotted PVC	0.75	77.00	902.22	150.00	829.22	127.00	852.22	147.00	832.22
0509 [b]		Central	541748.67	1724111.62	824.40	826.75	100.0	5/3/2005	Slotted PVC	0.75	20.00	804.40	80.00	744.40	68.00	756.40	78.00	746.40
0510 [b]	X	West	540879.83	1722795.65	925.74	927.69	250.0	5/10/2005	Slotted PVC	0.75	30.00	895.74	122.00	803.74	100.00	825.74	120.00	805.74
0511 [b]		Central	541746.94	1724116.35	824.57	826.67	26.0	5/4/2005	Slotted PVC	0.75	3.50	821.07	26.00	798.57	15.50	809.07	25.50	799.07
0512 [b]		Central	542140.89	1724101.76	784.29	786.29	110.0	5/6/2005	Slotted PVC	0.75	20.00	764.29	54.00	730.29	42.00	742.29	52.00	732.29
0513 [b]		Central	542140.89	1724101.76	784.29	786.49	19.0	5/6/2005	Slotted PVC	0.75	2.50	781.79	16.00	768.29	4.00	780.29	14.00	770.29
0514 [b]		Southeast	540555.64	1725145.94	948.40	950.65	150.0	5/12/2005	Slotted PVC	0.75	17.00	931.40	67.00	881.40	55.00	893.40	65.00	883.40
0515 [b]		South	539572.11	1723680.17	933.64	935.49	250.3	5/16/2005	Slotted PVC	0.75	20.00	913.64	82.00	851.64	70.00	863.64	80.00	853.64
0517 [d]	X	East	542182.52	1725397.24	935.14	937.68	139.6	3/19/2005	Slotted PVC	0.75	3.59	931.55	45.99	889.15	33.99	901.15	43.99	891.15
0519 [b]	X	Northeast	543732.89	1725136.52	991.07	992.97	150.5	5/19/2005	Slotted PVC	0.75	15.00	976.07	108.00	883.07	95.00	896.07	105.00	886.07
0520 [b]		West	542378.38	1721739.79	679.31	681.38	100.0	5/24/2005	Slotted PVC	0.75	34.00	645.31	96.00	583.31	84.00	595.31	94.00	585.31
0521 [b]	X	North	544199.55	1724054.58	1004.35	1006.48	70.4	5/23/2005	Slotted PVC	0.75	12.40	991.95	70.40	933.95	60.40	943.95	70.40	933.95
0522 [b]		Northwest	543873.44	1722326.41	901.64	903.54	250.5	5/26/2005	Slotted PVC	0.75	35.00	866.64	155.00	746.64	133.00	768.64	153.00	748.64
0523 [b]		West	542742.24	1722248.67	969.90	972.30	50.0	5/25/2005	Slotted PVC	0.75	24.00	945.90	50.00	919.90	38.00	931.90	48.00	921.90
0524 [b]		West	542745.10	1722251.41	696.91	699.14	18.0	5/25/2005	Slotted PVC	0.75	3.00	693.91	18.00	678.91	8.00	688.91	18.00	678.91
0525 [b]		West	542379.95	1721745.36	679.43	681.48	10.0	5/25/2005	Slotted PVC	0.75	2.00	677.43	10.00	669.43	5.00	674.43	10.00	669.43

NOTES:
Shaded = well not verified or closed
Elevation in feet above mean sea level
a = 1983 West Virginia State Planar Coordinates
b = Source: GAI Consultants. March 2006. Class F Industrial Landfill Facility Application, John E. Amos Landfill, Volume 1, Appendix K - Monitor Well Construction Diagrams.
c = Survey data and boring log not available, coordinates estimated based on AEP DWG. No. 13-30500-11-E.
d = Well was re-surveyed in September 2019. Ground surface was loweredto access stockpiled soil, and subsequently well casing was removed. Top of casing elevation changed from 947.01 to 937.68 at MW-8, and 947.35 to 937.68 at 0517.
amsl = above mean sea level
bls = Below land surface
ft = feet
NA = not applicable

FIGURES





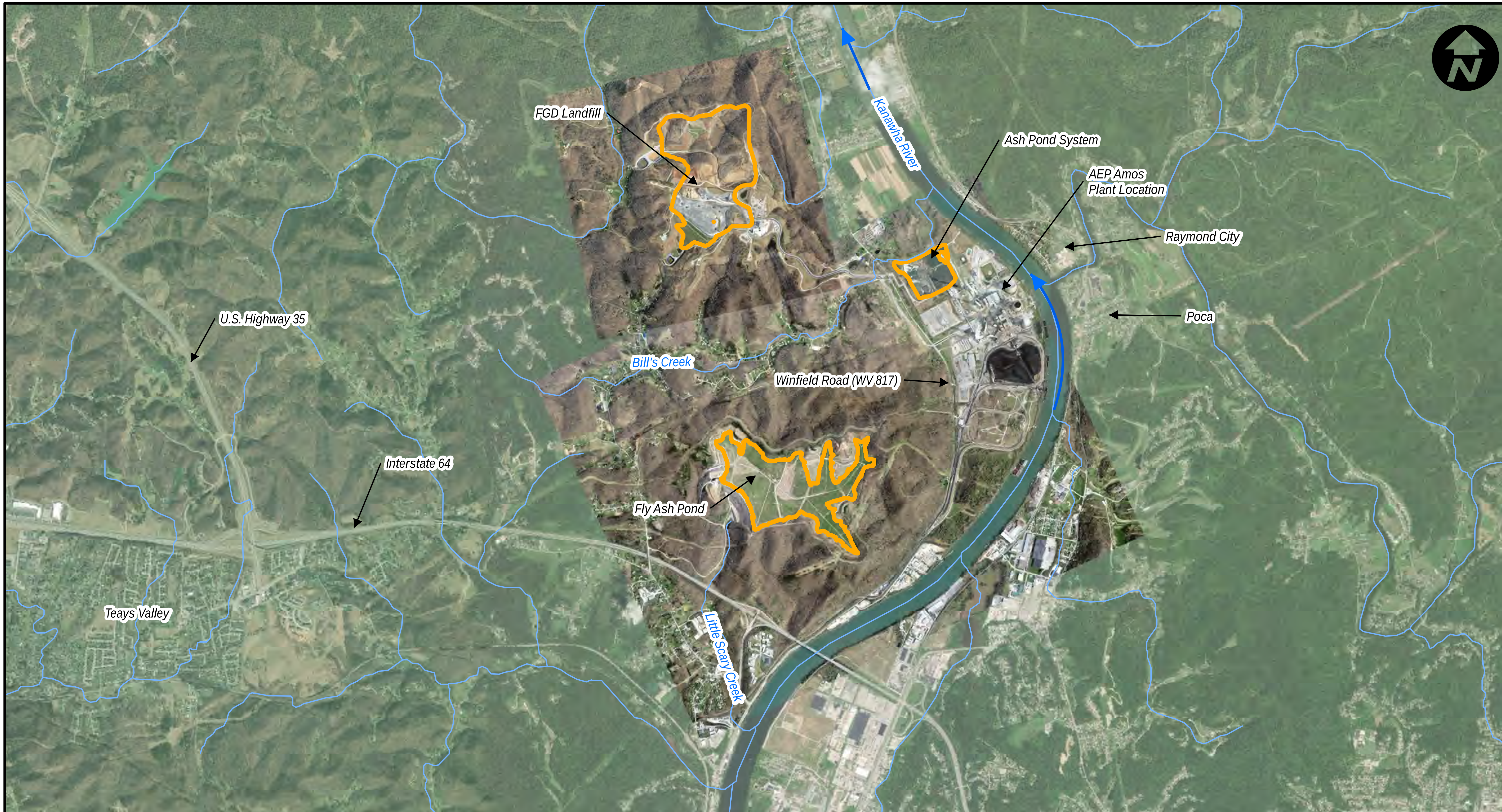
AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

SITE LOCATION MAP

ARCADIS

FIGURE
1

Document Path: Z:\GISProjects_ENV\AEP\Amos\mxd\Landfill Report\Sept2018\F1_ site map.mxd



LEGEND:

- Coal Combustion Residual (CCR) Unit
- Rivers and Streams
- Streamflow Direction

NOTES:
1. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. WEST VIRGINIA 1983 STATE PLANAR COORDINATES

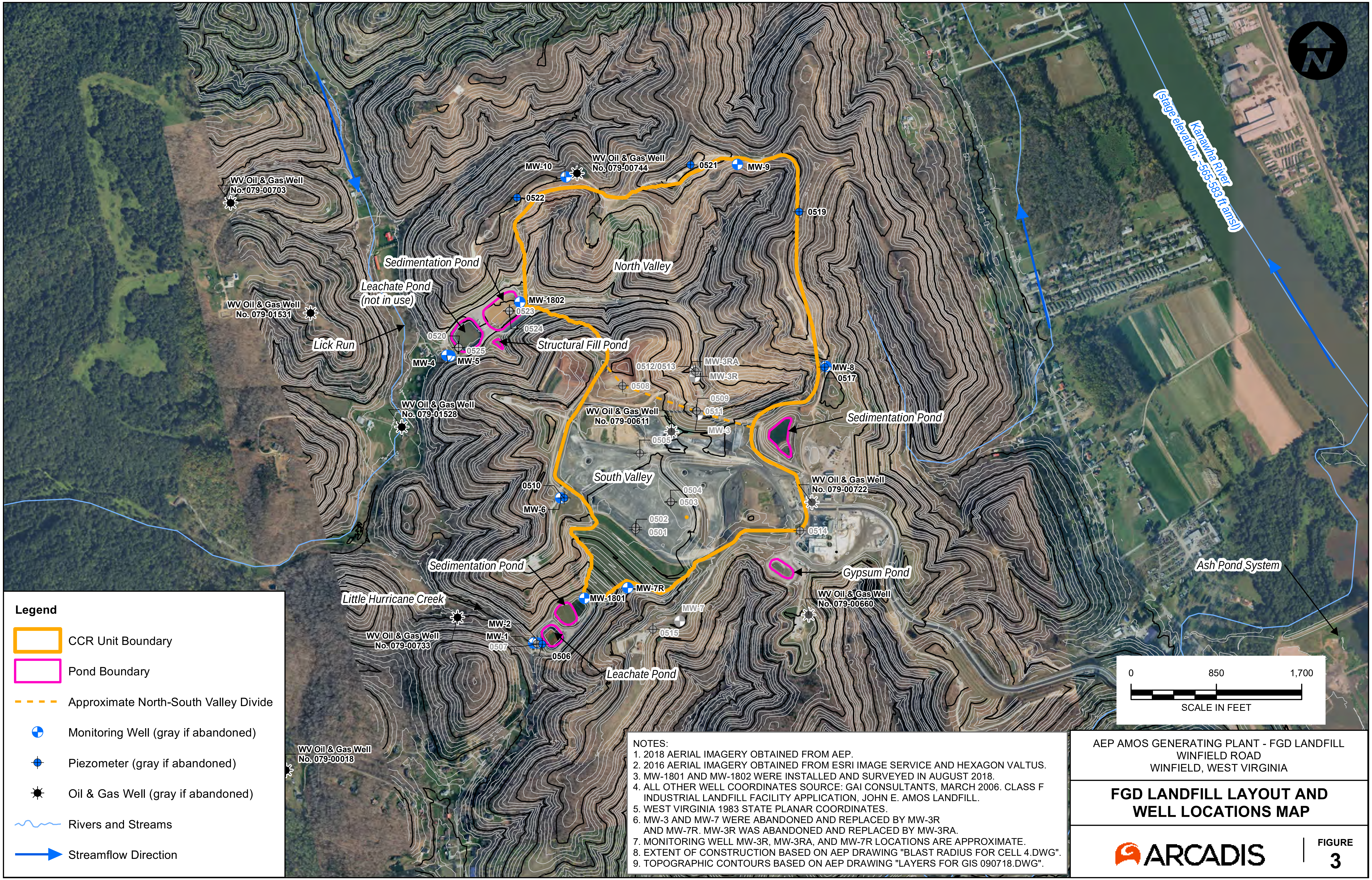
AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

PLANT AND CCR UNIT LOCATION MAP

ARCADIS

FIGURE
2

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: akens
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Landfill Report\Sept2018\F2_AmosRegionalMap.mxd 7/10/2019 7:01:39 AM



Legend

- CCR Unit Boundary
- Pond Boundary
- Approximate North-South Valley Divide
- Monitoring Well (gray if abandoned)
- Piezometer (gray if abandoned)
- Oil & Gas Well (gray if abandoned)
- Rivers and Streams
- Streamflow Direction

NOTES:
1. 2018 AERIAL IMAGERY OBTAINED FROM AEP.
2. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE AND HEXAGON VALTUS.
3. MW-1801 AND MW-1802 WERE INSTALLED AND SURVEYED IN AUGUST 2018.
4. ALL OTHER WELL COORDINATES SOURCE: GAI CONSULTANTS, MARCH 2006. CLASS F INDUSTRIAL LANDFILL FACILITY APPLICATION, JOHN E. AMOS LANDFILL.
5. WEST VIRGINIA 1983 STATE PLANAR COORDINATES.
6. MW-3 AND MW-7 WERE ABANDONED AND REPLACED BY MW-3R AND MW-7R. MW-3R WAS ABANDONED AND REPLACED BY MW-3RA.
7. MONITORING WELL MW-3R, MW-3RA, AND MW-7R LOCATIONS ARE APPROXIMATE.
8. EXTENT OF CONSTRUCTION BASED ON AEP DRAWING "BLAST RADIUS FOR CELL 4.DWG".
9. TOPOGRAPHIC CONTOURS BASED ON AEP DRAWING "LAYERS FOR GIS 090718.DWG".

AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

FGD LANDFILL LAYOUT AND WELL LOCATIONS MAP

ARCADIS

FIGURE
3

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Landfill Report\Sept2018\F3_FGDLandfill_aerial.mxd 5/20/2020 11:38:03 AM

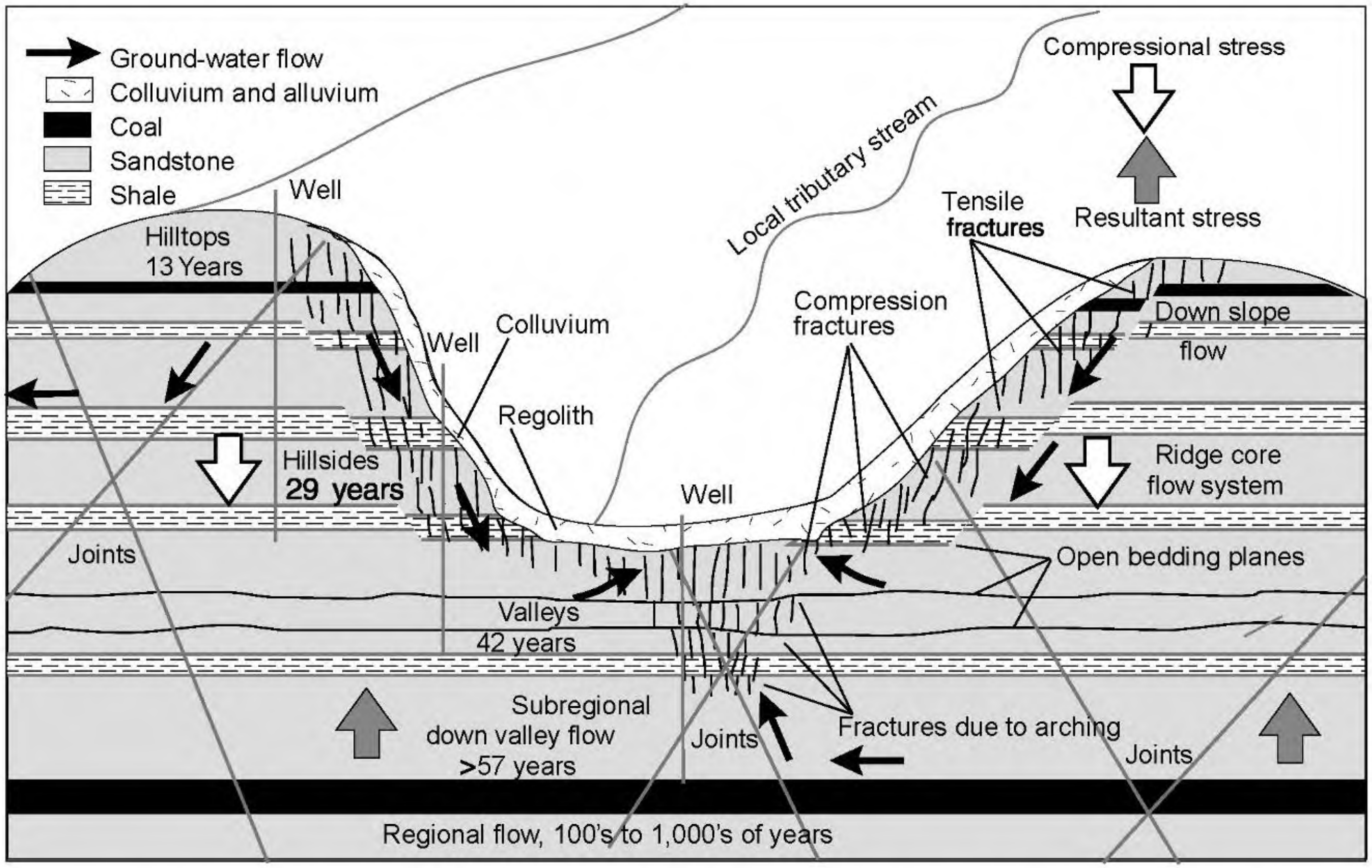


Figure 3. Revised conceptual model of ground-water flow in an Appalachian Plateaus fractured-bedrock aquifer including apparent age of ground water (Modified from Wyrick and Borchers, fig. 3.2-1, 1981 and Kozar, 1998).

References:

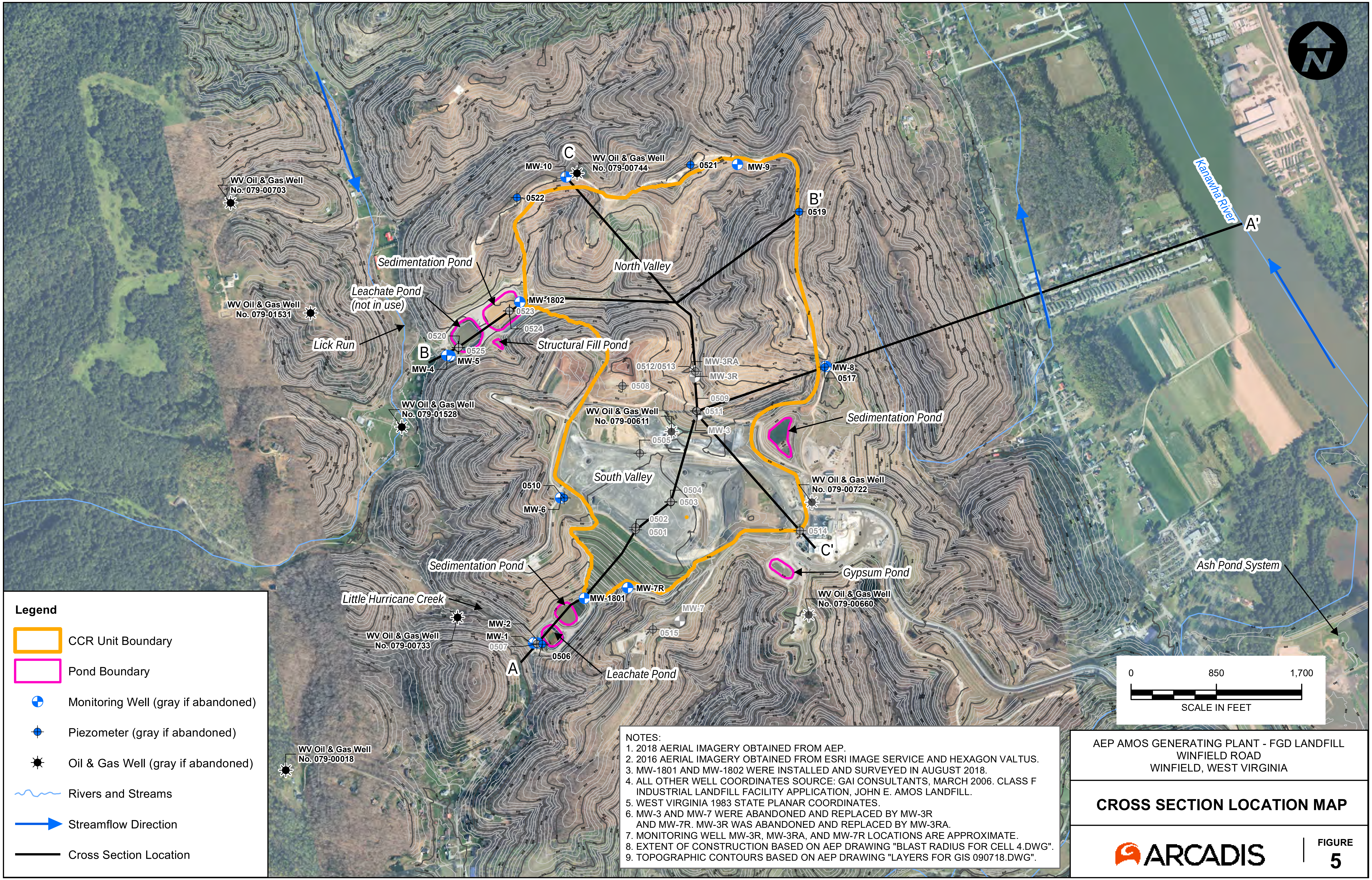
- United States Geological Survey (USGS), Wyrick, G.D. and J.W. Borchers, 1981. Hydrologic Effects of Stress-Relief Fracturing in an Appalachian Valley. Water-Supply Paper 2177.

AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

STRESS RELIEF FRACTURE SYSTEM CONCEPTUAL SITE MODEL

ARCADIS Design & Consultancy for natural and built assets

FIGURE
4



NOTES:
1. 2018 AERIAL IMAGERY OBTAINED FROM AEP.
2. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE AND HEXAGON VALTUS.
3. MW-1801 AND MW-1802 WERE INSTALLED AND SURVEYED IN AUGUST 2018.
4. ALL OTHER WELL COORDINATES SOURCE: GAI CONSULTANTS, MARCH 2006. CLASS F INDUSTRIAL LANDFILL FACILITY APPLICATION, JOHN E. AMOS LANDFILL.
5. WEST VIRGINIA 1983 STATE PLANAR COORDINATES.
6. MW-3 AND MW-7 WERE ABANDONED AND REPLACED BY MW-3R AND MW-7R. MW-3R WAS ABANDONED AND REPLACED BY MW-3RA.
7. MONITORING WELL MW-3R, MW-3RA, AND MW-7R LOCATIONS ARE APPROXIMATE.
8. EXTENT OF CONSTRUCTION BASED ON AEP DRAWING "BLAST RADIUS FOR CELL 4.DWG".
9. TOPOGRAPHIC CONTOURS BASED ON AEP DRAWING "LAYERS FOR GIS 090718.DWG".

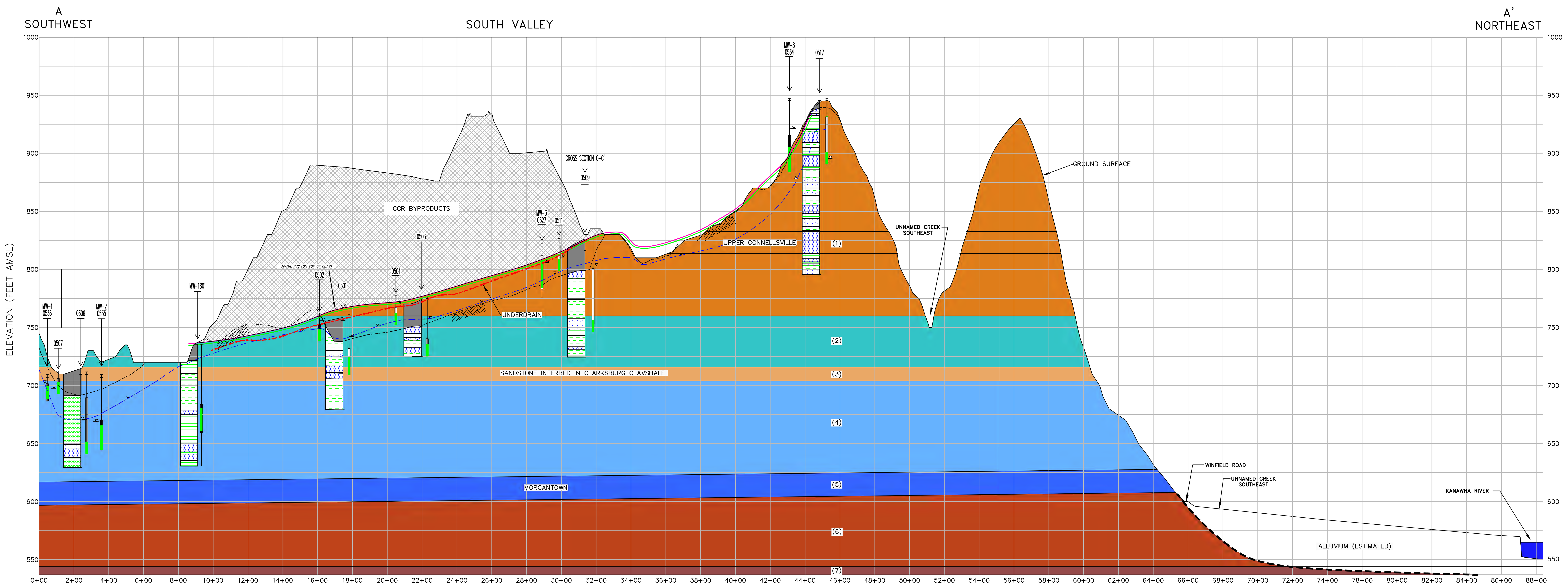
AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION LOCATION MAP

ARCADIS

FIGURE
5

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Landfill Report\Sept2018\F5_CrossSectionTrend_aerial.mxd 5/20/2020 11:49:37 AM



NOTES:
1. THE HORIZONTAL POSITION OF THE SAMPLED BORING IS CORRECT ON THE CROSS SECTIONS. THE PIEZOMETERS AND MONITORING WELLS HAVE BEEN MOVED OFF LOCATION SO THEIR INFORMATION CAN BE SEEN. THEIR VERTICAL LOCATIONS AND LENGTHS ARE CORRECT.
2. SUBGRADE ELEVATION IS BASED ON THE GAI CONSULTANTS DRAWING 2004-384-40-02-E-M004 SHEET 5 OF 25 PROVIDED BY AEP.
3. THE EXTENT AND DEPTH OF KANAWHA RIVER VALLEY ALLUVIUM ARE ESTIMATED. THERE IS NO AVAILABLE LITHOLOGY DATA BETWEEN THE FGD LANDFILL AND KANAWHA RIVER.

LEGEND:

SOIL AND DECOMPOSED ROCK
CLAYSTONE
SANDSTONE
SHALE
SILTSTONE

INFERRED TOP OF ROCK
POTENTIOMETRIC SURFACE TRACE
MW-1 MONITORING WELL NUMBER
0536 BORING NUMBER
LINE INDICATES BORING LOCATION
SUBBASE (AS BUILT)
CLAY LINER (AS BUILT)
GROUNDWATER UNDERDRAIN (AS BUILT)

PVC STICKUP
BENTONITE SEAL
WATER LEVEL RECORDED IN JULY, 2005
SAND PACK
SCREEN
BENTONITE SEAL
PIEZOMETERS AND MONITORING WELLS

(1) ALTERNATING SANDSTONE AND SHALE UNITS INCLUDING THE UPPER CONNELLSVILLE SANDSTONE
(2) LOWER CONNELLSVILLE SANDSTONE WITH SILTY TO SHALEY INTERBEDS
(3) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS
(4) CLARKSBURG HIGHLY FRACTURED AND WEATHERED SHALE ZONE WITH SILTSTONE AND SANDSTONE INTERBEDS
(5) MORGANTOWN SANDSTONE
(6) BIRMINGHAM RED BEDS/SHALE WITH OCCASIONAL SANDSTONE (GRAFFTON SANDSTONE)
(7) DEEP SANDSTONE UNITS

SOURCES:
1. POST-CONSTRUCTION UNDERDRAIN, SUBBASE, CLAY LINER AND 2018 GROUND SURFACE: GAI CONSULTANTS DRAWING 13-30500-05-A SHEET 5 OF 25 PROVIDED BY AEP.

HORIZONTAL SCALE: 1"=300'
VERTICAL SCALE: 1"=45'

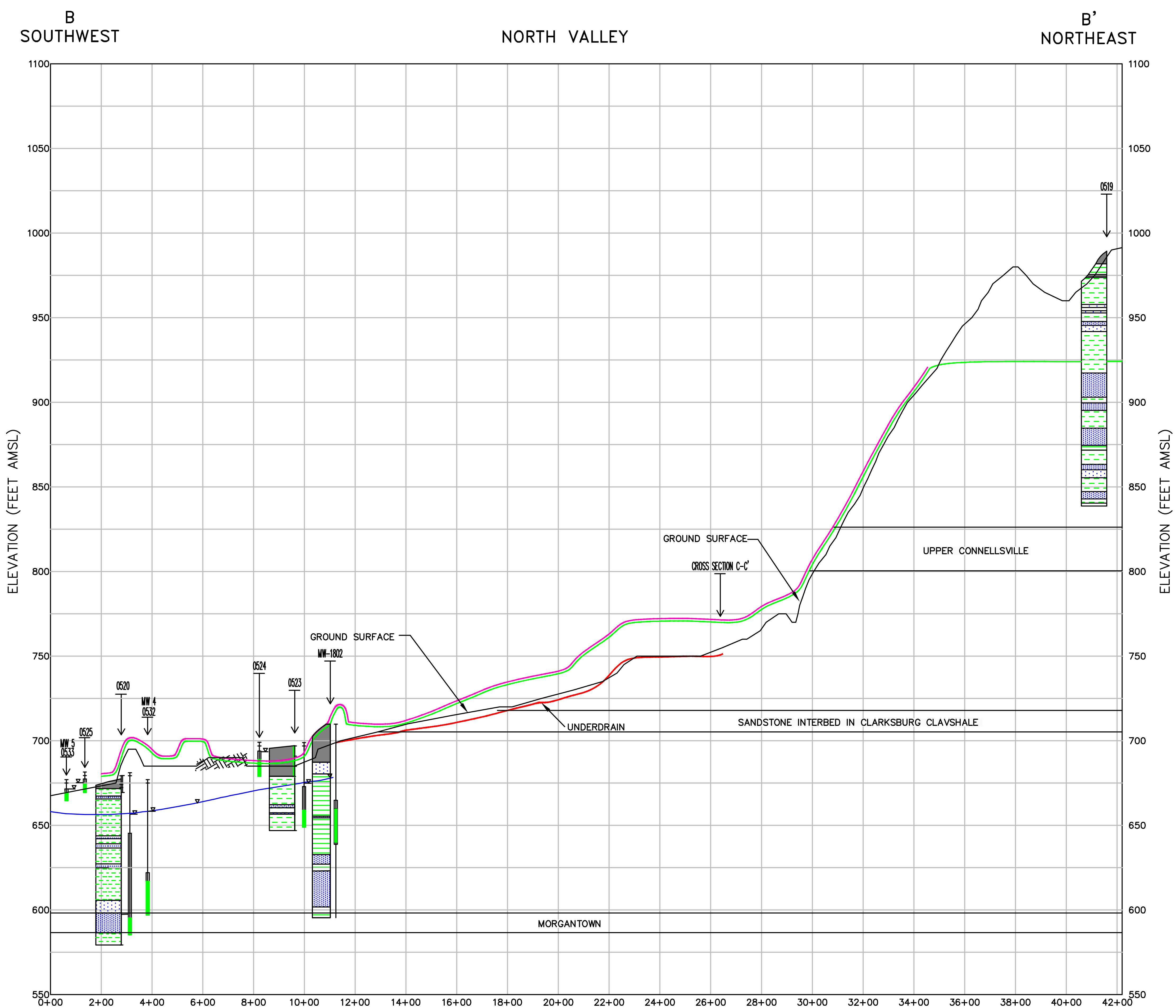
AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

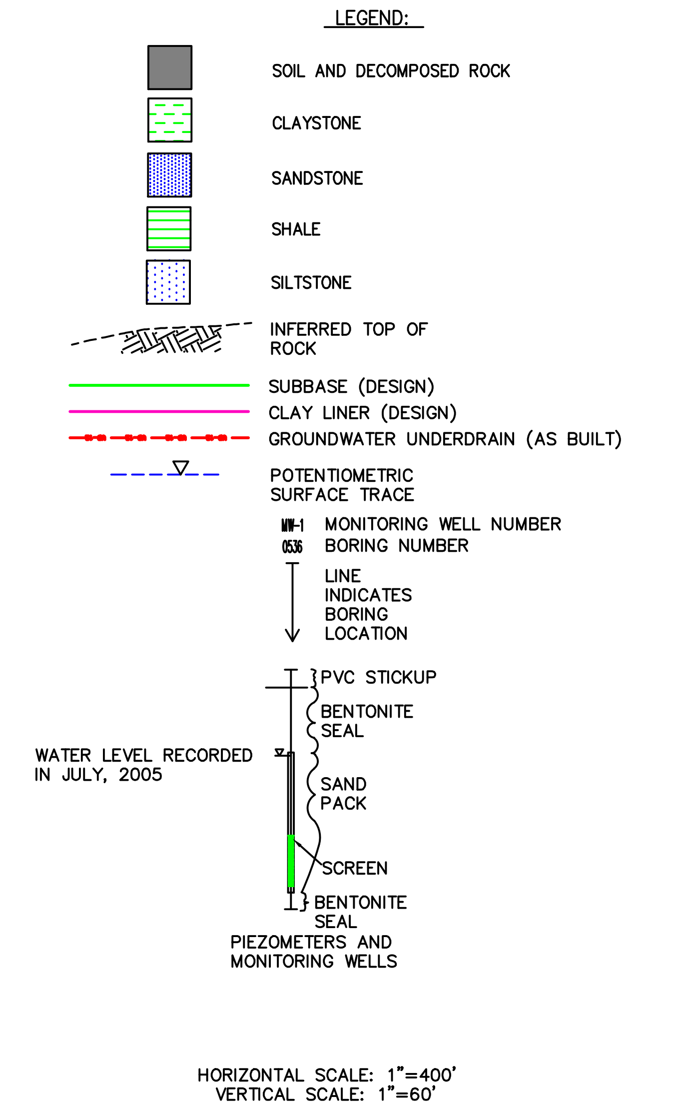
CROSS SECTION A-A'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6A

CITY:(COLUMBUS, OHIO) DIV/GROUP:(IM/DV) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(T. FORTNER) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\AMERICAN ELECTRIC POWER\AEP Amos FGD LANDFILL\2019\WV015976.0004\01-DWG\WV015976-04-LANDFILL-CS.dwg LAYOUT: CS A-A SAVED: 5/23/2019 11:14 AM ACADVER: 23.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB
PLOTTED: 5/24/2019 8:16 AM BY: SMITH, BOB
XREFS:





HORIZONTAL SCALE: 1"=400'
VERTICAL SCALE: 1"=60'

NOTES:
THE HORIZONTAL POSITION OF THE SAMPLED BORING IS CORRECT ON THE CROSS SECTIONS. THE PIEZOMETERS AND MONITORING WELLS HAVE BEEN MOVED OFF LOCATION SO THEIR INFORMATION CAN BE SEEN. THEIR VERTICAL LOCATIONS AND LENGTHS ARE CORRECT.

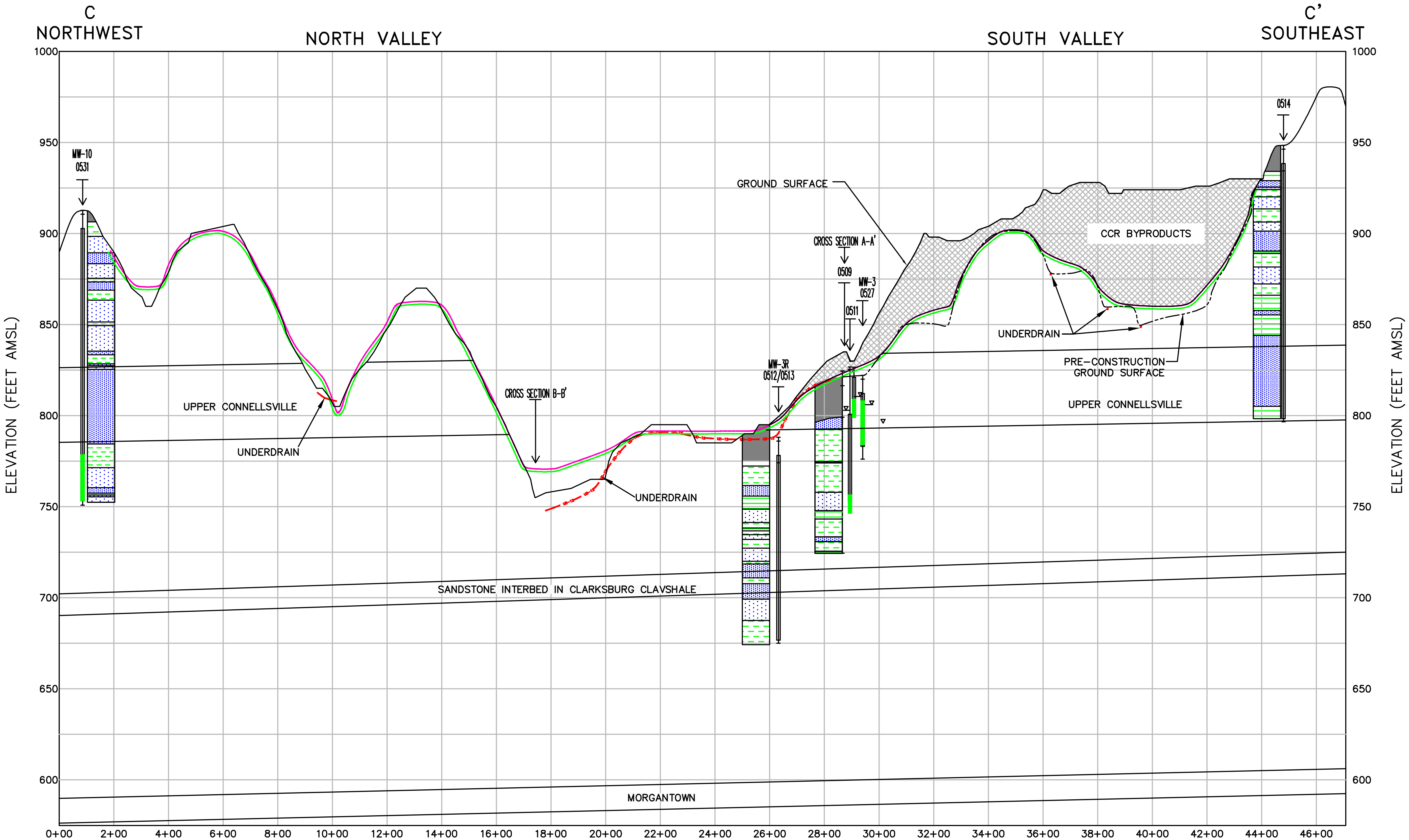
SOURCES:
1. POST-CONSTRUCTION UNDERDRAIN, SUBBASE, CLAY LINER AND 2018 GROUND SURFACE: GAI CONSULTANTS DRAWING 13-30500-05-A SHEET 5 OF 25 PROVIDED BY AEP.

AEP AMOS GENERATING PLANT -FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION B-B'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6B



LEGEND:

- SOIL AND DECOMPOSED ROCK
- CLAYSTONE
- SANDSTONE
- SHALE
- SILTSTONE
- INFERRED TOP OF ROCK
- POTENTIOMETRIC SURFACE TRACE
- MW-1 MONITORING WELL NUMBER
- 0536 BORING NUMBER
- LINE INDICATES BORING LOCATION
- SUBBASE (DESIGN IN NORTH VALLEY, AS BUILT IN SOUTH VALLEY)
- CLAY LINER (DESIGN IN NORTH VALLEY, AS BUILT IN SOUTH VALLEY)
- GROUNDWATER UNDERDRAIN (AS BUILT)

WATER LEVEL RECORDED IN JULY, 2005

PVC STICKUP
BENTONITE SEAL
SAND PACK
SCREEN
BENTONITE SEAL

PIEZOMETERS AND MONITORING WELLS

NOTES:

1. THE HORIZONTAL POSITION OF THE SAMPLED BORING IS CORRECT ON THE CROSS SECTIONS. THE PIEZOMETERS AND MONITORING WELLS HAVE BEEN MOVED OFF LOCATION SO THEIR INFORMATION CAN BE SEEN. THEIR VERTICAL LOCATIONS AND LENGTHS ARE CORRECT.
2. SUBGRADE ELEVATION IS BASED ON THE GAI CONSULTANTS DRAWING 2004-384-40-02-E-M004 SHEET 5 OF 25 PROVIDED BY AEP.

SOURCES:

1. POST-CONSTRUCTION UNDERDRAIN, SUBBASE, CLAY LINER AND 2018 GROUND SURFACE: GAI CONSULTANTS DRAWING 13-30500-05-A SHEET 5 OF 25 PROVIDED BY AEP.

HORIZONTAL SCALE: 1"=400'
VERTICAL SCALE: 1"=60'

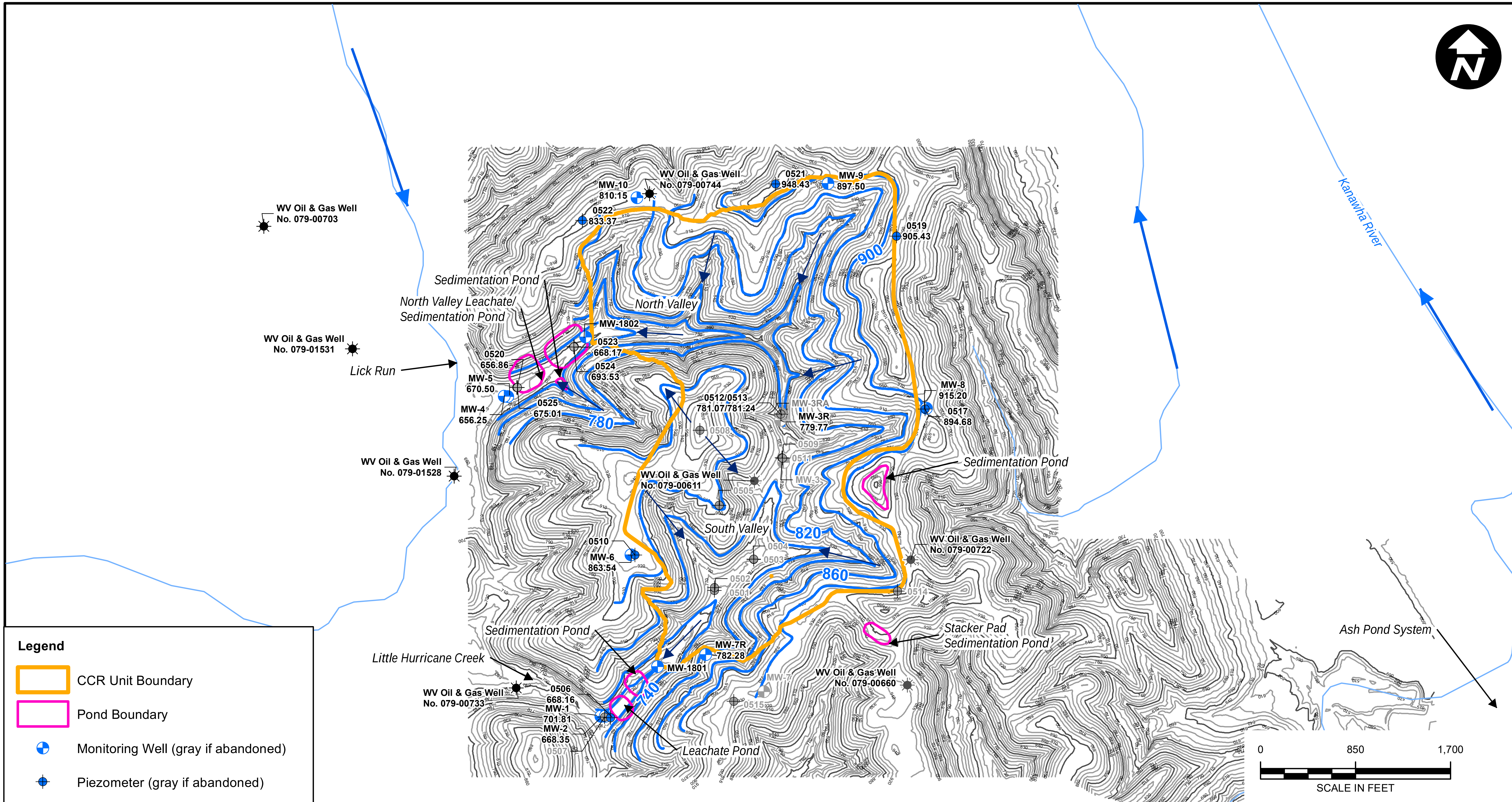
AEP AMOS GENERATING PLANT -FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

CROSS SECTION C-C'

ARCADIS Design & Consultancy for natural and built assets

FIGURE
6C

LAYOUT: CS C-C SAVED: 5/23/2019 11:14 AM ACADVER: 23.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB
PLOTTED: 5/24/2019 8:12 AM BY: SMITH, BOB
XREFS:



Legend

- CCR Unit Boundary
- Pond Boundary
- Monitoring Well (gray if abandoned)
- Piezometer (gray if abandoned)
- Oil & Gas Well (gray if abandoned)
- Rivers and Streams
- Streamflow Direction
- Potentiometric Surface Contour Lines
- Estimated Groundwater Flow Path

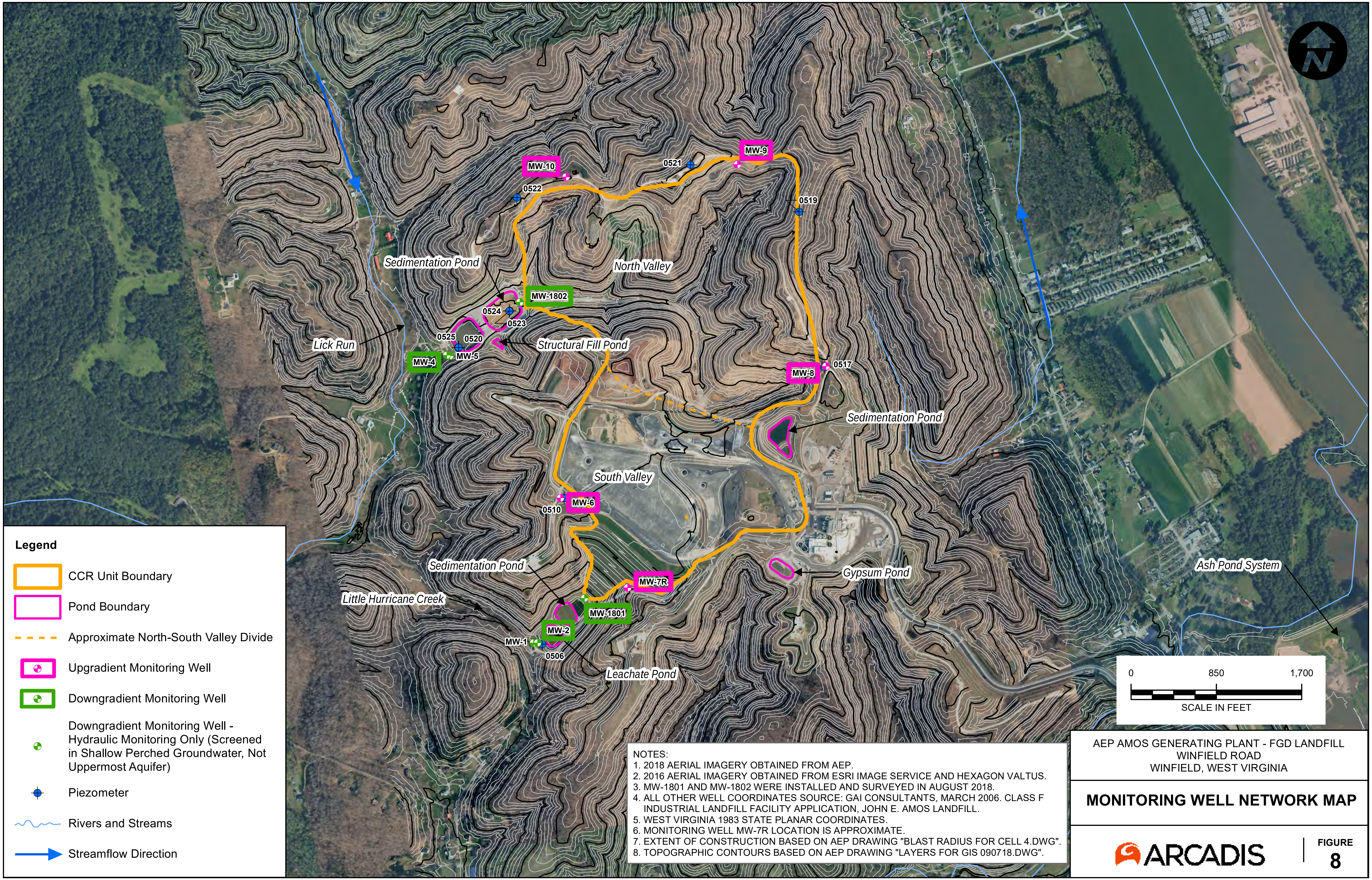
NOTES:
1. PRE-CONSTRUCTION TOPOGRAPHY FROM AEP DRAWING 13-30500-11-E. CONTOUR INTERVAL: 10 FEET
2. WELL COORDINATE SOURCE: GAI CONSULTANTS, MARCH 2006. CLASS F INDUSTRIAL LANDFILL FACILITY APPLICATION, JOHN E. AMOS LANDFILL.
3. WEST VIRGINIA 1983 STATE PLANAR COORDINATES.
4. MW-3 AND MW-7 WERE ABANDONED AND REPLACED BY MW-3R AND MW-7R. MW-3R WAS ABANDONED AND REPLACED BY MW-3RA.
5. MONITORING WELL MW-3R, MW-3RA, AND MW-7R AND LOCATIONS ARE APPROXIMATE.
6. MW-1801 AND MW-1802 WERE NOT GAUGED DURING THE NOVEMBER 2010 SAMPLING EVENT, AS THEY WERE INSTALLED AND SURVEYED IN AUGUST 2018.
7. EXTENT OF CONSTRUCTION BASED ON AEP DRAWING "BLAST RADIUS FOR CELL 4.DWG"

AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

POTENTIOMETRIC SURFACE MAP
NOVEMBER 22, 2010

ARCADIS

FIGURE
7



Legend

- CCR Unit Boundary
- Pond Boundary
- Approximate North-South Valley Divide
- Upgradient Monitoring Well
- Downgradient Monitoring Well
- Downgradient Monitoring Well - Hydraulic Monitoring Only (Screened in Shallow Perched Groundwater, Not Uppermost Aquifer)
- Piezometer
- Rivers and Streams
- Streamflow Direction

NOTES:
1. 2018 AERIAL IMAGERY OBTAINED FROM AEP.
2. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE AND HEXAGON VALTUS.
3. MW-1801 AND MW-1802 WERE INSTALLED AND SURVEYED IN AUGUST 2018.
4. ALL OTHER WELL COORDINATES SOURCE: GAI CONSULTANTS, MARCH 2006. CLASS F INDUSTRIAL LANDFILL FACILITY APPLICATION, JOHN E. AMOS LANDFILL.
5. WEST VIRGINIA 1983 STATE PLANAR COORDINATES.
6. MONITORING WELL MW-7R LOCATION IS APPROXIMATE.
7. EXTENT OF CONSTRUCTION BASED ON AEP DRAWING "BLAST RADIUS FOR CELL 4.DWG".
8. TOPOGRAPHIC CONTOURS BASED ON AEP DRAWING "LAYERS FOR GIS 090718.DWG".

AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

MONITORING WELL NETWORK MAP

ARCADIS

FIGURE
8

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Landfill Report\Sept2018\F8_FGDLandfill_aerial.mxd 5/20/2020 11:32:55 AM

APPENDIX A

Field Methodology

APPENDIX A

FIELD METHODOLOGY

Based on the recommended well network modifications, the following generalized tasks were completed:

- Installation of 2 bedrock borings at the FGD Landfill
- Installation and development of 2 new monitoring wells at the FGD Landfill

Arcadis provided oversight for drilling and installation of 2 bedrock monitoring wells by an AEP-licensed drilling crew. Implementation of the field activities began with the initial utility clearance activities beginning July 2018. Drilling, packer testing, well installation, and well development operations began on August 7, 2018 and ended on August 22, 2018. Well yield testing was completed on September 11 and 12, 2018.

Utilities Clearance

AEP completed a plant dig permit, which identified private plant utilities near the new monitoring well and borings locations. Arcadis retained the services of a utility locating subcontractor (The Underground Detective) to perform a geophysical survey (e.g. ground penetrating radar, electromagnetic survey, etc.) over an area of 25 feet by 25 to locate utilities at each new monitoring well location. The private utility locator also used an air knife/soil vacuum extraction system to pre-dig the proposed borehole locations to a diameter at least 10 percent larger than the largest diameter tooling to be used during drilling and to a depth of 8 feet below the ground surface (bgs) or to bedrock, whichever was encountered first.

Decontamination

All down-hole tools or equipment were decontaminated in accordance with ASTM D5088 prior to the start of drilling and between each borehole location. At a minimum, the tooling was washed with detergent solution followed by a potable water rinse. The use of a pressure washer was used when possible. Containerization was not required for decontamination water because all work was completed outside of the FGD Landfill area and not considered contaminated. Water for decontamination or drilling was potable and obtained from the AEP Amos Plant.

Borehole Advancement and Stratigraphy/Lithology

Bedrock boreholes began by using standard hollow-stem auger methods with a minimum 8.25" inner diameter auger in accordance with ASTM D5784 until the soil-rock interface was encountered. Continuous spit-spoon sampling and standard penetration testing was performed in accordance with ASTM D1586 until bedrock was encountered. A minimum 6-inch diameter PVC surface casing was temporarily set 2 feet into the competent bedrock prior to beginning rock coring. Bentonite chips were placed in the annulus between the borehole and the surface casing to ground surface, serving as a temporary seal around the surface casing during drilling operations. The chips were placed in a controlled manner to prevent contamination of the well. Chips were hydrated periodically during placement. The bentonite annulus seal was allowed to set for approximately 12 hours (overnight) before continuing with rock coring. The 6-inch PVC casing was removed upon installation of the permanent well casing.

Rock core samples were completed with NQ sized wireline system in accordance with ASTM D 2113-93. Upon completion of coring, the bore holes were enlarged to 6" diameter using rotary drilling methods in accordance with ASTM D 5783-95.

Arcadis logged all geologic samples collected during the drilling process for bedrock monitoring wells. Field logging of the soil and rock samples were performed in accordance with ASTM D5434-12. Unconsolidated soils were classified under the Unified Soil Classification System (USCS), while rock core logging was classified in accordance with the *Midwest Geosciences Group; Field Guide for Rock Core Logging and Fracture Analysis*. Boring logs and well construction details for all installations completed during this scope of work are provided in **Appendix B**. No unconsolidated soil samples were collected. Rock coring was completed continuously using a NQ wireline system that retrieved a 2-inch diameter core to the termination depth. The borehole was flushed to remove any remaining drilling debris.

Packer Testing

Single-straddle packer tests were conducted on select intervals of the open core holes. Final determination of intervals for packer testing was determined based on review of lithologic boring logs, and consultation between Arcadis and AEP. At a minimum, straddle packer testing was completed at the anticipated depth interval corresponding to monitoring well screen depths. Upper and lower inflatable rubber packers attached to a rigid riser pipe were inserted to the specified test interval. Once at the test interval, the rubber packers were inflated to create a seal. The riser pipe was fitted with a pressure gauge at a known and documented distance above the ground surface, as well as a totalizing flow meter. Water was injected through the riser pipe at a constant pressure, while the Arcadis representative measured and recorded totalizing flow volume and gauge pressure at specified time intervals for a total of up to 30 minutes per each pressure. At the completion of the straddle packer test, water injection ceased and gauge pressure was monitored until it returned to pre-test conditions. Once gauge pressure stabilized, the packers were deflated and either removed from the borehole or to the next specified depth interval to repeat the straddle packer test procedure. Straddle packer test data was analyzed according to the method described in U.S. Department of the Interior, Bureau of Reclamation, 1977. Ground Water Manual, A Water Resources Technical Publication, pp. 258-264. After packer testing, the core hole was reamed to 8-inch diameter using air rotary drilling methods and water injections to remove cuttings in accordance with ASTM D 5782-95-Use of Direct Air Rotary Drilling for Geoenvironmental Exploration and the Installation of Subsurface Water Quality Monitoring Devices. The bedrock boreholes were flushed of cuttings at the completion of reaming using potable water. The final borehole depth was confirmed via tagline measurement following borehole flushing.

Monitoring Well Installation and Construction

Monitoring well installation and construction was completed in accordance with the AEP- approved work plan prepared by Arcadis. Prior to beginning work, daily health and safety meetings were held each morning, including a thorough discussion of the day's scope of work, identified hazards, hazard mitigation, and completion of the AEP Job Safety Analysis documentation in the presence of AEP staff. Health and safety documentation was retained by both Arcadis and AEP.

Based on the field conditions, Arcadis directed AEP regarding the total drilling and well completion depths, well construction configuration, and well materials to be used. Screened intervals for bedrock monitoring wells targeted the uppermost saturated bedrock unit. Final well depths and screened intervals are included in **Appendix B**.

All monitoring wells were constructed in general accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011.

Bedrock monitoring wells were constructed of 2-inch Schedule 40 PVC risers and screens. The well was double-cased, with a 6-inch PVC surface casing installed into the upper two feet of bedrock. The surface casing was grouted in place using a bentonite grout. Well screens were constructed of 20 slot (0.020 ft screen openings) PVC. A primary filter pack of Global® #5 sand was placed across the screened interval to approximately 2 feet above the screen, followed by approximately 1 foot of secondary (finer gradation) filter pack composed of Global® #6 sand. Boring logs and well construction diagrams are provided in **Appendix B, Table 3** and well survey information can be seen in **Appendix C.**

Monitoring Well Development

Well development was completed at both newly-installed wells. Well development at new wells was performed a minimum of 48 hours after the completion of well construction. The static water level was measured in the well prior to initiation of development. All wells were developed through a pump and surge method in accordance with West Virginia Department of Environmental Protection Title 47 Series 60 Monitoring Well Design Standards dated June 21, 2011. The well was initially purged with a pump to remove loose material and fines from the well. Well development data are included as **Appendix D**.

Monitoring Well Yield Testing

Well yield testing was conducted by Arcadis in September 2018 at wells MW-1801 and MW-1802, both of which are installed in the uppermost aquifer. Yield tests were completed by pumping each well at variable and steady state extraction rates and measuring the water level response in each well during and after pumping (recovery). Extraction rates were maintained using a submersible pump. High-resolution water level data were collected during both pumping and recovery phases via data-logging pressure transducers installed in each test well. A summary of yield testing results is provided on **Table 2** and solution reports with individual curve matches are provided in **Appendix D.**

High Resolution Water Level Monitoring

Continuous water level data in the SRF and shallow alluvial zone were collected in May through August 2018 in order to better characterize hydrogeologic conditions and permeability within the SRF system and shallow alluvium at the FGD Landfill. Detailed information is presented in **Appendix D**.

Pressure transducers were installed at seven hydraulic monitoring locations that included three SRF monitoring wells located upgradient on ridges in the north valley (MW-8, MW-9 and MW-10), two down gradient SRF monitoring wells with one in the south valley (MW-2) and north valley (MW-4), and two down gradient shallow alluvium monitoring wells with one in the south valley (MW-1) and one north valley (MW-5). Water levels were recorded continuously during the testing period.

APPENDIX B

Boring/Well Construction Logs and Closure Information

ARCADIS

GAI Consultants, Inc. 2006

Boring Logs

B-0501 to B-0525 & MW-1 to MW-10

N 540558.4978
E 1723508.1269 Grade El. 759.08

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. 0501
ELEVATION ______ GWL 0 HRS 8.4 PROJECT NO. C040387.40-01
HRS ______
DATE 18-19 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	1 1	S-1			V. LOOSE	BROWN	SANDY SILT	ml	SLIGHTLY MOIST
1.5	1	REC 0.2							
	1	S-2							
3.0	3 3	REC 0.8			LOOSE	BROWN	SANDY SILT AND SMALL ROCK FRAGS.	ml	SLIGHTLY MOIST
	1 1	S-3			V. STIFF	BROWN	SILTY CLAY	cl	* 2.0 TSF
4.5	3	REC 0.9							
	1	S-4				GRAY +			
6.0	3 6	REC. 0.8			V. STIFF	BROWN MOTTLED	SANDY CLAY MOIST	cl	* 2.75 TSF
	5 6	S-5				GRAY +			WATER 26'
7.5	9	REC 1.3							
	4	S-6			V. STIFF	BROWN MOTTLED	SANDY CLAY MOIST	cl	* 3.0 TSF
9.0	4 4	REC 1.5				GRAY +			
	3 6	S-7			V. STIFF	BROWN MOTTLED	SANDY CLAY MOIST	cl	* 3.0 TSF
10.5	7	REC							
	5	S-8				GRAY +			
12.0	8 10	1.3			V. STIFF	BROWN MOTTLED	SANDY CLAY MOIST	cl	* 3.75 TSF
	3 7	S-9			HARD	GRAY + BROWN	SANDY CLAY : DECOMP. CLAYSTONE	Cl	* 4.5 TSF
13.5	8	REC 1.5				MOTTLED			
	4	S-10				GRAY +			
15.0	6 10	REC. 1.5			HARD	BROWN MOTTLED	SANDY CLAY : DECOMP. CLAYSTONE	cl	* 4.5 TSF
	3 5	S-11			HARD		SANDY CLAY : DECOMP. CLAYSTONE	cl	* 4.0 TSF
16.5	5	REC. 1.5							
	3	S-12							
18.0	4 4	REC 1.5			HARD	GRAY	SANDY CLAY: DECOMP CLAYSTONE	cl	* 4.25 TSF
	2 2	S-13			HARD	GRAY	SANDY CLAY: DECOMP CLAYSTONE	cl	* 4.5 TSF
19.5	2	REC. 1.5							
	3	S-14				GRAY, BLUE			
21.0	6 16	REC. 1.5			HARD	BROWN MOTTLED	SANDY CLAY: DECOMP CLAYSTONE	cl	* 4.5 TSF
22.3	16 24 50/0.3	S-15 REC. 1.3		22.3	SOFT	GRAY	DECOMPOSED SANDY CLAYSTONE		
					V. SOFT	GRAY &	HIGHLY WEATHERED CLAYSTONE	VBR-	30° SLICKENSIDED FRAC-
					TO SOFT	MAROON MOTTLING		BR	TURES AT 23.5, 23.75, 24.9
									LOW ANGLE FRACTURES AT
									22.7, 23.0, 23.6, 23.9, 24.05
	9.2 9.2	100%	71	27.4					24.2, 24.5, 24.6, 25.2, 26.0,
					SOFT	GRAY	SANDY CLAYSTONE	BR-BL	26.3, 27.7, 28.0, 28.4,
				29.0					29.6, 30.3
					SOFT TO	GRAY	INTERBEDDED SANDY SILTSTONE AND SANDSTONE	BL	45 FRACTURE 27.25-27.4

REMARKS ** DRILLED BY [illegible] 4000-T2 TRACK DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS, 4" Ø CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0501

(3-3)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0501
ELEVATION ______ GWL 0 HRS 8.4 PROJECT NO. C040384.40-01
HRS *
DATE 18-19 APR 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
31.5					M. SOFT	GRAY	INTERBEDDED SANDY SILTSTONE AND SANDSTONE (CON'T)	BL	LOW ANGLE FRACTURES 33.6, 34.4, 36.0, 36.2, 36.7, 37.35, 37.8, 38.0, 38.2, 41.1,
				34.6	SOFT	GRAY + MAROON MOTTLED	CLAYSTONE	VBR-BR	30° FRACTURES W/ SLICKENSIDES 35.4, 39.25, 39.75, 40.0, 41.3-41.5 BROKEN ZONES 35.6-35.8, 40.0-41.0, 41.5-42.3
	10.0 / 10.0	100%	70						
41.5				42.3	M. SOFT TO M. HARD	GRAY	SANDSTONE	BL	LOW ANGLE FRACTURES 42.3, 43.25, 48.0, 48.1, 48.5, 50.2, 51.5, 51.7, 52.2, 52.7, 53.4
	9.3 / 10.0	93%	88						
				48.0	SOFT	DK GRAY	SANDY CLAYSTONE	BR	
				48.5	M. SOFT TO M. HARD	GRAY	INTERBEDDED SANDSTONE AND SANDY SILTSTONE	BL	
51.5				53.4	SOFT	GRAY + MAROON MOTTLED	SANDY TO SILTY CLAYSTONE	VBR-BR	LOW ANGLE FRACTURES 53.7, 54.05, 54.3, 54.85, 55.4, 55.55, 55.7, 55.85, 56.35, 56.5, 56.7, 56.9, 57.2, 58.0, 58.5, 58.9, 59.4, 60.6, 60.85, 61.35 BROKEN ZONE 59.3-60.6
	9.3 / 10.0	93%	31						

REMARKS ** ~30° SLICKENSIDED FRACS. 54.4, 57.55, 57.9, 58.25, 58.75, 61.1

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0501

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 AMOS POWER PLANT ST ALBANS, WV | BORING NO. B0501
ELEVATION ______ GWL 0 HRS 8.4 | PROJECT NO. C040384.40-01
HRS ______
DATE 18-19 APR 2005 CLASSIFIED BY DAN SANGER | PAGE 3 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
61.5				61.6					
					SOFT	MAROON LT GRAY	CLAYSTONE HIGHLY WEATHERED -	VBR-	61.5-65.9 APPARENT
						YELLOW, AND	CORE IS HIGHLY PITTED	BR	ZONE OF CORE LOSS
						PURPLE MOTTLING			BROKEN ZONE: 69.5-66.7
									LOW ANGLE FRACTURES
	5.6 / 10.0	56%	28%						66.9, 67.15, 67.3, 67.75,
									67.85, 68.9, 69.1, 69.65,
									70.6
71.5									30° SLICKENSIDED
									FRACTURE 69.9, 71.1,
									71.4, 74.2, 75.0
									BROKEN ZONE 71.5-72.3
	7.6 / 8.5	89%	27						APPARENT CORE LOSS 72.3-
									73.2
									LOW ANGLE FRACTURES
80.0				80.0					74.55, 74.7, 75.35, 75.55,
							BOTTOM OF BORING : 80.0'		75.8, 76.1, 76.75, 77.5,
									77.65, 77.85, 78.2, 78.5
									78.65, 78.75, 78.85,
									79.0, 79.2, 79.5, 79.8,
									79.9

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B0501

(B-3)

N 540563.2422
E 1723508.0316 Grade El. 759.46

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0502
ELEVATION 758± GWL 0 HRS PROJECT NO. C040384.40-01
HRS
DATE 21 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							AUGER W/O SAMPLING TO 22'		
							SET PIEZOMETER - TIP AT 21'		
				22.0					
							BOTTOM OF BORING: 22'		

REMARKS** DRILLED BY TERRA TESTING INC. USING A SIMCO 4000 TZ TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" Ø SOLID STEM AUGERS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0502
(3-4)

N 540843.8055
E 1723858.5630 Grade El. 775.00

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. 0503
ELEVATION ______ GWL 0 HRS 11.4 PROJECT NO. C040384.40-01
HRS ______
DATE 18-19 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 2

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	1 W.O.H	S-1			V. LOOSE	BROWN	CLAYEY SILT	ml	MOIST
1.5	W.O.H	REC 1.0							
	1	S-2							
3.0	1 1	REC 1.1			V. LOOSE	BROWN	CLAYEY SILT, TRACE SAND	ml	MOIST
	1 1	S-3			V-SOFT	BROWN	SILTY CLAY	cl	WET, * 0.5
4.5	3	REC 0.1							
	2	S-4				GRAY +			
6.0	4 6	REC 1.4			HARD	BROWN MOTTLED	SANDY CLAY	cl	SLIGHTLY MOIST, * 4.5
	3 6	S-5			M. DENSE	BROWN	SANDY SILT	ml	SLIGHTLY MOIST
7.5	8	REC. 0.4							
	3	S-6				GRAY +			
9.0	9 12	REC. 1.2			HARD	BROWN MOTTLED	SANDY CLAY: DECOMP. CLAYSTONE	cl	SLIGHTLY MOIST, * 4.5 TSF
	3 3	S-7			STIFF		SANDY CLAY " "	cl	MOIST * 3.75 TSF
10.5	4	REC. 0.4							
	6	S-8				GRAY +			
12.0	5 5	REC. 1.2			HARD	BROWN MOTTLED	SANDY CLAY " "	cl	SLIGHTLY MOIST, * 4.5 TSF
	3 3	S-9			HARD	GRAY + BROWN	SANDY CLAY " "	cl	SLIGHTLY MOIST *4.5 TSF
13.5	5	REC. 1.3				MOTTLED			
	3	S-10							
15.0	5 5	REC. 1.0			HARD	GRAY	SANDY CLAY " "	cl	SLIGHTLY MOIST, 4.5 TSF
	3 3	S-11			HARD	GRAY	SANDY CLAY " "	cl	SLIGHTLY MOIST 4.5 TSF
16.5	4	REC 1.3							
	1	S-12							
18.0	2 1	REC 1.4			V-STIFF	GRAY	SANDY CLAY; SOME SILT "	cl	MOIST, * 3.75 TSF
	1 3	S-13			V. STIFF	DARK GRAY	SANDY CLAY, TRACE ORGANICS	cl	SLIGHTLY MOIST, * 3.75 TSF
19.5	6	REC. 1.3							
	6	S-14							
21.0	5 6	REC. 1.2			V. STIFF	DARK GRAY	SANDY CLAY, TRACE ORGANICS	cl	SLIGHTLY MOIST, * 3.5 TSF
	2 2	S-15			LOOSE	BLUE + GRAY	CLAYEY SAND, TRACE ROCK FRAGMENTS	SC	MOIST
22.5	4	REC 1.3							
	28	SS-16		23.4	SOFT	BLUE-GRAY	DECOMPOSED CLAYSTONE FRAGMENTS		
23.4	50/0.4	REC. 0.9							
				24.0	SOFT	GRAY	DECOMPOSED CLAYSTONE	VBR	TOP OF ROCK 23.4
					M. SOFT TO M. HARD	GRAY	SILTY SANDSTONE	VBR-BR	CLAY SEAM 24.7, 29 ?
									VERTICAL FRACTURES 23.4-24.4,
									25.25-25.3, 27.45-27.55
	7.5 7.5	100%	35						LOW ANGLE FRACTURES: 23.6,
									23.8, 24.05, 24.15, 24.3,
									24.4, 24.55, 24.9, 25.05, 25.15

REMARKS** DRILLED BY TERRA TESTING USING A SIMCO 4000-T2 TRACK MOUNTED DRILL RIG. BORING ADVANCED USING 5 1/4" Ø SOLID STEM AUGERS, NQ CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0503
(B-5)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0503

ELEVATION ________ GWL 0 HRS 11.4 PROJECT NO. C040384.40-01

HRS ________

DATE 18-19 APR 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 2

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
30.9				30.7					
									25.25, 25.3, 25.35, 25.5,
				32.0	SOFT	GRAY	CLAYSTONE	UBR-BR	25.55, 25.75 26.0, 26.15,
					SOFT	GRAY	SANDY CLAYSTONE	BR	26.25, 26.5, 26.7, 26.95, 27.2
				33.9					27.35, 27.45, 27.85, 27.95,
					M. SOFT	GRAY	SANDY SILTSTONE	BR	28.5, 28.75, 29.15, 29.35,
	10.0 10.0	100%	77	36.3					29.7, 30.3, 30.4, 30.9, 31.1
					SOFT	GRAY	CLAYSTONE		31.4, 31.7 32.15, 32.4
									32.7, 32.8, 33.4, 33.9 34.4
						GRAY + MAROON MOTTLED			35.1 35.5, 35.9, 36.7, 36.9
									37.1 37.6, 38.0, 38.75,
40.9									39.2, 39.3, 39.5, 40.9,
									41.6, 42.3, 42.75, 43.0,
				42.5					44.2, 44.8 45.05, 45.6,
					M. SOFT	GRAY	INTERBEDDED SANDY SILTSTONE AND	BR	46.15, 46.95, 47.6, 49.2,
							SANDSTONE		49.4, 50.0
	8.9 9.1	98%	82						30° FRACTURES 28.85,
				47.4					39.35 42.7
					SOFT	GRAY + MAROON MOTTLED	SANDY CLAYSTONE	BR-BL	BROKEN ZONE 40.9-41.6
50.0				50.0					
							BOTTOM OF BORING 50.0		

REMARKS ** ________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0503

(B-5)

N 540840.0544
E 1723859.8367 Grade El. 775.40

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0504

ELEVATION ________ GWL 0 HRS ________ PROJECT NO. C040384.40-01

HRS ________

DATE 20 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							AUGER w/o SAMPLING		
							TO 24' SET PIEZOMETER		
							TIP AT 23.2'		
				24.0					
							BOTTOM OF BORING : 24.0'		

REMARKS ** DRILLED BY TERRA TESTING USING A SIMCO 4000 T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" Ø SOLID STEM AUGERS

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B0504

gai consultants
transforming ideas into reality

N 541325.3505
E 1723551.3362 Grade El. 910.89

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B 0505
ELEVATION ________ GWL 0 HRS 84.0 PROJECT NO. C040384.40-01
HRS ________
DATE 20-25 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	1 3	S-1			LOOSE	TAN	SANDY SILT, SLIGHTLY MOIST	ML	
1.5	3	REC 0.7							
	5	S-2							
3.0	12 30	REC. 1.5			DENSE				DECOMPOSED SANDSTONE/
3.8	12 50/0.3	S-3 REC 0.8		3.8	V.DENSE				SANDY SHALE
					SOFT	TAN	SANDSTONE: HIGHLY WEATHERED	BR-VBR	TOP OF ROCK: 3.8'
				6.2	V.SOFT	TAN	SANDSTONE: COMPLETELY WEATHERED	VBR	
					M.SOFT	TAN	SANDSTONE: MODERATELY WEATHERED,	BR-BL	VERTICAL FRACTURE 6.2-6.5
	7.2 7.2	100%	62		TO M.HARD		MICACEOUS, FINE TO MEDIUM GRAINED		LOW ∠ FRACTURES: 6.7, 7.25,
									8.4, 9.8, 11.2, 11.45, 11.6
11.0									
				11.6					
					V.SOFT	TAN	SANDSTONE: COMPLETELY WEATHERED,	VBR	
							MICACEOUS, FINE TO MEDIUM GRAINED		
				14.0					
					SOFT	TAN	SANDSTONE: HIGHLY WEATHERED,	BR	LOW ∠ FRACTURES: 14.0, 14.2,
	10.0 10.0	100%	36				MICACEOUS, FINE TO MEDIUM GRAINED		14.3, 14.35, 14.45, 14.55, 15.75,
									16.5, 17.0,
								VBR	
				18.5					
					V.SOFT TO SOFT	TAN	SANDSTONE: COMPLETELY WEATHERED,		
							MICACEOUS, FINE TO MEDIUM GRAINED		
21.0				21.0					
					SOFT	TAN	SANDSTONE: HIGHLY WEATHERED	BR	LOW ∠ FRACTURES: 21.1,
							MICACEOUS, FINE TO MEDIUM GRAINED		22.3, 22.45, 22.55, 22.7, 23.0,
									23.1, 23.5, 23.75, 24.05,
									24.55,
	8.7 10.0	87%	55						
									STAINED 30° FRACTURE 21.9

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS, CONTINUOUS SPT, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B 0505

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. B-0505 ("27)

ELEVATION ________ GWL 0 HRS 84.0 PROJECT NO. C040384.40-01

HRS ________

DATE 20-APR 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
31.0				31.0					
				32.0	V. SOFT	TAN	SANDSTONE: COMPLETELY WEATHERED	VBR	
					M. HARD	BROWN	SANDSTONE: MODERATELY WEATHERED	BR-BL	
							MICACEOUS, MEDIUM GRAINED		
									70° HIGHLY STAINED
	100 10.0	100%	41						FRACTURE 34.6-35.1
				36.5					VERTICAL FRACTURE 35.7-36.6
					SOFT TO	BLUE-	SHALE	BR	LOW ∠ FRACTURES: 35.1,
					M. SOFT	GRAY			
				39.2					35.3, 35.45
				40.0	M. SOFT	TAN	SILTSTONE	VBR	STAINED VERT. FRAC. 39.2-40.0
41.0				41.3	M. HARD	DK GRAY	SILTY SANDSTONE	BR	HIGH ∠ STAINED FRACS:
					M. HARD	OLIVE	SANDSTONE: V. FINE GRAINED		40.0-40.3, 40.55-40.7
									LOW ∠ STAINED FRAC 41.8
				43.7					NEAR VERTICAL STAINED
					M SOFT	BLUE-GRAY	SILTY SHALE	VBR	FRACTURE 41.8-42.2
	10.0 10.0	100%	44		TO SOFT				HIGH ∠ STAINED FRACTURE
				47.0					45.6-46.1
					M. SOFT	OLIVE-GRAY	SANDSTONE. FINE GRAINED, SOME	BR	HIGH ∠ STAINED FRACTURE
							CROSSBEDDING		49.5-49.9, 52.7-52.9,
									54.15-54.3, 55.7-55.9
51.0									VERTICAL STAINED FRAC-
									TURE 51.5-52.2,
				55.4					
	10.0 10.0	100%	36		SOFT	GRAY	SANDY SHALE	VBR-	
									VERTICAL STAINED FRACS
									55.1-56.0,
									HIGH ∠ + VERTICAL STAINED
								BR	FRACTURES 57.2-59.6

REMARKS ** ________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0505 (27)

![gai consultants logo] gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST ALBANS, WV BORING NO. B-0505

ELEVATION ______ GWL 0 HRS 84.0 PROJECT NO. C040384.40-01

HRS ______

DATE 20-25 APR 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
61.0				61.2					30°s STAINED FRAC. 60.3'
					SOFT TO	GRAY	CLAY SHALE	BR-	HIGH & STAINED FRAC-
					M-SOFT			BL	TURE AT 62'
						MAROON MOTTLING			
	10.0 10.0	100%	52	65.5					
				66.1	M-HARD	GRAY	SANDSTONE	BL	
				66.9	SOFT	GRAY + MAROON	CLAY SHALE	BR	HIGH & STAINED FRAC 66.5-66.7
					M-HARD	LT GRAY	SANDSTONE		HIGH & FRACTURE 67.7-67.9
				68.8			SHALY 67.7-68.8		VERTICAL FRACTURE 68.2-68.6
					V-SOFT	BROWN-	CLAYSTONE - COMPLETELY WEATHERED	VBR-	
71.0						GRAY		BR	
				73.0					
					SOFT TO	DK GRAY	CLAYSTONE	BR	SLICKENSIDES 73.55,
					M-SOFT	TO GRAY			74.7, 74.8, 75.6, 75.9,
	10.0 10.0	100%	40						76.5, 77.0, 77.35
				78.0					VERTICAL STAINED
					M-HARD	BROWN + GRAY	SANDSTONE: FINE TO MEDIUM GRAINED	BR	FRACTURE 77.7-80.5
81.0									
								BL	
						BROWN			
	10.0 10.0	100%	76						
								BR	VERTICAL STAINED
									FRACTURE 87.5-88.8

REMARKS ** ______

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B0505

(27)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO.: B-0505
ELEVATION: ______ GWL 0 HRS: 84.0
PROJECT NO.: C040384.40-01
HRS: ______
DATE: 20-25 APR 2005
CLASSIFIED BY: DAN SANGER

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
91.0					M. HARD	BROWN	SANDSTONE (CON'T)	BR - BL	LOW ∠ FRACTURES 93.8, 94.0, 95.1, 95.2, 95.6
	10.0 / 10.0	100%	86			GRAY			
101.0				101.5					
					SOFT	GRAY	SILTY SHALE	VBR	MUCH OF CORE IS PIECES 0.1-0.2'
							: BECOMES SANDY AT 104.75		LOW ∠ FRACTURES 101.4, 102.0, 102.5, 102.9, 103.4, 104.3, 104.5, 104.75
	10.0 / 10.0	100%	18						VERTICAL FRACTURE 106.7-107.7
				108.7					V. BROKEN ZONE 107.0-107.7
					M. HARD	GRAY	SANDSTONE: FINE GRAINED		STAINED NEAR VERTICAL FRACTURE 108.1-108.7
111.0				112.2					
					SOFT TO M. SOFT	DK GRAY + MAROON	CLAYSTONE	VBR	45° SLICKENSIDE 112.9-113.0
									V. BROKEN ZONE 114.2-114.8
	9.2 / 10.0	92%			M. SOFT	GRAY			
									LOW ∠ FRACTURE 117.8, 119.6, 120.4
					SOFT	GRAY MAROON			

REMARKS **: ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0505

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0505
ELEVATION ______ GWL 0 HRS 84.0 PROJECT NO. C040384.40-01
HRS ______
DATE 20-25 APR 2005 CLASSIFIED BY DAN SANGER PAGE 5 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
121.0					SOFT	GRAY + MAROON	CLAYSTONE (CON'T) MODERATELY	VBR-	LOW & FRACTURES
						MAROON	TO HIGHLY WEATHERED	BR	121.4, 121.7, 122.3, 122.6,
									122.9, 123.1, 123.4, 123.8,
									124.1
					V. SOFT TO		: HIGHLY WEATHERED		
	6.0 / 10.0	60%	10		SOFT			VBR	124.8-132.0 HIGHLY
									BROKEN ZONE
131.0						GREEN-GRAY			
						MAROON		BR	
									45° SLICKENSIDES
									133.3, 134.2, 134.9,
									136.9, 139.2-139.4
	9.2 / 10.0	92%	67	136.0					
					M. SOFT	GRAY WITH	SANDY CLAYSTONE	BR-	
						MAROON CLASTS +		BL	SLICKENSIDES AT
						STRINGERS			142.35, 143.9, 144.7,
									145.1, 145.35, 146.25,
141.0									148.3, 148.9, 150.4,
									150.65
								VBR-	
	10.0 / 10.0	100%	55					BR	
							: BECOMES SILTY AT 144.6		
					SOFT	MAROON			
								BR	

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0505 (#27)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0505

ELEVATION ________ GWL 0 HRS 84.0 PROJECT NO. C040384.40-01

HRS ________

DATE 20-25 APR 2005 CLASSIFIED BY DAN SANGER PAGE 6 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
151.0					151.5					
						M. HARD	GREEN-GRAY	SANDSTONE	BR	
					153.2					
						M. SOFT	GRAY	SANDY SHALE	BR	LOW ∡ FRACTURE 153.4, 153.65
	10.0	10.0	100%	86	156.1					45° FRACTURE 154.35 - 154.5
						M. HARD	GRAY	SHALY SANDSTONE	BR-BL	LOW ∡ FRACTURE 157.35
					157.5					
						M. HARD	GRAY	SANDSTONE		
161.0										
	10.0	10.0	100%	84						
					168.5					CLAYSEAM 167.55 - 167.70
						M. SOFT TO SOFT	GRAY TO DK GRAY	CLAYSTONE	VBR-BR	LOW ∡ FRACTURES 168.75, 168.85, 169.15, 169.20, 170.7, 171.2, 171.6, 174.8, 174.95
171.0										
					173.4					
						M. SOFT TO M. HARD	GRAY + MAROON	SANDY CLAYSTONE	BL	45° ∡ FRACTURE 169.75 - 170.1, 172.35, 172.7
	9.3	10.0	93%	6.1						LOW ∡ SLICKENSIDES 170.4, 170.7, 171.85, 172.9, 173.1; 173.4
					179.0					
						M. SOFT	MAROON	CLAYSTONE	BR-VBR	45° SLICKENSIDES 179.2 - 179.4, 179.7, 179.9 - 180.0

REMARKS ** ____________________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0505

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0505
ELEVATION ________ GWL 0 HRS 84.0 PROJECT NO. C040384.40-01
HRS ________
DATE 20-25 APR 2005 CLASSIFIED BY DAN SANGER PAGE 7 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
181.0					M. SOFT	MAROON	CLAYSTONE		LWW & SLICKENSIDE 181.9,
									182.2, 183.2, 183.6, 184.0,
									184.15, 184.4
				185.0				VBR	V. BROKEN 184.4-185.0
	10.0 10.0	100%	67		M. HARD	GRAY	SANDSTONE	BL	
									CLAY SEAM 188.7
				190.0					
191.0				191.0	M. SOFT	MAROON	CLAYSTONE	BR	
					M. HARD	GRAY	SANDSTONE	BL	
	9.0 9.0	100%	88						
				198.1					
					M. SOFT	GRAY &	SANDY CLAYSTONE	VBR-	SLICKENSIDES 198.45, 198.9,
200.0						MAROON		BR	199.25, 199.35, 199.6, 199.8
							BOTTOM OF BORING: 200.0'		

REMARKS ** ____________________

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0505

N 539424.9688
E 1722518.6810 Grade El. 709.52

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS WV BORING NO. B-0506
ELEVATION ________ GWL 0 HRS 21.3 PROJECT NO. C040384.40-0:
HRS ________
DATE 21 APR 2005. CLASSIFIED BY DAN SANGER PAGE 1 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	1 2	S-1			LOOSE	BROWN	SANDY SILT SOME ORGANICS	ml	FILL
1.5	4	REC 0.6							
	4	S-2							
3.0	5 6	REC 0.9			M. DENSE	RED-BROWN	SANDY SILT MOIST	ml	
	3 5	S-3							
4.5	6	REC 1.5							
	7	S-4			M. DENSE	RED BROWN	CLAYEY SILT / SILTY CLAY w/ R.F.	ml/cl	
6.0	8 33	REC 1.5							
	4 5	S-5			M. DENSE	RED-BROWN	CLAYEY SILT AND ROCK FRAGMENTS	ml	MOIST
7.5	6	REC 0.2							
	11	S-6							
9.0	10 11	REC 0.6			M. DENSE	RED-BROWN	CLAYEY SILT AND ROCK FRAGMENTS	ml	MOIST
	7 12	S-7					(DECOMPOSED CLAYSTONE)		
10.5	15	REC 1.5							
	16	S-8							
12.0	18 18	REC. 1.0			DENSE	RED BROWN	CLAYEY SILT AND ROCK FRAGMENTS	ml	SLIGHTLY MOIST
	8 11	S-9					(DECOMPOSED CLAYSTONE)		
13.5	18	1.5							
	22	S-10			DENSE	RED, BROWN	DECOMPOSED CLAYSTONE		DRY
15.0	26 30	REC 1.2			V. DENSE	YELLOW, GRAY	DECOMPOSED CLAYSTONE		DRY
	18 25	S-11			V. DENSE		DECOMPOSED CLAYSTONE		DRY
16.5	36	REC 1.5							
	12	S-12							
18.0	19 50/0.5	REC. 1.5		18.0	HARD		DECOMPOSED CLAYSTONE		DRY
					SOFT TO	MAROON	CLAYSTONE	BL	LOW ∠ FRACTURES
	4.0 4.0	100%	90		M. SOFT				19.65, 20.05, 21.6
22.0									
									--
							: SANDY 24.7-25.4		BROKEN ZONE: 22.0-22.5
									45° ∠ FRACTURE w/ SLICKEN-
	9.6 10.0	96%	86						SIDES 22.75-22.95
							: SANDY 27.4-29.4		LOW ∠ FRACTURES
									24.6,
									45° ∠ SLICKENSIDE 28.3-28.55

REMARKS ** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000 T2 TRACK MOUNTED DRILL. BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" I.D. STEEL CASING, CONTINUOUS SPT, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0506

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0506

ELEVATION ______ GWL 0 HRS 21.3 PROJECT NO. C040384.40-01

HRS ______

DATE 22-2 APR 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					SOFT TO	MAROON	CLAYSTONE (CON'T)		LOW% FRACTURES W/
32.0					M.SOFT		: CORE SURFACE WEATHERED		SLICKENSIDES: 32.65,
									33.0, 33.25, 33.75,
								BL	34.05, 35.55, 36.65,
									38.4,
									45° FRACTURES W/
	9.9 / 10.0	99%	58				: IRREGULAR CALCAREOUS	BR	SLICKENSIDES: 36.9,
							CLASTS 37.5-38.7		37.25-37.45, 38.85-
								BL	38.95
42.0									
									LOW% FRACTURES W/
									SLICKENSIDES 42.4,
									42.65 42.95, 44.25
									45.25, 45.7, 45.9,
	10.0 / 10.0	100%	76						47.75,
									45°% FRACTURES W/
				51.0					SLICKENSIDES = 48.6,
52.0				51.7	M.SOFT	GRAY	SANDY CLAYSTONE		48.8, 49.0
						MAROON	CLAYSTONE		
								BR	LOW% FRACTURES W/
				54.9	HARD	GRAY	SANDSTONE 54.6-54.9		SLICKENSIDES: 52.3, 52.4
							SANDY CLAYSTONE	BL	53.5, 54.2
	10.0 / 10.0	100%	73	56.5					
					M.SOFT	MAROON	CLAYSTONE		45° FRACTURES W/ SLICK-
									ENSIDES 53.55-53.75
									54.45-54.6

REMARKS ** ______

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0506

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0506

ELEVATION ________ GWL 0 HRS 21.3 PROJECT NO. C040384.40-01

HRS ________

DATE 22-27 APR 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
					60.4	M. HARD	GRAY	SHALY SILTSTONE	BL	
62.0										
					64.1	M. HARD TO HARD	LT GRAY	SANDSTONE		VERTICAL FRACTURE 64.7-65.7
	10.0	10.0	100%	76						65° FRACTURE 65.9-66.2
					71.5	M. SOFT	GRAY	SILTY SHALE	BR	
72.0					72.7	SOFT TO M. SOFT	MAROON + GRAY	CLAYSTONE	BR-BL	LOW ∡ FRACTURE 72.6
	8.0	8.0	100%	78						30° FRACTURE W/SLICKEN-SIDE: 74.3
80.0					80.0					
								BOTTOM OF BORING: 80.0'		

REMARKS ** ________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0506

N 539428.8146
E 1722523.7682 Grade El. 709.99

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. R-0507
ELEVATION ______ GWL 0 HRS DRY PROJECT NO. [illegible]
HRS ______
DATE 26 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							AUGER W/O SAMPLING TO 18 FT.		
							PIEZOMETER INSTALLED, TIP AT 17 FT		
18.0				18.0					
							BOTTOM OF BORING: 18'		

REMARKS** DRILLED BY TERRA TESTING USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. R0507

N 541996.9754
E 1723377.3436 Grade El. 979.22

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0508
ELEVATION 982± GWL 0 HRS 87.3 PROJECT NO. C040384.40-01
HRS
DATE 27-28 APR 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
1.5	1 4 7	S-1 REC 1.0			M. DENSE	TAN	SILT AND DECOMPOSED SHALE	ML	SLIGHTLY MOIST
	18	S-2					FRAGMENTS		
3.0	24 50/0.4	REC 1.2			V. DENSE				
4.5	37 30 22	S-3 REC 1.3							
5.2	19 50/0.2	S-4 REC 0.7		5.2					
					SOFT	TAN TO BROWN	CLAY SHALE - HIGHLY WEATHERED	BR	LOW ∠ FRACTURES:
									5.7, 6.25, 6.75, 6.9
	5.7 5.7	100%	38						7.4, 7.7, STAINED:
									9.2, 9.6
									RED STAINED - 65° FRACTURE: 8.4-8.6, 9.0,
10.9				11.5					
				12.6	SOFT	TAN	SILTY SHALE	BR	10.4-10.7, 12.0-12.4
				13.7	SOFT	TAN + GRAY	SHALY SANDSTONE - WEATHERED		LOW ∠ FRACTURE 12.9, 13.5
					SOFT	TAN	SHALE - GRADES FROM SILT		BROKEN 14.1-14.3
							TO CLAY - WEATHERED		VERTICAL FRACTURE 14.8-15.0
	9.7 10.0	97%	50	16.4					LOW ∠ FRACTURES 15.6, 15.9,
					SOFT	MAROON	CLAYSTONE	BR-BL	16.3, 16.45, 17.0, 17.3,
									18.2, 18.65, 20.6
									VERTICAL FRACTURE 20.9-21.3
									70° FRAC. W/ SLICKENSIDES
20.9									AT 22.2-22.4
								BL	
	10.0 10.0	100%	64						
								BR	

REMARKS** DRILLED BY TERRA TESTING INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼"Ø SOLID STEM AUGERS, CONTINUOUS SPT, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508
(25)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0508

ELEVATION 982± GWL 0 HRS 87.3 PROJECT NO. C040384.10-01

HRS

DATE 27-28 APR 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
30.9					SOFT	MAROON	CLAYSTONE	NBR	LOW ∡ FRACTURES W/
								BR	SLICKENSIDES 31.0, 31.15,
									31.3, 31.5, 32.4, 33.0
									NEAR VERTICAL FRACTURE
									31.8-32.1
	9.6 / 10.0	96%	65						70° FRAC W/ SLICKENSIDES
						GRAY +			32.4-32.65
				38.5		MAROON			30° FRAC W/ SLICK. 34.2
					M. SOFT	OLIVE-GRAY	SHALY SANDSTONE - V. FINE GRAINED	BR	LOW ∡ FRACTURE 35.8, 37.3,
									37.5, 37.85
40.9									LOW ∡ ORANGE STAINED
									FRACTURE 39.0
									NEAR VERTICAL STAINED
									FRACTURE 39.4-39.7
				45.3					HIGH ∡ FRACTURE 40.4
	10.0 / 10.0	100%	91	46.2	SOFT TO	BROWN-	SANDY SHALE	BR	BROKEN 40.4-40.9
					M. SOFT TO	GRAY	SANDSTONE; FINE TO MED.	BR-BL	LOW ∡ FRACTURE 43.0
					M. HARD		GRAINED, MICACEOUS		
								BL	
50.9				51.0					
				51.9	M. SOFT	OLIVE	SANDY SHALE		
					M. SOFT TO	OLIVE-	SANDSTONE		
				54.3	M. HARD	GRAY			
				55.0	M. SOFT	OLIVE	SANDY SHALE		
	10.0 / 10.0	100%	87			MAROON + GRAY	CLAYSTONE	BR	BROKEN ZONE 55.2-55.4
									LOW ∡ FRACTURE 56.6,
									57.75
				59.7					

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508

(25)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV — BORING NO. B-0508
ELEVATION: 982± — GWL 0 HRS 87.3 — PROJECT NO. C040384.40-01
HRS
DATE: 27-28 APR 2005 — CLASSIFIED BY: DAN SANGER — PAGE 3 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
60.9					60.8	M. SOFT	GRAY	SANDY CLAYSTONE	BL	
						SOFT	GRAY	CLAY SHALE	BR	LOW∠ FRACTURES 61.5,
										62.2,
					64.2					STAINED 45° FRACTURE
							GRAY + MAROON	CLAY SHALE, TRACE SAND	BR	62.6-62.8, 63.6-
	10.0	10.0	100%	60	65.8					63.8.
						SOFT TO V. SOFT	MAROON	CLAYSTONE - WEATHERED		STAINED VERTICAL FRAC
										64.2-64.3, 64.7-64.8,
										65.3-65.45
70.9										
										45° FRACTURES 72.9,
									VBR	73.5
					73.5				BR	
					74.0			SANDY SHALE		
						M. SOFT TO	GRAY	SANDSTONE: V. FINE TO FINE		
	10.0	10.0	100%	75		M. HARD		GRAINED		
										SHALE PARTING 77.6
80.9										
					82.0					
						M. HARD	GRAY	SANDSTONE: FINE TO MEDIUM	BL	
								GRAINED		
	9.3	10.0	93%	71						
					88.1					STAINED VERTICAL FRACTURE
						SOFT	DK GRAY	CLAYSTONE	BR	87.6-88.15
										30° FRAC. W/ SLICKENSIDES 88.9

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508
(25)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS WV BORING NO. B-0508
ELEVATION 982± GWL 0 HRS 87.3 PROJECT NO. C040384.40-01
HRS
DATE 27-28 APR 2005 CLASSIFIED BY DAN SANGER PAGE 4 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
90.9					SOFT	DK GRAY	CLAYSTONE (CON'T)	BR	45° SLICKENSIDED
									FRACTURES 92.0-92.1,
									92.55-92.65
									BROKEN 92.9-93.2
									30° SLICKENSIDED FRACTURES
	10.0 10.0	100%	37	96.4					AT 93.0, 93.25, 93.6,
					M-SOFT TO M. HARD	GRAY	SILTY FINE GRAINED SANDSTONE	BL	93.9, 94.3
									45° FRACTURES W/ SLICKEN-
									SIDES 94.05, 94.85,
									95.75
100.9				101.1					NEAR VERTICAL FRAC-
				102.2	SOFT	GRAY + MAROON	CLAYSTONE	VBR	TURE 98.5-99.0
					M. SOFT	GRAY	SILTSTONE	BL	60° FRACTURE W/SLICKEN-
				104.0					SIDE 101.6-101.9, INTER-
					SOFT	MAROON + GRAY	CLAYSTONE	BR	SECTED BY 45° SLICKENSIDE
	10.0 10.0	100%	75	105.2	M. HARD	MOTTLED GRAY	SANDSTONE		45° SLICKENSIDE @ 104.5
				106.8					VERTICAL FRACTURE (NO
					M. SOFT	GRAY	SILTSTONE	BL	STAINING) 105.4-106.8
				108.9					
					SOFT TO	MAROON + GRAY	SILTY CLAYSTONE	BR	30° SLICKENSIDE 111.3
110.9					M. SOFT	MOTTLED		BL	
				112.3					
					M. SOFT	GRAY	SILTSTONE		SHALE PARTING 114.3
				114.7					
	10.0 10.0	100%	92	116.0		GRAY	SANDSTONE. FINE GRAINED		
							SILTSTONE		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508
(25)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0508
ELEVATION 982± GWL 0 HRS 87.3 PROJECT NO. C040384.40-01
HRS
DATE 27-28 APR 2005 CLASSIFIED BY DAN SANGER PAGE 5 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
120.9				120.1	M. HARD	GRAY	SANDSTONE	BR	HEAVILY STAINED VERTICAL
				121.5	↓	↓	↓	↓	FRACTURE 120.2 – 122.2
				123.4	M. SOFT	GRAY	SILTSTONE	BL	SHALE PARTING 122.3
					M. HARD	GRAY	SANDSTONE	BL	
				125.5		↓	↓	↓	
	10.0 10.0	100%	85		M. SOFT	GRAY	ARGILLACEOUS SILTSTONE	BL	
130.9									
							132.8-133.4 MAROON CLAYSTONE		
							133.4-134.0 SANDY		
	10.0 10.0	100%	79						
				137.4	↓	↓	↓	↓	
					M. SOFT TO M HARD	GRAY	SANDY SILTSTONE W/ THIN	BR	NEAR VERTICAL FRAC-
							INTERMITTENT SANDSTONE		TURE (NO STAINING)
				140.0	↓	↓	STRINGERS	↓	138.1 - 140.0
140.9				141.4	M. SOFT	GRAY	ARGILLACEOUS SILTSTONE	BR	SLICKENSIDES 141.2
					SOFT	GRAY-MAROON-YELLOW	CLAYSTONE		LOW ∠ SLICKENSIDES
									141.8, 142.0, 143.5
						↓			30° SLICKENSIDES 142.3,
						GRAY			142.5, 142.75, 144.9,
	10.0 10.0	100%	78	146.0	↓	↓	↓		145.6
				147.2	M. HARD	LT GRAY	SANDSTONE: MICACEOUS		
							INTERBEDDED SHALY SILTSTONE		
							AND SILTY SHALE		
				150.0	↓	↓	↓	↓	

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508
(25)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0508

ELEVATION: 982± GWL 0 HRS 873 PROJECT NO. C040384.40-01

HRS

DATE: 27-28 APR 2005 CLASSIFIED BY: DAN SANGER PAGE 6 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
150.9				150.0	M. HARD	GRAY	SANDSTONE: FINE TO MEDIUM GRAINED, MICACEOUS	BL	
	10.0 10.0	100%	100						
160.9									
	10.0 10.0	100%	100						
170.9									
				173.0					
					M. SOFT	GRAY	ARGILLACEOUS SILTSTONE	BR-BL	PARTING 173.4, 176.25
	10.0 10.0	100%	96						
				177.8					
					M. SOFT TO M. HARD	LT. GRAY	SHALY SANDSTONE: MICACEOUS	BL	

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508

(#25)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO. B-0508
ELEVATION 982 ± GWL 0 HRS 87.3
HRS
PROJECT NO. C040384.41-01
DATE 27-28 APR 2005
CLASSIFIED BY DAN SANGER
PAGE 7 of 7

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
180.9									
				181.6	M. SOFT	GRAY	SILTSTONE		
				184.3					
					SOFT TO M. SOFT	GRAY	SILTY CLAYSTONE	BR-BL	
	10.0 10.0	100%	79						45° SLICKENSIDES 185.6-185.75, 186.6-186.7, 186.9-187.05
						MAROON GRAY	; SANDY 187.3-188.8		30° SLICKENSIDES 186.9, 187.2, 187.3
190.9									
							: 191.8-200.9 IRREGULAR CALCAREOUS CLASTS AND STRINGERS THROUGHOUT	BL	
						MAROON AND GRAY			
	10.0 10.0	100%	96						
								BR	
200.9									
							BOTTOM OF BORING: 200.9'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0508
(25)

N 541748.6664
E 1724111.6219 Grade El. 824.40

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0509
ELEVATION 825± GWL 0 HRS 53.4 PROJECT NO. C040384.40-01
23 HRS 16.0 (after drilling)
DATE 28APR-02MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
1.5	1 2 2	S-1 REC 1.0			M. STIFF	TAN	SILTY CLAY MOIST	cl	* 0.75 TSF
3.0	3 3 4	S-2 REC 1.2			STIFF				* 1.5TSF
4.5	4 8 10	S-3 REC 1.5			M. DENSE		CLAYEY SILT: DECOMPOSED CLAYSTONE	ml	DRY
6.0	13 15 19	S-4 REC 1.5			DENSE	TAN + GRAY			DRY
7.5	6 7 12	S-5 REC 1.5			M. DENSE				DRY
9.0	15 15 16	S-6 REC 1.4			V. STIFF		SILTY CLAY: DECOMPOSED CLAYSTONE	cl	SLIGHTLY MOIST, * 3.5TSF
10.5	5 7 10	S-7 REC 1.5			V. STIFF				" " "
12.0	10 11 15	S-8 REC 1.5			V. STIFF				" " * 4.0 TSF
13.5	9 7 10	S-9 REC 1.5			V. STIFF				" " * 4.0 TSF
15.0	10 11 12	S-10 REC 1.5			V. STIFF		: TRACE ROCK FRAGMENTS		" " * 3.25 TSF
16.5	4 8 9	S-11 REC 1.5			M. DENSE		CLAYEY SILT: DECOMPOSED CLAYSTONE	ml	" "
18.0	6 8 12	S-12 REC 1.5			STIFF		SILTY CLAY: DECOMPOSED CLAYSTONE	cl	MOIST * 1.5 TSF
19.5	3 5 6	S-13 REC 1.5			STIFF				MOIST * 1.75 TSF
21.0	8 11 9	S-14 REC 1.5			N-STIFF				MOIST * 2.25 TSF
22.5	5 7 6	S-15 REC 1.5			STIFF				MOIST * 2.0 TSF
24.0	10 10 8	S-16 REC 1.5			STIFF				MOIST * 1.5TSF
25.5	W.O.H. 7 14	S-17 REC 1.5			M. DENSE	GRAY	DECOMPOSED SANDSTONE		
25.9	50/0.4	S-18 REC 0.4		25.9	V. DENSE	GREEN-GRAY			TOP OF ROCK: 25.9
					SOFT	BROWN	SANDSTONE: HIGHLY TO COMPLETELY WEATHERED	VBR	
	1.1 6.1	18%	0						

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼ SOLID STEM AUGERS, 4" I.D. STEEL CASING, NQ-2 WIRELINE CORING TOOLS.

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0509
(7)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO. B-0509
ELEVATION 825 ± GWL 0 HRS 53.4
23 HRS 16.0
PROJECT NO. C040384.40-01
DATE 28 APR-02 MAY 2005 CLASSIFIED BY DAN SANGER
PAGE 2 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
32.0					32.0					
						SOFT	MAROON	CLAYSTONE	BR-BL	
	7.1	[illegible]	71	46						
						M. SOFT	GREEN-GRAY	: IRREGULAR CALCAREOUS CLASTS AND STRINGERS (AT 43')		
42.0										
										LOW & FRACTURED W/ SLICKENSIDES 43.0, 44.4, 44.55, 46.2, 46.45, 46.95, 47.4, 49.0
	9.8	10.0	98%	79						
					49.7					
					50.4	M. HARD	LT GRAY	SANDSTONE		
						M. SOFT	GREEN-GRAY	CLAYSTONE		
52.0										
									BR	
					53.9					
						M. SOFT	GREEN-GRAY	SILTY TO SANDY CLAYSTONE WITH IRREGULAR MAROON CLAYSTONE CLASTS	BR-BL	LOW & FRACTURED 54.9, 55.5, 57.2, 58.7, 59.0, 60.0
	10.0	10.0	100%	85				: SANDY 56.7 TO 57.3		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0509

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS WV — BORING NO. B-0509

ELEVATION 825± GWL 0 HRS 53.4 — PROJECT NO. C040384.40-01

23HRS 16.0

DATE 28 APR - 02 MAY 2005 CLASSIFIED BY DAN SANGER — PAGE 3 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR	CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
								CLAYSTONE (CON'T)		LOW ∠ FRACTURES
62.0										62.2, 62.6 62.8, 63.4,
										63.7 64.1, 64.3 64.5,
										64.9, 65.2
					66.5					
	10.0		100%	67		M. SOFT	GRAY	INTERBEDDED SILTSTONE AND	[illegible] L	
								CLAYSTONE		
72.0										
	10.0	10.0	100%	92	76.6					
						M. HARD	GRAY	SANDSTONE	BL	
					81.2					
82.0						M. SOFT	DK GRAY	SILTY TO SANDY SHALE	BR	LOW ∠ FRACTURES 81.3,
					83.6					81.45, 82.7, 83.1, 83.6
						SOFT	GRAY	CLAYSTONE		LOW ∠ FRACTURES
										83.9, 84.1, 84.2, 84.7,
										85.1, 85.5
	10.0	10.0	100%	77						HIGH ∠ FRAC W/ SLICKENSIDES
								: BECOMES SILTIER @ 87.5		87.0 - 87.2

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0509

(7)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT BORING NO. B-0509
ELEVATION 825± GWL 0 HRS 53.4 PROJECT NO. C040344.40.01
23 HRS 16.0
DATE 28 APR - 02 MAY 2005 CLASSIFIED BY PAGE 4 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
				91.0	↓	↓	↓	↓	
92.0					M. HARD	LT GRAY	SANDSTONE	BR	
				93.6	↓	↓	↓	↓	
					SOFT TO M. SOFT	MAROON	CLAYSTONE	BR	30° FRACTURES 95.1, 95.6, 96.4, 97.3, 98.4, 98.6
	8.0 8.0	100%	62						
									60° SLICKENSIDE 98.0-98.2
				98.9	↓	↓	↓	↓	
100.0				100.0	M. HARD	GRAY	SILTY SHALE/SILTSTONE	BL	
							BOTTOM OF BORING 100.0'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0509

(7)

N 540879.8326
E 1722795.6504 Grade El. 925.74

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0510
ELEVATION ______ GWL 0 HRS 36.0 PROJECT NO. C040384.40-01
HRS
DATE 03-04 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
1.5	1 1 1	S-1 REC 1.2			V. LOOSE	TAN	SANDY SILT	ml	MOIST
3.0	2 4 7	S-2 REC 1.3			M. DENSE	TAN + GRAY	CLAYEY SILT	ml	SLIGHTLY MOIST
4.5	7 7 10	S-3 REC 1.2			V. STIFF		SILTY CLAY	cl	DRY
6.0	10 12 10	S-4 REC. 1.3			V. STIFF	GRAY	SILTY CLAY	cl	DRY
7.5	13 13 13	S-5 REC.			HARD	GRAY	SILTY CLAY: DECOMPOSED CLAYSTONE		DRY
8.4	14 50/0.4	S-6 REC 0.9		8.4	HARD	MAROON + YELLOW	DECOMPOSED CLAYSTONE		TOP OF ROCK 8.4
10.7	2.3 2.3	100%	30		SOFT	LT. BROWN + OLIVE	INTERBEDDED CLAY SHALE AND CLAYEY SILTSTONE: HIGHLY WEATHERED	BR	HEAVILY STAINED HIGH ∡ FRACTURE 9.4, 9.7, LOW ∡ STAINED FRACTURES 9.8, 10.4, 10.7, 11.3, 12.6, 12.75, 13.9,
				14.0					
20.7	10.0 10.0	100%	58		M. SOFT / M. HARD	BROWN / GRAY	SANDSTONE: WEATHERED TO ~15.25, MICACEOUS, FINE TO MEDIUM GRAINED	BR-BL	STAINED LOW ∡ FRACTURES 17.0, 17.3, 18.0
				20.7					
				22.0	SOFT	GRAY	CLAYSTONE	VBR	
				23.9	M. SOFT	GRAY	SILTSTONE / SILTY SHALE	BR	STAINED HIGH ∡ FRACTURE (60-70°) 22.8-23.0
	10.0 10.0	100%	65		SOFT	LT. GRAY / DK GRAY + MAROON	CLAYSTONE	VBR-BR	NEAR VERTICAL PARTIALLY STAINED FRACTURE 23.3-23.9

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" I.D. STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510
(26)

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E. Amos Power Plant St. Albans WV BORING NO. B-0510
ELEVATION ______ GWL 0 HRS 36.0 PROJECT NO. C040384.4J-01
HRS ______
DATE 03-04 MAY 2005 CLASSIFIED BY Dan Sanger PAGE 2 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
30.7						Soft		Claystone (con't) highly weathered	BR-BL	
					35.0					
	9.5	10.0	95%	60		M. soft to M. hard	Greenish gray	Interbedded silty claystone with calcareous clasts and sandy siltstone	BR-BL	30° fracture 36.2; 60° fracture 36.2-36.65
									VBR	
40.7							Maroon			
									BL	
							Gray			
	10.0	10.0	100%	91						Low ∡ fracture 45.8, 46.0, 48.0, 52.5, 52.6, 53.5, 55.1, 55.5, 57.85
							Maroon + gray mottled			
50.7										
									BR	
	10.0	10.0	100%	76						Slightly stained vertical fracture 55.75-56.1

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510
(26)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0510
ELEVATION ______ GWL 0 HRS 36.0 PROJECT NO. C040384.40-01
HRS
DATE 03-04 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
60.7					M-SOFT	MAROON & GRAY	INTERBEDDED CLAYSTONE AND SILTSTONE (CON'T)	BR-BL	LOW ∠ FRACTURES 61.1, 61.6, 62.0, 63.2 63.5, 63.75, 63.9, 64.65, 65.0
	10.0 / 10.0	100%	92						
70.7									
							SANDY SILTSTONE 73.0-75.0		
	10.0 / 10.0	100%	96						
80.7									
								BR	30° SLICKENSIDES 81.3, 81.5, 81.8, 82.1, 82.7, 82.9, 83.8, 84.1
	10.0 / 10.0	100%	60						
				87.6					
					M. HARD	GRAY	SANDSTONE FINE TO MEDIUM GRAINED, MICACEOUS	BL	

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510
(26)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0510

ELEVATION ________ GWL 0 HRS 36.0 PROJECT NO. C040384.40-01

HRS ________

DATE 03-04 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 4 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
90.7						M. HARD	LT GRAY	SANDSTONE (CON'T)	BL	
	10.0	10.0	100%	100						
100.7										
	10.0	10.0	100%	100						
110.7										
					112.0					
						M-SOFT TO M-HARD	GRAY	INTERBEDDED SANDSTONE AND SILTSTONE, SOME THIN SHALE UNITS	BR-BL	LOW ∠ FRACTURE 112.4, 114.4, 114.55, 114.7, 119.1
	10.0	10.0	100%	91						

REMARKS ** ________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510

(26)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0510
ELEVATION ______ GWL 0 HRS 36.0 PROJECT NO. C040384.40-01
HRS ______
DATE 03-04 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 5 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
120.7										
					121.5					
						SOFT TO M.SOFT	GRAY + MAROON	CLAYSTONE : IRREGULAR CALCAREOUS CLASTS + STRINGERS: 122.6-124.0, 135.0-138.7	BR-VBR	LOW ∢ FRACTURES W/ SLICKENSIDES 122.35, 122.8, 123.35, 124.2, 124.7, 124.9, 125.4, 126.1, 127.65, 128.3, 129.1, 130.1, 130.45, 130.7, 131.5, 131.9, 132.6, 134.5, 135.3
	10.0	10.0	100%	47						
130.7										
										HIGH ∢ SLICKENSIDE 133.25-133.6
	10.0	10.0	100%	60						
140.7					140.7					
						M.SOFT	GREEN-GRAY, MAROON, YELLOW MOTTLED	SILTY CLAYSTONE: INTERMITTENT IRREGULAR CALCAREOUS CLASTS AND STRINGERS	BR	MOST PIECES 0.2-0.4' LONG
	10.0	10.0	100%	73						

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510
(26)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT BORING NO. B-0510
ELEVATION ______ GWL 0 HRS 36.0 PROJECT NO. C040384.40-01
HRS ______
DATE 03- MAY 2005 CLASSIFIED BY DAN SANGER PAGE 6 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
150.7							SILTY CLAYSTONE (CON'T)		
				153.2	M-HARD	LT GRAY	SANDSTONE: FINE TO MEDIUM GRAINED, MICACEOUS	BL	
	10.0 10.0	100%	84						1 PIECE OF CORE: 7.6'
160.7									
									1 PIECE OF CORE 6.7'
	10.0 10.0	100%	100						
170.7									
				175.1					
	10.0 10.0	100%	53		SOFT TO M-SOFT	GRAY + MAROON	CLAYSTONE	VBR	MOST PIECES 0.2' ~30° SLICKENSIDES 176.0, 176.35, 177.55, 177.7, 178.1, 178.45, 178.65, 179.0, 60° SLICKENSIDES 179.1-179.35, 179.65-179.85

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO. B-0510
ELEVATION ______ GWL 0 HRS 36.0
HRS ______
PROJECT NO. C040384.40-01
DATE 03-14 MAY 2005
CLASSIFIED BY DAN SANGER
PAGE 7 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
180.7							CLAYSTONE (CON'T)		
				181.5	M. SOFT	GRAY	SANDY SILTSTONE	BR-BL	
	10.0 10.0	100%	84	185.8					
					SOFT TO M. SOFT	MAROON	CLAYSTONE	BR	LOW ∡ SLICKENSIDES 187.0, 187.6, 187.8, 189.0
190.7				190.2	M. HARD	LT GRAY	SILTY SANDSTONE	BL	
				194.0	M. SOFT	GRAY + MAROON	INTERBEDDED SANDY CLAYSTONE AND SILTSTONE	BR	LOW ∡ SLICKENSIDES 194.15, 196.1, 196.75, 197.15, 197.5, 197.85, 198.2,
	10.0 10.0	100%	81						
				198.2	M SOFT TO M. HARD	GRAY + LT GRAY	INTERBEDDED SILTSTONE AND SANDSTONE	BR-BL	
200.7									
				203.0	SOFT TO M. SOFT	MAROON	SILTY CLAYSTONE	BR	LOW ∡ SLICKENSIDES 204.25, 205.0, 205.25, 205.8, 206.7, 206.85, 207.25, 207.7, 207.85
	10.0 10.0	100%	70						
				209.7					

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510
(26

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0510

ELEVATION ________ GWL 0 HRS 36.0 PROJECT NO. C040384.13-01

HRS ________

DATE 03-04 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 8 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
210.7						M. SOFT	GRAY	SHALY SILTSTONE, SOME SAND	BL-BR	
										VERTICAL FRACTURE
										(NOT STAINED)
										212.75 - 214.3
	10.0	10.0	100%	79						
							GRAY + MAROON			
							GRAY			
220.7										
					221.3					
						M. SOFT TO SOFT	MAROON + GRAY	SILTY CLAYSTONE	BR-BL	
										45° SLICKENSIDE 223.0
	10.0	10.0	100%	34					BR	225.2, 226.0, 226.6,
									VBR	226.8
										LOW ∢ SLICKENSIDES
										223.75, 224.25, 224.4,
										224.7, 224.8, 225.0,
230.7										225.4, 225.7, 226.0,
										226.1, 226.3
										226 - 233 VBR
									BR	PIECES 0.1-0.2' W/
	9.7	10.0	97%							SLICKENSIDES (LOW
										+ HIGH ∢)
										HIGH ∢ SLICKENSIDES 233.4,
										233.9, 234.0, 236.6,
										237.6, 238.3, 240.2

REMARKS ** ________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510

(26)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO.: B-0510
ELEVATION: ______ GWL 0 HRS: 36.0
HRS: ______
PROJECT NO.: C040384.40.01
DATE: 03-04 MAY 2005
CLASSIFIED BY: DAN SANGER
PAGE 9 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
240.7					M. SOFT TO SOFT	MAROON + GRAY + PURPLE	CLAYSTONE	VBR	PIECES ~0.1-0.2' w/ SLICKENSIDES
								BR	30° SLICKENSIDES APPROX. EVERY 0.4-0.5'
	10.0 10.0	100%	56						
								VBR	
				248.3	M. SOFT	MAROON + GRAY	INTERBEDDED SANDY CLAYSTONE AND SILTSTONE	BR-BL	
250.7									
							BOTTOM OF BORING: 250.7'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0510
(26)

N 541746.9425
E 1724116.3536 Grade El. 824.57

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0511
ELEVATION ______ GWL 0 HRS ______ PROJECT NO. C040384.40-01
HRS ______
DATE 03-04 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							AUGER w/o SAMPLING		
							TO 26 FT		
							PIEZOMETER INSTALLED		
							TIP AT 25.5 FT		
				26.0					
							BOTTOM OF BORING: 26'		

REMARKS** DRILLED BY TERRA TESTING, INC USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0511
(8)

N 542140.8876
E 1724101.7636 Grade El. 784.29

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0512
ELEVATION 795± GWL 0 HRS 2.6 PROJECT NO. C040384.40-01
HRS
DATE 04-05 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
1.5	1 1 2	S-1 REC 0.8			V. LOOSE	BROWN	SILT, TRACE ORGANICS	ml	MOIST
3.0	2 2 3	S-2 REC 1.0			STIFF	BROWN	SILTY CLAY	cl	MOIST * 1.5 TSF
4.5	2 3 5	S-3 REC 1.3			LOOSE	BROWN	SANDY SILT, SOME ROCK FRAGMENTS	ml	SLIGHTLY MOIST
6.0	5 5 9	S-4 REC 1.2			STIFF	GRAY + BROWN	SILTY CLAY, TRACE ROCK FRAGMENTS	cl	SLIGHTLY MOIST * 1.5 TSF
7.5	3 1 2	S-5 REC 0.8		8.0	M. STIFF			cl	WET * 1.0 TSF
9.0	9 26 43	S-6 REC 1.5			V. DENSE	MAROON + GRAY	ROCK FRAGMENTS AND SANDY SILT: DECOMPOSED CLAYSTONE	gm	DRY
10.5	32 32 36	S-7 REC 1.5						gm	DRY
12.0	13 18 18	S-8 REC 1.5		12.0				gm	DRY TOP OF ROCK: 12.0'
12.0	50/0.0	S-9 REC 0.0			M. SOFT	GREEN-GRAY, MAROON, PURPLE MOTTLED	SILTY CLAYSTONE	BR VBR BR	
	10.0 10.0	100%	40						
22.0				22.65	M. HARD	LT GRAY	SILTY SANDSTONE	BL	
	10.0 10.0	100%	91	28.5					
					M. SOFT TO M. HARD	GRAY	SILTY TO SANDY SHALE	BR-BL	

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" ID STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0512

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV — BORING NO. B-0512
ELEVATION 795 ± GWL 0 HRS 2.6 — PROJECT NO. C04 0384.40-01
HRS
DATE 04-05 MAY 2005 CLASSIFIED BY DAN SANGER — PAGE 2 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
						M. SOFT TO M. HARD	GRAY	SHALE (CON'T)	BR-BL	
32.0										
					35.7					
	10.0	10.0	100%	95		M. SOFT TO M. HARD	GRAY	INTERBEDDED SANDY SHALE AND SILTSTONE	BL	
42.0										
					42.95					
						SOFT	DK GRAY	CLAYSTONE	BR	LOW ∡ SLICKENSIDE 43.1, 44.15, 45.0, 45.2, 45.8
					46.0					
	10.0	10.0	100%	90	47.6	M. SOFT	GRAY	SANDY SHALE	BR-BL	
						SOFT	GRAY + MAROON	CLAYSTONE	BR	LOW ∡ FRACTURE 49.0
					49.7					
						M. SOFT TO M. HARD	LT GRAY	SANDY SILTSTONE	BL	
52.0					52.25					
						M. SOFT	MAROON	CLAY STONE	BR	LOW ∡ SLICKENSIDES 52.55, 53.0, 53.6, 53.85, 54.4, 54.65, 55.35
	9.9	10.0	99%	85	57.1					
						M. SOFT TO M. HARD	LT GRAY	INTERBEDDED SANDY SHALE AND SILTSTONE	BL	

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0512

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0512
ELEVATION 795± GWL 0 HRS 2.6 PROJECT NO. C040384.40-01
HRS
DATE 04-05 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
62.0					M. SOFT TO M. HARD	LT GRAY	INTERBEDDED SANDY SHALE AND SILTSTONE (CON'T) CLAYSTONE 62.7-63.2	VBR	
				64.2	SOFT TO M. SOFT	MAROON	CLAYSTONE	BR	VERTICAL FRACTURE 64.2-64.6
	10.0 10.0	100%	94	65.1	M. HARD	LT GRAY	SHALY SANDSTONE: FINE TO MEDIUM GRAINED, MICACEOUS	BL	
72.0									
				73.3	M. SOFT	MAROON + GRAY	SILTY CLAYSTONE	BR	VERTICAL FRACTURE 75.1-75.3; 45° FRACTURE 75.65
	10.0 10.0	100%	87	74.5	M. HARD	LT GRAY	SANDSTONE: MICACEOUS	BL	
82.0									
	9.8 10.0	98%	77	85.0	M. SOFT	GRAY	SILTSTONE	BR	LOW ∠ FRACTURES 85.0, 86.35, 86.5, 88.0, 89.3
				89.7					

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0512

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT
BORING NO. B-0512
ELEVATION: 795± GWL 0 HRS: 2.6
PROJECT NO. C040384.30-01
HRS:
DATE: 04-05 MAY 2005
CLASSIFIED BY: DAN SANGER
PAGE 4 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					M. SOFT	MAROON + GRAY	INTERBEDDED CLAYSTONE AND SILTSTONE	BR	
92.0									
				96.7					
	12.0 10.0	100%	67		M. SOFT TO SOFT	OLIVE-GRAY + MAROON + YELLOW	CLAYSTONE W/ INTERMITTENT IRREGULAR CALCAREOUS CLASTS + STRINGERS. PITTED CORE SURFACE	BR	30° SLICKENSIDES 97.0, 97.2, 97.6, 98.75, 99.25, 99.35, 99.7, 100.1, 100.6, 102.3, 102.5, 103.8, 104.1, 109.15, 109.5, 109.75
102.0									
								BL	
	6.8 8.0	85%	52						
								BR	
110.0				110.0					
							BOTTOM OF BORING: 110.0'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0512

N 542140.8876
E 1724101.7636 Grade El. 784.29

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0513

ELEVATION ______ GWL 0 HRS ______ PROJECT NO. C040384.40-01

HRS ______

DATE 06 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							BORING NOT DRILLED		
							LOG INCLUDED FOR CON-		
							TINUITY AND COMPLETENESS		
							PIEZOMETER INSTALLED		
							IN SAME BORE HOLE		
							AS B-0512		

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0513
(10)

N 540555.6419
E 1725145.9412 Grade El. 948.40

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. B-0514
ELEVATION ________ GWL 0 HRS 32.1 PROJECT NO. C040384.V0-01
HRS ________
DATE 09-10 MAY 2005 CLASSIFIED BY DANIEL SANGER PAGE 1 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS (DESCRIPTION)	COLOR (DESCRIPTION)	MATERIAL CLASSIFICATION (DESCRIPTION)	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	4 4	S-1			LOOSE	BROWN	SILTY SAND, SOME ROCK	SM	
1.5	2	REC 0.9					FRAGMENTS		
	4 3	S-2			↓	↓	↓	↓	
3.0	2	REC. 0.2							
	2 5	S-3			V. STIFF	MAROON	SILTY CLAY	CL	* 3.5 TSF
4.5	4	REC 1.1							
	4	S-4							* 3.0 TSF
6.0	4 9	REC. 1.3							
	7 7	S-5							* 3.0 TSF
7.5	10	REC. 0.6							
	7	S-6			↓				
9.0	9 9	REC 0.4			HARD		: DECOMPOSED		* > 4.5 TSF
	12 13	S-7					CLAYSTONE		* > 4.5 TSF
10.5	15	REC. 1.0		10.5	↓	↓	↓	↓	
	17	S-8			DENSE	TAN	DECOMPOSED SANDY SHALE	SM	
12.0	15 16	REC 1.4							
	21 20	S-9							
13.5	22	REC 1.5			↓	↓	↓	↓	
14.2		S-10 REC 0.7		14.2	V. DENSE	DK BROWN	DECOMPOSED SANDSTONE FRAGMENTS	SM	
					SOFT	LT. BROWN	HIGHLY WEATHERED SHALY	VBR-	HEAVILY STAINED
							SANDSTONE / SANDY SHALE	BR	VERTICAL FRACTURE
							HEAVILY STAINED		14.3-14.5, 17.5-17.7,
									18.2-18.3
	7.8 7.8	100%	45	19.3	↓	↓	↓		STAINED FRACTURES
					M. HARD	BROWN	SANDSTONE : STAINED TO		[illegible] 15.5, [illegible]
						↓	~ 22.2'		17.1, 17.6
22.0						GRAY			
				22.8	↓	↓	↓	↓	
				24.2	M. SOFT	GRAY	SILTSTONE STAINED 23.85-24.25	BR	LOW & STAINED FRACS 24.1, 24.15
					M. SOFT TO SOFT	DK GRAY	CLAYSTONE W/ CALCAREOUS	BR	LOW & STAINED FRACTURE
							CLASTS + STRINGERS		25.4, 26.6,
	10.0 10.0	100%	62				: SANDY 25.8-26.25		LOW & FRACTURES 27.4
				28.2	↓	↓	↓	↓	27.8
					M. SOFT	GRAY	INTERBEDDED SANDY SHALE AND	BR	
					↓	↓	SILTSTONE	↓	

REMARKS ** DRILLED BY TERRA TESTING USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS, 1" I.D. STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0514
(22)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0514
ELEVATION ______ GWL 0 HRS 32.1 PROJECT NO. C040384.0-01
HRS ______
DATE 09-10 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					M. SOFT	GRAY	SHALE/SILTSTONE (CON'T)	BR	LOW ∠ FRACTURES 29.5, 31.0, 31.15, 32.9, 33.45, 34.5
32.0									
				34.8					
	10.0 / 10.0	100%	52		SOFT	MAROON	CLAYSTONE	BR	~30° FRACTURES w/ SLICKENSIDES 35.8, 37.8, 39.2, 39.8, 40.7, 41.15, 41.35
42.0				42.0					
					M. SOFT TO M. HARD	GRAY	INTERBEDDED SANDY SHALE AND SILTSTONE	BR-BL	
	10.0 / 10.0	100%	89	47.0					
					M. HARD	LT GRAY	SANDSTONE	BL	
52.0									
	10.0 / 10.0	100%	97						
				57.9					
				59.3	M. SOFT	GRAY	SILTY SHALE	BR	~30° FRACTURES 57.9, 58.4
						DK. GRAY	CLAYSTONE, SLIGHTLY CALCAREOUS	VBR-BR	

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0514
(22)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0514

ELEVATION ______ GWL 0 HRS 32.1 PROJECT NO. C040384.40-01

HRS ______

DATE 09-13 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					M. SOFT	GRAY + MAROON	CLAYSTONE (CON'T)	BR	LOW ∡ FRACTURES
62.0									59.5, 59.9, 60.4, 61.2
									45° FRACTURE W/ SLICKENSIDE 62.1-62.25
									30° FRACTURES 62.6
	10.0 10.0	100%	86	66.7					62.7, 62.8, 63.0, 63.4
					M. SOFT TO M. HARD	GRAY	SANDY SHALE/SILTSTONE W/ NUMEROUS IRREGULAR CALCAREOUS CLASTS AND STRINGERS	BL	63.5, 64.1, 64.4, 65.25, 65.5, 65.75, 66.1, 66.5
72.0							: MAROON CLAYSTONE 71.25-71.55, 72.0-72.4		SLICKENSIDES 71.4, 72.0
				76.0					
	10.0 10.0	100%	92		M. SOFT	MAROON	CLAYSTONE W/ NUMEROUS IRREGULAR CALCAREOUS CLASTS AND STRINGERS	BR	
						GRAY + MAROON MOTTLED			
82.0				82.2					
					M. SOFT TO M. HARD	GRAY	SILTY SHALE W/ INTERMITTENT CALCAREOUS STRINGERS, SOME THIN (≤2") SANDSTONES	BL	
								BR	VERTICAL FRACTURE 86.6-87.6
	10.0 10.0	100%	90					BL	

REMARKS ** ______

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0514

(22)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0514
ELEVATION ______ GWL 0 HRS 32.1 PROJECT NO. C040384.40-01
HRS ______
DATE 09-10 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 4 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
				90.65					
					M. HARD	LT. GRAY	SANDSTONE	BL	
92.0									
				93.0					
					M. SOFT	GRAY	SILTY TO SANDY SHALE	BL	
	10.0 10.0	100%	95						
							CLAY SHALE 98.4-99.0	BR	LOW ∠ FRACTURES 98.4,
								BL	98.6, 98.95
102.0						MAROON + GRAY MOTTLED			SLICKENSIDE 102.0
									111.0 (~45°)
				104.3					
					M. HARD	LT GRAY	SANDSTONE	BL	
	10.0 10.0	100%	98						
112.0									
	10.0 10.0	100%	73						

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0514
(22)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0514
ELEVATION ______ GWL 0 HRS 32.1 PROJECT NO. C040384.40-01
HRS ______
DATE 09-10 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 5 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
						M. HARD	LT GRAY	SANDSTONE; MICACEOUS (CON'T)	BL	
122.0										
	10.0	10.0	100%	100						
132.0										
	10.0	10.0	100%	100						
142.0										
					143.2					
						M. SOFT	DK GRAY	CLAY SHALE	BR-BL	
										~30° FRACTURE W/SLICK
	8.0	8.0	100%	87						143.7, 146.3, 148.8
										LOW ∠ FRACTURE 146.3
150.0										

BOTTOM OF BORING: 150.0'

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0514
(22)

N 539572.1065
E 1723680.1660 Grade El. 933.64

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0515
ELEVATION ______ GWL 0 HRS 42.3 PROJECT NO. C040384.40-01
HRS ______
DATE 10-11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS
1	2	3	4	5	6	7	8	9	10
	1 3	S-1			STIFF	ORANGE-BROWN	SANDY CLAY	CL	* 1.5 TSF
1.5	4	REC 1.3							
	3 5	S-2				BROWN & GRAY			
3.0	5	REC 1.3			V.STIFF	GRAY	SANDY CLAY	CL	* 2.5 TSF DRY
	7 10	S-3			DENSE	BROWN	DECOMPOSED SANDSTONE FRAGMENTS		
4.6	20	REC 1.2							
	16	S-4			V.DENSE	BROWN & GRAY	DECOMPOSED SANDSTONE AND SANDY CLAY	SC	
5.4	50/0.4	REC. 0.9		5.4					TOP OF ROCK 5.4
				6.5	SOFT	BROWN	HIGHLY WEATHERED SANDSTONE	VBR-BR	
					M.SOFT TO M. HARD	BROWN	MODERATELY WEATHERED SAND-	BR	
	3.6 4.9	73%	40			GRAY	STONE		
				8.8					
10.3					SOFT	MAROON	CLAYSTONE: HIGHLY WEATHERED	VBR	~30° [illegible]
						TAN			w/ [illegible]
								BR	10.5, [illegible], 11.4, [illegible]
									13.9
								BL	
	10.0 10.0	100%	65						
				17.3	M SOFT TO SOFT	OLIVE-GRAY	CLAY SHALE: MODERATELY TO HIGHLY WEATHERED	BR	LOW ∠ [illegible]
									[illegible]
20.3									[illegible]
				21.0					NEAR VERTICAL [illegible]
				22.2	M.SOFT		SILTY SHALE	BR	FRACTURE [illegible]
					M.SOFT TO M.HARD	OLIVE-GRAY	SILTY SANDSTONE [illegible]	BL	
	10.0 10.0	100%	83						
						GRAY			

REMARKS ** DRILLED BY TERRA TESTING USING A SIMCO 10000-72 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515
(24)

gai consultants
transforming ideas into reality

PROJECT AAEYA ?/? JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0515
ELEVATION ______ GWL 0 HRS 42.3 PROJECT NO. C040384.??-01
HRS ______
DATE 10-11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
30.3							SANDSTONE (CON'T)		~65° STAINED FRACTURE 30.6-31.0, LOST WATER
				32.1	SOFT	GRAY + MAROON	INTERBEDDED CLAY SHALE AND CLAYSTONE: HIGHLY WEATHERED	VBR-BR	LOW & FRACTURES 32.2, 32.5, 32.9, 33.05, 34.0, 34.3, 35.1
	8.8 10.0	88%	51	34.3	SOFT	GRAY w/ MAROON MOTTLING	CLAYSTONE	BR	
40.3				40.8	M. SOFT TO M. HARD	GRAY	SANDY SILTSTONE	BR	VERT CALC FRACTURE 41.1-42.6
	10.0 10.0	100%	63	42.6	M. SOFT	GRAY / MAROON / GRAY	CLAYSTONE w/ INTERMITTENT IRREGULAR CALCAREOUS NODULES AND STRINGERS : BECOMES SANDY AT 50.1	BR	~25-30° FRACTURE w/ SLICKENSIDES 43.15, 44.55, 45.45, 47.4, 47.75, 48.6, 49.85, 53.5
50.3									
	10.0 10.0	100%	93	53.7	M. SOFT	GRAY / MAROON / GRAY	SANDY SHALE: INTERMITTENT SMALL (≤2 mm) CALCAREOUS NODULES	BR	

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515
(24)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST ALBANS, WV BORING NO. B-0515

ELEVATION ______ GWL 0 HRS 42.3 PROJECT NO. C040384.40-01

HRS ______

DATE 10-11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
60.3								SANDY SHALE (CON'T)		LOW ∡ FRACTURES
										63.0, 63.4, 68.0
								: MAROON CLAYSTONE 62.9-		(SLIGHT SLICKENSIDE),
								63.4		68.6,
										VERTICAL FRACTURE 69.1-
	10.0	10.0	100%	86						69.6, 70.3-70.7,
										70.85-71.05, 74.8-
										75.1, 76.25-77.4
70.3										LOW ∡ FRACTURE
										72.7, 79.4, 79.45,
										80.05
	10.0	10.0	100%	80						
80.3										
					83.5	SOFT	DK GRAY	CLAYSTONE		PITTED CORE SURFACE.
										LOW ∡ FRACTURES W/ SLICKEN-
	9.2	10.0	92%	72						SIDES 83.6, 83.95,
										84.2, 84.55, 84.7, 85.0,
					87.7					85.45
						M.SOFT	GRAY	SANDY SHALE	BR-BL	HIGH ∡ FRACTURE W/ SLICKEN-
										SIDES 86.2-86.35

REMARKS ** ______

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515
(241)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0515

ELEVATION ______ GWL 0 HRS 42.3 PROJECT NO. C040384-00-01

HRS ______

DATE 10-11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 4 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
90.3				90.5	SOFT TO M. SOFT	GRAY	CLAY SHALE	BL-BR	NEAR VERTICAL IRREGULAR FRACTURE W/SLICKENSIDES 91.65-92.05 (NO STAINING)
				94.4	M. SOFT TO M. HARD	LT. GRAY	SHALY SANDSTONE, MICACEOUS	BR-BL	VERTICAL FRACTURE 92.4-92.8, 93.35-93.85
	10.0 / 10.0	100%	75						
								BL	
100.3									
	10.0 / 10.0	100%	100						
110.3									
							SHALE CLASTS 112.5-113.4		
	10.0 / 10.0	100%	97						
				117.0	SOFT TO M. SOFT	GRAY	CLAY SHALE	BR	V. BROKEN 118.4-119.1 HIGH X FRACTURE 119.0-119.2

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO. B-0515
ELEVATION ________ GWL 0 HRS 42.3
HRS ________
PROJECT NO. C040384.43-01
DATE 10-11 MAY 2005
CLASSIFIED BY DAN SANGER
PAGE 5 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
120.3				120.5	M. SOFT	GRAY	SANDY SHALE	BR	
				122.6					
					M. SOFT TO M. HARD	LT GRAY	SHALY SANDSTONE: MICACEOUS	BR	
	10.0 / 10.0	100%	64	125.55	M. SOFT TO SOFT	GRAY & MAROON MOTTLED	CLAYSTONE	BR	45° SLICKENSIDE 126.9-127.05. PIECES ~0.2-0.4'
								VBR	LOW ∡ FRACTURE EVERY 0.1-0.85'
130.3									25-30° SLICKENSIDES 131.1, 131.25, 131.3 131.75
									V. BROKEN ZONE 131.75-137.1: NUMEROUS
	10.0 / 10.0	100%	32						~30° SLICKENSIDES
						MAROON			PIECES 0.1-0.3'
				138.5					CALCAREOUS NODULES 137.2-138.0
					M. SOFT	GRAY	SHALE WITH NUMEROUS IRREGULAR CALCAREOUS NODULES AND STRINGERS	BR-BL	
140.3									
	10.0 / 10.0	100%	91						
							: SANDY 148.3-148.6, 149.35-150.15		

REMARKS ** ________

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515 (2 1/1)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT BORING NO. B-0515
ELEVATION ______ GWL 0 HRS 42.3 PROJECT NO. C04038470-01
HRS ______
DATE 10 - 11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 6 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
150.3							SHALE (CON'T)		
							: SANDY 154.6 - 155.7		60° IRREGULAR
							157.0 - 160.2 (FEW		FRACTURE 155.2 - 155.5
	10.0 10.0	100%	88				NODULES)		
160.3				161.0					
					M. SOFT	GRAY + PURPLE	CLAYSTONE	BR - VBR	20 - 30° SLICKENSIDES
									161.4, 161.8, 162.2,
				164.7					163.2, 163.35, 163.65
									164.0, 164.1
	10.0 10.0	100%	77		M. SOFT	GRAY	SANDY SHALE	BR-BL	
170.3				171.7					
					M. HARD	LT GRAY	SANDSTONE : MICACEOUS	BL	
				174.8					
	10.0 10.0	100%	100		M. SOFT	GRAY	SANDY SHALE	BL	

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515
(24)

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT | BORING NO. B-0515
ELEVATION ________ GWL 0 HRS 42.3 | PROJECT NO. C040384.40-01
HRS ________
DATE 10-11 MAY 2005 | CLASSIFIED BY DAN SANGER | PAGE 7 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
180.3								SANDY SHALE (CON'T)		
					184.0					
						SOFT TO M-SOFT	DK GRAY	CLAY STONE	VBR-BR	~30° SLICKENSIDES EVERY 0.2-0.4'
	10.0	10.0	100%	50						
							MAROON			
190.3					190.3					
						M. SOFT	GRAY + MAROON	SILTY TO SANDY SHALE	BL-BR	LOW ∡ FRACTURE 194.1, 194.3, 195.0, 196.05, 196.4, 196.9 197.6, 197.9
	10.0	10.0	100%	82						
					197.0					30° FRACTURE 196.15
						SOFT TO M. SOFT	MAROON	CLAYSTONE	BR-VBR	30° SLICKENSIDES ~ EVERY 0.4'
200.3					200.5					
						M. SOFT	MAROON	SILTY SHALE	BL	GRADES INTO SILTY SHALE
	10.0	10.0	100%	100						
					206.55					
						M. SOFT TO M. HARD	GRAY	SHALY SANDSTONE	BR	
						M. HARD	LT GRAY	SANDSTONE	BR	

REMARKS** ________

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515
(24)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0515

ELEVATION ______ GWL 0 HRS 423 PROJECT NO. C040384.40-01

HRS ______

DATE 10-11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 8 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
210.3					210.3	M. SOFT TO M. HARD	GRAY	SANDY SHALE	BR	
					212.4					
					214.3	M. SOFT	MAROON	SILTY SHALE	BR	
						M. SOFT	BROWN, MAROON, GRAY, MOTTLED	CLAYSTONE	BR	25-30° SLICKENSIDES
	10.0	10.0	100%	88						215.0, 215.20, 215.55
										216.15, 217.85, 218.15
										60° SLICKENSIDE 215.3-215.45
					218.8					
						M. HARD	LT GRAY	SHALY SANDSTONE	BR	
220.3										
					221.5	M. SOFT	GRAY + MAROON	SANDY CLAYSTONE	BR	
					223.5					30° SLICKENSIDE 123.1
						M. SOFT	GRAY	SANDY SHALE	BR-BL	
										LOW ∡ FRACTURES
	10.0	10.0	100%	90						125.55, 125.8
					229.7					
230.3						M. SOFT TO SOFT	GRAY, OLIVE, MAROON MOTTLED	CLAYSTONE	BR	20-30° SLICKENSIDES
										229.9, 231.4, 231.5
										232.2, 232.4, 232.5
										233.0, 233.2, 233.8
										234.4, 235.6, 236.1
	10.0	10.0	100%	56						236.4, 237.5, 237.9,
										238.9, 239.1, 239.6,
										239.8, 240.1

REMARKS ** ______

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515

(24)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0515
ELEVATION ________ GWL 0 HRS 42.3 PROJECT NO. C040384.40-01
HRS ________
DATE 10-11 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 9 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
240.3					SOFT	MAROON	CLAYSTONE (CON'T)	VBR	20-30° SLICKENSIDES EVERY 0.1-0.3'
	10.0 10.0	100%	0						
250.3									
							BOTTOM OF BORING: 250.3'		

REMARKS ** ________

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0515
(24)

N 540842.6369
E 1724930.8565 Grade El. 864.94

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0516
ELEVATION ______ GWL 0 HRS N/A PROJECT NO. C040384.40-01
HRS ______
DATE 13 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	4 4	S-1			LOOSE	BROWN	SANDY SILT, FEW ROCK FRAGMENTS	ML	DRY
1.5	5	Rec 1.5							
	7	S-2							
3.0	9 22	Rec. 1.2			M. DENSE	BROWN & MAROON	SILTY SAND AND ROCK FRAGMENTS:	SM-GM	DRY
3.9	24 50/0.4	S-3 Rec 0.9		3.9			DECOMPOSED CLAYSTONE		
							BORING CANCELLED AND BACKFILLED		

REMARKS** DRILLED BY TERRA TESTING, INC USING A SIMCO 4000-T2 TRACK MOUNTED DRILL. BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0516

(23)

N 542185.2965
E 1725391.3276 Grade El. 945.55

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0517
ELEVATION 948± GWL 0 HRS 18.1 PROJECT NO. C040384.40-01
HRS
DATE 16-17 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	3 3	S-1			V. STIFF	MAROON-RED	SILTY TO SANDY CLAY (DECOMPOSED	CL	* 2.5 TSF
1.5	4	REC. 1.5							
	3	S-2					CLAYSTONE)		
3.0	5 7	REC 0.8			STIFF				* 1.5 TSF
	6 9	S-3			HARD		DECOMPOSED CLAYSTONE,		* >4.5 TSF
4.5	13	REC. 1.5							
	17	S-4					TRACE CALCAREOUS NODULES		
6.0	19 22	REC. 1.2							
	9 20	S-5							
7.5	18	REC. 1.5							
	8	S-6		8.0					
9.0	25 42	REC 1.5			V. DENSE	YELLOW-GRAY	DECOMPOSED SANDY SHALE	SM	
9.9	28 50/0.4	S-7 REC 0.9		9.9					
	2.0 2.1	95%	81	11.1	M. SOFT	OLIVE	SANDY SHALE	BR	
12.0					M. HARD	LT. GRAY	SANDSTONE	BR	
				12.9					
					M. SOFT	OLIVE-GRAY	INTERBEDDED SANDY SHALE	BR-	
							AND SHALY SANDSTONE	BL	STAINED ~60° FRACTURE
									13.45-13.6, 19.05-19.3,
	10.0 10.0	100%	74						19.7-19.9, 20.2-20.5
									LOW ∠ FRACTURES 14.3,
									15.25, 15.4, 15.65
									16.9, 19.3, 20.1, 20.65
22.0									STAINED V. BROKEN
							SANDSTONE 22.5-23.5		ZONE 19.3-19.7
				24.9					STAINED LOW ∠ FRAC-
					SOFT	MAROON	CLAYSTONE	BR-	TURES 22.35, 23.45,
	9.9 10.0	99%	84	27.1				VBR	23.9, 24.15, 24.25, 25.0
					M. SOFT TO M. HARD	OLIVE-GRAY	SHALY SANDSTONE - MICACEOUS	BR-	VBR 25.7-26.2
								BL	

REMARKS ** DRILLED BY TERRATESTING USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0517
(21)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B0517
ELEVATION 948± GWL 0 HRS 18.1 PROJECT NO. C040384.40-01
HRS
DATE 16-17 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
						M. HARD	GRAY	SANDSTONE (CON'T)		
32.0										
										STAINED LOW ∢ FRACTURES 32.3, 34.15
					36.2					
	10.0	10.0	100%	82		SOFT	MAROON	CLAYSTONE	BR	20-30° SLICKENSIDES 36.7, 37.4, 37.8, 38.4
									VBR	38.8, 38.95, 39.2
					40.5					
						M. SOFT	GRAY	INTERBEDDED SHALE AND SANDSTONE	BR	
42.0										
										44.6 CLAY SEAM
	9.6	100	96%	96	47.6					
						M. HARD	LT. GRAY	SANDSTONE - FINE TO MED GRAINED, MICACEOUS	BL	
52.0										
										VERTICAL FRACTURE (NO STAINING) 53.3-54.4
					55.7					
	10.0	10.0	100%	70	56.7	M. HARD	LT GRAY	CALCAREOUS SANDSTONE	BR	LOW ∢ FRACTURES 55.7, 56.2, 56.7, 57.5, 58.1
						SOFT	GRAY	CLAY SHALE, SOME SILT	BR	59.25, 59.55, 59.7, 60.0, 60.25,
					59.7					

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B0517

PROJECT: AREA 2/3, JOHN E. AMOS POWER PLANT, ST. ALBANS, WV
BORING NO. B-0517
ELEVATION 948± GWL 0 HRS 18.1
HRS
PROJECT NO. C040384 40-01
DATE 16-17 MAY 2005
CLASSIFIED BY DAN SANGER
PAGE 3 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
						SOFT	DARK GRAY + MAROON	CLAYSTONE	BR-VBR	20-35° SLICKENSIDES ~EVERY 0.2-0.4'
62.0										
	10.0	10.0	100%	67	66.7					
						M. HARD	GRAY	SILTSTONE w/ INTERMITTENT IRREGULAR CALCAREOUS NODULES AND STRINGERS, SOME SAND	BL	LOW ∠ FRACTURE 70.35, INTERSECTING 45° FRACTURE AND 30° FRACTURE 71.6-71.9
72.0										NEAR VERTICAL FRACTURE 72.9-73.4
					75.5					
	10.0	10.0	100%	79		SOFT	MAROON	CLAYSTONE	BR-VBR	30° SLICKENSIDES ~EVERY 0.2-0.3'
					78.0					
						M. SOFT TO M. HARD	GRAY	SANDY SILTSTONE w/ INTERMITTENT IRREGULAR CALCAREOUS NODULES (≤ ½") AND STRINGERS	BR-BL	~45° FRACTURE AT LARGE CALC. NODULE AT 78.6-78.8
82.0					82.0					
						SOFT TO M. SOFT	MAROON + GRAY	INTERBEDDED CLAYSTONE AND SANDY SILTSTONE (UNITS ARE 0.9-1.5' IN THICKNESS) w/ INTERMITTENT IRREGULAR CALCAREOUS NODULES (1½") AND STRINGERS	BR-BL	SLICKENSIDES (30°) 82.25
	10.0	10.0	100%	97						

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0517

(21)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST-ALBANS, WV BORING NO. B-0517
ELEVATION 948± GWL 0 HRS 18.1 PROJECT NO. C040384.40-01
HRS
DATE 16-17 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 4 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY-CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
					90.2	M. HARD	LT GRAY	SHALY SANDSTONE: MICACEOUS	BL-	
92.0										
	10.0	10.0	100%	90	97.4					
						SOFT TO M. SOFT	GRAY + MAROON	SILTY SHALE	BR	LOW ∡ FRACTURE 98.15, 98.8, 101.0
										60° FRACTURE 99.1-99.4, 100.0-100.5
102.0					101.8					
					103.0	M. HARD	LT. GRAY	SHALY SANDSTONE		
						M. SOFT	GRAY	SILTSTONE	BL	
					106.0					
	10.0	10.0	100%	94		M. SOFT	GRAY + MAROON	INTERBEDDED SILTSTONE AND SANDY CLAYSTONE		30° SLICKENSIDE 106.8
					108.7		MAROON, BROWN, + GRAY	CLAYSTONE W/ INTERMITTENT IRREGULAR CALCAREOUS NODULES (≤1/2") AND STRINGERS	BR	20-30° SLICKENSIDES 109.2, 109.85, 110.75, 111.2, 111.45,
112.0					112.0					
						M. SOFT TO M. HARD	GRAY	SANDSTONE WITH SOME SHALE SEAMS TO 120.6	BL	
	10.0	10.0	100%	100						

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0517

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST. ALBANS, WV — BORING NO. B-0517

ELEVATION 948± GWL 0 HRS 18.1 — PROJECT NO. C040384.40-01

HRS

DATE 16-17 MAY 2005 CLASSIFIED BY DAN SANGER — PAGE 5 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					M. HARD	GRAY TO	SANDSTONE (CON'T)	BL	
122.0						LT. GRAY			
	10.0 10.0	100%	100						
132.0				132.0					
					M. SOFT	GRAY	SANDY SHALE	BL	
				136.0					
	10.0 10.0	100%	96		M. HARD	LT GRAY	SANDSTONE		
				139.0					
					M. SOFT	GRAY	SANDY SHALE		
				140.7					
142.0				142.0	M. SOFT	LT. GRAY	SHALY SANDSTONE		
					M. SOFT TO SOFT	GRAY	SANDY CLAYSTONE	BR	SLICKENSIDES 142.3, 143.65, 144.2,
						DK GRAY			144.7, 145.0 145.15,
	8.0 8.0	100%	95	146.0					145.75. NUMEROUS BREAKS DURING CORE EXTRACTION
					M. SOFT	GRAY	SILTSTONE	BL	CALCAREOUS NODULE 146.0-146.2
150.0							BOTTOM OF BORING: 150'		

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0517

(21)

N 541508.473
E 1724947.2614
Grade El. 1015.78

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT
BORING NO. B-0518
ELEVATION 1005± GWL 0 HRS 14.2, BACKFILLED
PROJECT NO. C040384.40-01
HRS
DATE 17 MAY 2005 CLASSIFIED BY DAN SANGER
PAGE 1 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	2 2	S-1			LOOSE	BROWN	FINE TO MEDIUM SAND	SP	
1.5	4	REC 1.4							
	5	S-2							
3.0	8 13	REC 1.3			M.DENSE				
3.6	50 50/0.1	S-3 REC. 0.6		3.6	V. DENSE				TOP OF ROCK: 3.6'
					SOFT	YELLOW-BROWN	SANDSTONE: MICACEOUS,	VBR	AFTER THIS RUN,
							COMPLETELY WEATHERED		DROVE CASING TO 10.8'
	5.0 7.2	69%	0						
10.8									
							: HIGHLY WEATHERED	BR	PIECES 0.3-0.6'
							: COMPLETELY WEATHERED	VBR	PIECES ≤ 0.2'
	9.4 10.0	94%	46						
20.8									
	6.8 10.0	68%	18						

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0518
(29)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO. B-0518
ELEVATION: 1005±
GWL 0 HRS: 14.2, BACKFILLED
HRS:
PROJECT NO. C040384.40-01
DATE: 17 MAY 2005
CLASSIFIED BY: DAN SANGER
PAGE 2 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
30.8					SOFT	YELLOW-BROWN	SANDSTONE (CON'T)	VBR	
							; HIGHLY WEATHERED	BR	70° STAINED FRACTURE 30.8-31.3
	10.0 10.0	100%	39						
				36.8					
					M. SOFT	BROWN	SANDY TO SILTY SHALE	BR	30° STAINED FRACTURES 37.6, 38.6, 39.0
				39.0		GRAY			
					SOFT	MAROON, PURPLE, YELLOW, GRAY	CLAYSTONE	BR	SLICKENSIDES: 41.05, 41.3, 41.7, 42.9, 43.5, 44.9, 45.15, 45.85, 46.5, 47.3, 47.95, 48.15, 49.25, 49.8, 50.15, 50.45, 50.8, 51.1, 51.4, 51.8, 52.2, 52.75, 53.15, 53.7, 54.2
40.8									
	10.0 10.0	100%	64						
50.8									
	9.5 10.0	95%	64						
								VBR	VERTICAL FRACTURE 56.4-58.7

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0518

(29)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. B-0518
ELEVATION 1005± GWL 0 HRS 14.2, BACKFILLED PROJECT NO. C040384.40-01
HRS
DATE 17 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
60.8					SOFT	MAROON, GRAY, PURPLE YELLOW	CLAYSTONE (CON'T)	BR-VBR	
	4.2			62.8					
					M. SOFT	GRAY	SANDY SILTSTONE W/ CALCAREOUS NODULES AND STRINGERS	BR-BL	
65.0				65.0					
							BOTTOM OF BORING: 65.0'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0518
(29)

N 543732.8856
E 1725136.5233 Grade El. 991.07

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0519
ELEVATION ________ GWL 0 HRS 32.85 PROJECT NO. C040384.41-01
HRS ________
DATE 17-19 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	1 2	S-1		0.7	V. LOOSE	BROWN	TOP SOIL		
1.5	3	REC. 1.2							
	8	S-2			LOOSE	BROWN	SANDY SILT	ML	
3.0	6 5	REC. 1.3			M. DENSE				
	7 10	S-3					SILT, TRACE CLAY		
4.5	12	REC 1.3							
	15	S-4							
6.0	18 30	REC. 1.0			DENSE	BROWN + GRAY	DECOMPOSED SHALE	GM	
	28 41	S-5			V. DENSE				
7.4	50/0.4	REC 1.3		7.4					TOP OF ROCK 7.4
					SOFT	BROWN + GRAY	CLAY SHALE: COMPLETELY WEATHERED	NBR	
	3.1 3.1	100%	0						NUMEROUS LOW ∠ FRACTURES
10.5									HIGHLY BROKEN ZONE 8.1-8.7
				13.7					
				14.7	SOFT		CLAYSTONE: COMPLETELY WEATHERED	BR	HIGH ∠ FRACTURE 13.7
	9.5 10.0	95%	49	15.5	M. HARD		SANDSTONE	BR	
					SOFT	MAROON W/ YELLOW MOTTLING	CLAYSTONE: HIGHLY WEATHERED	BR	30° SLICKENSIDES 18.7, 19.4, 19.85 23.0, 23.3, 23.6, 23.9, 24.05
20.5									
					SOFT TO M. SOFT		: SOME CALCAREOUS NODULES		
									45° FRACTURE 22.2
					M. SOFT	GRAY			
	10.0 10.0	100%	60						
						GRAY W/ MAROON MOTTLING	: PIECES 0.2-0.4' LONG		STAINED 20-30° FRACTURES 24.7, 25.2, 25.8, 26.0

REMARKS ** DRILLED BY TERRA TESTING USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0519

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST ALBANS, WV BORING NO. B-0519
ELEVATION ______ GWL 0 HRS ______ PROJECT NO. C040384.40-01
HRS ______
DATE 17-19 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
30.5								CLAYSTONE (CON'T)	VBR	
					31.4	M. SOFT	OLIVE-GRAY	SANDY SILTSTONE	BR	STAINED LOW ∠ FRACTURE 32.2, 33.0, 33.3
					33.2	SOFT TO M. SOFT	GRAY	CLAY SHALE		34.3, 34.8, 35.1, 35.45
	10.0	10.0	100%	58	35.1	M. SOFT	OLIVE-GRAY	SANDY SILTSTONE		
					36.4	SOFT TO M. SOFT	MAROON + GRAY	CLAYSTONE	BR-BL	
40.5					41.5					20° SLICKENSIDE, 40.5
										70° SLICKENSIDE 41.0-41.3
						M. HARD	GRAY	SANDSTONE: MICACEOUS	BR-BL	NEAR VERTICAL FRACTURE 42.85-43.8
	10.0	10.0	100%	71	43.8	M. SOFT	GRAY	SHALY SILTSTONE, SOME SAND	BR	
					47.4	M. SOFT	GRAY + MAROON + DK GRAY	SILTY CLAYSTONE	BR	20-30° SLICKENSIDES 48.65, 49.6, 50.2
50.5										50.8, 52.8, 53.2, 53.5, 54.2 54.8, 55.3, 55.6, 55.8, 56.0, 56.6 57.0, 57.4, 57.8, 58.1, 58.4, 59.2
	10.0	10.0	100%	53						

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0519
(20)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST ALBANS, WV | BORING NO. B-0519
ELEVATION ______ GWL 0 HRS 32.85 | PROJECT NO. C040384.43-01
HRS ______
DATE 17-19 MAY 2005 | CLASSIFIED BY DAN SANGER | PAGE 3 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
60.5	◇				SOFT TO	MAROON	CLAYSTONE (CON'T)	BR	20°-30° SLICKENSIDES
					M SOFT			↓	EVERY ~ 0.2-0.5'
								VBR	
								BR	
	8.7 / 10.0	87%	41						
								VBR	
									30° SLICKENSIDES
70.5	◇								70.9, 71.7
								BR	VERTICAL FRACTURE
				71.9					70.5-70.8, 71.9-72.1
					M. SOFT	GRAY	SANDSTONE; V. FINE GRAINED,	BR-BL	
					M. HARD		ARGILLACEOUS, SOME		
							CROSS BEDDING, FEW		
	10.0 / 10.0	100%	78				IRREGULAR CALCAREOUS		
							NODULES		
									VERTICAL FRACTURE
									78.5-78.8, 80.0-80.5
80.5	◇								
									CLOSED VERTICAL FRAC-
	10.0 / 10.0	100%	95	86.2					TURE 84.3-85.3
					M. SOFT	MAROON + GRAY	SANDY CLAYSTONE	BR	
									30° SLICKENSIDE 88.5,
				89.6					89.15
					M. SOFT/M. HARD	LT GRAY	SHALY SANDSTONE	BR	

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0519
(20)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV — BORING NO. B-0519

ELEVATION ________ GWL 0 HRS 32.85 — PROJECT NO. C040384.40-01

HRS ________

DATE 17-19 MAY 2005 — CLASSIFIED BY DAN SANGER — PAGE 4 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
90.5					M. SOFT TO M. HARD	LT. GRAY	SHALY SANDSTONE (CON'T)	BR	10-20° FRACTURES 91.1, 91.55, 92.0, 92.4, 92.6, 93.1,
				94.0	M. SOFT	GRAY + MAROON MOTTLED	SANDY CLAYSTONE	BR	VERTICAL FRACTURE 92.6-93.1, 94.3-94.6
	10.0 / 10.0	100%	50	95.8	M. SOFT TO SOFT	MAROON	CLAYSTONE	BR-VBR	20-30° SLICKENSIDES EVERY ~0.1-0.3'
100.5								VBR	100.5-102.7 VERY BROKEN ZONE, HEAVILY STAINED 100.5-101.7
						GRAY			
				104.5					
	10.0 / 10.0	100%	58		M. SOFT TO M. HARD	LT. GRAY	SHALY SANDSTONE	BR-BL	
110.5				110.5					
					M. HARD	LT. GRAY	SANDSTONE; MICACEOUS	BL	110.5-114.7 - 1 PIECE
				114.7					
	10.0 / 10.0	100%	77		M. SOFT	GRAY	SANDY SHALE	BL	VERTICAL FRACTURE 115.25-115.75
				117.5	M. SOFT	GRAY + MAROON MOTTLED	CLAYSTONE	BR	20-30° SLICKENSIDES EVERY ~0.3-0.5'

REMARKS ** ____________________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0519

(20)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0519
ELEVATION ________ GWL 0 HRS 32.85 PROJECT NO. C040384.110-01
HRS ________
DATE 17-19 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 5 of 5

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
120.5	◇				M. SOFT	GRAY + MAROON	CLAYSTONE (CON'T)	VBR-	20-30° SLICKENSIDES
								BR	~ EVERY 0.1-0.3'
							; SANDY 124.0-125.1		
	10.0 / 10.0	100%	47	125.9					
					M. HARD	LT GRAY	SHALY SANDSTONE	BR	RQD IN THIS UNIT
				129.15					
					M. SOFT	GRAY W/	INTERBEDDED SANDY	BR	
130.5	◇					MAROON MOTTLING	CLAYSTONE AND SILTSTONE		
							SOME SANDSTONE		
				133.8					
	10.0 / 10.0	100%	76	135.3	M. SOFT	MAROON	CLAYSTONE	VBR	
					M. SOFT TO	GRAY	SANDY CLAYSTONE WITH	BR	LOW ∠ FRACTURES
					M. HARD		SMALL CALCAREOUS NODULES		136.05, 136.4, 136.8,
							AND STRINGERS		137.3, 137.9, 138.4,
									138.9, 139.0
140.5	◇				M. SOFT	MAROON			
				142.0					
					M. SOFT	LT GRAY	SHALY SANDSTONE	BL	
					TO M. HARD				
							; CLAYSTONE SEAM		
	10.0 / 10.0	100%	80	146.3			144.1-144.65		
				147.4	M. SOFT	GRAY	SANDY CLAYSTONE	BR	VERTICAL FRACTURE 147.2-
						MAROON	CLAYSTONE		148.15
				148.8					
150.5	▲				M. HARD	GRAY	SANDY SHALE/SHALY SANDSTONE	BL	

REMARKS ** BOTTOM OF BORING 150.5

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0519
(20)

N 542378.3755
E 1721739.7942 Grade El. 679.31

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0520
ELEVATION ______ GWL 0 HRS 18.6 PROJECT NO. C040384.40-01
HRS ______
DATE 23 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	1 3	S-1			STIFF	MAROON	SANDY CLAY AND ROCK FRAGMENTS	CL	* 2.0 TSF
1.5	4	REC 0.9							
	4 4	S-2							
3.0	4	REC. 1.5							*2.5 TSF
	5 5	S-3							*2.0 TSF
4.5	6	REC. 1.5							
	5	S-4							
6.0	6 10	REC. 1.5			M. DENSE	BROWN + BLACK	CLAYEY SILT AND ORGANICS	ML	WET
	8 13	S-5		7.0					
7.5	35	REC. 1.5							
7.6	50/0.1	S-6 REC 0.1		7.6	V. DENSE	GRAY + MAROON	DECOMPOSED CLAYSTONE	GM	TOP OF ROCK: 7.6'
					SOFT	MAROON	CLAYSTONE: HIGHLY WEATHERED	VBR-BR	MOST PIECES 0.2'
	4.4 4.4	100%	12				: GRAY 10.9-11.2		
12.0				12.0					
					SOFT	GRAY	SANDY SHALE: WEATHERED	VBR-BR	
				13.7					
					SOFT	MAROON	CLAYSTONE	BR	VERTICAL FRACTURE 16.6-17.4
						GRAY	: CALCAREOUS NODULES 16.0-16.5		
	9.3 10.0	93%	51				: SANDY 16.5-17.1		
						MAROON			20° SLICKENSIDE 19.75
22.0									
									30° SLICKENSIDE 26.4
	9.2 10.0	92%	65						27.7, 28.7, 29.25, 29.8

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0520
(15)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0520

ELEVATION ______ GWL 0 HRS 18.6 PROJECT NO. C040384.40-01

HRS ______

DATE 23 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
						SOFT	MAROON	CLAYSTONE (CON'T)	BR	
32.0										
					35.5					
	9.9	10.0	99%	47	37.2	M. HARD	LT. GRAY	SHALY SANDSTONE/SANDY SHALE	BL	
						M. SOFT	MAROON	CLAYSTONE	BR	
					40.2					
						M. HARD	LT GRAY	SHALY SANDSTONE/SANDY SHALE	BR	VERTICAL FRACTURE
42.0										40.4-41.0, 42.0-42.3
					41.7					
						M. SOFT	MAROON	INTERBEDDED SANDY CLAYSTONE	BR-BL	
						M. HARD	GRAY	AND SANDY SHALE, FEW THIN		
								(≤0.5') SANDSTONE UNITS,		
	10.0	10.0	100%	85				FEW IRREGULAR CALCAREOUS		
								NODULES AND STRINGERS		
52.0					52.1					
						M. HARD	LT GRAY	SHALY SANDSTONE	BL	
					54.4					
						M. SOFT	MAROON + GREEN-GRAY	CLAYSTONE W/ NUMEROUS IRREGULAR	BL-BR	SLICKENSIDES 56.1,
								CALCAREOUS NODULES AND		56.5, 56.75, 57.0,
	10.0	10.0	100%	81				STRINGERS		60.7, 61.0, 61.3

REMARKS ** ______

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0520

(15)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST. ALBANS, WV — BORING NO. B-0520
ELEVATION ______ GWL 0 HRS 18.6 — PROJECT NO. C040384.40-01
HRS ______
DATE 23 MAY 2005 — CLASSIFIED BY DAN SANGER — PAGE 3 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
						M. SOFT	MAROON + GRAY	CLAYSTONE (CON'T)	BR	
62.0										
					66.2					
	10.0	10.0	100%	75		M. SOFT	GRAY	SANDY CLAYSTONE, FEW SANDY SILTSTONE SEAMS	BR	
72.0										
					73.6					
						M. SOFT	GRAY	INTERBEDDED SILTSTONE AND FINE GRAINED SANDSTONE	BR-BL	
	10.0	10.0	100%	96						
					81.1					
82.0						M. HARD	LT. GRAY	SANDSTONE	BL	
	9.9	10.0	99%	100						

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0520
(15)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST. ALBANS, WV — BORING NO. B-0520
ELEVATION ______ GWL 0 HRS 18.6 — PROJECT NO. CO403840.YO-01
HRS ______
DATE 23 MAY 2005 — CLASSIFIED BY DAN SANGER — PAGE 4 of 4

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					M. HARD	LT GRAY	SANDSTONE (CON'T)	BL	
92.0									
	7.6 / 8.0	95%	77						
				97.8					
					M. SOFT	GRAY + MAROON	CLAYSTONE	BR	
100.0									
							BOTTOM OF BORING: 100'		

REMARKS ** ______

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0520
(45)

N 544199.5521
E 1724054.5791 Grade El. 1004.35

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0521
ELEVATION ~1003 GWL 0 HRS 24.6 PROJECT NO. C040384.40-01
HRS
DATE 23 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	2 3	S-1			V. STIFF	MAROON	SILTY CLAY/CLAYEY SILT	CL/ML	< 3.0 TSF
1.5	4	REC. 1.2							
	6	S-2			DENSE	BROWN-GRAY	SANDY SILT, FEW SHALE FRAGMENTS	ML	
3.0	7 24	REC. 1.2							
3.4	50/0.4	S-3, REC 0.3		3.4	V. DENSE		DECOMPOSED SANDY SHALE		
						OLIVE-			
					SOFT	BROWN	SILTY SHALE, SOME SAND	BR	STAINED VERTICAL
									FRACTURE 4.5-5.1,
									6.1-6.7
	7.0 7.0	100%	40						LOW ∡ STAINED FRACTURES
									4.0, 5.1, 5.5, 6.1, 8.0,
									8.55, 9.55
10.4				10.3	M. SOFT	BROWN-	SANDY SHALE	VBR-	
						GRAY		BR	PIECES 0.1-0.4'
				13.3	M. HARD	BROWN-	SANDSTONE: MEDIUM GRAINED	BL	
						GRAY			
	10.0 10.0	100%	78						
20.4									
	10.0 10.0	100%	92						LOW ∡ FRACTURES
									28.2, 28.45, 28.85, 29.35,
									29.85, 30.15, 30.3
									VERTICAL STAINED
									FRACTURE 29.3-29.7

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4 SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0521

(19)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0521
ELEVATION 1003± GWL 0 HRS 24.6 PROJECT NO. C040384.40-01
HRS
DATE 23 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR	CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
30.4						M. HARD	BROWN-GRAY	SANDSTONE: MEDIUM GRAINED, MICACEOUS (CON'T)	BL	ALL BREAKS ARE MECHANICAL - CORE IN 4' AND 6' PIECES - BROKE DURING HANDLING
	10.0	10.0	100%	100						
40.4										
	10.0	10.0	100%	100						
50.4										
	9.7	10.0	97%	94						0.05' CARBONACEOUS SHALE AT 59.8

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0521
(19)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0521

ELEVATION 1003 ± GWL 0 HRS 24.6 PROJECT NO. C040384.40-01

HRS

DATE 23 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 3

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
60.4						M-HARD	BROWN-GRAY	SANDSTONE (CON'T)	BL	
					64.0					
					65.1	M-SOFT	LT. GRAY	SANDY CLAYSTONE W/ CALCAREOUS NODULES	BR	
	9.6	10.0	96%	58	66.5		GRAY	SILTY CLAYSTONE		
							MAROON	CLAYSTONE		30° SLICKENSIDES 66.75, 67.6, 68.0, 68.25, 68.4, 68.6, 69.1, 69.45, 69.7, 70.3, 70.4
70.4					70.4					
								BOTTOM OF BORING: 70.4'		

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0521

gai consultants
transforming ideas into reality

N 543873.4417
E 1722326.4148 Grade El. 901.64

PROJECT: AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0522
ELEVATION: 902± GWL 0 HRS 56.8 PROJECT NO. C040384.40-01
HRS
DATE: 24-25 MAY 2005 CLASSIFIED BY: DAN SANGER PAGE 1 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
	2 2	S-1			V. STIFF	MAROON	SILTY CLAY	CL	* 3.5 TSF
1.5	3	REC 0.6							
	3	S-2							
3.0	5 6	REC. 1.2		3.4					
	18 38	S-3			V. DENSE	OLIVE-GRAY	DECOMPOSED SANDY SHALE		
4.2	50/0.2	REC 1.0		4.2					TOP OF ROCK: 4.2'
					SOFT TO M. SOFT	OLIVE + GRAY	INTERBEDDED SANDY SHALE AND SHALY SANDSTONE	BR	LOW ∡ FRACTURES 4.7, 5.1, 6.1, 6.65, 6.95, 7.35
	6.3 6.3	100%	63						STAINED 30° FRACTURE 8.4
10.5									VERTICAL STAINED FRACTURE 8.85-9.2
									STAINED LOW ∡ FRACTURES 10.8, 11.6, 12.55, 12.65, 14.7, 14.9, 15.2, 15.3, 15.9, 16.05,
	10.0 10.0	100%	36					VBR	16.45, 16.5, EVERY 0.1
								BR	TO 0.3' 16.5-
				20.0					
20.5					SOFT TO V. SOFT	MAROON + GRAY	CLAYSTONE	BR	
								[illegible]	
								BL	
	8.8 10.0	88%	46					VBR-BR	
				27.0					
					M. HARD	GRAY	SHALY SANDSTONE	BR	STAINED VERTICAL FRACTURE 27.0-28.0 30.7-30.9

REMARKS** DRILLED BY TERRA TESTING, INC USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522
(10)

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0522

ELEVATION 902± GWL 0 HRS 56.8 PROJECT NO. C040384-40-01

HRS

DATE 24-25 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
30.5									
				31.1					
					V. SOFT	MAROON	CLAYSTONE	VBR	NO RECOVERY IN
									THIS UNIT
	3.6 10.0	36%	24						
				37.5					
					M. SOFT	OLIVE +	INTERBEDDED CLAYSTONE AND	BR	
						GRAY	SANDY SHALE		LOW ∡ FRACTURES
									41.45, 41.7, 41.9, 43.7,
40.5									43.8, 46.8, 48.4, 49.4,
									50.0, 50.9, 51.1, 51.4, 52.2
									STAINED HIGH ∡ FRAC-
									TURES 45.5-46.5
									47.4-47.9, 48.7-
	10.0 10.0	100%	56						48.95
50.5									
				52.3					
					M. SOFT	OLIVE-	SANDY SHALE	BR	LOW ∡ FRACTURES 52.7,
						GRAY			53.9, 54.3, 54.65, 55.1, 56.4
									57.45, 59.3
	10.0 10.0	100%	80						STAINED LOW ∡ FRACTURE
									53.45, 55.75-55.9, 56.5,
				57.9					57.1, 58.4 60.0
					SOFT TO	MAROON +	CLAYSTONE	BR-	HIGH ∡ STAINED FRACTURE
					M. SOFT	GRAY		VBR	58.7-59.3

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0522
ELEVATION 902± GWL 0 HRS 56.8 PROJECT NO. C040384.40-01
HRS
DATE 24-MAY 2005 CLASSIFIED BY DAN SANGER PAGE 3 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
60.5				60.7					
					M. SOFT	GRAY	SANDY SHALE	BR	STAINED LOW ∠ FRAC-
				63.0	↓	↓	↓		TURES 60.75, 61.0,
				64.0	M. SOFT	MAROON	CLAYSTONE		61.5, 61.9
					M. SOFT	GRAY	SHALY SANDSTONE / SANDY		HEAVILY STAINED NEAR
	10.0 10.0	100%	36				SHALE		VERTICAL FRACTURE 65.35-67.2
									@67' 100% WATER LOSS *
									STAINED VERTICAL FRAC-
								↓	TURE 68.1-68.7, 69.2-
				70.4		↓	↓	VBR	70.3
70.5						MAROON	CLAYSTONE	BR	
						+ GRAY			VERTICAL FRACTURE
									74.6-76.5
								↓	
								VBR	
	10.0 10.0	100%	61					BR	
								↓	
							; SANDY 78.5-80.5	BR	
80.5									LOW ∠ FRACTURE 80.8,
								↓	81.2, 83.1, 83.7, 84.5
								VBR	V. BROKEN ZONE 81.3-83.1
						↓			
						DK GRAY		↓	
								BR	HIGH ∠ FRACTURE 84.2-
	10.0 10.0	100%	57	86.1	↓	↓	↓	↓	84.45
					M. SOFT	GRAY	SILTSTONE	BR	LOW ∠ FRACTURE 87.1, 87.65
									88.3,
									NEAR VERTICAL STAINED
					↓	↓	↓	↓	FRACTURE 88.5-89.2

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522
(1.P)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV — BORING NO. B-0522

ELEVATION 902± — GWL 0 HRS 56.8 — PROJECT NO. C040384.40-01

HRS

DATE 24-25 MAY 2005 — CLASSIFIED BY DAN SANGER — PAGE 4 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
90.5				90.0	M. HARD	LT GRAY	SHALY SANDSTONE MICACEOUS	BL	
	10.0 10.0	100%	93						
100.5									
	10.0 10.0	100%	95						
							: SHALE 107.0 - 107.6 (BR)		
							: SHALE PEBBLES/CHIPS 108.6 - 109.8		
110.5									
	10.0 10.0	100%	95						

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522

(18)

gai consultants
transforming ideas into reality

PROJECT: AREA 2/3, JOHN E. AMOS POWER PLANT ST. ALBANS, WV
BORING NO. B-0522
ELEVATION: 902± GWL 0 HRS 56.8
PROJECT NO. C040384.40-01
HRS
DATE: 24-25 MAY 2005
CLASSIFIED BY: DAN SANGER
PAGE 5 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
120.5						M-HARD TO HARD	LT GRAY	SANDSTONE (con't)	BL	
	10.0	10.0	100%	100						
130.5										
	10.0	10.0	100%	100						
140.5										
	10.0	10.0	100%	100						

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV | BORING NO. B-0522

ELEVATION 902± GWL 0 HRS 56.8 | PROJECT NO. C040384.40-01

HRS

DATE 24-25 MAY 2005 CLASSIFIED BY DAN SANGER | PAGE 6 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
150.5				150.8			SANDSTONE (CON'T)		
					SOFT	MAROON, GRAY, PURPLE, YELLOW	CLAYSTONE, SOME SAND	BR	30° SLICKENSIDES 153.05, 153.6, 154.0
				154.5	M. SOFT TO M. HARD	GRAY TO LT. GRAY	INTERBEDDED SANDY SHALE AND SANDSTONE	BL	
	10.0 10.0	100%	75						
160.5									
	10.0 10.0	100%	100						
170.5									
				173.0					
					SOFT	GRAY	CLAY SHALE	BR	
				174.7					
	10.0 10.0	100%	72		SOFT	DK GRAY + MAROON	SILTY TO SANDY CLAYSTONE	BR	20-30° SLICKENSIDES 175.0, 175.4, 175.55, 176.1, 176.6, 177.35, 177.65, 177.75, 178.35, 179.15, 179.4,
							- IRREGULAR CALCAREOUS STRINGERS 179.4-180.0		

REMARKS **

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522

(18)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST ALBANS, WV BORING NO. B-0522
ELEVATION 702± GWL 0 HRS 56.8 PROJECT NO. C04032[illegible]
HRS
DATE 24-25 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 7 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
180.5					180.0	M. SOFT	GRAY	SHALY SILTSTONE	BL	
					183.0					
						M. SOFT TO SOFT	MAROON + GRAY	CLAYSTONE	BL-BR	30° SLICKENSIDES AT 185.1, 185.3, 185.5, 186.4, 186.7, 187.0, 187.2, 187.55, 188.1
	10.0	10.0	100%	78						
					188.6					
190.5						SOFT TO M. SOFT	MAROON + GRAY	INTERBEDDED CLAYSTONE AND SANDY SHALE, SOME SANDSTONE,	BL	
	10.0	10.0	100%	90						
200.5					200.5					
						M. SOFT	MAROON + GRAY	CLAYSTONE	BR-BL	20-30° SLICKENSIDES 202.3, 202.65, 202.9, 203.2, 203.45, 203.7
	10.0	10.0	100%	86	206.5					
						M. HARD	GRAY	SANDY SILTSTONE	BL	
					209.7					

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522
(1:2)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV　BORING NO. B-0522
ELEVATION 902 ±'　GWL 0 HRS 56.8　PROJECT NO. C040384.40-01
HRS
DATE 24-25 MAY 2005　CLASSIFIED BY DAN SANGER　PAGE 8 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN		SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2		3	4	5	6	7	8	9	10
210.5						M. HARD	LT. GRAY	SANDSTONE; FINE TO MEDIUM GRAINED, MICACEOUS	BL	
	10.0	10.0	100%	100						
					220.0					
220.5						M. SOFT TO SOFT	MAROON, GRAY, PURPLE, GREEN-GRAY	CLAYSTONE ; SILTY 220-225'	BR	
	10.0	10.0	100%							225-252.5 - CORE PIECES 0.2-0.4' W/20-30° SLICKENSIDES
								; CALCAREOUS NODULES 227.5-235.5'		
230.5										
	10.0	10.0	100%							

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522
(18)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. B-0522
ELEVATION 902± GWL 0 HRS 56.8 PROJECT NO. C040384.40-01
HRS
DATE 24-25 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 9 of 9

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
240.5					M. SOFT TO SOFT	MAROON, GRAY, PURPLE, GREEN-GRAY	CLAYSTONE (CON'T)	BR	CORE PIECES 0.2-0.4' W/20-30° SLICKENSIDES
	10.0 / 10.0	100%							
							: SILTY 247.8-248.9		
250.5									
							BOTTOM OF BORING: 250.5'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0522
(18)

N 542742.2422
E 1722248.6749 Grade El. 696.90

gai consultants

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST ALBANS, WV BORING NO. B-0523
ELEVATION ______ GWL 0 HRS 22.0 PROJECT NO. C040384.10-01
HRS ______
DATE 24 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 2

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
1.5	1 1 1	S-1 REC 0.7		2.0	V. LOOSE	BROWN	SILT, SOME CLAY	ml	
3.0	2 4 4	S-2 REC 1.2			LOOSE				
4.5	4 5 5	S-3 REC 0.6					CLAYEY SILT AND ROCK FRAGMENTS		
6.0	4 4 3	S-4 REC 0.5		6.0					
7.5	4 4 7	S-5 REC 0.3			STIFF	BROWN, GRAY, MAROON	CLAYEY SILT / SILTY CLAY AND ROCK FRAGMENTS	ml-cl	MOIST * 2.0 TSF
9.0	8 8 5	S-6 REC 1.5			V. STIFF		SILTY CLAY - DECOMPOSED CLAYSTONE		* 3.0 TSF
10.5	5 10 10	S-7 REC 1.1							
12.0	10 13 38	S-8 REC 0.6		12.0	HARD				* >4.5 TSF
13.5	10 23 34	S-9 REC 1.3			V. DENSE	MAROON + GRAY + YELLOW	DECOMPOSED CLAYSTONE	gm-gc	
15.0	23 25 34	S-10 REC 0.9							
16.5	17 28 38	S-11 REC 0.8							
17.9	20 38 50/0.4	S-12 REC 0.4		17.9					TOP OF ROCK: 17.9'
	3.4 / 4.1	83%	41		SOFT	MAROON + BROWN + GRAY	CLAYSTONE: HIGHLY WEATHERED	BR-BL	LOW ∠ FRACTURE 19.5, 20.3, 20.5, 21.0, 21.2
22.0									45° SLICKENSIDE 20.5-20.65
									LOW ∠ FRACTURES 23.6, 24.55, 24.85, 26.4, 27.9, 29.1, 30.3, 30.6, 31.2,
	10.0 / 10.0	100%	88						

REMARKS** DRILLED BY TERRA TESTING, INC USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5¼" SOLID STEM AUGERS, 4" STEEL CASING, NQ-2 WIRELINE CORING TOOLS.

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0523

(13)

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. B-0523
ELEVATION 696± GWL 0 HRS 22.0 PROJECT NO. C050384 ...
HRS
DATE 24 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 2 of 2

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
					SOFT TO M. SOFT	MAROON + GRAY	CLAYSTONE (CON'T)	BR	
32.0									
									LOW∠ FRACTURES 34.0, 34.5, 34.7
				34.7					
				36.5	M. SOFT	GRAY	SHALY SANDSTONE		
	10.0 10.0	100%	65		SOFT	MAROON	CLAYSTONE	VBR-BR	LOW∠ FRACTURES 37.05, 37.9, 38.1
				38.5	M. SOFT TO M. HARD	GRAY	SHALY SANDSTONE	BR	LOW∠ FRACTURE 39.95
				40.3	SOFT	MAROON + GRAY	CLAYSTONE	BR	
42.0									LOW∠ FRACTURES 40.5, 40.6, 40.8, 40.9, 41.1, 42.4, 43.3, 43.45, 43.7
	8.0 8.0	100%	73						30° SLICKENSIDES 42.75, 43.9, 44.2, 44.4, 44.7, 44.85, 45.0, 45.75, 48.0, 49.4
50.0									VERTICAL FRAC. 48.0-48.9
							BOTTOM OF BORING : 50.0'		

REMARKS **

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0523
(13)

N 542745.0961
E 1722251.4149 Grade El. 696.91

gai consultants
transforming ideas into reality

PROJECT AREA 2/3 JOHN E. AMOS POWER PLANT ST. ALBANS, WV BORING NO. B-0524
ELEVATION ______ GWL 0 HRS DRY PROJECT NO. C040384.40-01
HRS ______
DATE 25 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							AUGER w/o. SAMPLING TO 18 FT		
							INSTALL PIEZOMETER, TIP AT 18 FT		
							SEE BORING B-0523 FOR SOIL DESCRIPTIONS		
18.0				18.0					
							BOTTOM OF BORING: 18.0 FT		

REMARKS** DRILLED BY TERRA TESTING USING A SIMCO 4000-T2 TRACK MOUNTED DRILL
BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0524
(14)

N 542379.9472
E 1721745.3670 Grade El. 679.43

gai consultants
transforming ideas into reality

PROJECT AREA 2/3, JOHN E. AMOS POWER PLANT, ST. ALBANS, WV BORING NO. B-0525
ELEVATION ______ GWL 0 HRS DRY PROJECT NO. C040384.40-01
HRS ______
DATE 25 MAY 2005 CLASSIFIED BY DAN SANGER PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
							AUGER w/o SAMPLING TO 10 FT.		
							INSTALL PIEZOMETER, TIP AT 10 FT		
							SEE BORING B-0520 FOR SOIL DESCRIPTION		
10.0				10.0					
							BOTTOM OF BORING 10.0 FT		

REMARKS** DRILLED BY TERRA TESTING, INC. USING A SIMCO 4000-T2 TRACK MOUNTED DRILL. BORING ADVANCED USING 5 1/4" SOLID STEM AUGERS

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. B-0525
(16)

N 539371.31
E 1753962.87 Grade El. 709.57 Top of PVC Riser El. 711.47

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E. Amos Power Plant BORING NO. 0536 (MW-1)
ELEVATION ______ GWL 0 HRS Dry PROJECT NO. C040384.40.01
24 HRS 13.8
DATE 7-12-05 CLASSIFIED BY TR Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Red BR	Clayey Silt and Rock Fragments - Trace Sand		Start 1:35 Moist
				8.0					
						BR	Sand and Rock Fragments		Damp, RF > 2" Φ
				10.0					
						Red BR	Clayey Silt and Rock Fragments		Moist RF < 2" Φ
				11.0					
						Red	Decomposed Claystone		Damp. Dry @ 14'
				19.0					
							Bottom @ 19.0'		Finish 2:00
							Installation		Material
							Sand 19.0' to 18.0'		10' Screen, cap
							10' Screen 18.0 to 8.0'		9 Bags Sand
							Sand 18.0' to 6.0'		1 3/4 Bucket Pellets
							Bentonite Pellets 6.0' to 3.0'		10 Bags Concrete Mix
							Water added to pellets		1 6"x5' Steel Casing
							1.9' Stickup PVC		
							2.3' Stick up Steel Casing		

REMARKS** 4 1/4" ID Hollow Stem Augers to 19.0', 4000-T2 Simco Track Drill
Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0536 (MW-1)

N 539367.47
E 1753964.89 Grade El. 709.41 Top of PVC Riser El. 711.01

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Plant BORING NO. 0535 (MW-2)
ELEVATION ______ GWL 0 HRS 40.1' PROJECT NO. C040384.40.01
24 HRS 38.2'
DATE 7-12-05 CLASSIFIED BY T. R. Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Red	Clayey Silt and Rock		Moist, Start 8:45
						BRN	Fragments - trace sand		RF >2" φ
				10.0					
						Red	Decomposed Claystone		Dry
				18.0					TOR 18.0'
				20.0		Red	weathered Claystone		Auger to 20.0'
						BR &	Fine Grain Sandstone w/		
				23.0		Red	Interbedded claystone		
					Hard	Gray	Interbedded sandstone &		
							Siltstone - few thin Red		
				30.0			Claystone Seams		
						Red	Claystone		few sec. of moist
				54.0					cuttings @ 42.0'
						Gray	Siltstone/shale		[illegible]
				58.0					[illegible]
				60.0		Red	Claystone		Moist cuttings back
						Gray	Siltstone		@ 62 wait 15 min
				62.5					water from hole
							Bottom @ 62.5'		End 10:35AM
							Installation		Materials
							Sand 62.5 to 62.0'		20' 2" φ PVC Screen
							Screen 62.0' to 42.0'		4 Bags Sand
							Sand 62.0' to 37.0'		1/4 Bucket Pellets
							Bentonite Pellets 37.0 - 34.0		4 Bags Volclay grout
							Pellets into water		10 Bag Concrete MIX
							Volclay to 4.0'		
							Concrete 4.0 to 0.0', 6' φ Pad		
							Steel Casing 2.1' stickup		

REMARKS** 4 1/4" ID Hollow Stem Augers to 20', 4" φ Air Rotary to 62.5', Simco 4000-T2 Track Drill, Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0535 (MW-2)

N 541672.50
E 1755563.50 Grade El. 823.00 Top of PVC Riser El. 825.00

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Plant BORING NO. 0527 (MW-3)
ELEVATION ______ GWL 0 HRS Dry PROJECT NO. C040384.40.01
48 HRS 17.0
DATE 6-24-05 CLASSIFIED BY TR Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Red-	Silty Clay		Start 10:15 AM
				2.0'		BR.	↓		Damp
						BR	Clayey Silt		Dry
				12.0'		↓	↓		
						Red-	- Silty Clay to Decomposed		Dry, slow
						BR.	claystone		augering
						↓	↓		damp at ≈16'
				25.5		Gray	Weathered sandstone - with		moist at ≈25'
						BR	fine mica grains		Auger Refusal 25.5'
				30.0		↓	↓		6-27-05 WL=17'
						Red	Siltstone		Start air rotary
				41.0		↓	↓		@ 8:30 AM
							Bottom @ 41.0		Finish @ 9:00 AM
									Clean hole 9:00 to
							Installation:		11:00. Drilling
							Pellets 41 to 32.5'		while cleaning 41.0'
							Sand 32.5 to 32.0		Material
							20' Screen 32.0'-12.0'; 1½" cap		20' 2" ϕ screen
							32.0 to 9.0' Sand		2 caps
							Bentonite pellets 9.0' to 7.0'		12 bags sand
							1 bucket water poured on pellets		1 bucket pellets
							Volclay grout to 3.3'		½ Bag Volclay
							Concrete Mix 10 Bags		10 Bags Concrete Mix
							5' steel pipe 6" ϕ 2.5' stickup		6" x 5' Steel Casing
							2' PVC stick up		
							2.5' Steel Casing Stick up		

REMARKS** 30' south of 0509; 4¼" ID HSA to 25.5', 4" ϕ air rotary w/hammer to 41.0'
Simco 4000-T2 Track Rig, Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0527 (MW-3)

N 542305.16
E 1753086.04 Grade El. 674.76 Top of PVC Riser El. 676.36

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Plant BORING NO. 0532 (MW-4)
ELEVATION ________ GWL 0 HRS 19.2' PROJECT NO. C040384.40.01
24 HRS 17.9'
DATE 7-7-05 CLASSIFIED BY T R Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
				2.0		BR	Sandy Silt		Damp, Start 9:45
						BR	Sand and Rock Fragments		Damp
				6.0		↓	of shale		
						BR	Sandy Clay - some Rock		RF < 2" ϕ, moist
				9.0		↓	Fragments of Sandstone		Auger to 10.0' refusal
						Red	Decomposed claystone		Damp, TOR 10.0'
				12.5		↓	to weathered claystone ↓		
						Gray	Siltstone Interbedded with		
						Red	Claystone/clayshale		
				41.0		↓	↓		
						Gray	Silt shale/Siltstone - trace		
				49.0		↓	Red seams of claystone		
					Soft	Red	Claystone		
				53.0		↓	↓		
						Gray	[illegible] shale &		
				58.0		Red	claystone		
						Gray	Siltstone		Wet cuttings lost
				70.0		↓	↓		dust @ 58.0' water
						Gray	Sandstone		from hole by 62.0'
				78.5		↓	↓		More water @ 71.0'
							Bottom @ 78.5'		
							Installation		Materials
							Sand 78.5 to 78.0', 20'		4 Bags Sand
							Screen 78.0 to 58.0', Sand		1/2 bucket pellets
							78.0 to 53', Bentonite to		2 bags Volclay grout
							49.0', Volclay grout to 3'		10 Bags Concrete Mix
							Concrete to 0.0, 6'ϕ Pad		6"x5' Steel Casing
							PVC stickup 1.6', Steel 2.1'		

REMARKS** 4 1/4" ID HSA to 10.0', 4" ϕ Air Rotary 10.0' to 78.5', Simco 4000-T2 Track Rig
Doug Novotny Driller, Terra Testing.

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0532 (MW-4)

N 542305.96
E 1753080.68 Grade El. 674.84 Top of PVC Riser El. 676.84

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E BORING NO. 0533 (MW-5)
ELEVATION ________ GWL 0 HRS Dry PROJECT NO. C040384.40.01
24 HRS 8.6'
DATE 7-7-05 CLASSIFIED BY T R Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						BR	Sandy Silt		Damp
				3.0		↓	↓		
						BR	Sand and Rock Fragments		Damp
				6.0		↓	↓		
						BR	Sandy Clay and Rock		Moist
				9.0		↓	Fragments		
				10.2		Red	Decomposed Claystone		Dry
							Bottom @ 10.2'		
							Installation		Material
							3" sand to 10.0'		4 Bag Sand
							5' Screen w/ cap 10.0'-5.0'		1/2 Bucket Pellets
							Sand 10.0 to 4.0'		10 Bags Concrete Mix
							Bentonite Pellets 4.0'-3.0'		6"x5' Steel Casing
							Cemment 3.0'-0', 6' ϕ Pad		
							2' stick up PVC		
							2.2' stick up steel Casing		

REMARKS** 4 1/4" ID HSA to 10.2', Simco 4000-T2 Track Rig
Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0533 (MW-5)

N 540837.74
E 1754220.53 Grade El. 927.29 Top of PVC Riser El. 929.59

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E. Amos Power Plant BORING NO. 0526 (MW 6)
ELEVATION ______ GWL 0 HRS 62.5' in well PROJECT NO. C040384.40.01
24 HRS 62.5'
DATE 6-23-05 CLASSIFIED BY TRGower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Red	Clayey Silt		Start 9:00 AM
				10.5		Brn.	↓		
						Yellow	Highly weathered siltstone		
				13.5		BR	to fine grain claystone		
									Auger to 14'
						Lt Brn	Sandstone		Air Hammer 14' to 91'
						Gray	@ 25'		8'/10min in sandstone
				28.0			↓		
						Gray	Shale		
				30.0			↓		
						Red	Claystone		
				36.0			↓		
						Gray	Sand stone		
				38.0			↓		
						Gray	Interbedded shale and		
			▽ 76'	76.0		Red	siltstone / fine sandstone		Water encountered
							water @ 76'		@ 76'
				91.0			↓		End 11:30 AM
							Bottom of Boring @ 91.0'		
							Installation		Material
							Clean hole 11:30-12:25		
							Stabilize water @ 62.55' 2:00		
							Place bentonite pellets 91.0'		2 buckets bentonite
							to 78.5', Sand 78.5' to 78.0'		4 50lbs bags sand
							Set 20' screen @ 78' to 58'		2 1/2 50lb bag volclay
							3" screen cap on end, stick up		10 Bags Concrete Mix
							2.3', Sand 78.0 to 55',		6"x5' steel casing
							bentonite pellets 55' to 50'		
							Volcay grout to 4.0' 6-29-05		
							Concrete to surface, 2.5' Steel Stickup		

REMARKS** 4 1/4" ID Hollow Stem Augers to 14', 4" Φ downhole hammer w/air to 91.0'
Simco 4000-T2 Track Rig, Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0526 (MW-6)

N 539635.79
E 1755425.04 Grade El. 943.15 Top of PVC Riser El. 945.15

gai consultants transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Plant BORING NO. 0528 (MW-7)
ELEVATION ______ GWL 0 HRS 40.0 PROJECT NO. C040384.40.01
18 HRS 37.0
DATE 6-27-05 CLASSIFIED BY TR Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						BR	Silty Sand and Sandstone		Start 3:50 PM
				2.0		↓	Rock Fragments		Dry
						Yellow	Decomposed Sandstone		Dry
				6.0		BR	↓		Auger Refusal @ 6.0'
						Gray	Sandstone		Dry
						BR	↓		
				22.0	Hard	Gray	18.0' to 22.0'		≈1'/min
						BR	Siltstone		
						to Gray	↓		
						Red	from 24'		Water Encountered
						& Gray			@ 40.0'
				55.5		↓	↓		End 5:00 PM
							Bottom @ 55.5'		Clean with air
									untill 5:40PM
							Installation		Materials
							Sand 55.5' to 52.0'		4 bag sand
							20' Screen 52.0 to 32.0'		1/4 bucket pellets
							Sand 52.0 to 30.0'		2 Bags Volclay
							Bentonite Pellets 30.0' to 28.0'		1.0 Bags Concrete
							Bucket of water on Pellets		6" Φ steel Casing
							Volclay Grout to 3.3'; 3.3' of		5' total length
							Concrete. Pad 6' diameter		
							2' stickup PVC		
							2.5' stickup steel casing		

REMARKS** 4 1/4" ID HSA to 6.0', 4" Φ Air Rotary w/hammer to 55.5'
Simco 4000-T2 Track Rig, Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0528 (MW-7)

N 542134.95
E 1756839.14 Grade El. 945.01 Top of PVC Riser El. 947.01

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Plant BORING NO. 0534 (MW-8)
ELEVATION ______ GWL 0 HRS 19.8' PROJECT NO. C040384.40.01
48 HRS 23.8'
DATE 7-11-05 CLASSIFIED BY T R Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Red	Silty Clay		Start 11:00AM
				6.0		↓	↓		moist
						Red	Decomposed Claystone		Dry
				9.0		↓	↓		
						Gray &	Sandy Shale / Sandstone		TOR 10.0'
				23.0		BR	Med Grain.		10:30 am Rotary
						Red	Claystone		Slight Hammering
				26.0		↓	↓		
				28.0		BR	Sandstone / Sandy shale		
					Hard	Gray	Sandstone		
						BR	@ 34		
				37.0	↓	↓	↓		
						Red	Claystone		Moist @ top 6"
				41.0		↓	↓		Moist cuttings back
					Hard	Gray	Sandstone / Sandy shale		≈ 1/2 of a 10' Run
				60.5	↓	↓	↓		End 12:35PM
							Bottom @ 60.5'		
							Installation		Material
							60.5' to 60.0' Sand		20' Screen, 2 caps
							3" cap on bottom 20' Screen		5 Bags Sand
							Screen 60.0 to 40.0'		1/4 Bucket Pellets
							Sand 60.0 to 30.0'		3 Bags Volclay
							Bentonite Pellets to 27.0'		11 Bags Concrete Mix
							Volclay Grout to 3.0'		4"x5' Steel Casing
							Concrete 3.0 to 0.0', 6' φ Pad		
							2' stick up of PVC		
							2.5' Stick up of Steel Casing		

REMARKS** 4¼" ID Hollow Stem Augers to 10.0', 4" φ Air Rotary to 60.5', 4000-T2 Simco Track Rig, Doug Novotny Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0534 (MW-8)

N 544221.98
E 1756158.78 Grade El. 933.39 Top of PVC Riser El. 935.39

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos BORING NO. 0530 (MW-9)
ELEVATION ______ GWL 0 HRS 47.4' PROJECT NO. C040384.40.01
24 HRS 30.2'
DATE 6-30-05 CLASSIFIED BY T. R. Gower PAGE 1 of 1

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	DESCRIPTION: SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	DESCRIPTION: COLOR	DESCRIPTION: MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Red	Silty Clay		Start 11:10 AM
				2.0			↓		Moist
						Red	Decomposed Claystone		Dry, Auger to 5.0'
				5.0			↓		Air Rotary 11:30
						Red	Claystone / clayshale		Hammer in claystone
				15.0		trace gray	↓		Less @ 12'
						BR	Fine grain Sandstone		
				20.0	Hard	Gray	18 to 20'		
				31.0		BR	Sandy shale		
						Red	Claystone / Clayshale		
				36.0			↓		
						Gray	Siltstone w/sandstone		
						trace red	seams / silt shale		
				44.0			Water Encountered @ 42'		Water Encountered 42'
						Red	Claystone		
				51.0			↓		
					Hard	Gray	Sandstone		End Drilling 12:40PM
				62.5			↓		
							Bottom @ 62.5'		Let sit 15min blow
									out water ≈ 30 sec
							Installation		then dry, 15min
							62.5 to 62.0' Sand		on 15 sec of water
							20' Screen 62.0' to 42.0'		Add pottable water to
							Sand 62.0' to 37.0'		clean hole 50 gal total
							Bentonite Pellets 37.0'-34.5'		Material
							Volclay grout to 3.0'		5 Bags Sand
							Concrete 3.0'-0.0' 6' Diameter		20' Screen
							Pad, 2' stickup PVC		1/4 bucket pellets
							2 1/2' stick up 6" ϕ steel		wateradded, 2 bags
							Casing 2.5' stickup		Volclay, 9 bags Concrete

REMARKS** 25 ft N345°W from Survey Pt. 307, 4 1/4" ID HSA to 5.0', 4" ϕ Air rotary w/hammer to
Simco 4000-T2 Track Rig, Doug Novotny-Driller, Terra Testing

* POCKET PENETROMETER READINGS
** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0530 (MW-9)

N 544019.11
E 1754183.58 Grade El. 909.43 Top of PVC Riser El. 911.43

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Station BORING NO. 0531 (MW-10)

ELEVATION ______ GWL 0 HRS Dry PROJECT NO. 040384.40.01

24 HRS 102'

DATE 6-30-05 CLASSIFIED BY T. R. Gower PAGE 1 of 2

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
				9.0		BR	Clayey Silt		Start 4:00.
						Red	Decomposed Claystone		Dry
				11.0		↓	to weathered claystone		Auger to 10.0'
						Lt BR	Silty Shale / siltstone		
				20.0		↓	↓		
						BR	Sandstone		
				26.0		↓	↓		
						Lt Gray	Siltstone - Red @ 29.0'		
				34.0		↓	Gray @ 31.0'		
				36.0		Red	Claystone		
					Hard	Gray	Fine grain Sandstone		
				40.5		↓	↓		
						Red	Claystone		
				46.0		Gray	↓		
				58.0		Gray	Siltstone		Stop 5:00 @ 52'
				60.0		Red	Claystone		
						Gray	Siltstone / V. Fine Grain		
				71.0		↓	Sandstone, shaley		
					Hard	Gray	Sandstone		
				76.0	↓	↓	↓		
					Soft	Red	Siltstone / Claystone		
				81.0	↓	↓	↓		
				82.0	Hard	Gray	Sandstone		
						Gray	Siltstone		
				84.0		↓	↓		
					Hard	Gray	Sandstone / w/ 6" seams		
							of softer siltstone		Stop @ 112' 11:05 AM
				125.0	↓	↓	↓		
						Red	Claystone		
				138.0		↓	↓		

REMARKS** 4 1/4" ID Hollow Stem Augers to 10.0', 4" ϕ Air Rotary w/ hammer 10.0' to 157.0'
Simco 4000-T2 Track Rig, Doug Novotny Driller, Terra Testing.

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0531 (MW-10)

gai consultants
transforming ideas into reality

PROJECT Area 2/3 John E Amos Power Station BORING NO. 0531 (MW-10)

ELEVATION ________ GWL 0 HRS Dry PROJECT NO. 040384.40.01

24 HRS 102

DATE 7-1-05 CLASSIFIED BY T. R. Gower PAGE 2 of 2

DEPTH (FT.)	BLOWS PER SIX INCHES OR CORE RECOVERY/RUN	SAMPLE NO., TYPE & RECOVERY OR % ROCK RECOVERY	RQD (%) OR TORVANE	DESCRIPTION: PROFILE	SOIL DENSITY - CONSISTENCY OR ROCK HARDNESS	COLOR	MATERIAL CLASSIFICATION	USCS OR ROCK BROKENNESS	REMARKS*
1	2	3	4	5	6	7	8	9	10
						Gray	Siltstone		Dry
				149.0		↓	↓		
						Gray	Sandstone		
				152.0		↓	↓		
				153.0		Red	Claystone		
				154.0		DK Gray	Sandstone w/mica grains		
						Gray	Siltstone		
						↓	↓		
				157.0		↓	↓		End 12:05 PM
							Bottom @ 157.0'		
							Installation		Material
							Hole measured @ 154.0'		11 bags sand
							Sand to 153.0', 20' Screen		1/4 bucket pellets
							153.0' to 133.0', Sand		4 1/2 bags volclay
							153.0 to 85.0', bentonite		10 Bags Concrete MIX
							pellets to 81.0', Volclay		6" ϕ x 5' Steel
							to 3.5', Concrete 3.5 to 0.0'		Casing
							6" ϕ x 5' steel Casing, 6'		
							diameter Pad		
							2' Stick up PVC		
							2.5' Stick up Steel Casing		

REMARKS ** ________

* POCKET PENETROMETER READINGS

** METHOD OF ADVANCING AND CLEANING BORING

BORING NO. 0531 (MW-10)

gai consultants
transforming ideas into reality

Definition of Terms
Used to Describe Subsurface Materials

SOILS

DENSITY OF GRANULAR SOILS BASED ON STANDARD PENETRATION RESISTANCE

DESIGNATION	STANDARD PENETRATION RESISTANCE (BLOWS/FOOT)
VERY LOOSE	0 - 4
LOOSE	5 - 10
MEDIUM DENSE	11 - 30
DENSE	31 - 50
VERY DENSE	OVER 50

CONSISTENCY OF COHESIVE SOILS IS BASED ON FIELD AND/OR LABORATORY TESTS

CONSISTENCY	UNC COMPRESSIVE STR. (TONS PER SQUARE FOOT)	FIELD IDENTIFICATION
VERY SOFT	LESS THAN 0.25	EASILY PENETRATED SEVERAL INCHES BY FIST
SOFT	0.25 TO 0.50	EASILY PENETRATED SEVERAL INCHES BY THUMB
MEDIUM STIFF	0.50 TO 1.0	CAN BE PENETRATED SEVERAL INCHES BY THUMB WITH MODERATE EFFORT
STIFF	1.0 TO 2.0	READILY INDENTED BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT
VERY STIFF	2.0 TO 4.0	READILY INDENTED BY THUMBNAIL
HARD	MORE THAN 4.0	INDENTED WITH DIFFICULT BY THUMBNAIL

ADDITIONAL TERMS USED IN THE DESCRIPTION OF SOILS:

AND	INDICATES APPROXIMATELY EQUAL AMOUNTS OF MATERIALS, SUCH AS A SAND AND GRAVEL MIXTURE. IF THE MATERIALS OCCUR IN THIN SEPARATE SEAMS, IT IS NOTED IN THE DETAILED WORD CLASSIFICATION. THE THICKNESS IS GIVEN WHERE POSSIBLE.
SOME	INDICATES A SIGNIFICANT AMOUNT OF THE ACCESSORY MATERIAL. EXAMPLE: MEDIUM DENSE SILTY SAND - SOME GRAVEL
TRACE	INDICATES A MINOR AMOUNT OF THE ACCESSORY MATERIAL. EXAMPLE: LOOSE SILTY SAND - TRACE OF GRAVEL
INTERBEDDED	USED TO DESCRIBE THIN ALTERNATING SEAMS. THICKNESS IS GIVEN WHERE POSSIBLE. EXAMPLE: HARD INTERBEDDED SILT AND CLAY (APPROXIMATELY 1/16" THICK)

ROCK

TERM	DEFINITION
SEAM	THIN (12 INCHES OR LESS) PROBABLY CONTINUOUS LAYER
SOME	INDICATES SIGNIFICANT (15 TO 40 PERCENT) AMOUNTS OF THE ACCESSORY MATERIAL. EXAMPLE: ROCK COMPOSED OF SANDSTONE (70%) AND SEAMS OF SHALE (30%) WOULD BE: SANDSTONE - SOME SHALE SEAMS
FEW	INDICATES: MINOR (0-15 PERCENT) AMOUNTS OF THE ACCESSORY MATERIAL. EXAMPLE: ROCK COMPOSED OF SANDSTONE (90%) AND SEAMS OF SHALE (10%) WOULD BE: SANDSTONE - FEW SHALE SEAMS
INTERBEDDED	USED TO INDICATE THIN OR VERY THIN ALTERNATING SEAMS OF MATERIAL OCCURRING IN APPROXIMATELY EQUAL AMOUNTS. EXAMPLE: ROCK COMPOSED OF SANDSTONE (50%) AND SHALE (50%) SEAMS WOULD BE INTERBEDDED SANDSTONE AND SHALE.

THE DEGREE OF BROKENNESS OF THE ROCK IS DESCRIBED BY ONE OF THE FOLLOWING TERMS:

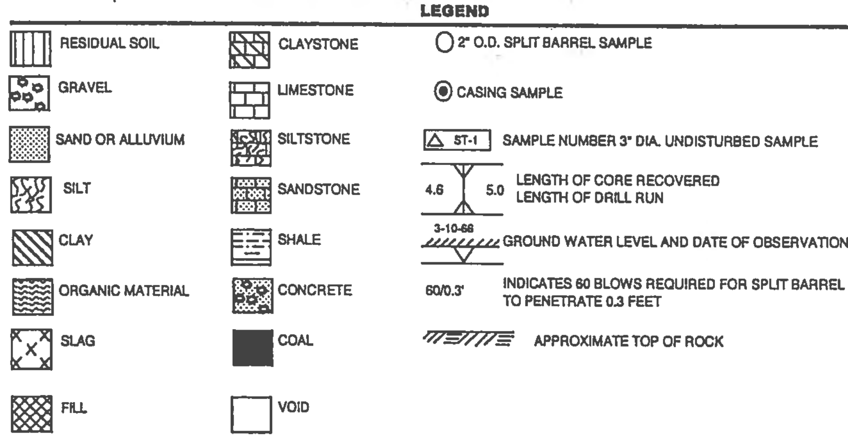
DESCRIPTIVE TERMS	ABBREVIATION	SPACING
VERY BROKEN	(V. BR.)	LESS THAN 2 INCHES
BROKEN	(BR.)	2 INCHES - 1 FOOT
BLOCKY	(BL.)	1 FOOT - 3 FEET
MASSIVE	(M.)	3 FEET - 10 FEET

RQD-ROCK QUALITY DESIGNATION IS CUMULATIVE LENGTH OF PIECES OF CORE EQUAL TO OR GREATER THAN FOUR INCHES IN LENGTH DIVIDED BY THE TOTAL LENGTH OF CORE RUN, EXPRESSED AS A PERCENTAGE.

THE FOLLOWING BASIC NAMES ARE APPLIED TO SEDIMENTARY ROCK:

ROCK TYPE	CHARACTERISTICS
SANDSTONE	MADE UP PREDOMINANTLY OF GRANULAR MATERIALS RANGING BETWEEN 1/16 AND 2MM IN DIAMETER
SILTSTONE	MADE UP OF GRANULAR MATERIALS LESS THAN 1/16 MM IN DIAMETER. FRACTURES IRREGULARLY, MEDIUM THICK TO THICK BEDDED
CLAYSTONE	VERY FINE GRAINED ROCK MADE UP OF CLAY MATERIALS. FRACTURES IRREGULARLY, VERY SMOOTH TO TOUCH. GENERALLY HAS IRREGULARLY SPACED PITTING ON SURFACE OF DRILLED CORES.
SHALE	A FISSILE VERY FINE GRAINED ROCK. FRACTURES ALONG BEDDING PLANES
LIMESTONE	ROCK MADE UP PREDOMINANTLY OF CALCITES (CA CO3) EFFERVESCES UPON THE APPLICATION OF HYDROCHLORIC ACID
COAL	ROCK CONSISTING MAINLY OF ORGANIC REMAINS

LEGEND



GAI Consultants, Inc. 2006

Well Construction Diagrams

B-0501 to B-0515, B-0517, B-0519 to B-0525 & MW-1 to MW-10

gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 JOHN E. AMOS POWER PLANT

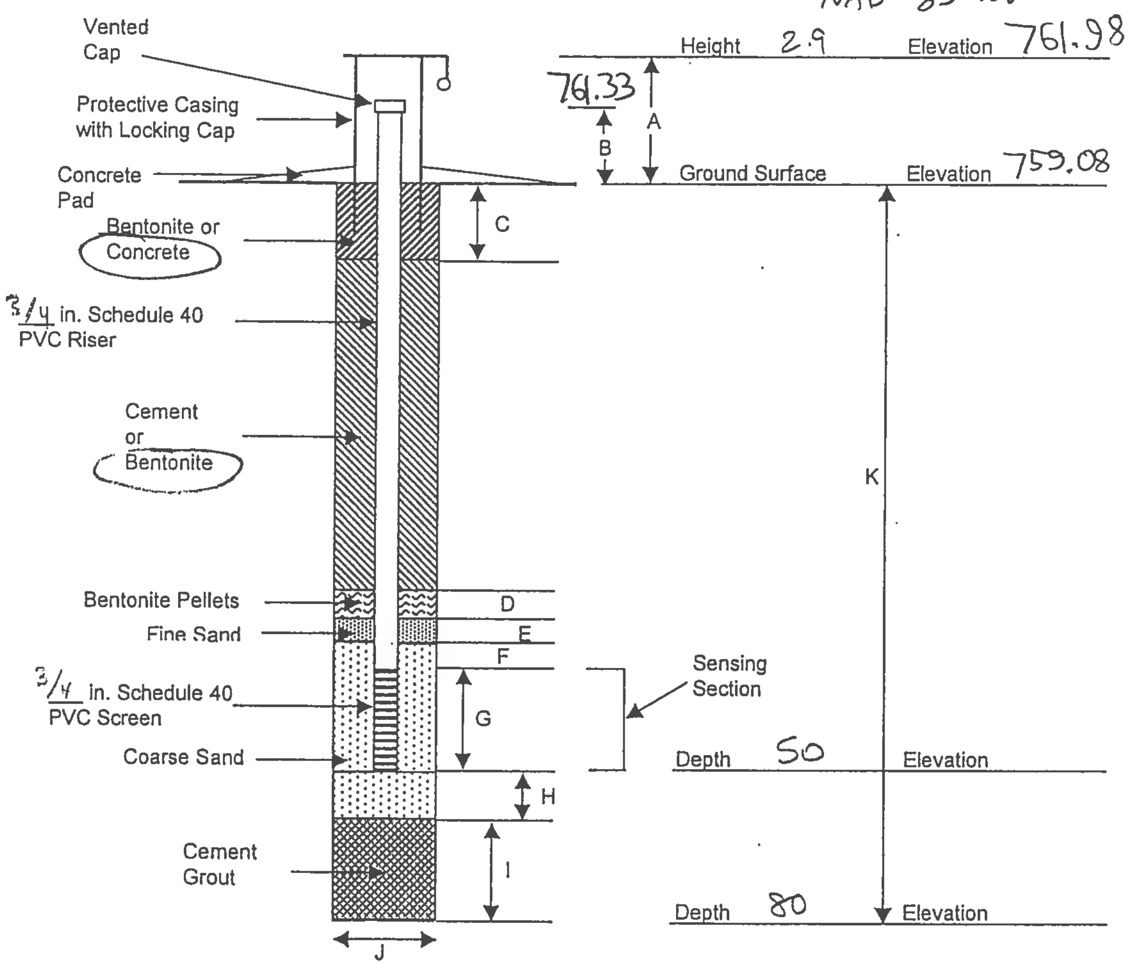
Project No. C040384.40-01

Date 21 APR 2005

Engineer/Geologist DBS

Well No. B-0501

N 540,558.4978
E 1723508.1269
NAD 83 WV SOUTH



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.9	2.25	35	0	0	5
G	H	I	J	K	
10	3	30	0.25	80.0	

Remarks

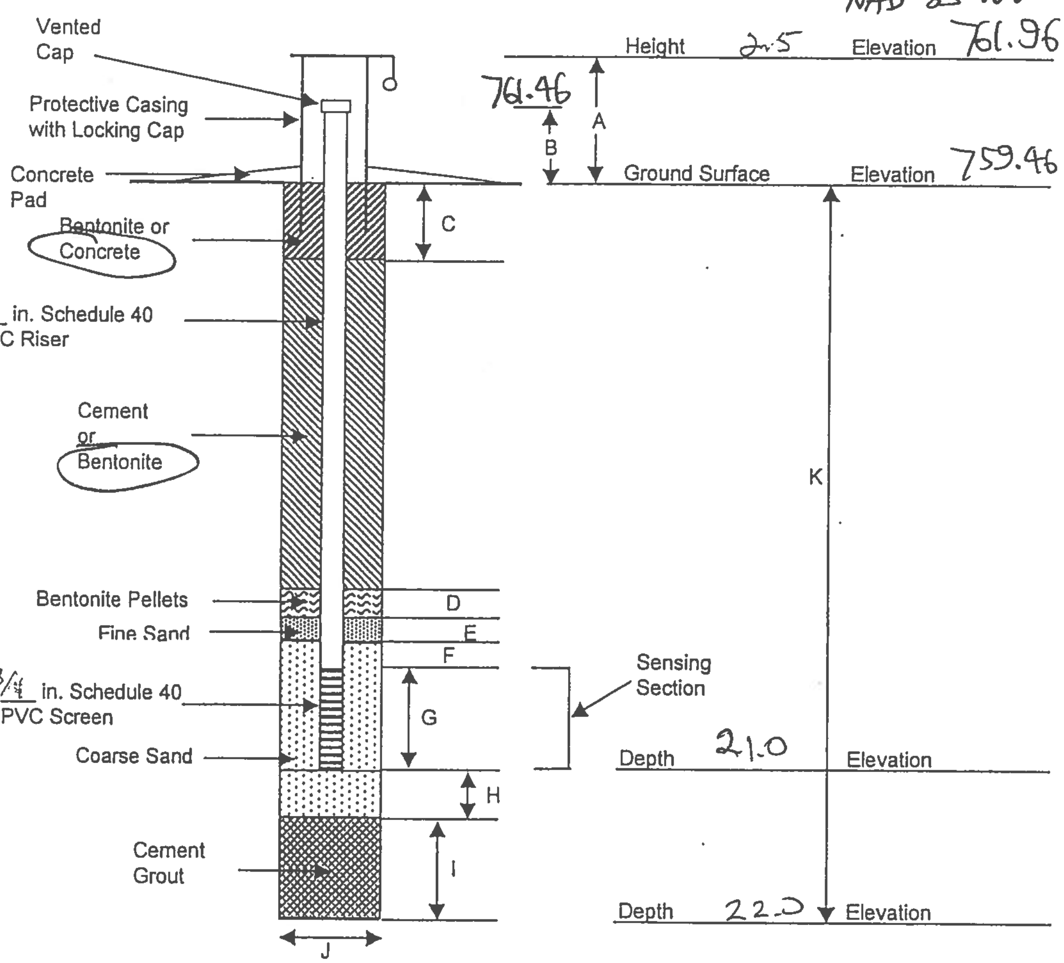
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 JOHN E. AMOS POWER PLANT   Project No. C040384.40-01

Date 21 APR 2005   Engineer/Geologist DBS   Well No. B0502

N 540563.2422
E 1723508.0316
NAD 83 WV SOUTH



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.5	2.0	7.0	0	0	4
G	H	I	J	K	
10	1	0	0.25	22.0	

Remarks ____________

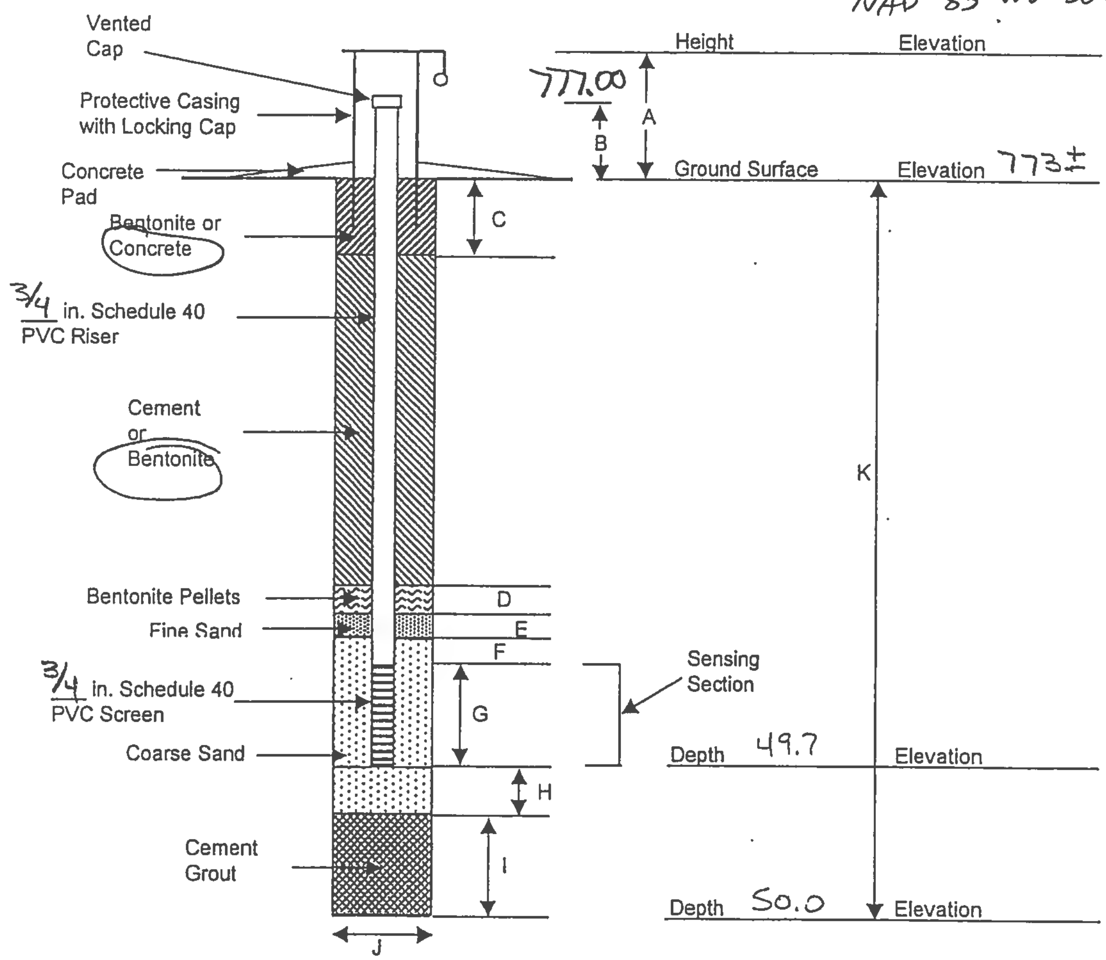
gal consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT | Project No. C240374.110-01

Date 20 APR 2005 | Engineer/Geologist DBS | Well No. 0503

N 540843.8055
E 1723858.5630
NAD 83 WV SOUTH



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.6	2.0	34.7	0	0	5
G	H	I	J	K	
10	0.3	0	0.25	50.0	

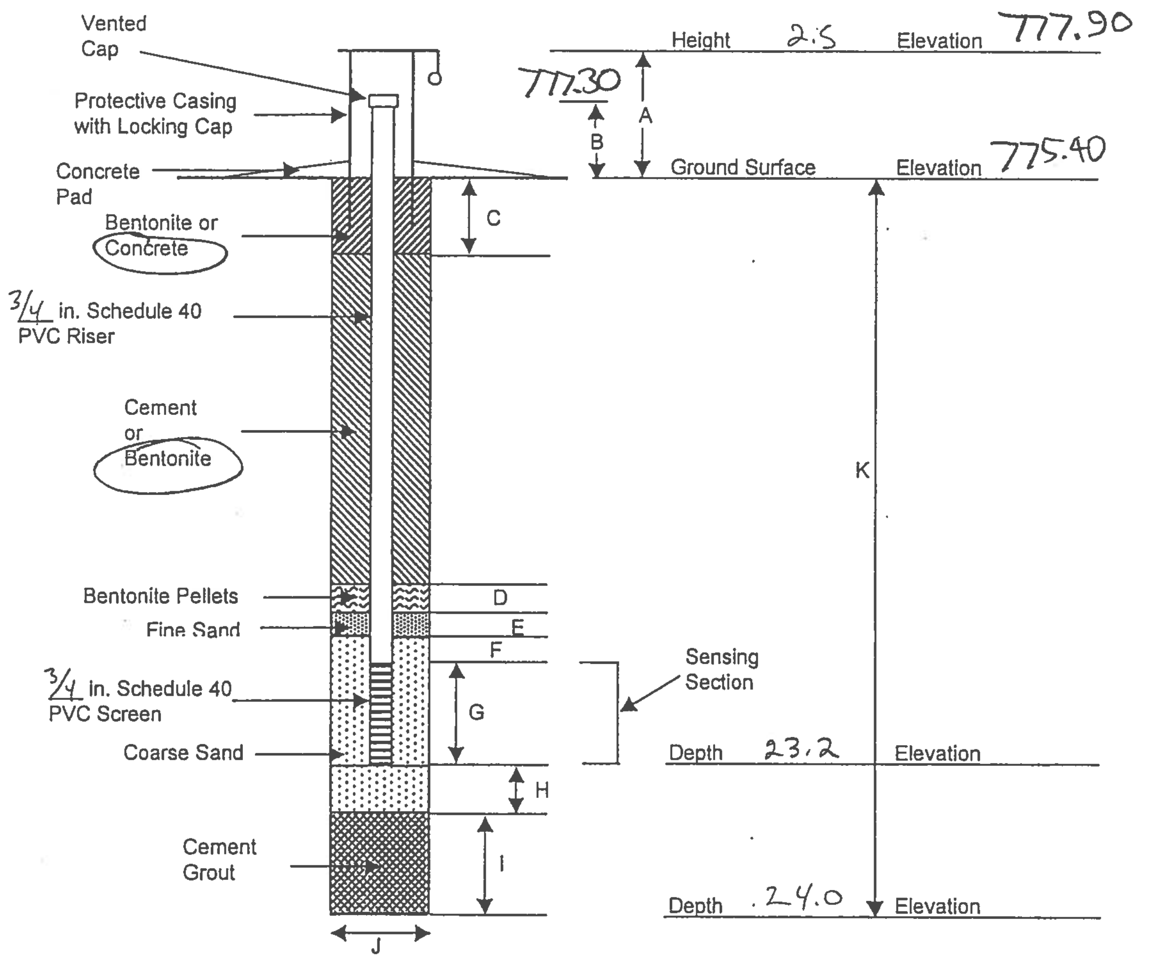
Remarks ______________________

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 JOHN E. AMOS POWER PLANT Project No. C040384.40-01

Date 20 APR 2005 Engineer/Geologist DBS Well No. B0504

N 540840.0544
E 1723859.8367



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.5	1.9	8.2	0	0	5
G	H	I	J	K	
10	0.8	0	0.25	24.0	

Remarks

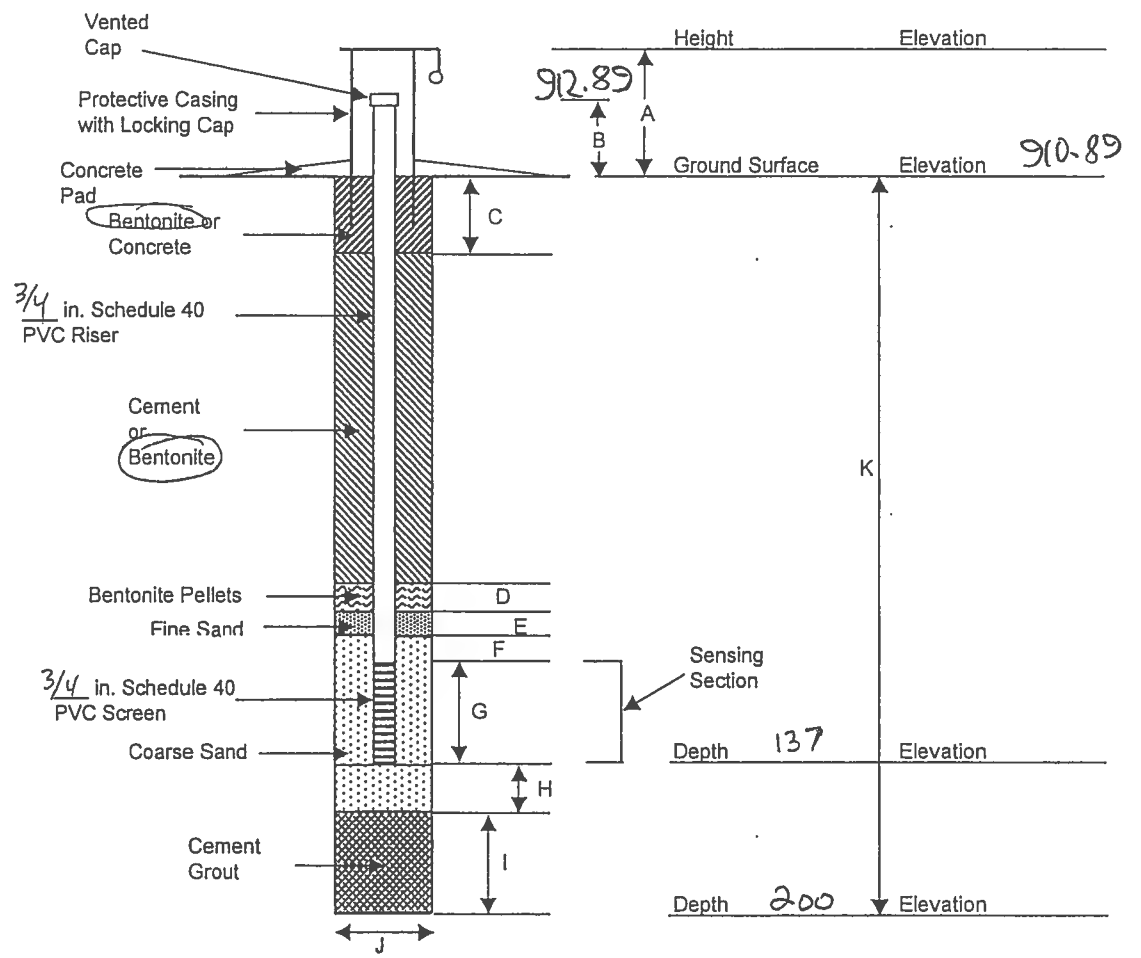
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 JOHN E. AMOS POWER PLANT   Project No. C040384.40-01

Date 27 APR 2005   Engineer/Geologist DBS   Well No. B 0505 ~~(27)~~

N 541325.3505
E 1723551.3362



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.5	2.0	10	0	0	107
G	H	I	J	K	
20	3	60	0.25	200	

Remarks ____________________

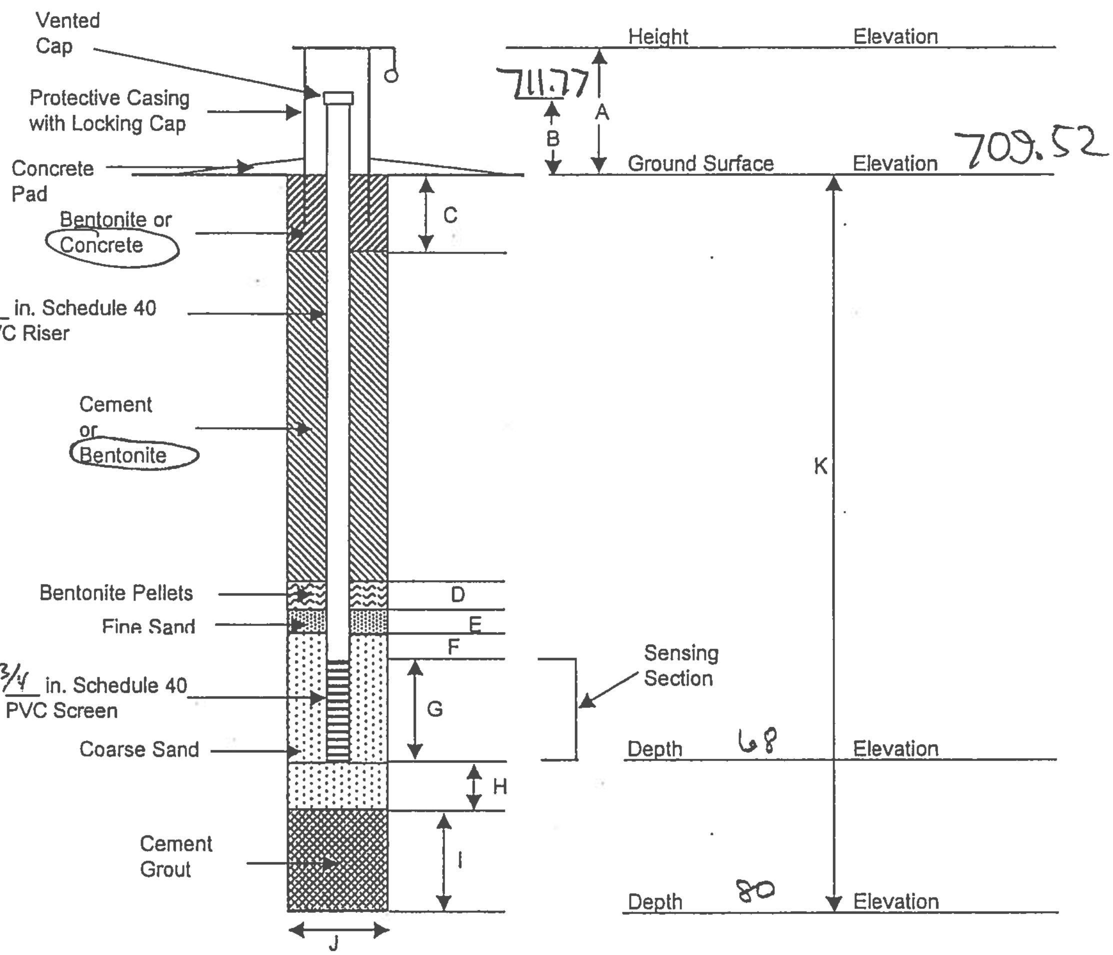
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT   Project No. C040384.40-01

Date 28APR2005   Engineer/Geologist DBS   Well No. B0506

N 539424.9688
E 1722518.6810



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.55	2.25	20	0	0	38
G	H	I	J	K	
10	2	10	0.25	80	

Remarks

gal consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 JOHN E. AMOS POWER PLANT

Project No. C040384.40-01

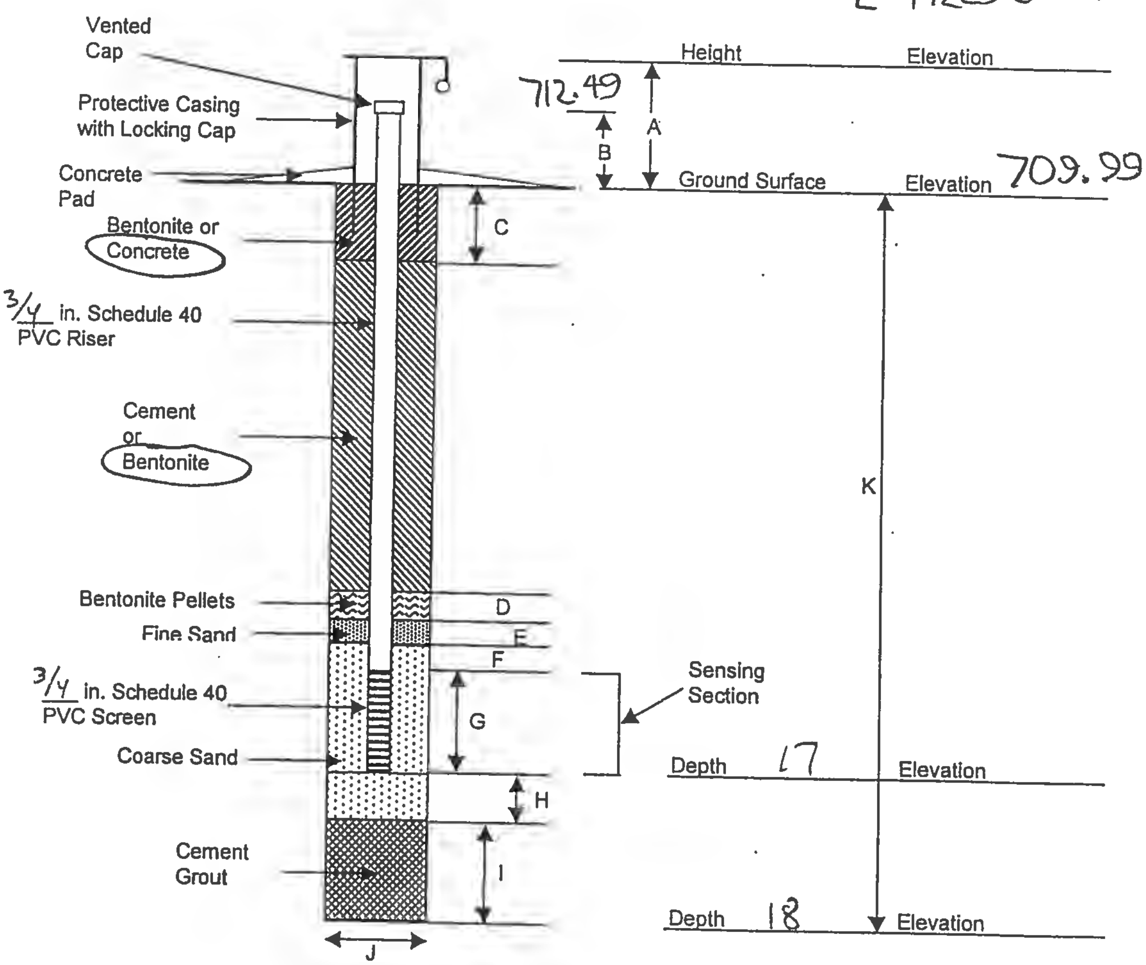
Date 22 APR 2005

Engineer/Geologist DBS

Well No. B0507

N 539428.8146

E 1722523.7682



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.72	2.50	4	0	0	3
G	H	I	J	K	
10	1	0	0.25	18	

Remarks ______________________

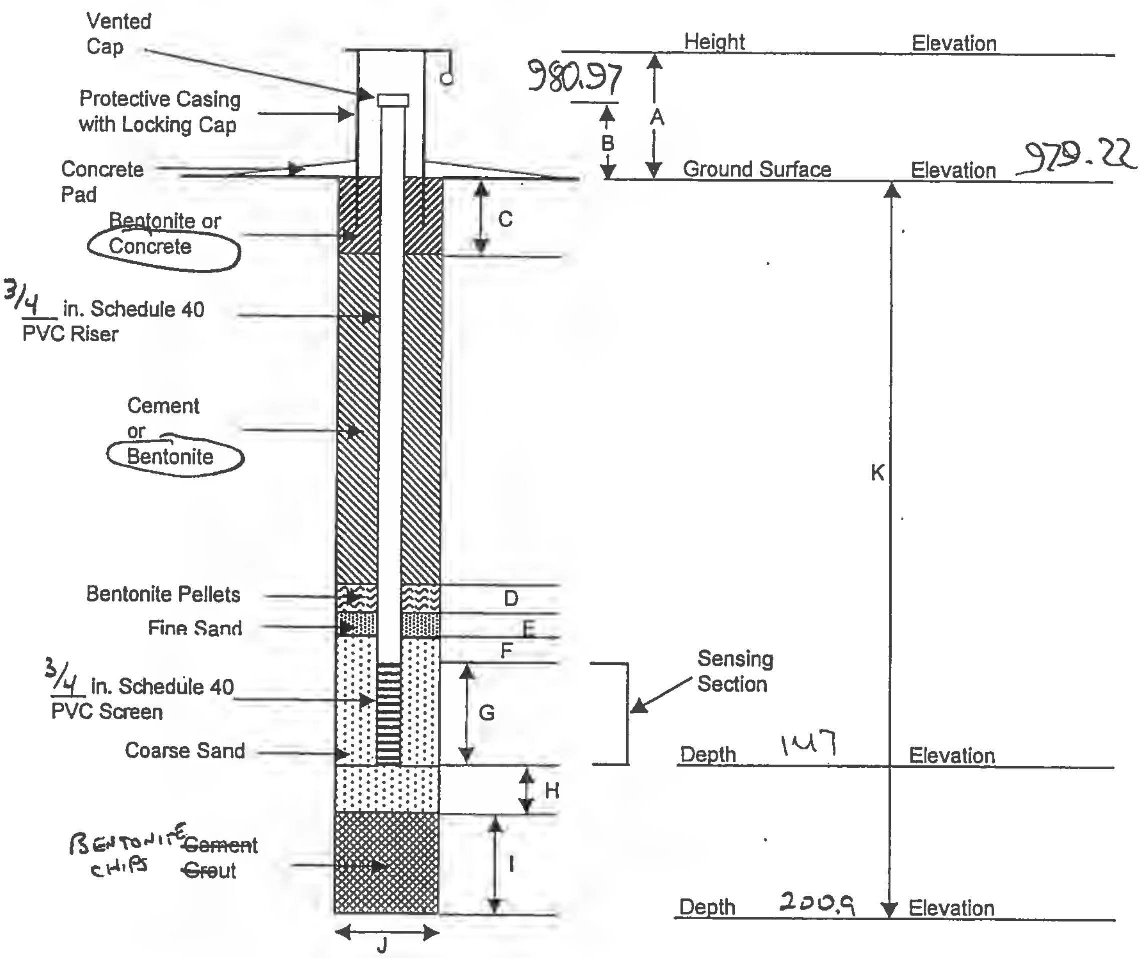
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3, AMOS POWER PLANT   Project No. C040384.40-01

Date 03 MAY 2005   Engineer/Geologist DBS   Well No. B-0508

N 541 996.9754
E 1723 377.3436



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.5	1.75	77	—	—	50
G	H	I	J	K	
20	3	50.9	0.25	200.9	

Remarks

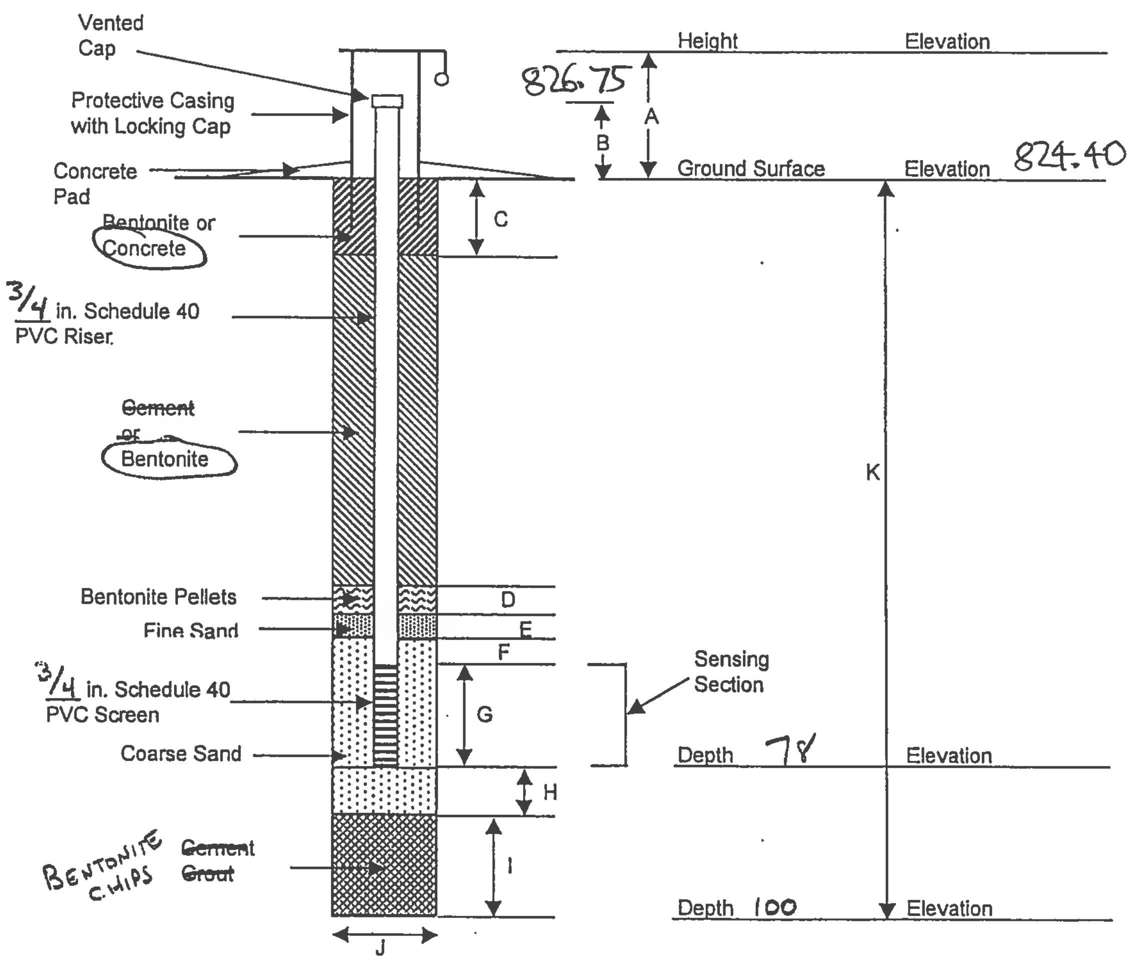
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT Project No. C040384.40-01

Date 03 MAY 2005 Engineer/Geologist DBS Well No. B-0509

N 541748.6664
E 1724111.6219



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.6	2.35	20	—	—	48
G	H	I	J	K	
10	2.0	20	0.25	100	

Remarks ______

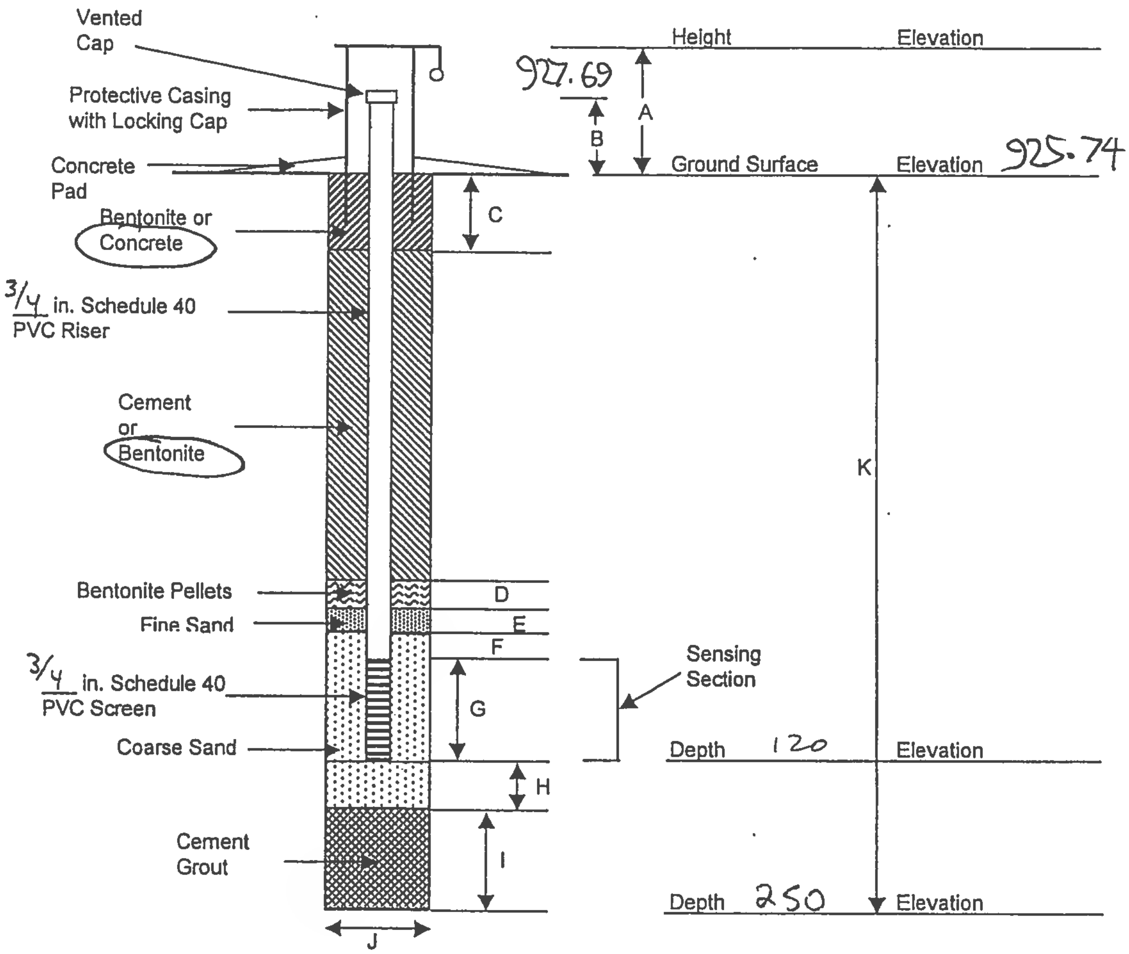
gal consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT   Project No. C040384.40-01

Date 10 MAY 2005   Engineer/Geologist DBS   Well No. B-0510

N 540879.8326
E 1722795.6504



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.6	1.95	30	—	—	70
G	H	I	J	K	
20	2	128.7	0.25	250.7	

Remarks

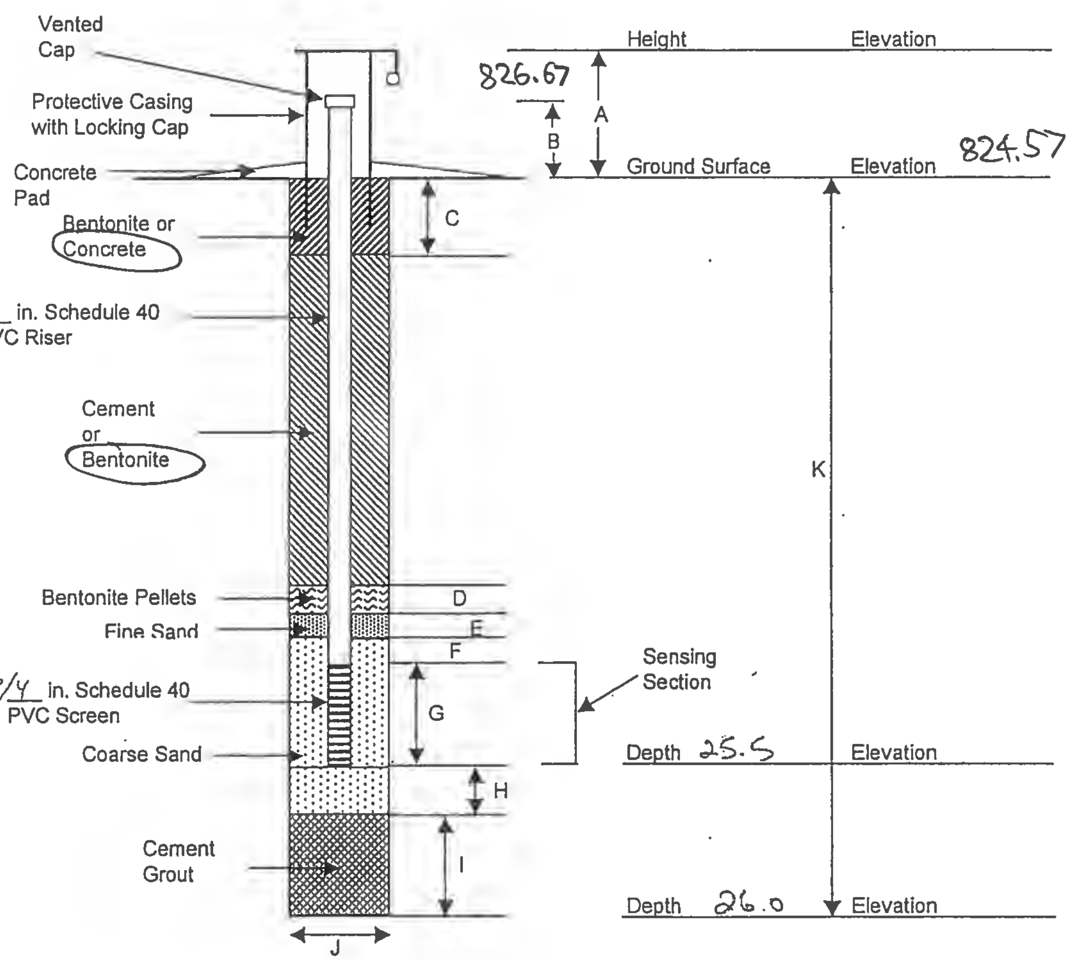
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3, JOHN E. AMOS POWER PLANT Project No. C040384.45-01

Date 04 MAY 2005 Engineer/Geologist DBS Well No. B-0511

N 541746.9425
E 1724116.3536



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.45	2.1	3.5	—	—	12.0
G	H	I	J	K	
10	0.5	—	0.25	26.0	

Remarks

gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT

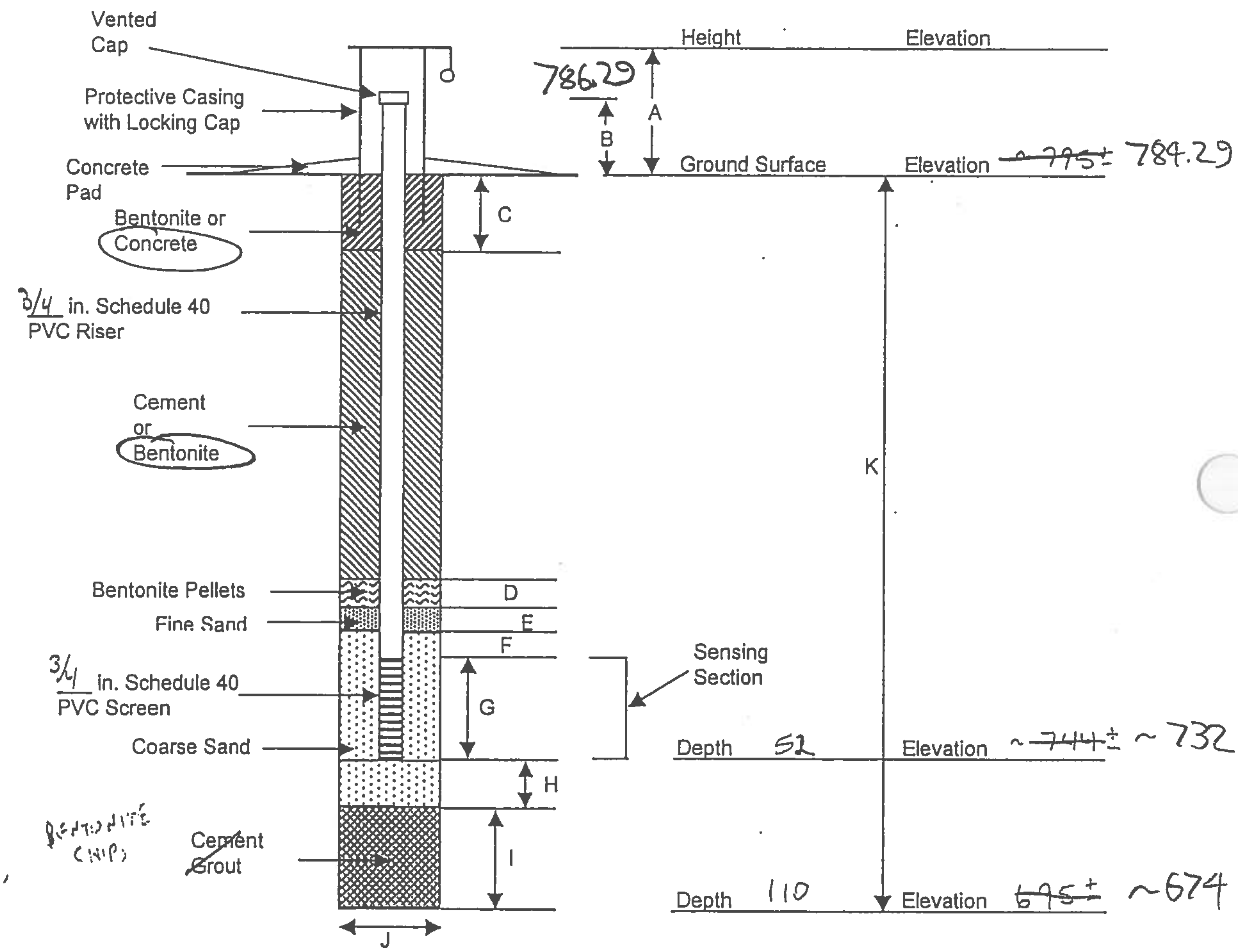
Project No. C040384.40-01

Date 06 MAY 2005

Engineer/Geologist DBS

Well No. B-0512

N 542140.8876
E 1724101.7636



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.6	2.0	20.0	—	—	22.0
G	H	I	J	K	
10	2	56	0.25	110	

Remarks PIEZOMETER B-0513 INSTALLED IN SAME BORE HOLE (TIP AT 14 FT)

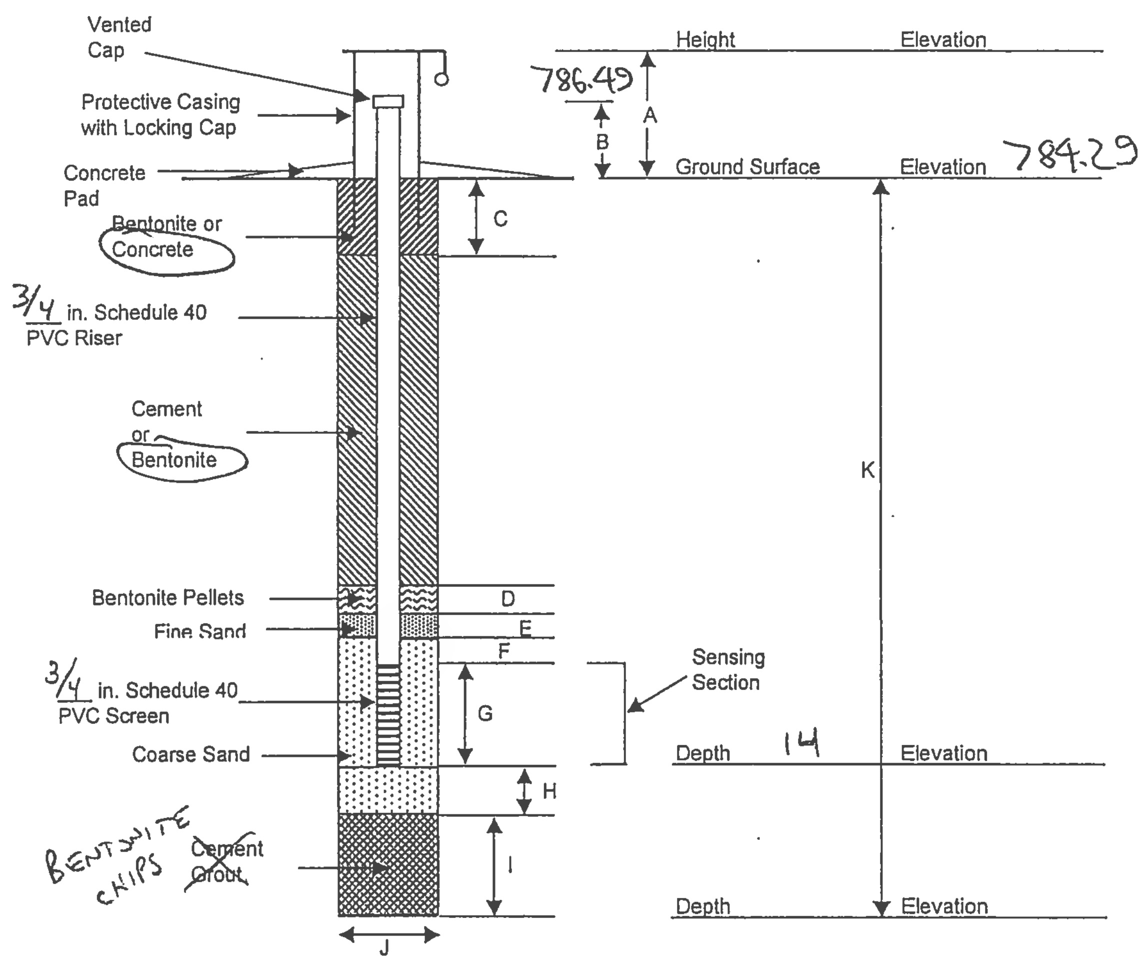
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT Project No. C040384.40-01

Date 06 MAY 2005 Engineer/Geologist DBS Well No. B-0513

N 542140.8876
E 1724101.7636



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.6	2.2	3	—	—	1.5
G	H	I	J	K	
10	2	3**	0.25	*	

Remarks *NOTE: PIEZOMETER INSTALLED IN SAME BORE HOLE AS B-0512

** 2 FT SEAL BETWEEN SAND PACK FOR B-0512 AND SAND PACK FOR B-0513

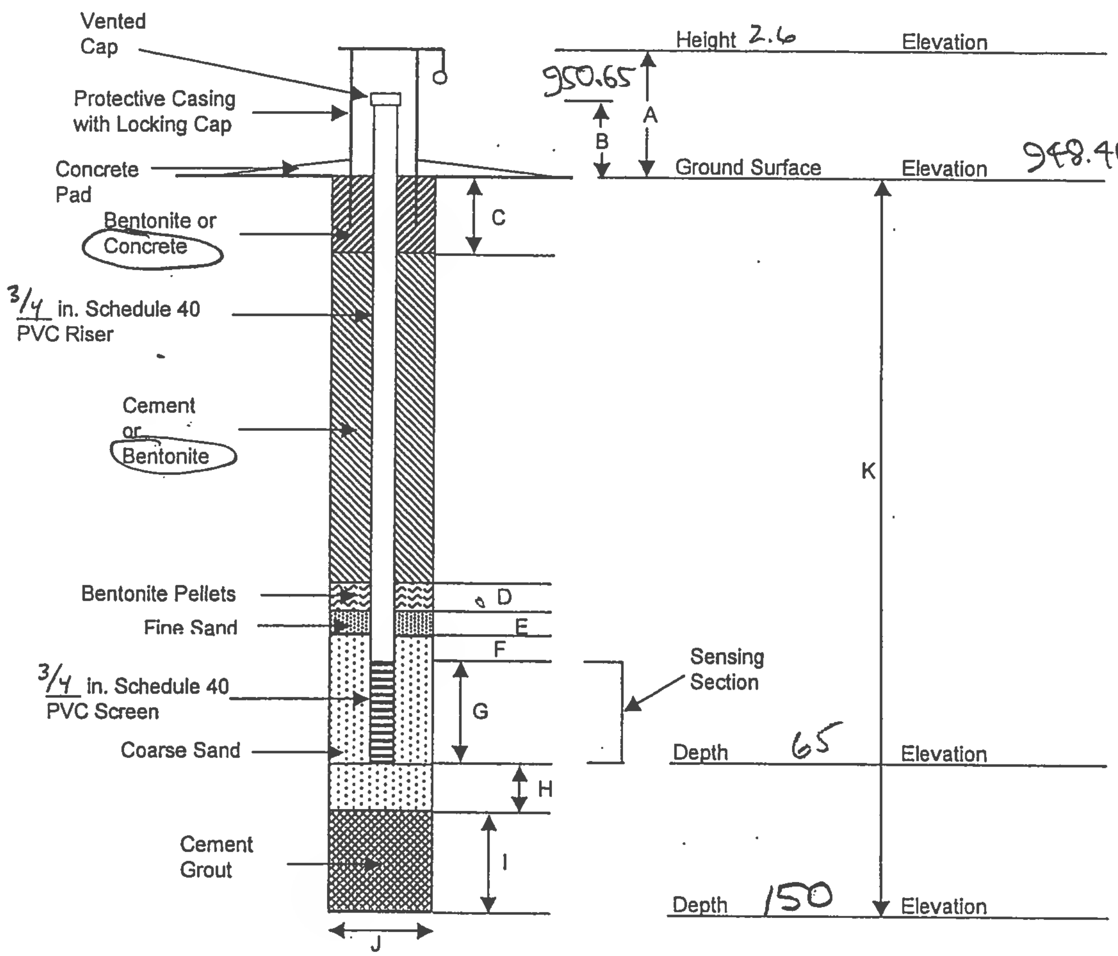
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT   Project No. C040384.40-01

Date 12 MAY 2005   Engineer/Geologist DBS   Well No. B-0514

N 540555.6419
E 1725145.9412



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.6	2.25	17	—	—	38
G	H	I	J	K	
10	2	83	0.25	150	—

Remarks ______________________

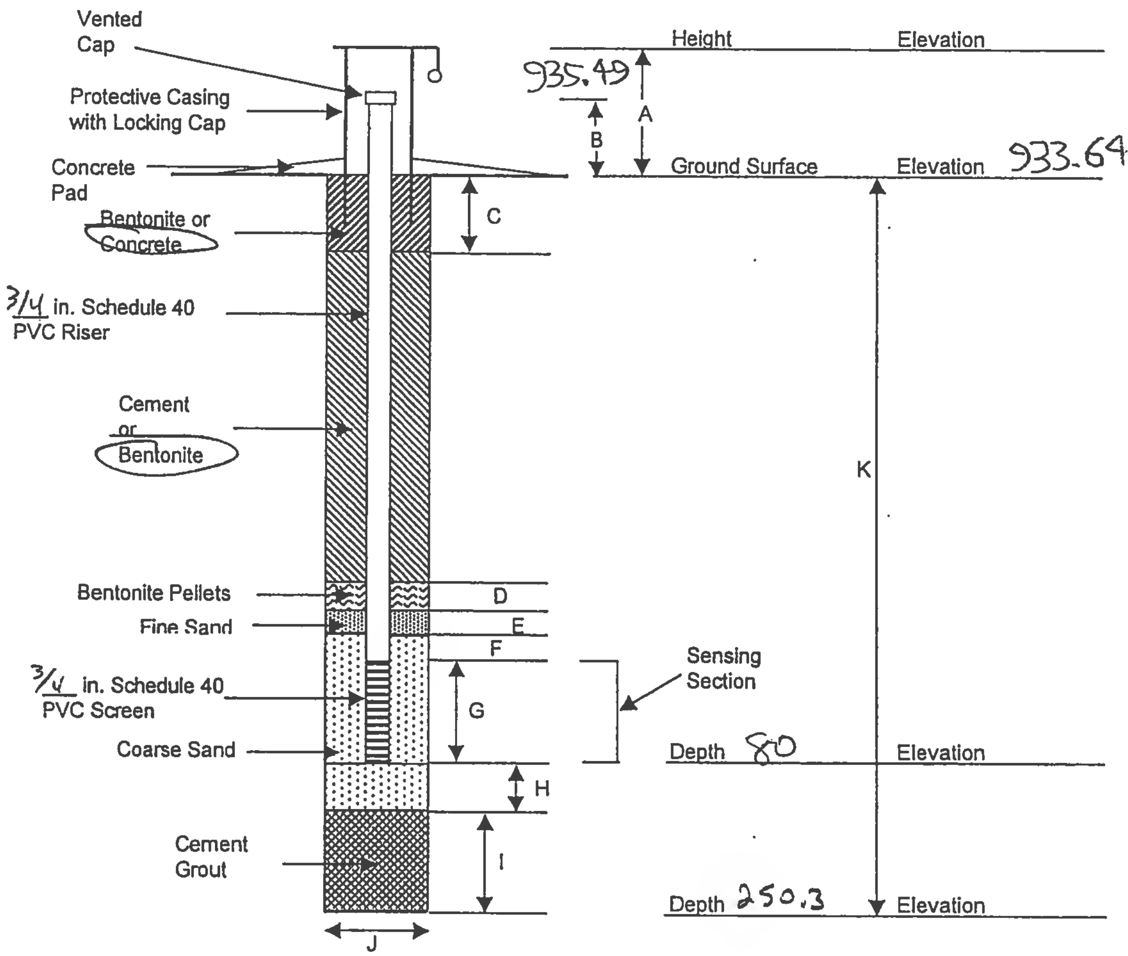
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3, JOHN E. AMOS POWER PLANT Project No. C040384.40-01

Date 16 MAY 2005 Engineer/Geologist DBS Well No. B-0515

N 539572.1065
E 1723680.1660



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.1	1.85	20.0	—	—	50
G	H	I	J	K	
10	2	168.3	0.25	250.3	

Remarks ______

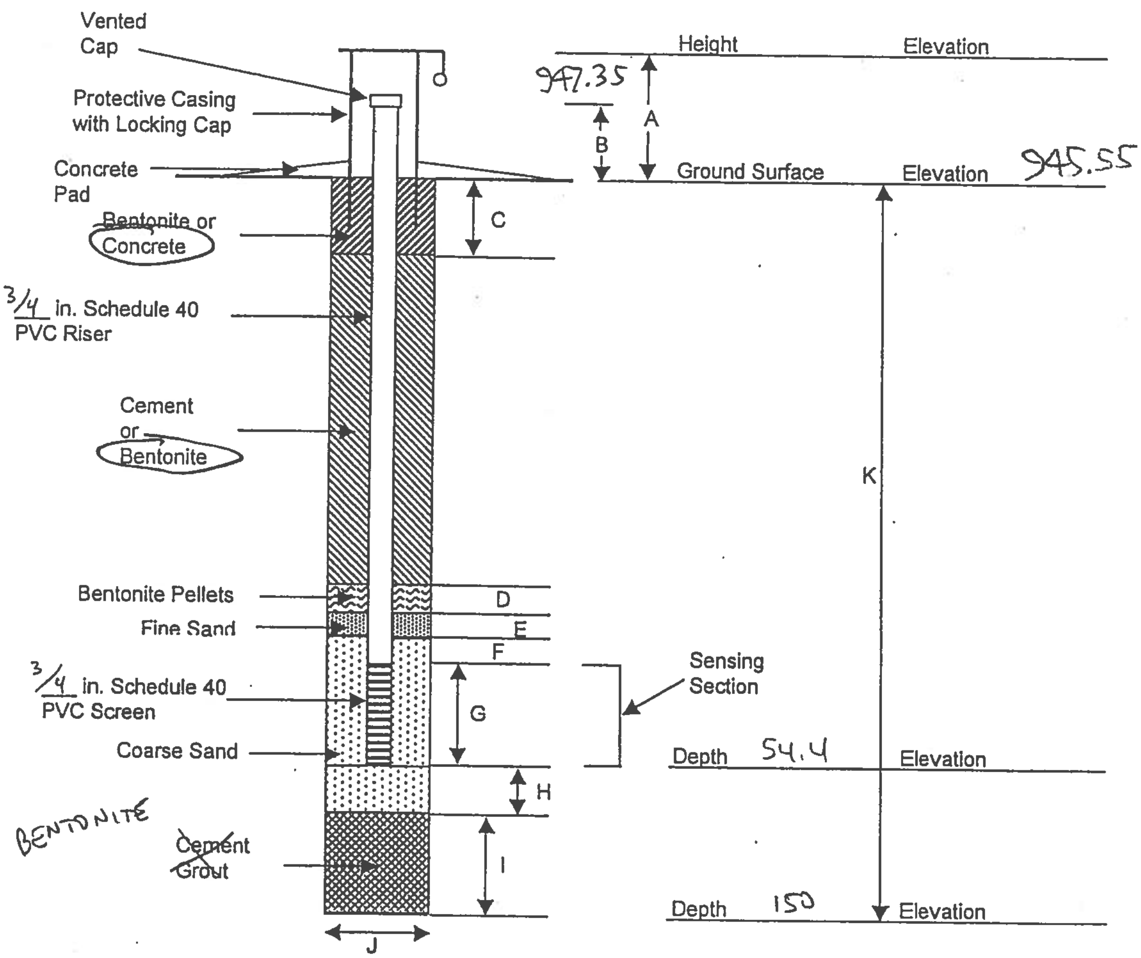
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT Project No. C040384.40-01

Date 19 MAR 2005 Engineer/Geologist DBS Well No. B-0517

N 542185.2965
E 1725391.3276



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.3	1.8	14	—	—	30.4
G	H	I	J	K	
10	2	93.6	0.25	150	

Remarks PACKER ASSEMBLY STUCK IN HOLE. SALVAGED UPPER PACKER AND PUMP. PUSHED REMAINDER DOWN HOLE.

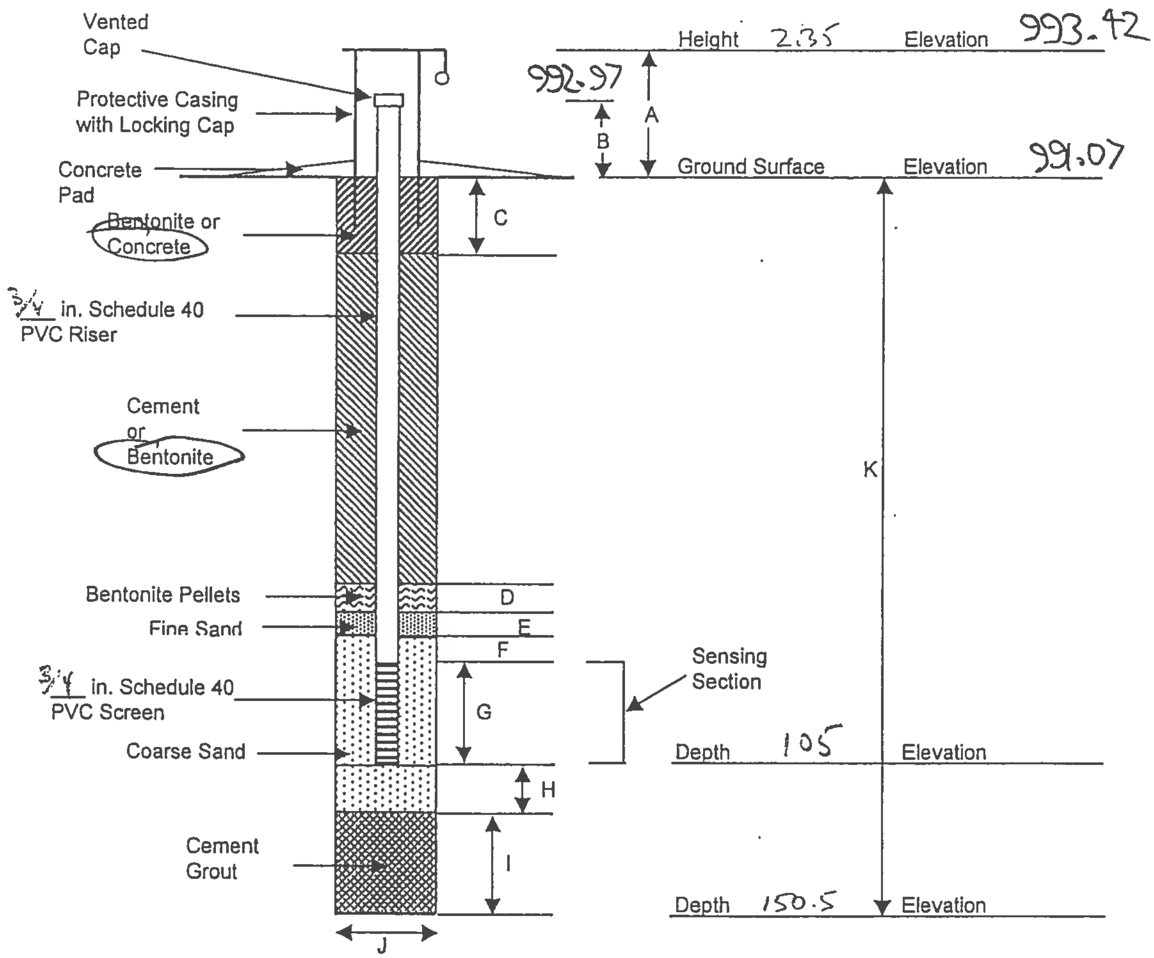
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 3/9, JOHN E. AMOS POWER PLANT   Project No. C040384.40-01

Date 19 MAY 2005   Engineer/Geologist DBS   Well No. B-0517

N 543732.8856
E 1725136.5233



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.35	1.9	15	—	—	80
G	H	I	J	K	
10	3	42.5	0.25	150.5	

Remarks ______________________________

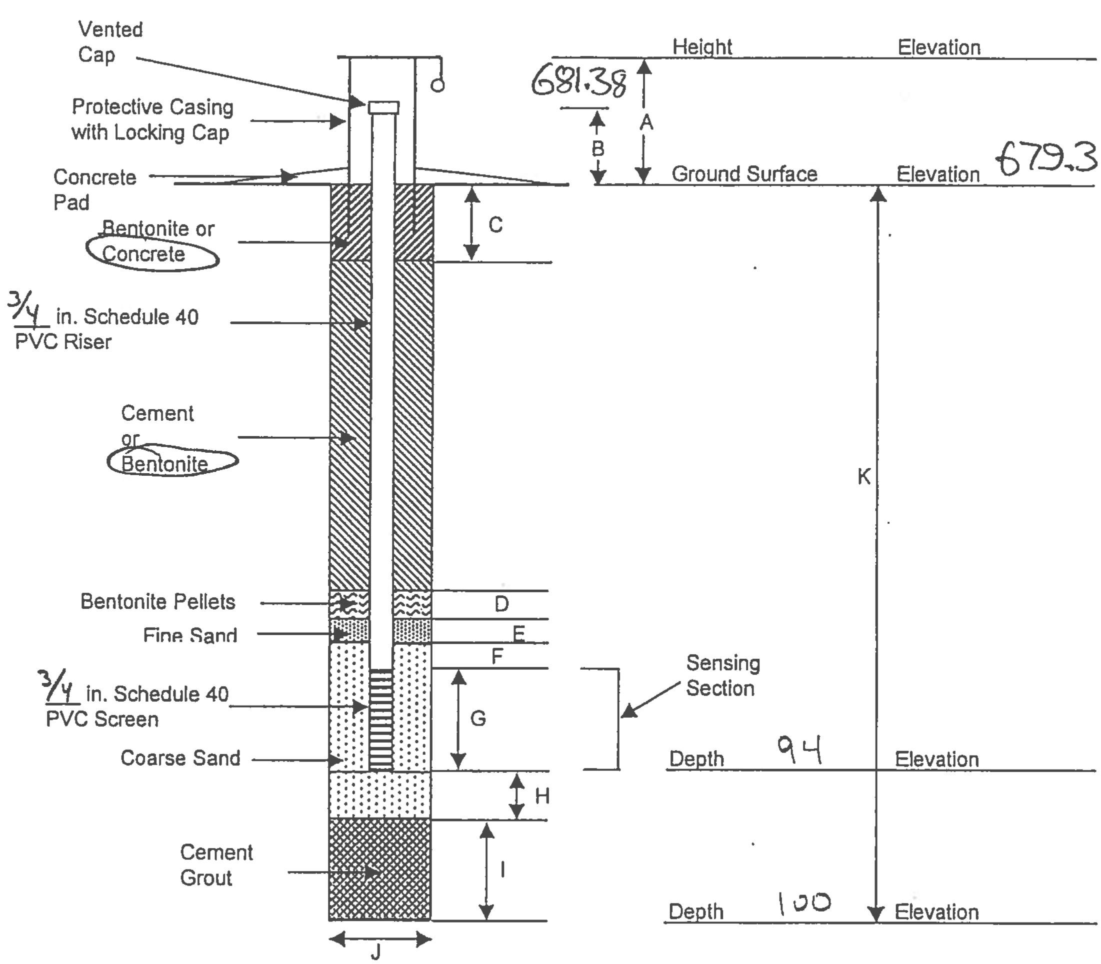
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT Project No. C040384.40-01

Date 24 MAY 2005 Engineer/Geologist DBS Well No. B-0520

N 542378.3755
E 1721739.7942



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.4	2.07	34	—	—	50
G	H	I	J	K	
10	2	4	0.25	100	

Remarks ______________________

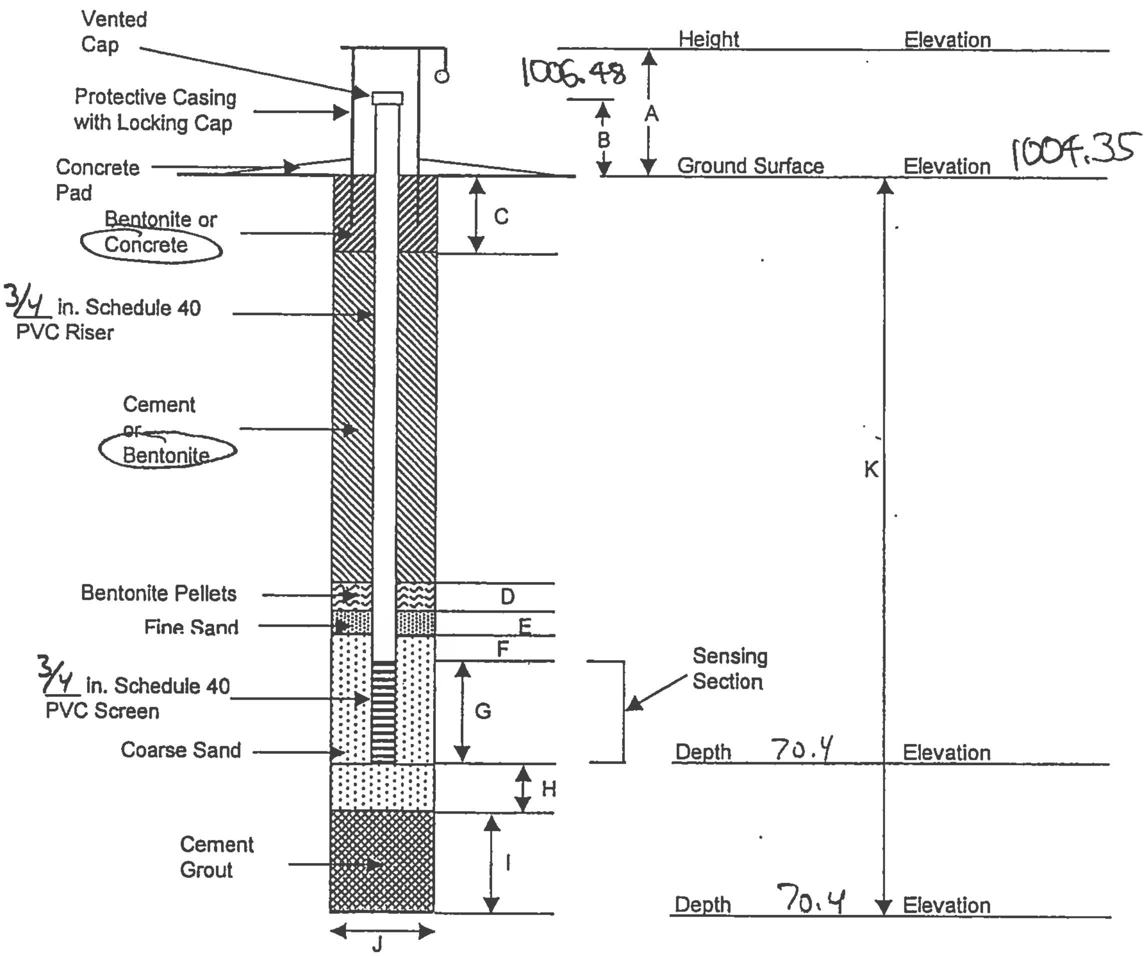
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3, AMOS POWER PLANT   Project No. C040384.40-01

Date 23 MAY 2005   Engineer/Geologist DBS   Well No. B-0521

N 544199.5521
E 1724054.5791



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.58	2.13	12.4	—	—	48
G	H	I	J	K	
10	—	—	0.25	70.4	

Remarks ______________________________

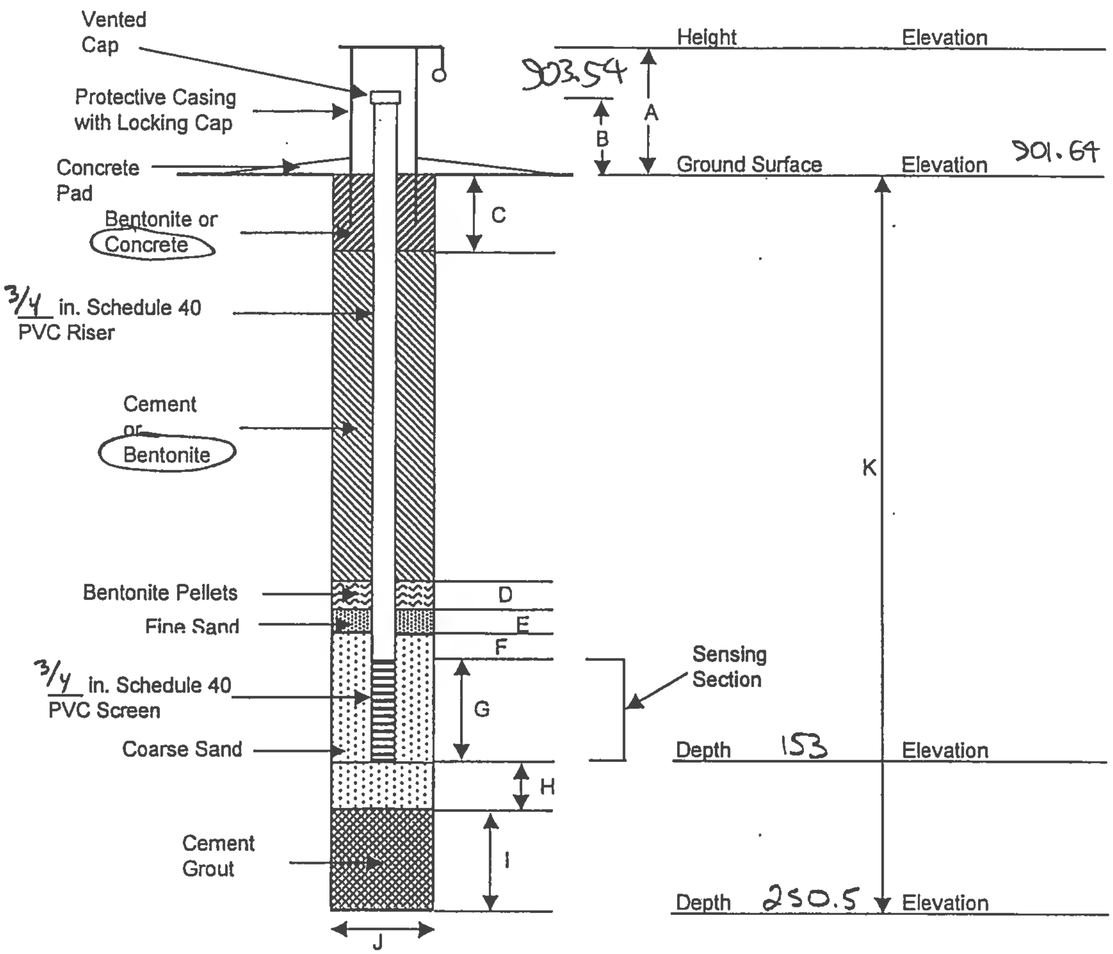
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT   Project No. C040384.40-01

Date 25/26 MAY 2005   Engineer/Geologist DBS   Well No. B-0522

N 543873.4417
E 1722326.4148



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.18	1.9	35	—	—	98
G	H	I	J	K	
20	2	95.5	0.25	250.5	

Remarks

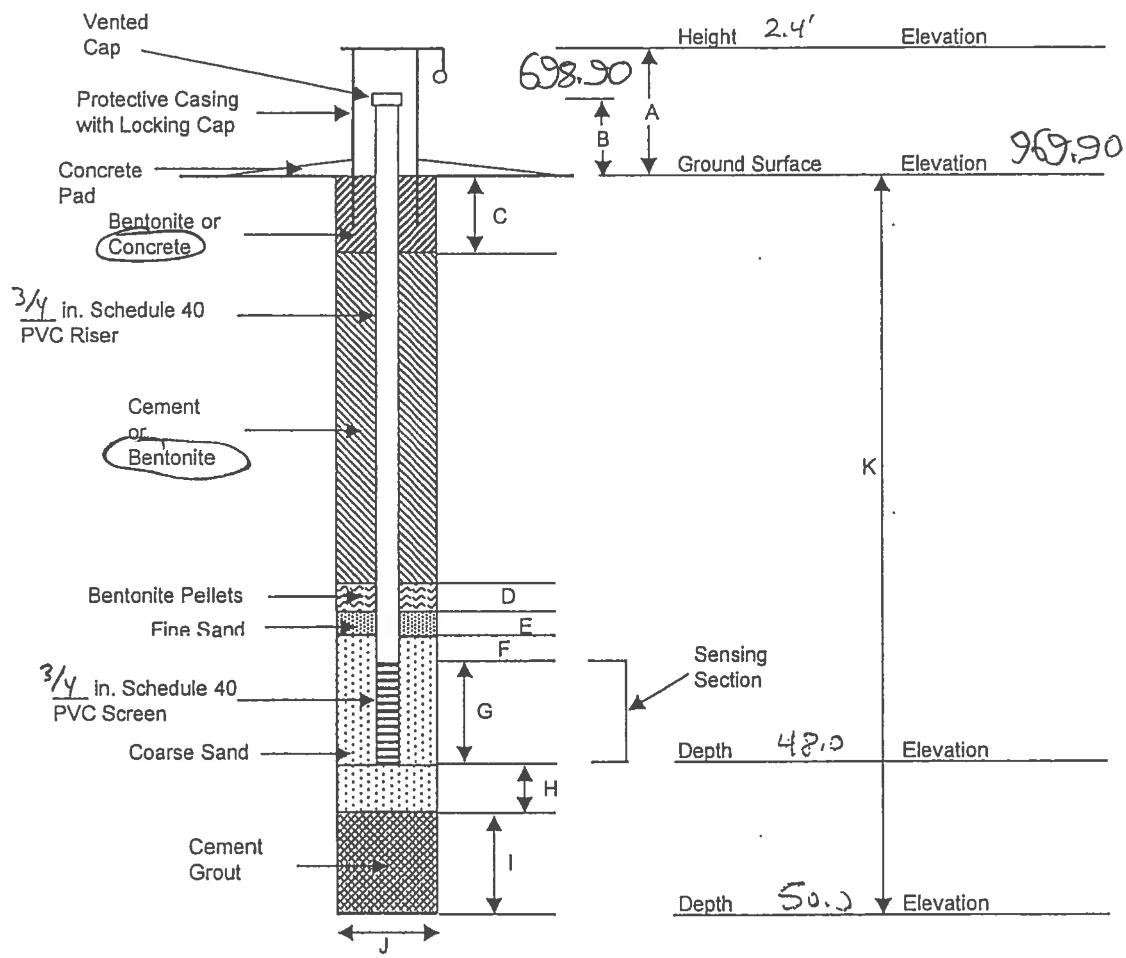
gal consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT Project No. C040384.40-01

Date 25 MAY 2005 Engineer/Geologist DBS Well No. B-0523

N 542742.2422
E 1722248.6749



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.4	2.0	24	—	—	14
G	H	I	J	K	
10	2	–	0.25	50.0	

Remarks ______

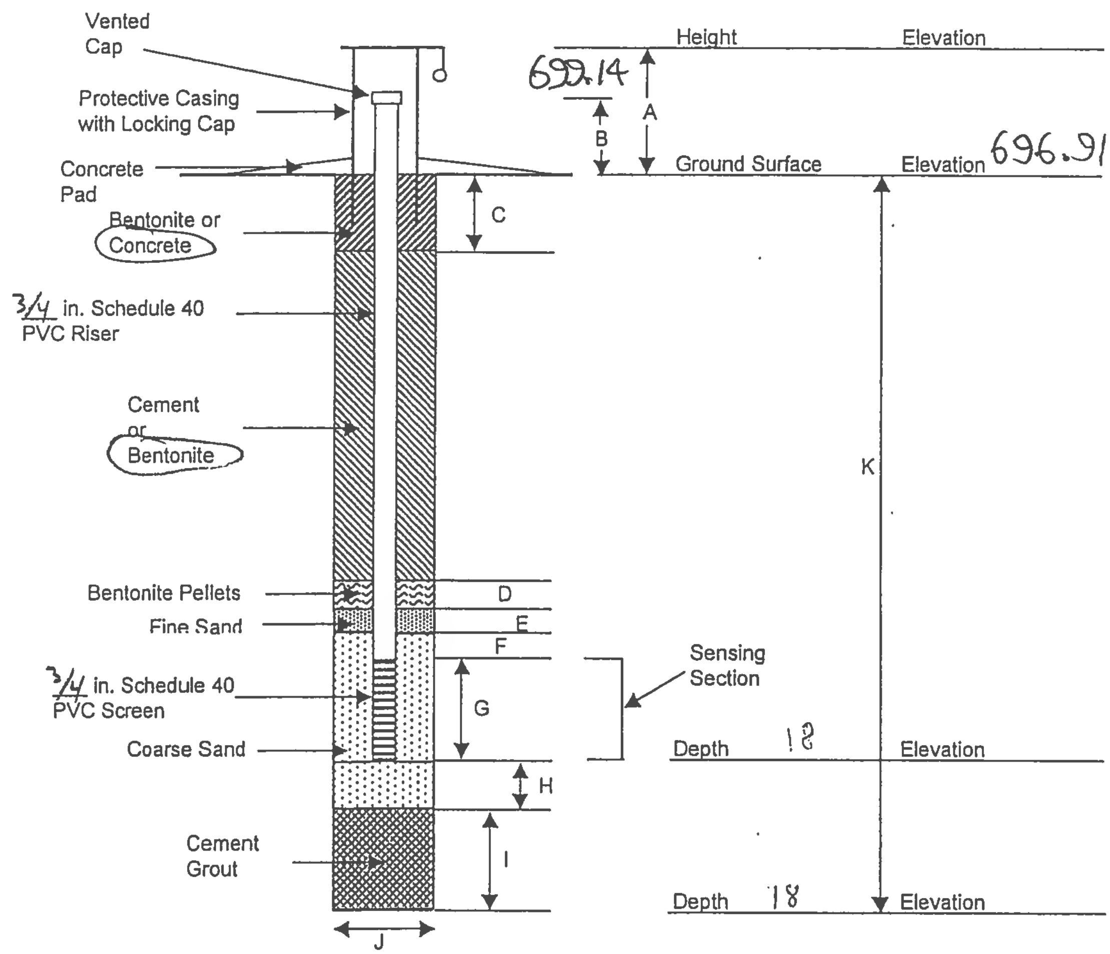
gai consultants
transforming ideas into reality

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3, AMOS POWER PLANT   Project No. C040324.40-01

Date 25 MAY 2005   Engineer/Geologist DBS   Well No. B-0524

N 542745.0961
E 1722251.4149



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.55	2.23	3	—	—	5
G	H	I	J	K	
10	-	-	0.25	18	

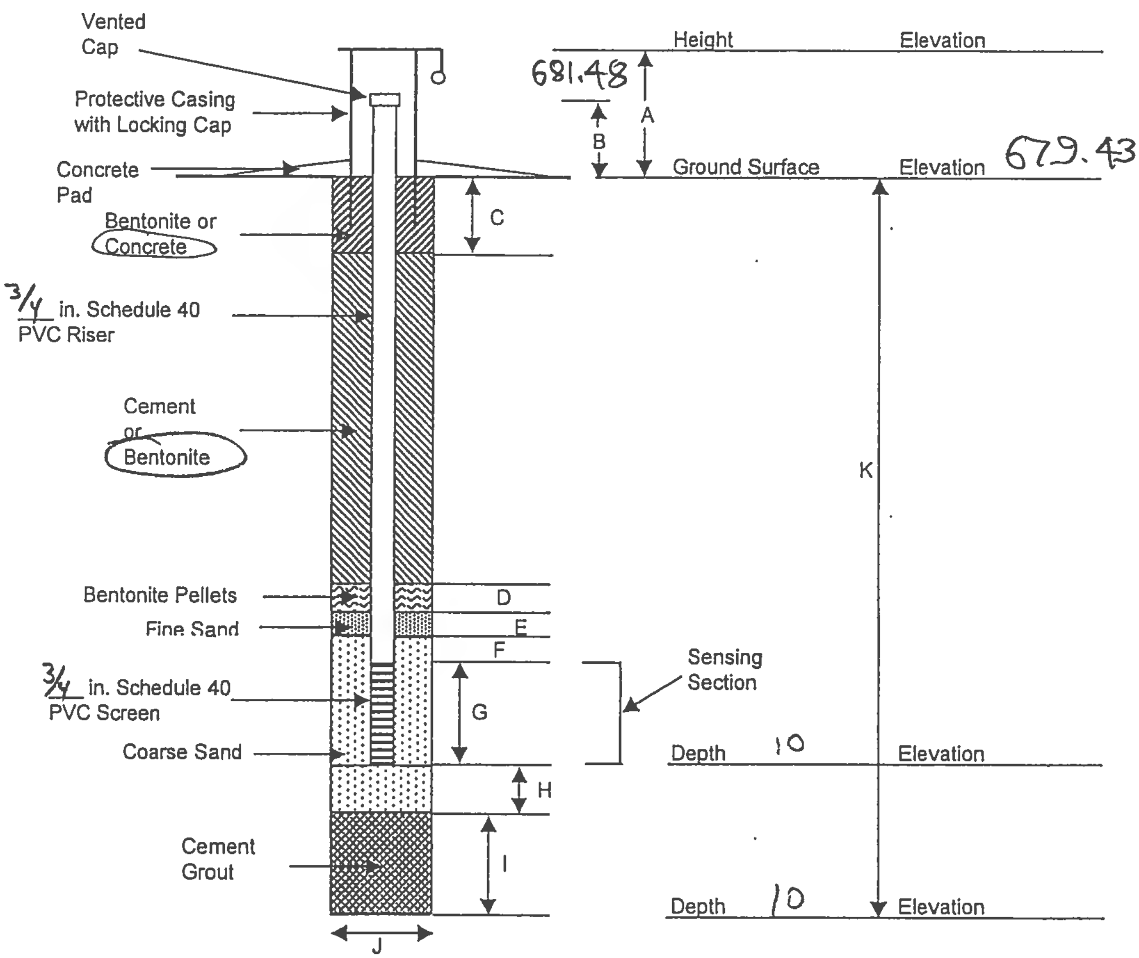
Remarks

MONITORING WELL CONSTRUCTION DIAGRAM
(Not to Scale)

Project AREA 2/3 AMOS POWER PLANT Project No. C040384.20-01

Date 25 MAY 2025 Engineer/Geologist DBS Well No. B-0525

N 542379.9472
E 1721745.3620



STANDPIPE PIEZOMETER INSTALLATION SKETCH

DIMENSIONS (Feet)					
A	B	C	D	E	F
2.3	2.05	2	—	—	3
G	H	I	J	K	
5	0	—	0.25	10	

Remarks

TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

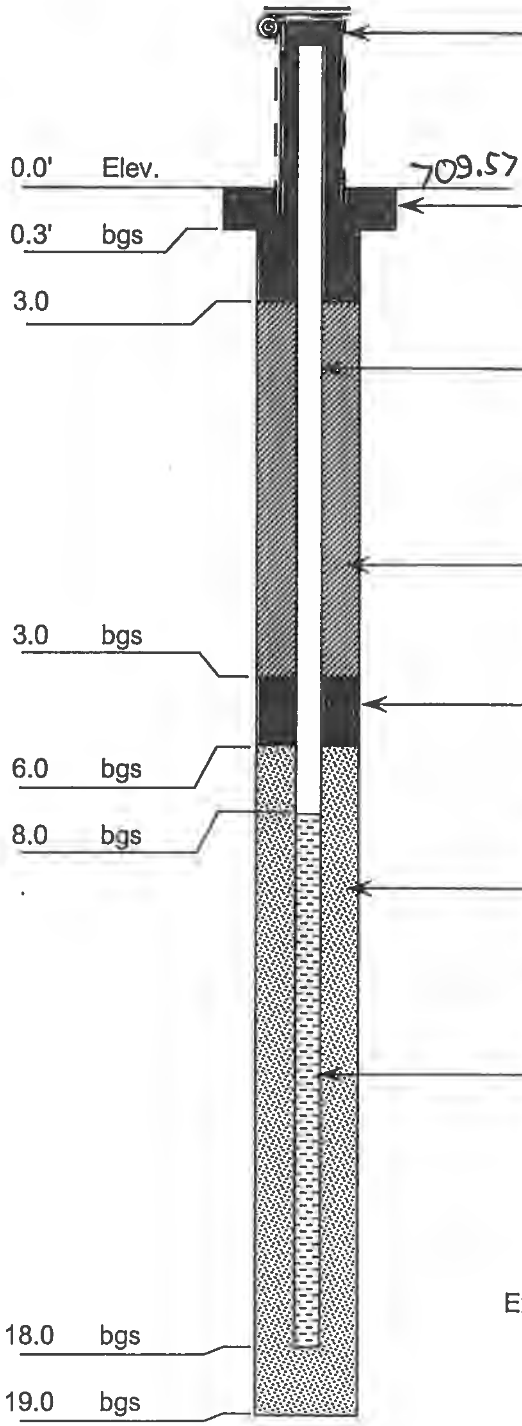
Geotechnical & Environmental Drilling

Well No: 05-36/MW-1 **Project:** John E. Amos Power Plant

Well Tag: 0275-24-05 **TTI Proj. No:** 05639

Date Installed: 07/12/05 **Client:** GAI Consultants, Inc.

GPS Location: **Latitude:** N 38° 28' 41.8" **Longitude:** W 081° 51' 33.8"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	10	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	N/A	lbs.

Bentonite	87	lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	9	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	10	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0024-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0024-05
Grid Location:
a. Latitude: 38 28 41 ..8
b. Longitude: 81 51 33 ..8
c. Method Used: GPS

Company/Project Well No.:
05639/05-36-MW-1

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

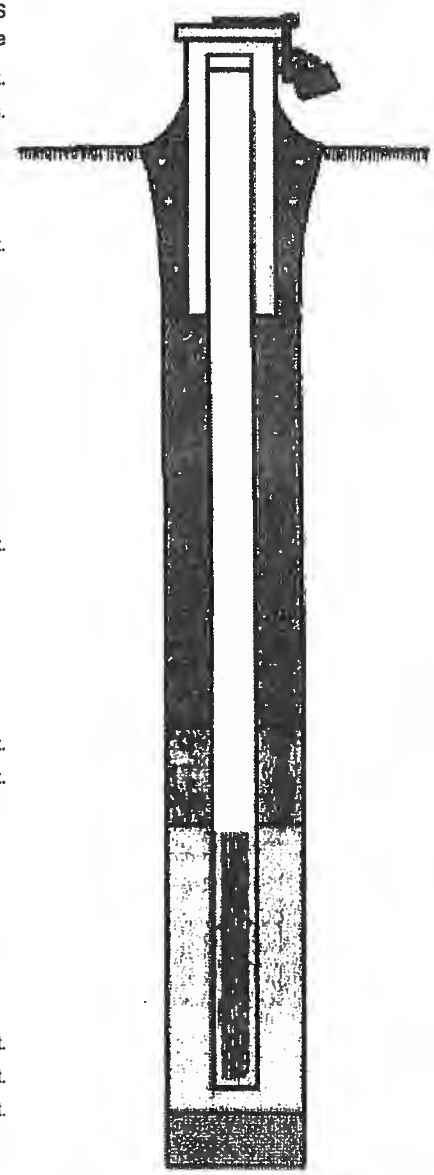
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
07/12/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format) .

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: not applicable -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 3 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 87 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 6 ft.
15.Depth to Top of Screen: 8 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 10 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 18 ft.
19.Bottom of Filter Pack: 19 ft.
20.Bottom of Borehole: 19 ft.
21.Backfill Material (below filter pack): Sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350



TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

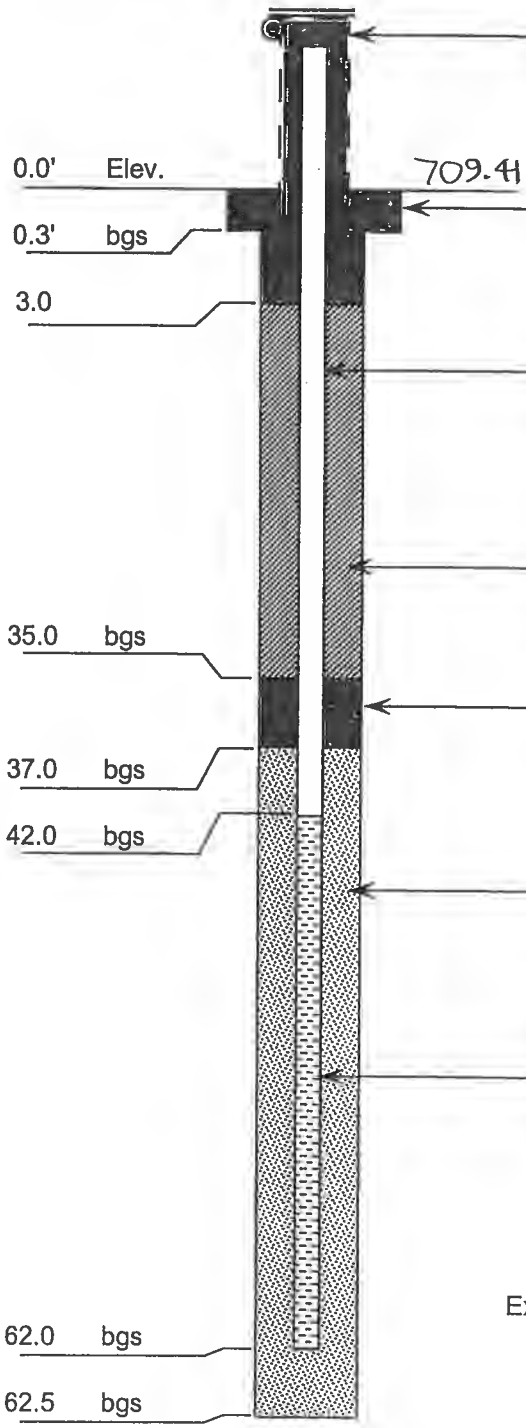
Geotechnical & Environmental Drilling

Well No: 05-35/MW-2 **Project:** John E. Amos Power Plant

Well Tag: 0275-25-05 **TTI Proj. No:** 05639

Date Installed: 07/12/05 **Client:** GAI Consultants, Inc.

GPS Location: **Latitude:** N 38° 28' 41.8" **Longitude:** W 081° 51' 33.3"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	44	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	200	lbs.

Bentonite	12.5	lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	4	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	20	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0025-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0025-05
Grid Location:
a. Latitude: 38 28 41 ..8
b. Longitude: 81 51 33 ..3
c. Method Used: GPS

Company/Project Well No.:
05639/05-35-MW-2

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

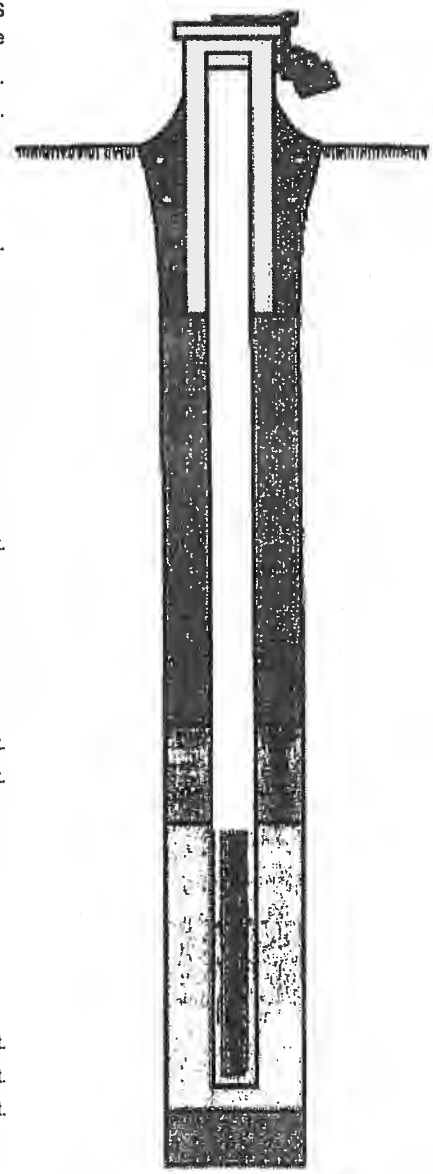
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
07/12/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 35 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 12.5 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 37 ft.
15.Depth to Top of Screen: 42 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravty Fed
18.Well Depth: 62 ft.
19.Bottom of Filter Pack: 62.5 ft.
20.Bottom of Borehole: 62.5 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350



TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

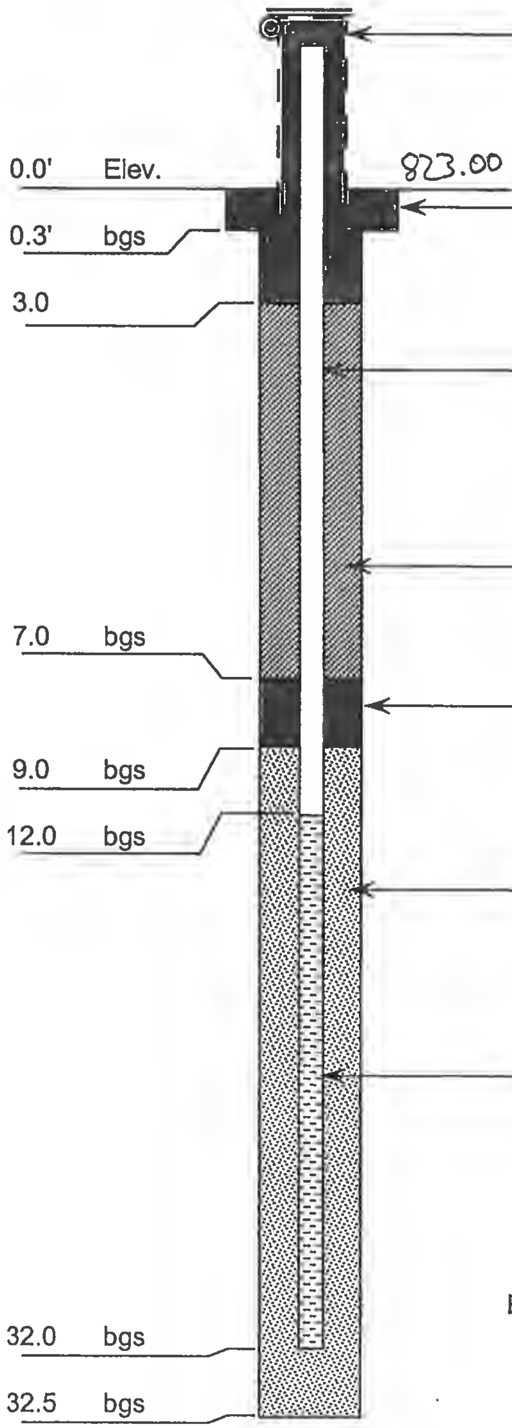
Geotechnical & Environmental Drilling

Well No: 05-27/MW-3 **Project:** John E. Amos Power Plant

Well Tag: 0275-26-05 **TTI Proj. No:** 05639

Date Installed: 06/27/05 **Client:** GAI Consultants, Inc.

GPS Location: **Latitude:** N 38° 29' 04.4" **Longitude:** W 081° 51' 13.5"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	14	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	25	lbs.

Bentonite	50	lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	12	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	20	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0026-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0026-05
Grid Location:
a. Latitude: 38 29 4 ..4
b. Longitude: 81 51 13 ..5
c. Method Used: GPS

Company/Project Well No.:
05639/05-27-MW-3

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

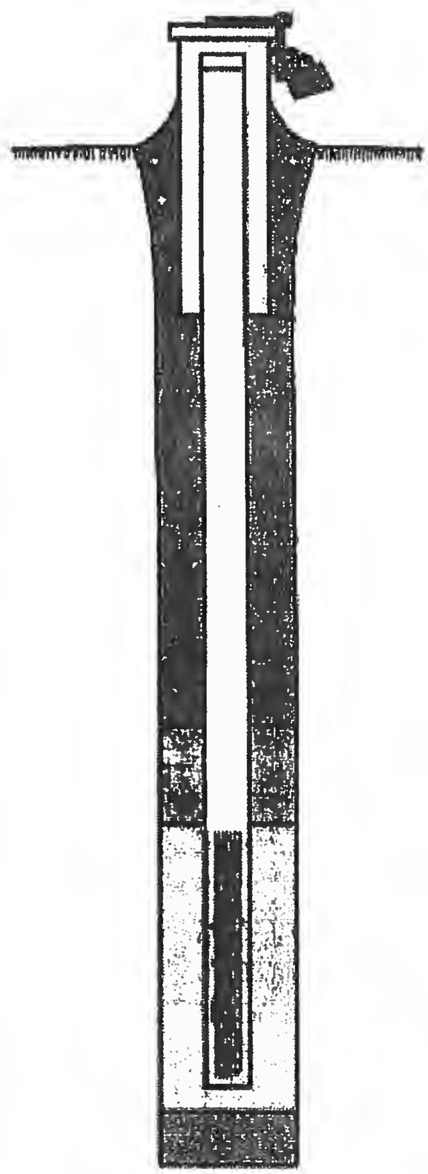
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
06/27/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 7 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 50 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 9 ft.
15.Depth to Top of Screen: 12 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity fed
18.Well Depth: 32 ft.
19.Bottom of Filter Pack: 32.5 ft.
20.Bottom of Borehole: 32.5 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350

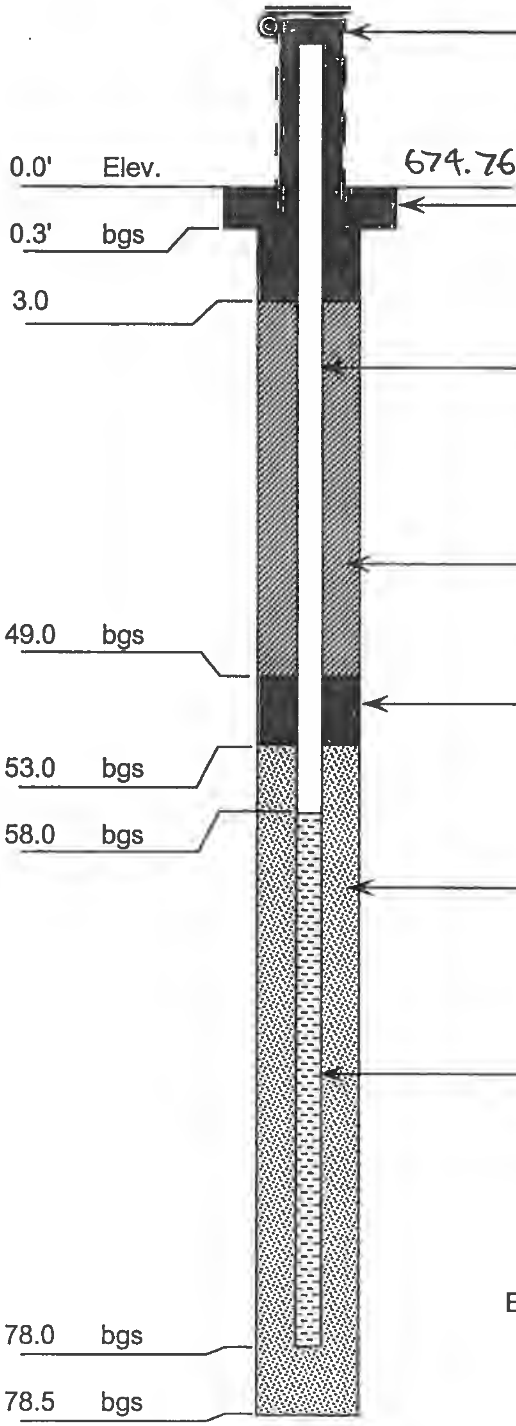


TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

Geotechnical & Environmental Drilling

Well No: 05-32/MW-4 **Project:** John E. Amos Power Plant
Well Tag: 0275-27-05 **TTI Proj. No:** 05639
Date Installed: 07/07/05 **Client:** GAI Consultants, Inc.
GPS Location: **Latitude:** N 38° 29' 10.03" **Longitude:** W 081° 51' 45.0"



STEEL PROTECTIVE COVER (Stick-up)
Size: 6" x 5'
Riser Stick-up: 2'

CONCRETE PAD
Size: 6' diameter
No. of Bags: 10
Bags Size: 80

Riser:
Type: Sch. 40 PVC
Size: 2 inches I.D.
Length 60 feet

Grout Backfill
Cement: N/A No. of Bags
Bags Size: N/A lbs.
Gran. Bentonite N/A lbs.
Volclay 100 lbs.

Bentonite 50 lbs.

Sand Pack
Type: Best #430
Bags Size: 50 lbs.
No. of Bags 4

Screen
Type: Sch. 40 PVC
Size: 2 inches I.D.
Slot Size: 0.01 inches
Length: 20 feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0027-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0027-05
Grid Location:
a. Latitude: 38 29 10 ..03
b. Longitude: 81 51 45 .
c. Method Used: GPS

Company/Project Well No.:
05639/05-32-MW-4

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

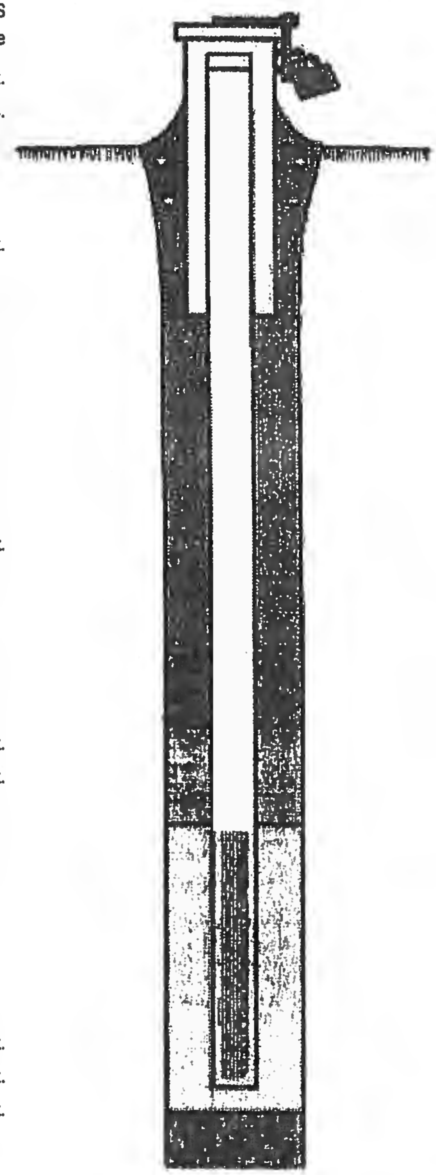
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
07/07/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 49 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 50 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 53 ft.
15.Depth to Top of Screen: 58 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 78 ft.
19.Bottom of Filter Pack: 78.5 ft.
20.Bottom of Borehole: 78.5 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350



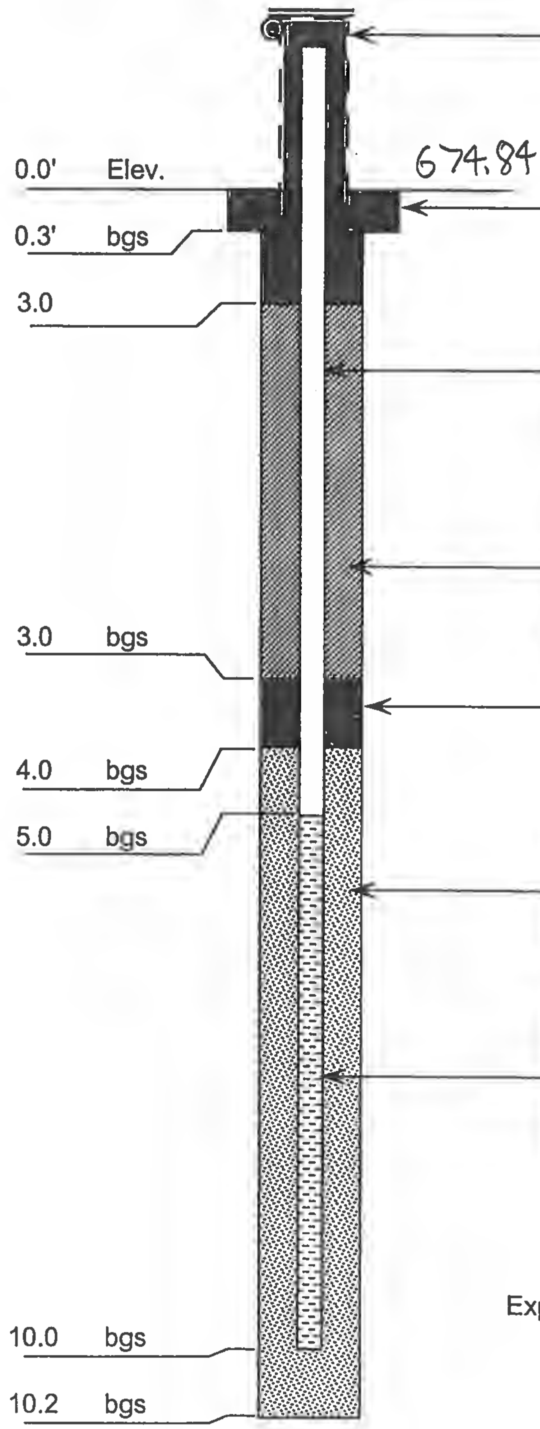
TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

Geotechnical & Environmental Drilling

Well No: 05-33/MW-5
Well Tag: 0275-28-05
Date Installed: 07/07/05
GPS Location: **Latitude:** N 38° 29' 10.00"

Project: John E. Amos Power Plant
TTI Proj. No: 05639
Client: GAI Consultants, Inc.
Longitude: W 081° 51' 44.6"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	7	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	N/A	lbs.

Bentonite	25	lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	4	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	5	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0028-05

Site Name/Physical Address:
Site: . Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0028-05
Grid Location:
a. Latitude: 38 29 10 .
b. Longitude: 81 51 44 ..6
c. Method Used: GPS

Company/Project Well No.:
05639/05-33-MW-5

Purpose of Monitoring Well:
Monitor Groundwater

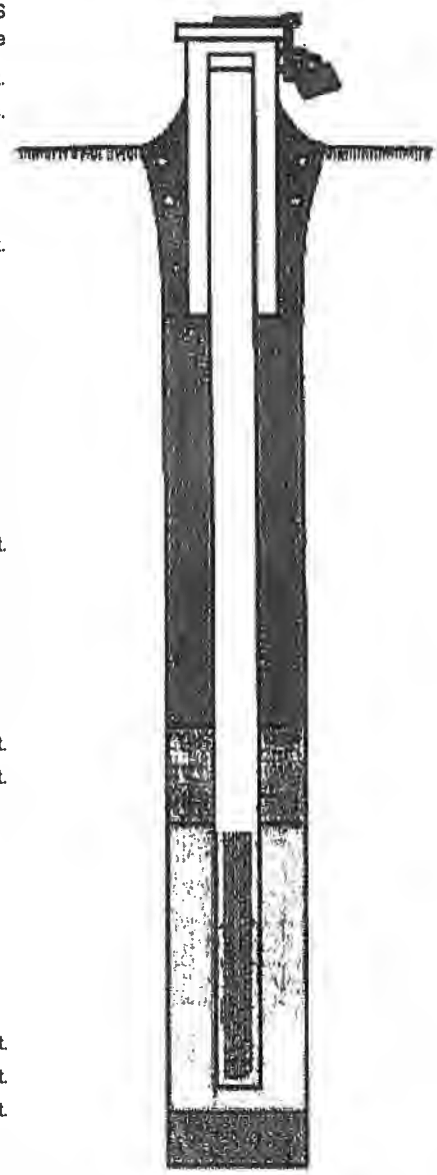
Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
07/07/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 3 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 25 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 4 ft.
15.Depth to Top of Screen: 5 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 5 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 10 ft.
19.Bottom of Filter Pack: 10.2 ft.
20.Bottom of Borehole: 10.2 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350

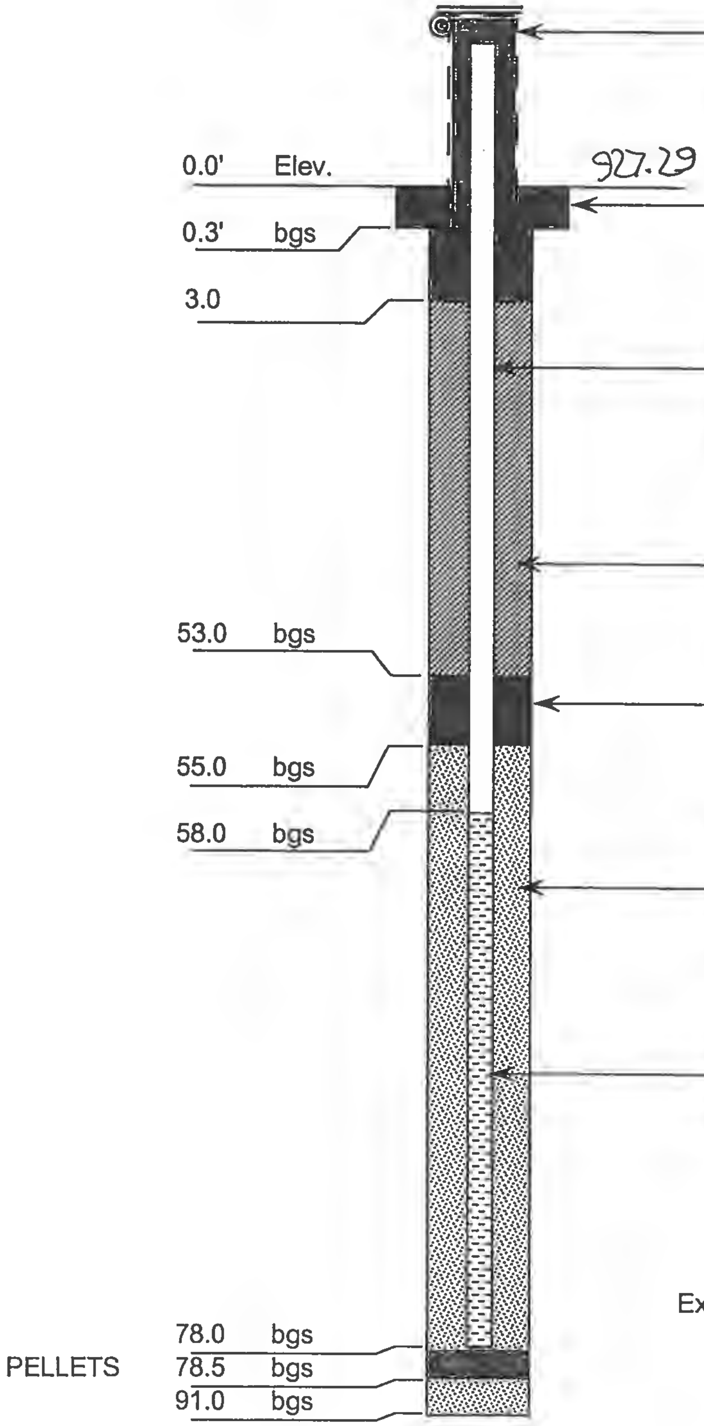
TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

Geotechnical & Environmental Drilling

Well No: 05-26/MW-6
Well Tag: 0275-29-05
Date Installed: 06/23/05
GPS Location: **Latitude:** N 38° 28' 56.1"

Project: John E. Amos Power Plant
TTI Proj. No: 05639
Client: GAI Consultants, Inc.
Longitude: W 081° 51' 30.6"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	60	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	125	lbs.

Bentonite 100 lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	4	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	20	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0029-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0029-05
Grid Location:
a. Latitude: 38 28 56 ..1
b. Longitude: 81 51 30 ..6
c. Method Used: GPS

Company/Project Well No.:
05639/05-26-MW-6

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

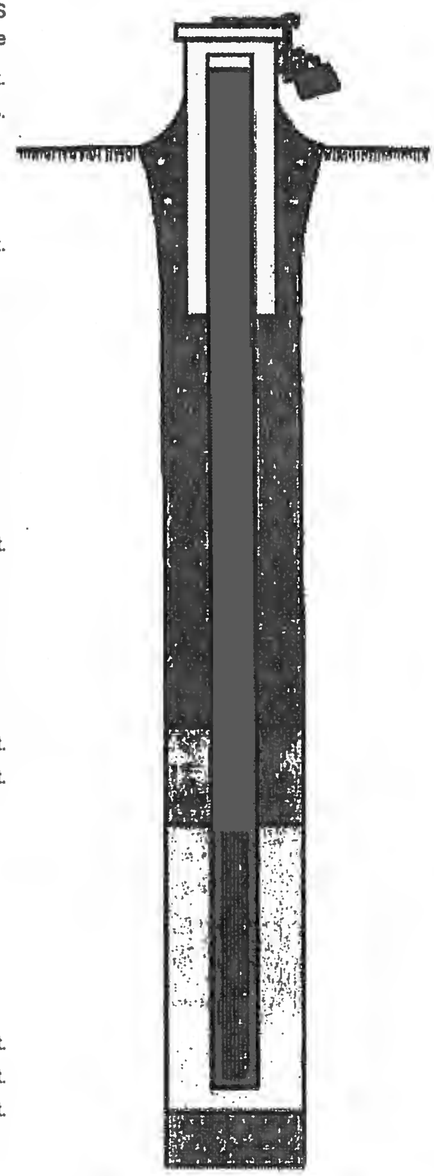
Installed By (Name, Firm, Address):
Installer: Vim Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
06/23/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 53 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 100 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 55 ft.
15.Depth to Top of Screen: 58 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 78 ft.
19.Bottom of Filter Pack: 78.5 ft.
20.Bottom of Borehole: 91 ft.
21.Backfill Material (below filter pack): Bentonite Pellets
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350



TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

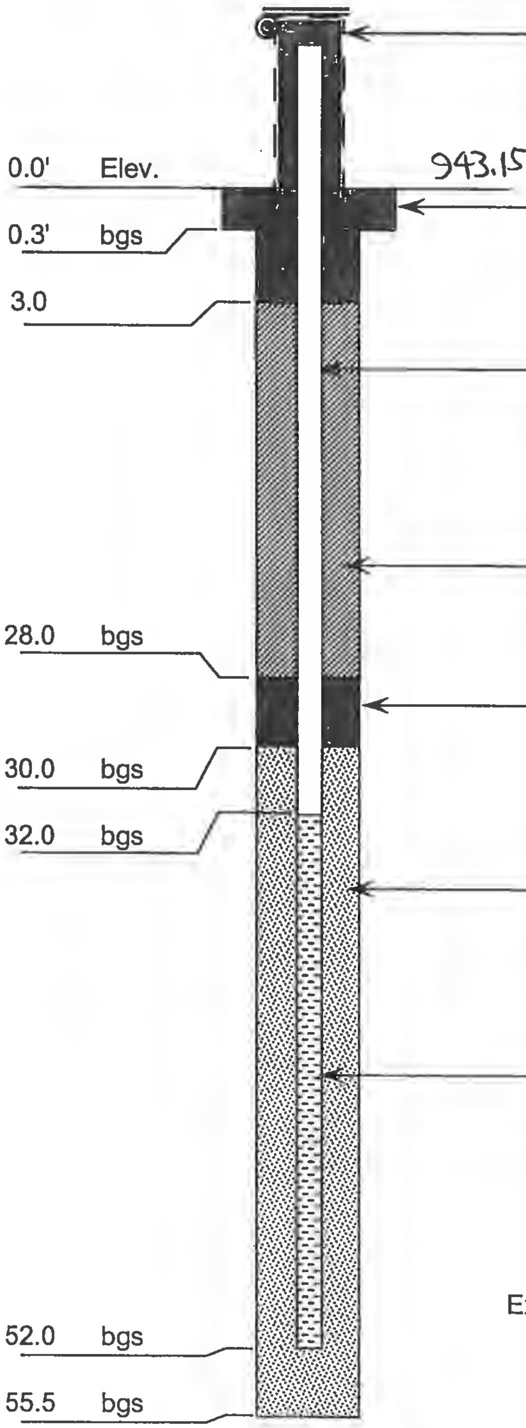
Geotechnical & Environmental Drilling

Well No: 05-28/MW-7 **Project:** John E. Amos Power Plant

Well Tag: 0275-30-05 **TTI Proj. No:** 05639

Date Installed: 06/28/05 **Client:** GAI Consultants, Inc.

GPS Location: Latitude: N 39° 28' 44.1" **Longitude:** W 081° 51' 15.5"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	34	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	100	lbs.

Bentonite	12.5	lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	4	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	20	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0030-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0030-05
Grid Location:
a. Latitude: 38 28 44 ..1
b. Longitude: 81 51 15 ..5
c. Method Used: GPS

Company/Project Well No.:
05639/05-28-MW-7

Purpose of Monitoring Well:
Monitor Groundwater

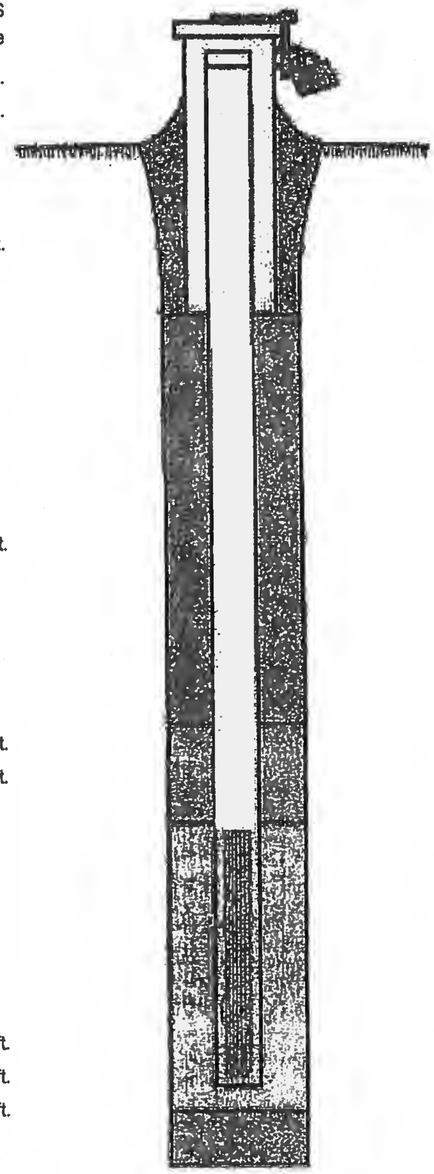
Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
06/28/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)



1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 28 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 12.5 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 30 ft.
15.Depth to Top of Screen: 32 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 52 ft.
19.Bottom of Filter Pack: 55.5 ft.
20.Bottom of Borehole: 55.5 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350

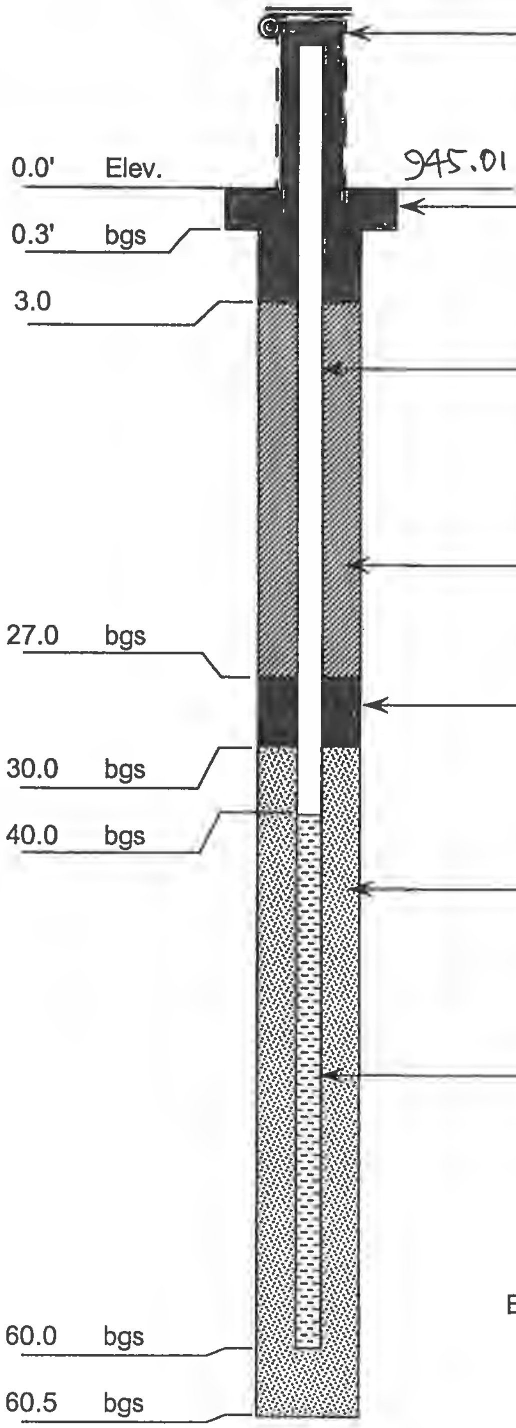
TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

Geotechnical & Environmental Drilling

Well No: 05-34/MW-~~11~~D8
Well Tag: 0275-33-05
Date Installed: 07/11/05
GPS Location: **Latitude:** N 38° 29' 09.3"

Project: John E. Amos Power Plant
TTI Proj. No: 05639
Client: GAI Consultants, Inc.
Longitude: W 081° 50' 57.5"



STEEL PROTECTIVE COVER (Stick-up)
Size: 6" x 5'
Riser Stick-up: 2'

CONCRETE PAD
Size: 6' diameter
No. of Bags: 10
Bags Size: 80

Riser:
Type: Sch. 40 PVC
Size: 2 inches I.D.
Length 42 feet

Grout Backfill
Cement: N/A No. of Bags
Bags Size: N/A lbs.
Gran. Bentonite N/A lbs.
Volclay 150 lbs.

Bentonite 12.5 lbs.

Sand Pack
Type: Best #430
Bags Size: 50 lbs.
No. of Bags 5

Screen
Type: Sch. 40 PVC
Size: 2 inches I.D.
Slot Size: 0.01 inches
Length: 20 feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0033-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0033-05
Grid Location:
a. Latitude: 38 29 9 ..3
b. Longitude: 81 50 57 ..3
c. Method Used: GPS

Company/Project Well No.:
05639/05-34-MW-11

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

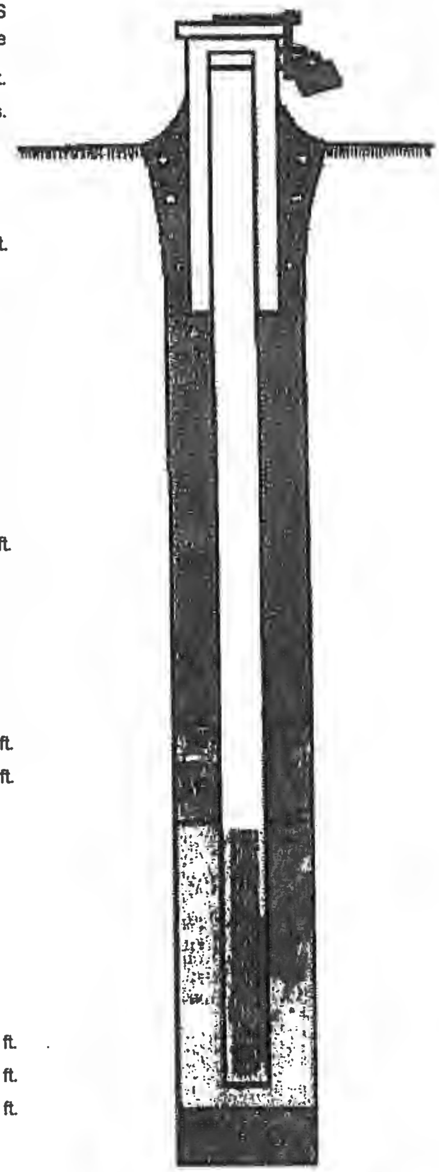
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
07/11/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 27 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 12.5 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 30 ft.
15.Depth to Top of Screen: 40 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 60 ft.
19.Bottom of Filter Pack: 60.5 ft.
20.Bottom of Borehole: 60.5 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350

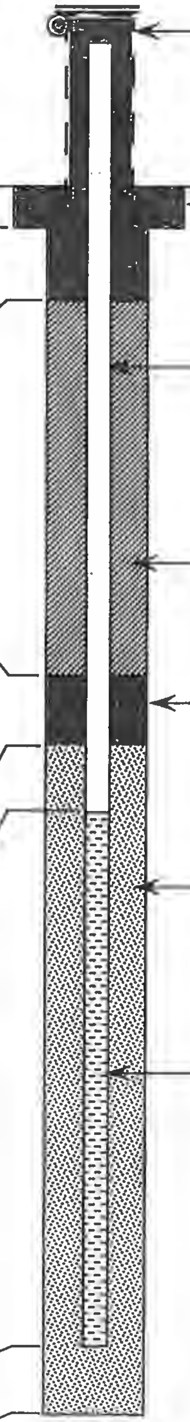


TTI
TERRA
TESTING

WELL / PIEZOMETER SCHEMATIC

Geotechnical & Environmental Drilling

Well No: 05-30/MW-9
Well Tag: 0275-31-05
Date Installed: 06/30/05
Project: John E. Amos Power Plant
TTI Proj. No: 05639
Client: GAI Consultants, Inc.
GPS Location: **Latitude:** N 38° 29' 29.1" **Longitude:** W 081° 51' 8.8"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'	
Riser Stick-up:	2'	

CONCRETE PAD

Size:	6' diameter	
No. of Bags:	10	
Bags Size:	80	

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	44	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	100	lbs.

Bentonite 12.5 lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	4	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	20	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0031-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0031-05
Grid Location:
a. Latitude: 38 29 29 ..1
b. Longitude: 81 51 8 ..8
c. Method Used: GPS

Company/Project Well No.:
05639/05-30-MW-9

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

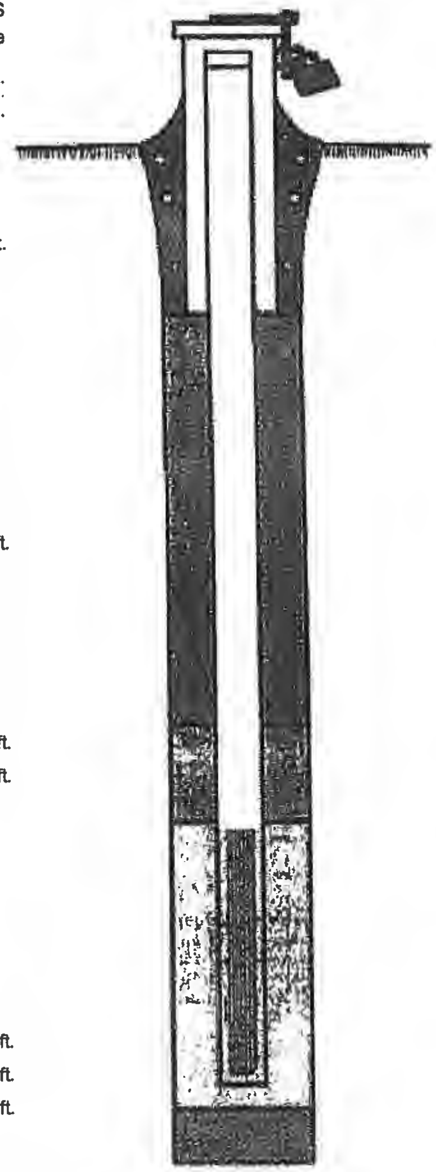
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
06/30/2005

Driller's WV Cert No.
WV00275

Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 34.5 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 12.5 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 37 ft.
15.Depth to Top of Screen: 42 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 62 ft.
19.Bottom of Filter Pack: 62.5 ft.
20.Bottom of Borehole: 62.5 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350

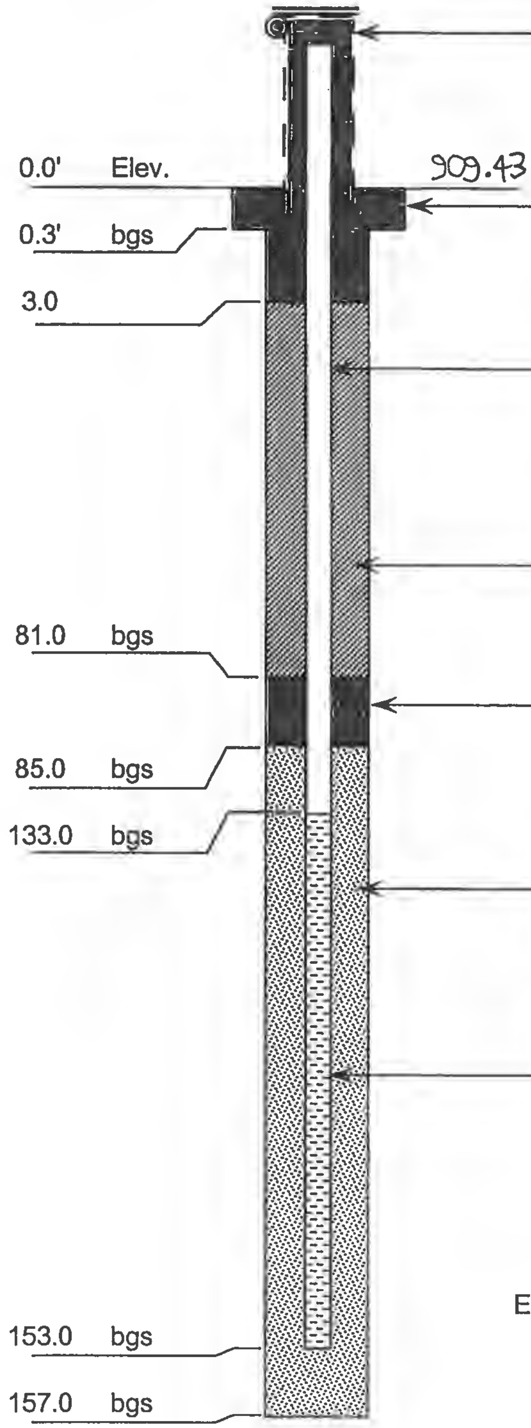


TERRA TESTING

WELL / PIEZOMETER SCHEMATIC

Geotechnical & Environmental Drilling

Well No: 05-31/MW-10
Project: John E. Amos Power Plant
Well Tag: 0275-32-05
TTI Proj. No: 05639
Date Installed: 07/06/05
Client: GAI Consultants, Inc.
GPS Location: **Latitude:** N 38° 29' 27.7" **Longitude:** W 081° 51' 30.3"



STEEL PROTECTIVE COVER (Stick-up)

Size:	6" x 5'
Riser Stick-up:	2'

CONCRETE PAD

Size:	6' diameter
No. of Bags:	10
Bags Size:	80

Riser:

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Length	135	feet

Grout Backfill

Cement:	N/A	No. of Bags
Bags Size:	N/A	lbs.
Gran. Bentonite	N/A	lbs.
Volclay	225	lbs.

Bentonite 12.5 lbs.

Sand Pack

Type:	Best #430	
Bags Size:	50	lbs.
No. of Bags	10	

Screen

Type:	Sch. 40 PVC	
Size:	2	inches I.D.
Slot Size:	0.01	inches
Length:	20	feet

Additional Well Supplies

Expanding Locking Cap	Y
Locks	
PVC Slip Cap	
PVC Threaded Cap	
PVC Bottom Plug	Y
Auger Plugs	
No. of 55-gallon Drums Used	
No of Guard Posts Used	

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00275-0032-05

Site Name/Physical Address:
Site: Proposed Landfill
Line 1: Area 2/3
Line 2: Blue Lick Road
City: Windfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00275-0032-05
Grid Location:
a. Latitude: 38 29 27 ..7
b. Longitude: 81 51 30 ..3
c. Method Used: GPS

Company/Project Well No.:
05639/05-31-MW-10

Purpose of Monitoring Well:
Monitor Groundwater

Well Owner (Name, Firm, Address):
Owner: Tom Carroll
Line 1: John E. Amos Power Plant
Line 2: 1530 Winfield Road
City: Windfield
State: WV
Zip: 25213-
Phone: 304-759-3156

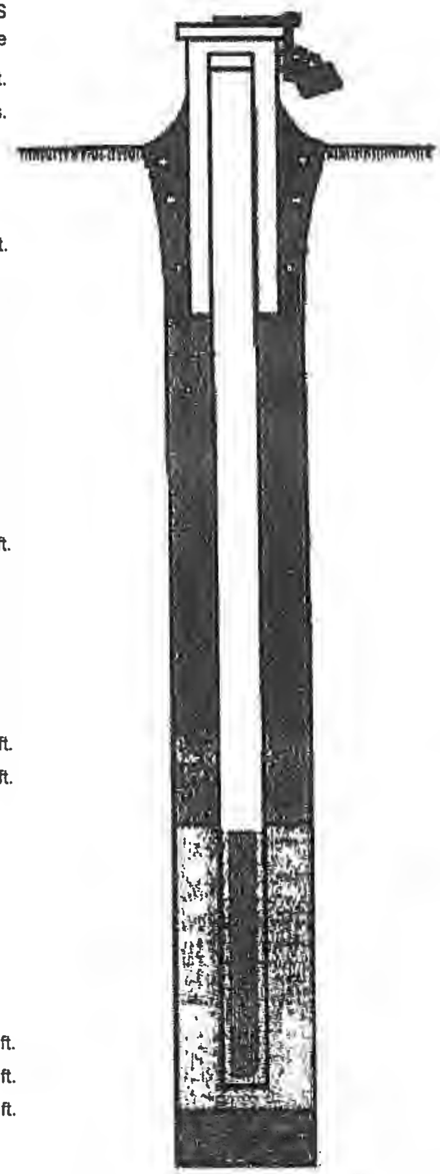
Installed By (Name, Firm, Address):
Installer: Vern Curtis / Douglas Novotny
Line 1: Terra Testing, Inc.
Line 2: 260 Meadowlands Boulevard
City: Washington
State: PA
Zip: 15301-
Phone: 724-746-9100

Date Well Installed:
07/06/2005

Driller's WV Cert No.
WV00275

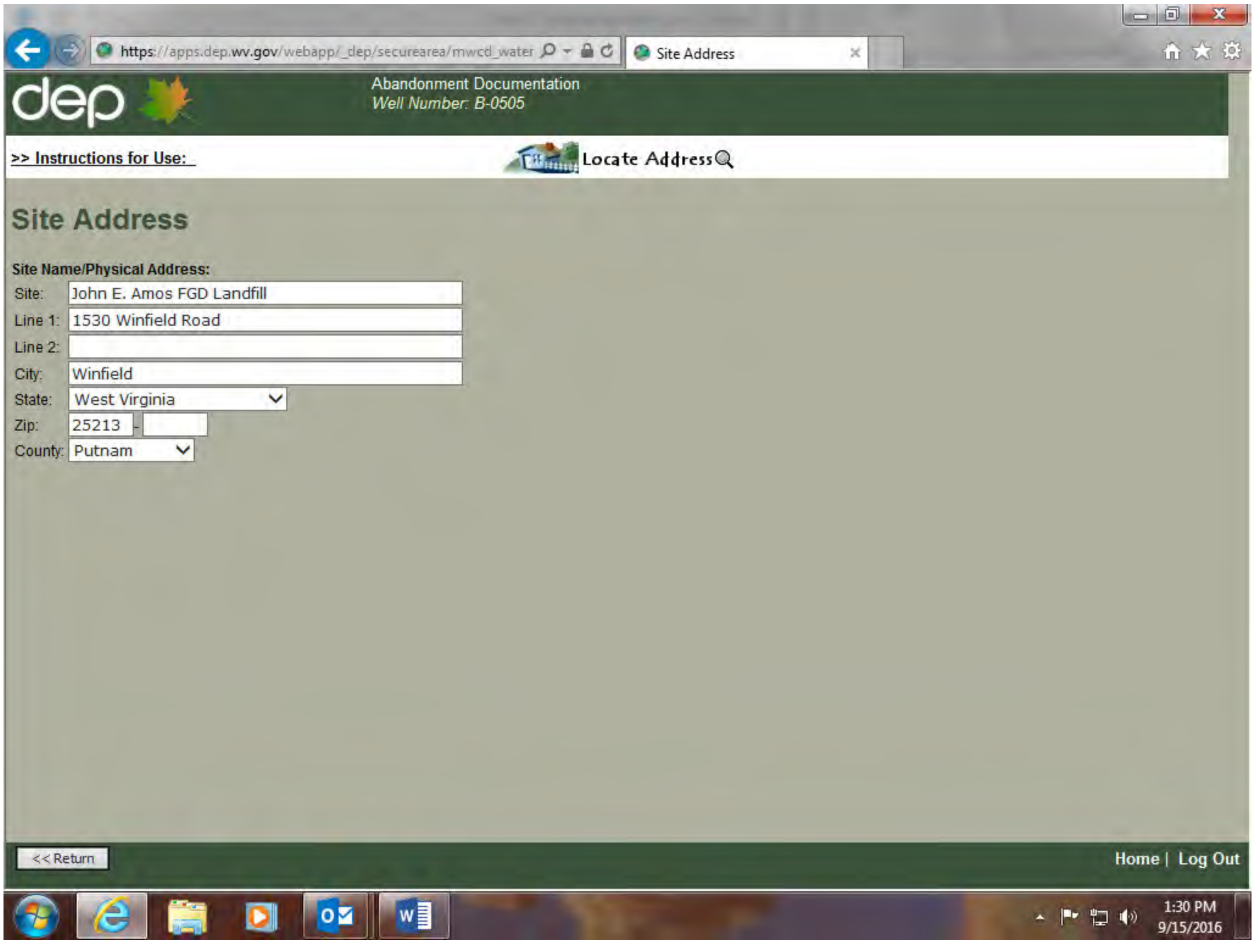
Section B: (all number fields must be in decimal format)

1.Cap and Lock: YES
2.Protective Cover: Protective Cover Pipe
3.Monitoring Well Reference Point: 0 ft.
4.Borehole Diameter: 4 inches.
5.Ground Surface Seal:
a.Material: concrete
b.Installation Procedure: Hand Mixed
6.Surface Seal Bottom/Annular Space Top: 3 ft.
7.Well Riser: a.OD Well Riser: 2.38 inches. b.ID Well Riser: 2 inches.
c.Material: PVC
d.Installation Procedure: Thru Augers & Open Bedrock Hole
8.Annular Space Seal:
a.Material: high solids grout -
b.Installation Procedure: pour
9.Well Development Procedure: other - By Client
10.Drilling Method Used: percussion -
11.Annular Space Seal Bottom/Filter Seal Top: 81 ft.
12.Drilling Fluid Used: Yes Source: Air
13.Filter Pack Seal:
a.Material: bentonite pellet
b.Installation Procedure: Gravity Fed
c.Volume Added: 12.5 pounds
14.Bottom of Bentonite Seal/Filter Pack Top: 85 ft.
15.Depth to Top of Screen: 133 ft.
16.Screen:
a.Material: PVC
b.Installation Procedure: Thru Augers & Open Bedrock Hole
c.Slot Size: .01 inches. d.Screen Length: 20 ft.
17.Filter Pack:
a.Material: medium sand
b.Installation Procedure: Gravity Fed
18.Well Depth: 153 ft.
19.Bottom of Filter Pack: 157 ft.
20.Bottom of Borehole: 157 ft.
21.Backfill Material (below filter pack): sand
22.Decontamination Procedures: None
23.Special Circumstances and Exceptions: Yes Variance Number: MW-07-05
24.WV Contractor License No. WV002350



ARCADIS

WVDEP Monitoring Well & Piezometer Closure Information


https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water
Site Address
dep
Abandonment Documentation
Well Number: B-0505
>> Instructions for Use:
Locate Address
Site Address
Site Name/Physical Address:
Site: John E. Amos FGD Landfill
Line 1: 1530 Winfield Road
Line 2:
City: Winfield
State: West Virginia
Zip: 25213 -
County: Putnam
<< Return
Home | Log Out
1:30 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Abandonment Information

dep

Abandonment Documentation
Well Number: B-0505

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○

Monitoring Well: ● B-0505

Condition of Well: Good

Reason for Abandonment: Landfill Expansion

Abandonment Date: 4/8/2008 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: Coated .25" Bentonite Pellets

Procedure Used: Gravity - Hydrated pellets above SWL - Used ~25#

Total Well Depth: 137 ft. Height of Standing Water in Well: 89 ft. (if dry put 0)

Annular Space Type: Impermeable

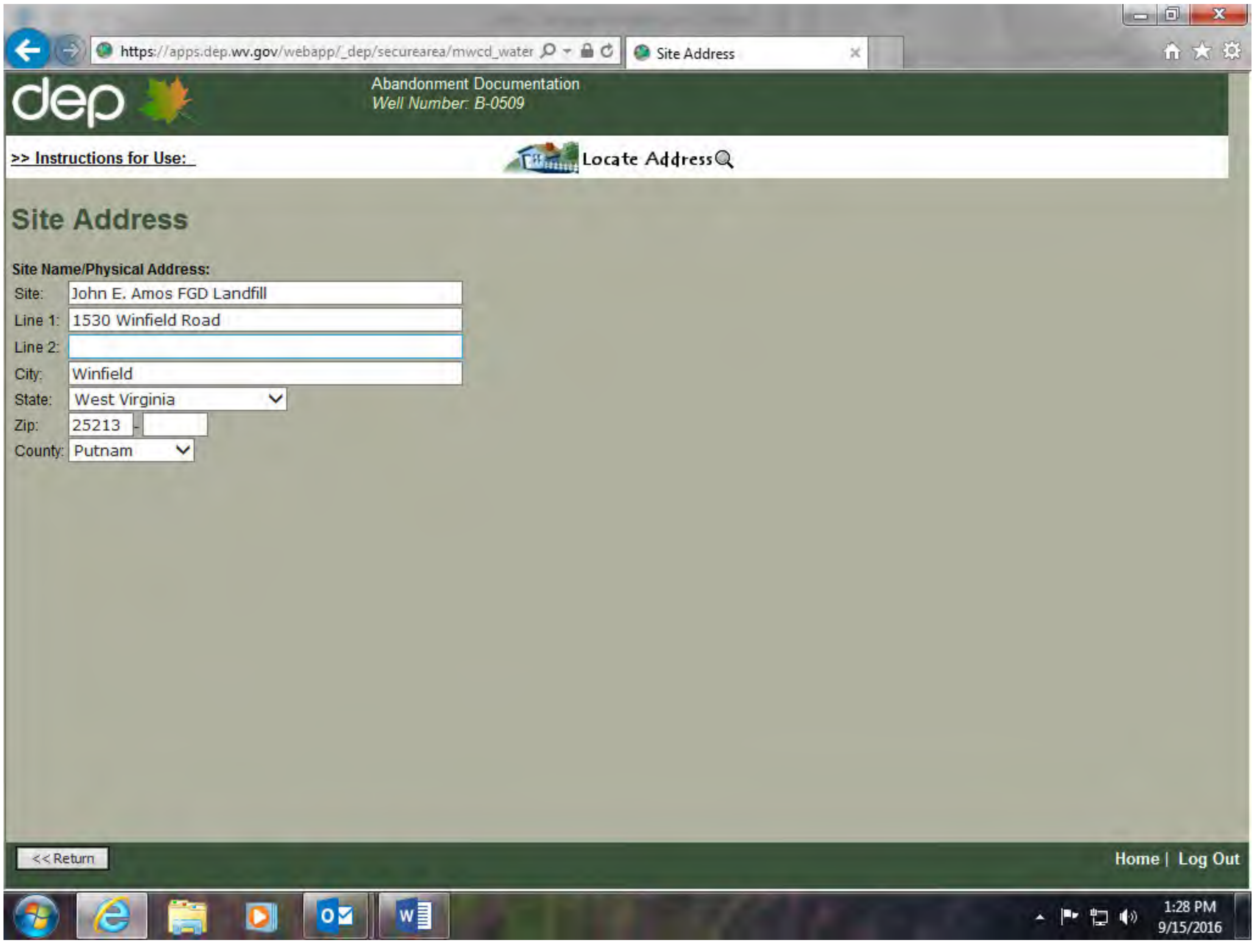
Decontamination Procedure: None

Special Circumstances: No Number:

<< Return

Home | Log Out

1:31 PM
9/15/2016


https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water
Site Address
dep
Abandonment Documentation
Well Number: B-0509
>> Instructions for Use:
Locate Address
Site Address
Site Name/Physical Address:
Site: John E. Amos FGD Landfill
Line 1: 1530 Winfield Road
Line 2:
City: Winfield
State: West Virginia
Zip: 25213
County: Putnam
<< Return
Home | Log Out
1:28 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water | Abandonment Information

dep

Abandonment Documentation
Well Number: B-0509

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○

Monitoring Well: ● B-0509

Condition of Well: Good

Reason for Abandonment: Landfill Expansion

Abandonment Date: 4/8/2008 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: Coated .25" Bentonite Pellets

Procedure Used: Gravity - Hydrated above SWL - Used ~15# - Cut c

Total Well Depth: 80 ft. Height of Standing Water in Well: 19 ft. (if dry put 0)

Annular Space Type: Impermeable

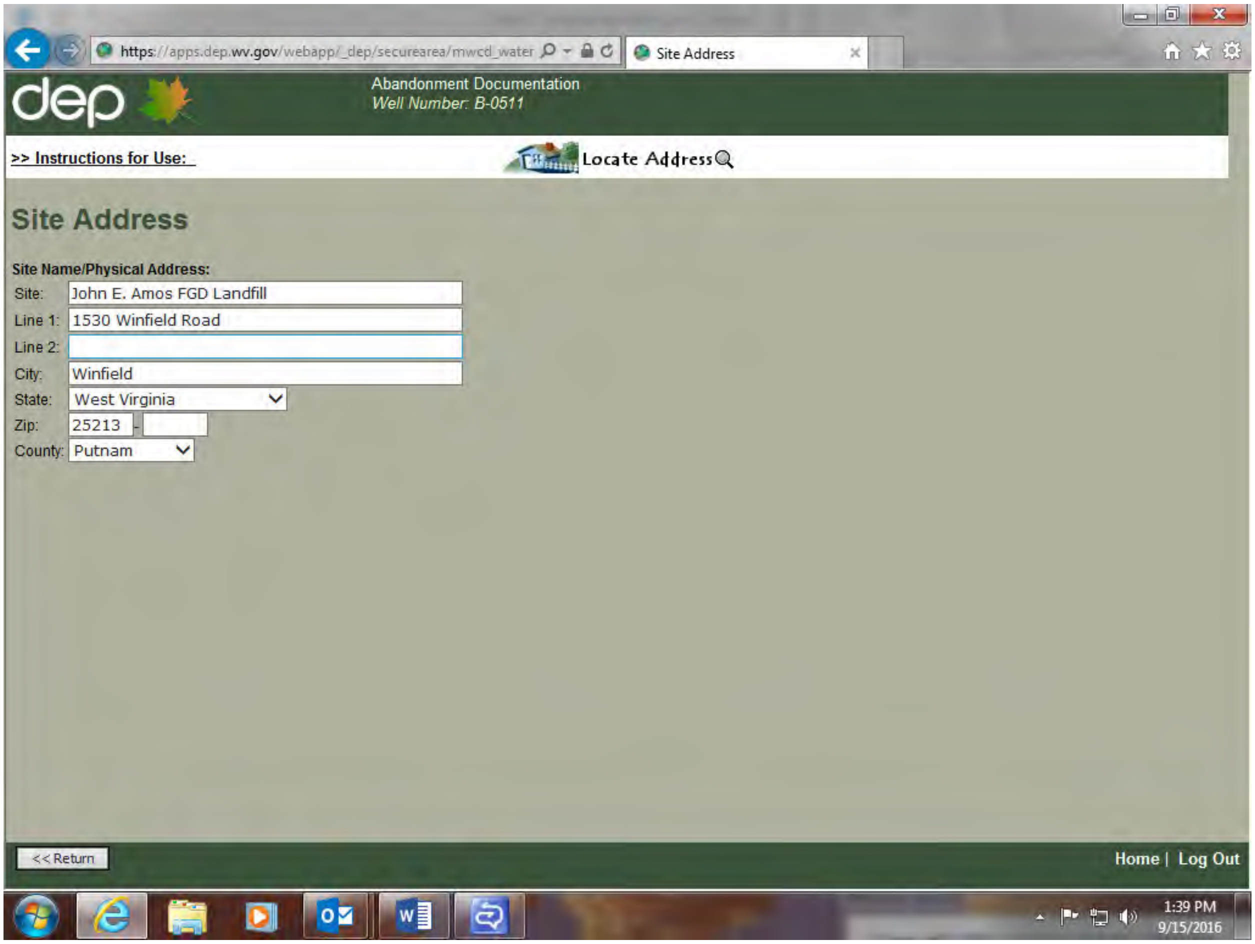
Decontamination Procedure: None

Special Circumstances: No Number:

<< Return

Home | Log Out

1:28 PM
9/15/2016


https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water
Site Address
dep
Abandonment Documentation
Well Number: B-0511
>> Instructions for Use:
Locate Address
Site Address
Site Name/Physical Address:
Site: John E. Amos FGD Landfill
Line 1: 1530 Winfield Road
Line 2:
City: Winfield
State: West Virginia
Zip: 25213
County: Putnam
<< Return
Home | Log Out
1:39 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water Abandonment Information

dep

Abandonment Documentation
Well Number: B-0511

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○

Monitoring Well: ● B-0511

Condition of Well: Good

Reason for Abandonment: Landfill Expansion

Abandonment Date: 4/8/2008 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: Coated .25" Bentonite Pellets

Procedure Used: Gravity - Hydrated above SWL - Used ~8# - Cut of

Total Well Depth: 26 ft. Height of Standing Water in Well: 17 ft. (if dry put 0)

Annular Space Type: Impermeable

Decontamination Procedure: None

Special Circumstances: No Number:

<< Return

Home | Log Out

1:39 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation

Well Number: B-0512

>> Instructions for Use:

Locate Address

Site Address

Site Name/Physical Address:

Site:	Amos FGD Landfill
Line 1:	50 Bills Creek Road
Line 2:	
City:	Winfield
State:	West Virginia
Zip:	25213 -
County:	Putnam

<< Return

Home | Log Out

1:33 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Abandonment Information

Abandonment Documentation
Well Number: B-0512

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○

Monitoring Well: ● B-0512

Condition of Well: Good

Reason for Abandonment: No longer in use.

Abandonment Date: 4/16/2013 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: 3/8" Coated Pellets / 20 lbs

Procedure Used: Gravity / Pulled protector / Dug 3' / Placed clay cap

Total Well Depth: 52 ft. Height of Standing Water in Well: 4 ft. (if dry put 0)

Annular Space Type: Impermeable

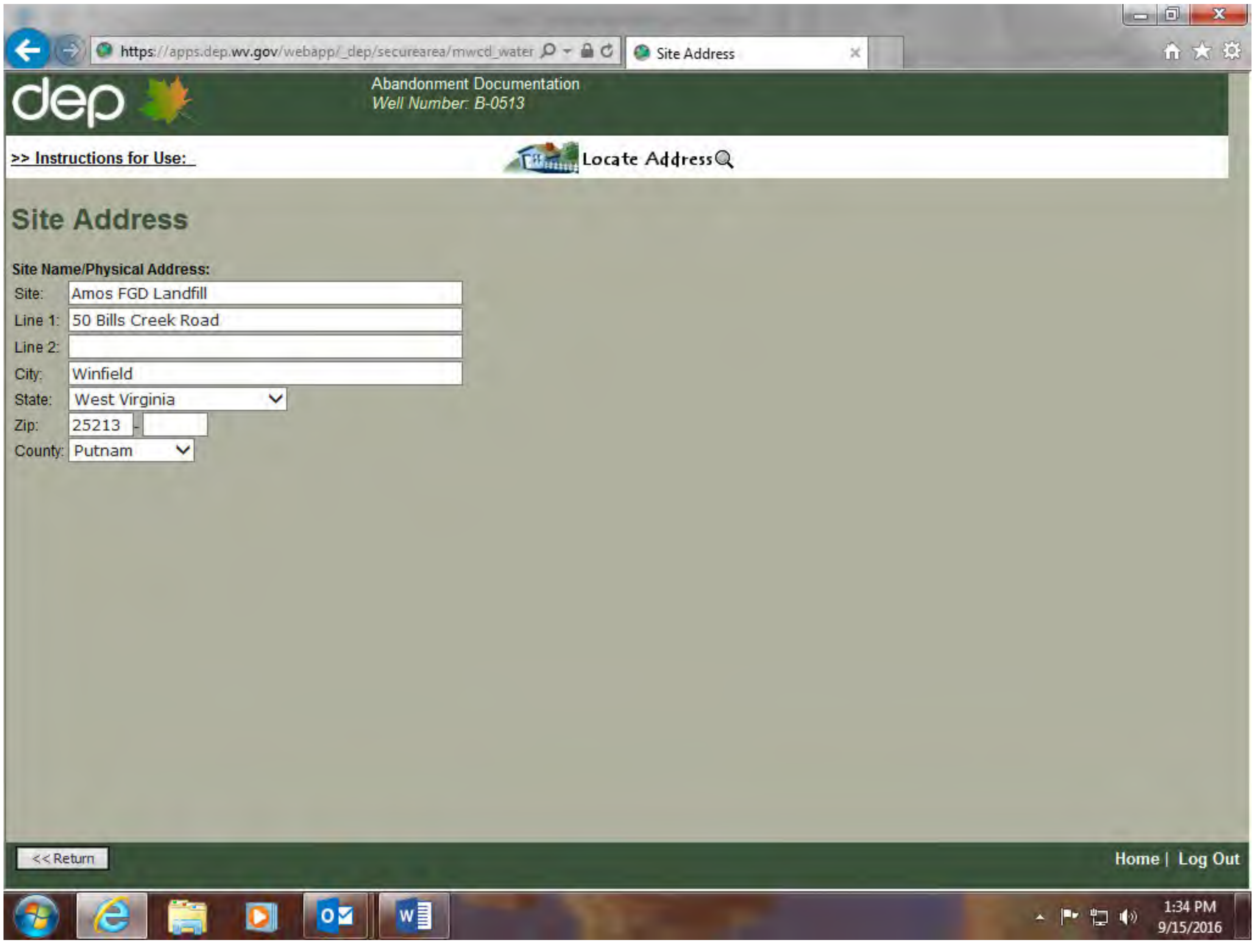
Decontamination Procedure: Liquid Nox

Special Circumstances: No Number:

<< Return

Home | Log Out

1:33 PM
9/15/2016



https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation
Well Number: B-0513

>> Instructions for Use:

Locate Address

Site Address

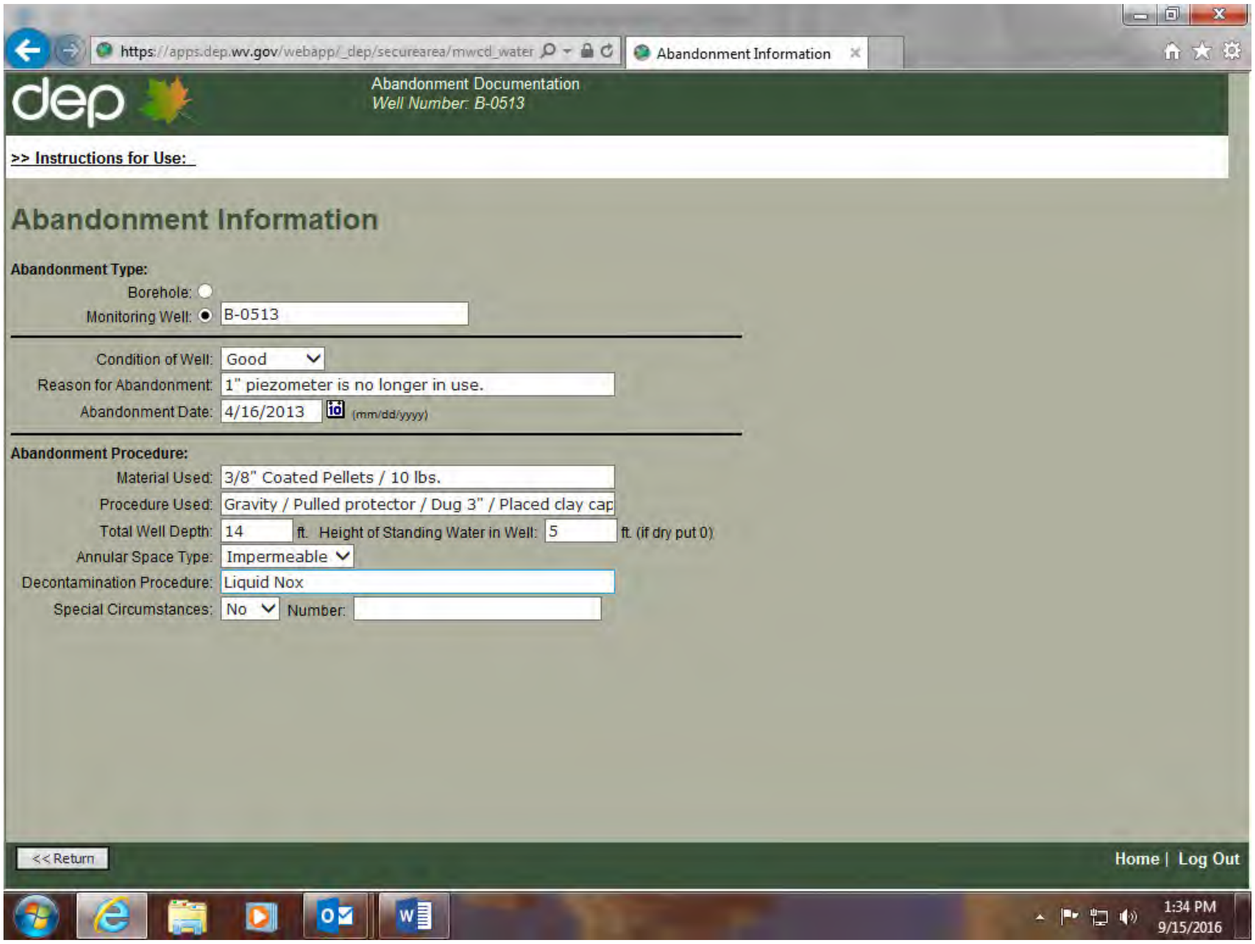
Site Name/Physical Address:

Site:	Amos FGD Landfill
Line 1:	50 Bills Creek Road
Line 2:	
City:	Winfield
State:	West Virginia
Zip:	25213 -
County:	Putnam

<< Return

Home | Log Out

1:34 PM
9/15/2016



https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Abandonment Information

Abandonment Documentation
Well Number: B-0513

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○

Monitoring Well: ● B-0513

Condition of Well: Good

Reason for Abandonment: 1" piezometer is no longer in use.

Abandonment Date: 4/16/2013 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: 3/8" Coated Pellets / 10 lbs.

Procedure Used: Gravity / Pulled protector / Dug 3" / Placed clay cap

Total Well Depth: 14 ft. Height of Standing Water in Well: 5 ft. (if dry put 0)

Annular Space Type: Impermeable

Decontamination Procedure: Liquid Nox

Special Circumstances: No Number:

<< Return

Home | Log Out

1:34 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation
Well Number: B-0523

>> Instructions for Use:

Locate Address

Site Address

Site Name/Physical Address:

Site:	Amos FGD Landfill
Line 1:	50 Bills Creek Road
Line 2:	
City:	Winfield
State:	West Virginia
Zip:	25213 -
County:	Putnam

<< Return

Home | Log Out

1:34 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water | Abandonment Information

dep

Abandonment Documentation
Well Number: B-0523

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○
Monitoring Well: ● B-0523

Condition of Well: Good
Reason for Abandonment: 1" piezometer is no longer in use.
Abandonment Date: 4/16/2013 (mm/dd/yyyy)

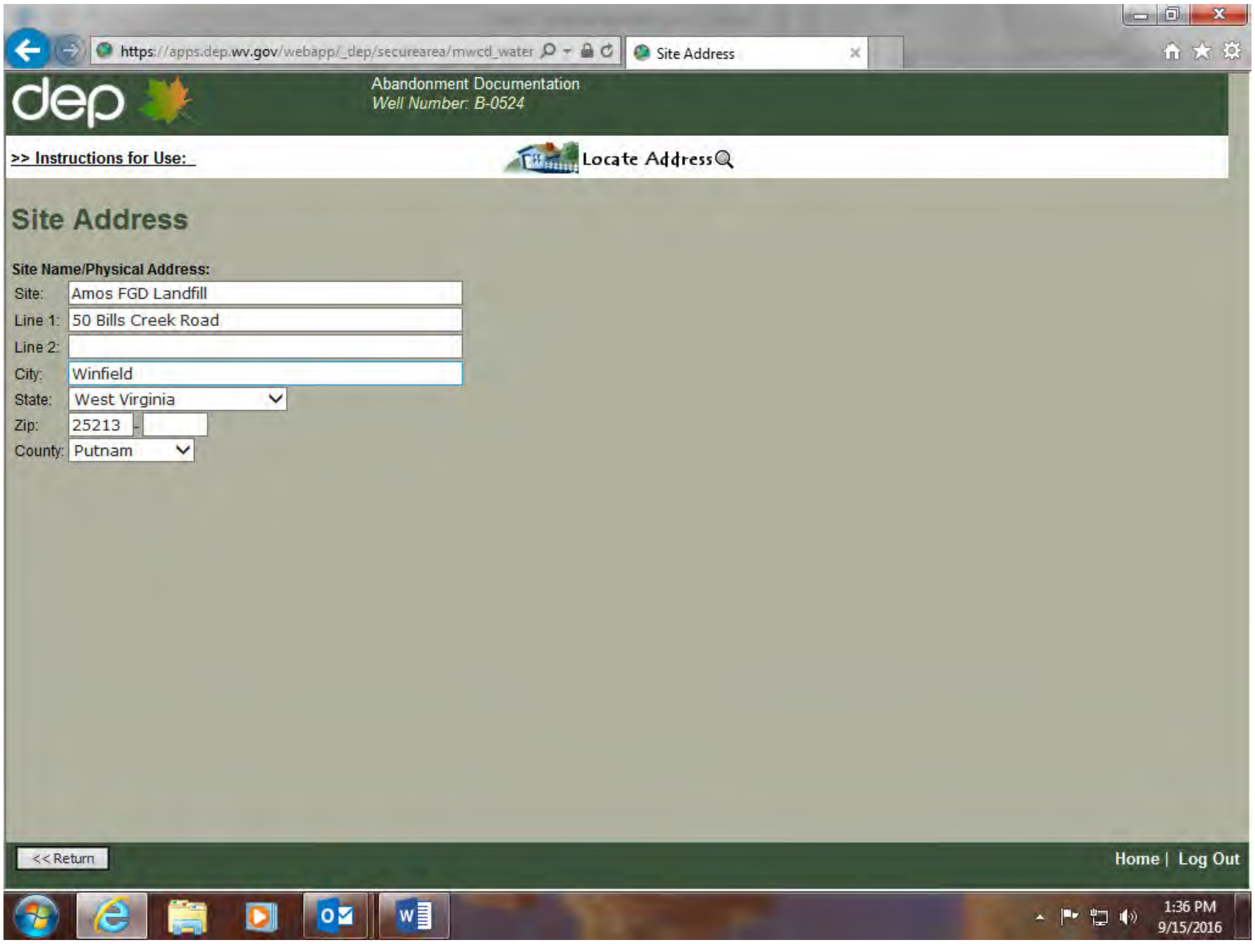
Abandonment Procedure:

Material Used: 3/8" Coated Pellets / 15 lbs.
Procedure Used: Gravity / Pulled protector / Dug 3' / Placed clay cap
Total Well Depth: 50 ft. Height of Standing Water in Well: 22 ft. (if dry put 0)
Annular Space Type: Impermeable
Decontamination Procedure: Liquid Nox
Special Circumstances: No Number:

<< Return

Home | Log Out

1:35 PM
9/15/2016



https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation
Well Number: B-0524

>> Instructions for Use:

Locate Address

Site Address

Site Name/Physical Address:

Site:	Amos FGD Landfill
Line 1:	50 Bills Creek Road
Line 2:	
City:	Winfield
State:	West Virginia
Zip:	25213 -
County:	Putnam

<< Return

Home | Log Out

1:36 PM
9/15/2016

dep

Abandonment Documentation
Well Number: B-0524

>> Instructions for Use:

Abandonment Information

Abandonment Type:

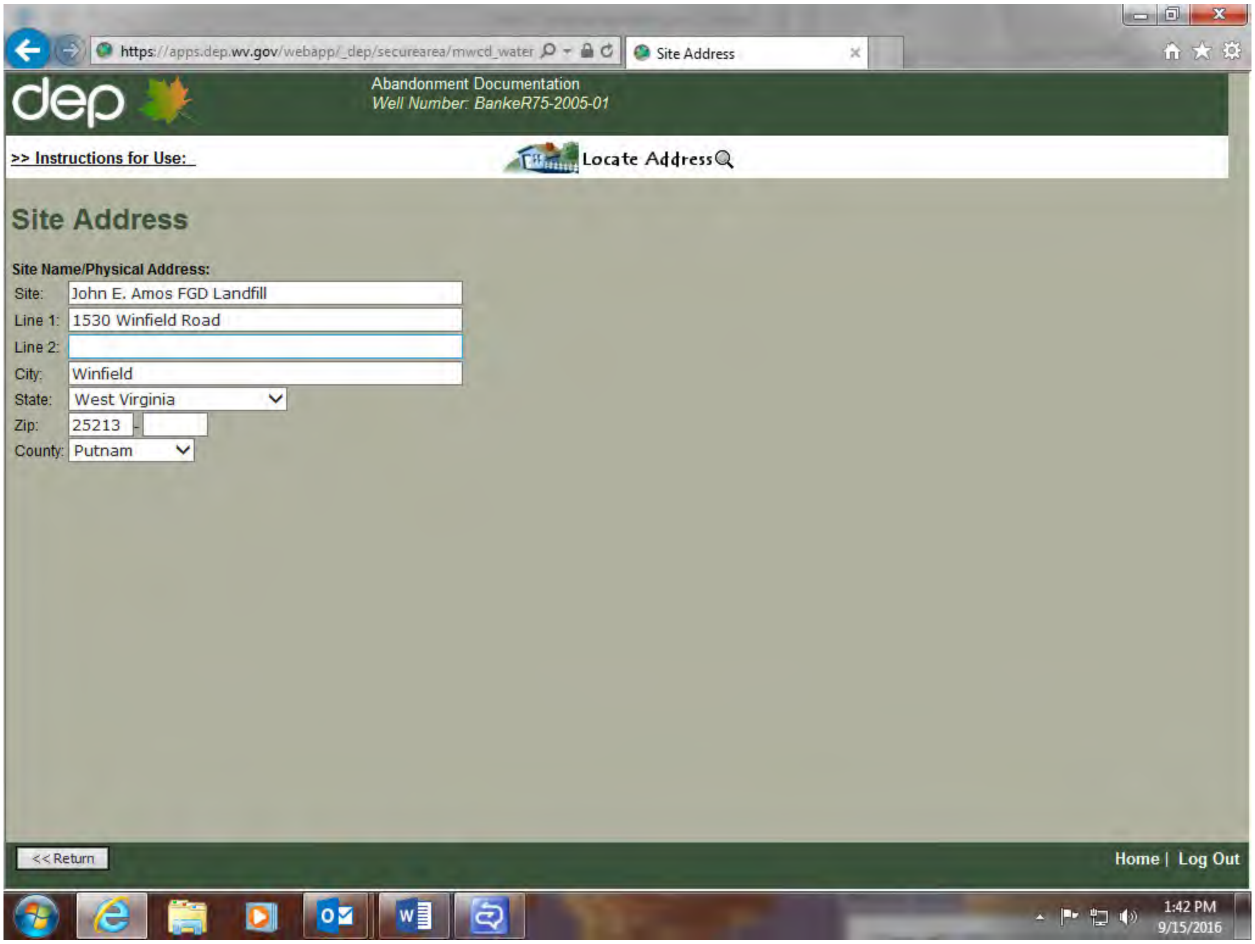
Borehole: ○
Monitoring Well: ● B-0524

Condition of Well: Good
Reason for Abandonment: No Longer in use.
Abandonment Date: 4/16/2013 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: 3/8" Coated Pellets / 15 lbs.
Procedure Used: Gravity / Pulled protector / Dug 3' / Placed clay cap
Total Well Depth: 20 ft. Height of Standing Water in Well: 4 ft. (if dry put 0)
Annular Space Type: Impermeable
Decontamination Procedure: Liquid Nox
Special Circumstances: No Number:

<< Return
Home | Log Out


https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water
Site Address
dep
Abandonment Documentation
Well Number: BankeR75-2005-01
>> Instructions for Use:
Locate Address
Site Address
Site Name/Physical Address:
Site: John E. Amos FGD Landfill
Line 1: 1530 Winfield Road
Line 2:
City: Winfield
State: West Virginia
Zip: 25213 -
County: Putnam
<< Return
Home | Log Out
1:42 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Abandonment Information

dep

Abandonment Documentation
Well Number: BankeR75-2005-01

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○
Monitoring Well: ● BankeR75-2005-01

Condition of Well: Good
Reason for Abandonment: No longer in use
Abandonment Date: 4/25/2007 (mm/dd/yyyy)

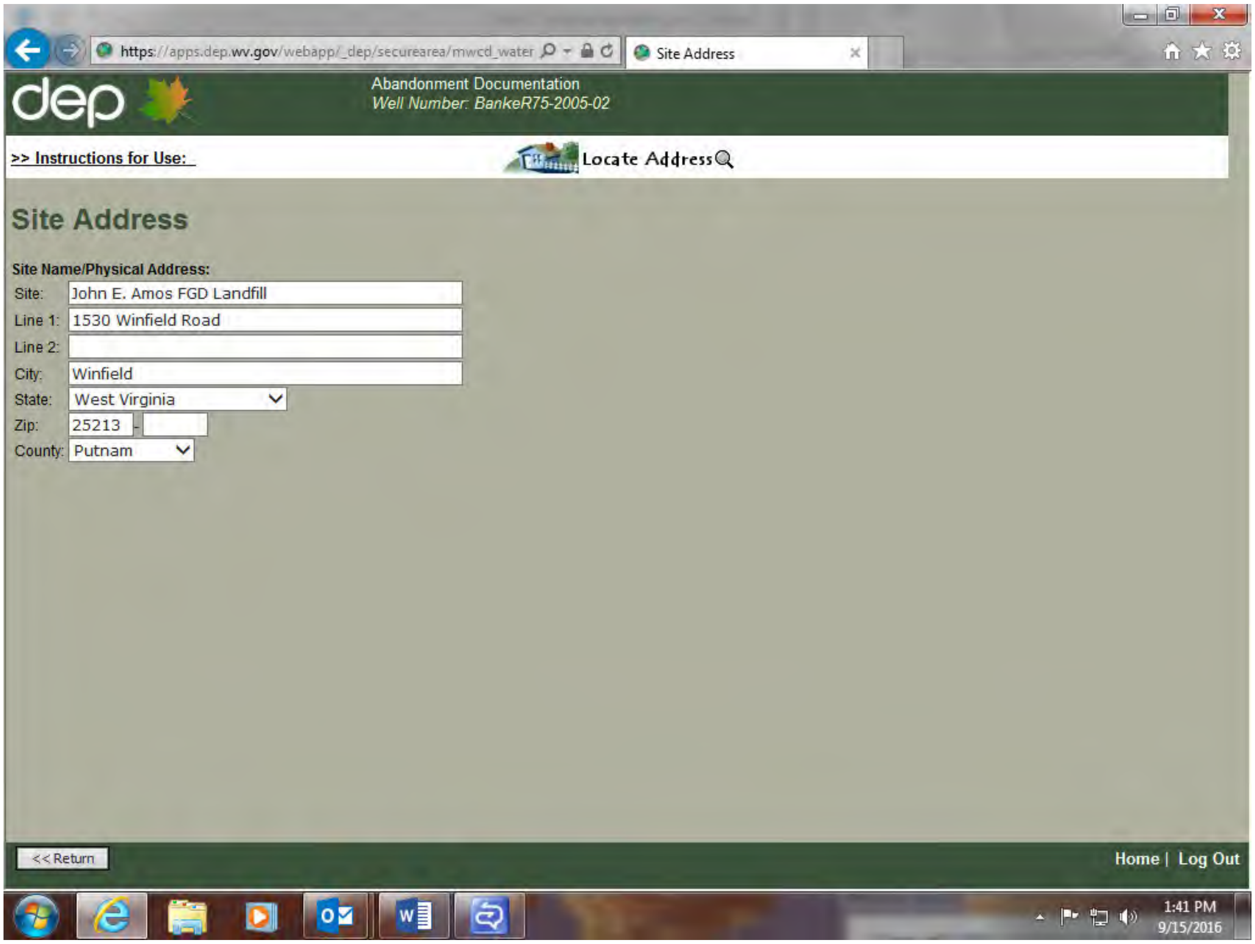
Abandonment Procedure:

Material Used: 14.8 lbs of 3/8 Bentonite Coated Pellets
Procedure Used: Casing cut 30" below surface and dropped 3/8 Ber
Total Well Depth: 51.17 ft. Height of Standing Water in Well: 19.85 ft. (if dry put 0)
Annular Space Type: Impermeable
Decontamination Procedure: None
Special Circumstances: No Number: 05-01

<< Return

Home | Log Out

1:42 PM
9/15/2016


https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water
Site Address
dep
Abandonment Documentation
Well Number: BankeR75-2005-02
>> Instructions for Use:
Locate Address
Site Address
Site Name/Physical Address:
Site: John E. Amos FGD Landfill
Line 1: 1530 Winfield Road
Line 2:
City: Winfield
State: West Virginia
Zip: 25213 -
County: Putnam
<< Return
Home | Log Out
1:41 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water | Abandonment Information

dep

Abandonment Documentation
Well Number: BankeR75-2005-02

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○
Monitoring Well: ● BankeR75-2005-02

Condition of Well: Good
Reason for Abandonment: No longer in use
Abandonment Date: 5/3/2007 (mm/dd/yyyy)

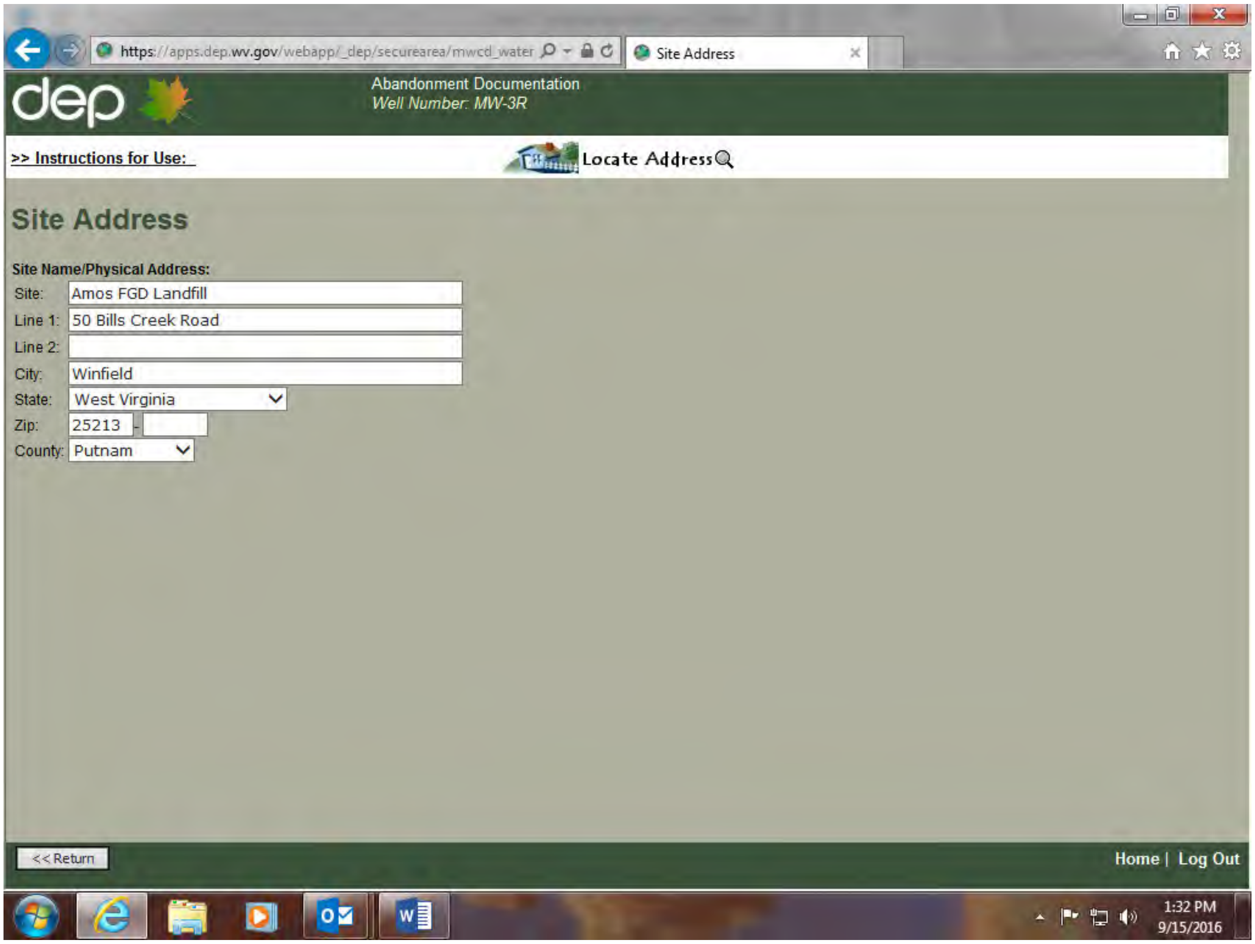
Abandonment Procedure:

Material Used: 6.1 lbs of 3/8 Bentonite Coated Pellets
Procedure Used: Casing cut 30
Total Well Depth: 21.2 ft. Height of Standing Water in Well: 5.83 ft. (if dry put 0)
Annular Space Type: Impermeable
Decontamination Procedure: None
Special Circumstances: No Number:

<< Return

Home | Log Out

1:41 PM
9/15/2016


https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation

Well Number: MW-3R

>> Instructions for Use:

Locate Address

Site Address

Site Name/Physical Address:

Site:	Amos FGD Landfill
Line 1:	50 Bills Creek Road
Line 2:	
City:	Winfield
State:	West Virginia
Zip:	25213 -
County:	Putnam

<< Return

Home | Log Out

1:32 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Abandonment Information

dep

Abandonment Documentation

Well Number: MW-3R

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○

Monitoring Well: ● MW-3R

Condition of Well: Good

Reason for Abandonment: No longer in use.

Abandonment Date: 4/16/2013 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: 3/8" Coated Pellets - 8 lbs.

Procedure Used: Pulled pump / Gravity pellets / Pulled protector / Du

Total Well Depth: 50 ft. Height of Standing Water in Well: 12 ft. (if dry put 0)

Annular Space Type: Impermeable

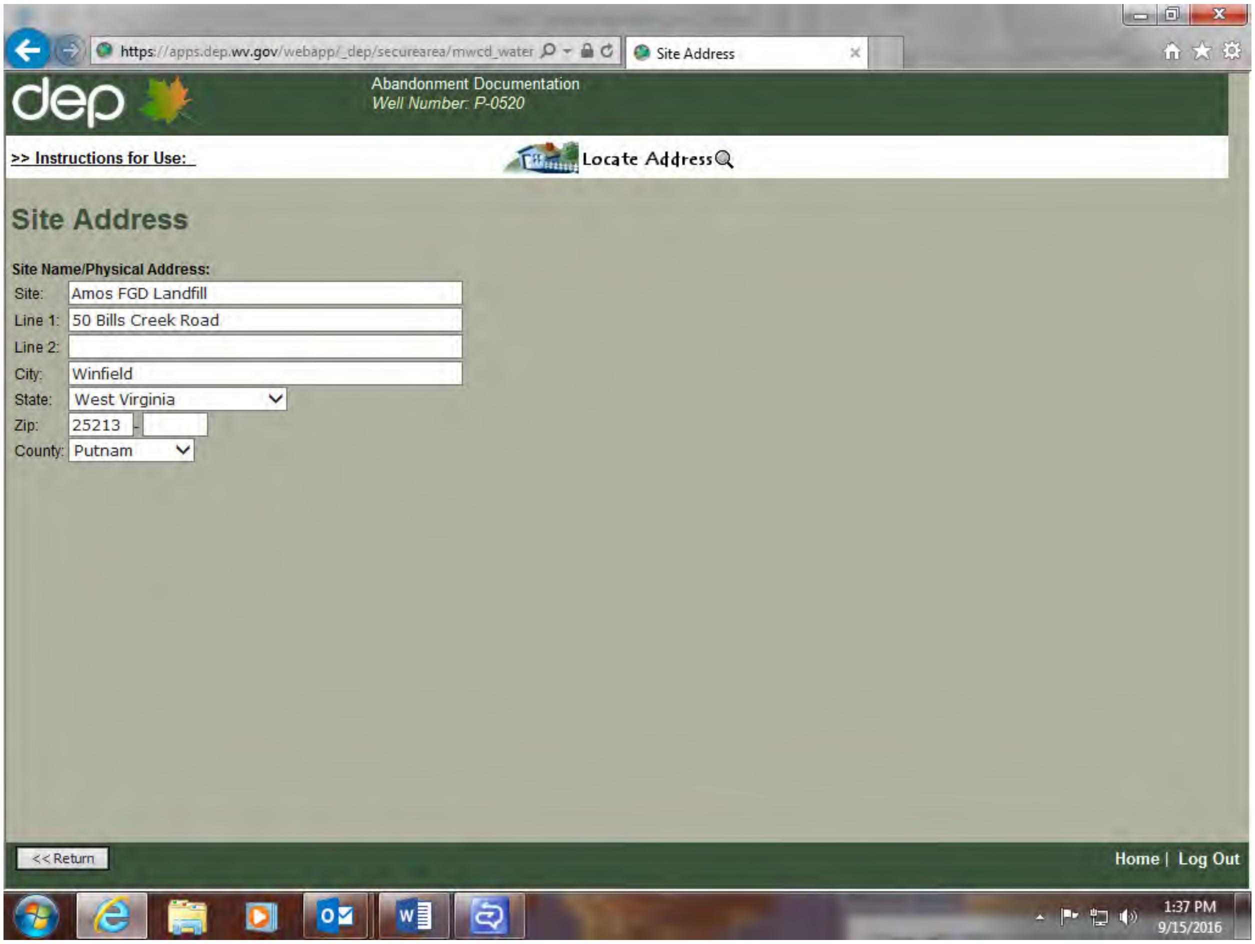
Decontamination Procedure: Liquid Nox

Special Circumstances: No Number:

<< Return

Home | Log Out

1:32 PM
9/15/2016



https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation

Well Number: P-0520

>> Instructions for Use:

Locate Address

Site Address

Site Name/Physical Address:

Site:	Amos FGD Landfill
Line 1:	50 Bills Creek Road
Line 2:	
City:	Winfield
State:	West Virginia
Zip:	25213 -
County:	Putnam

<< Return

Home | Log Out

1:37 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water | Abandonment Information

dep

Abandonment Documentation
Well Number: P-0520

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○
Monitoring Well: ● P-0520

Condition of Well: Good
Reason for Abandonment: No longer in use
Abandonment Date: 3/26/2015 (mm/dd/yyyy)

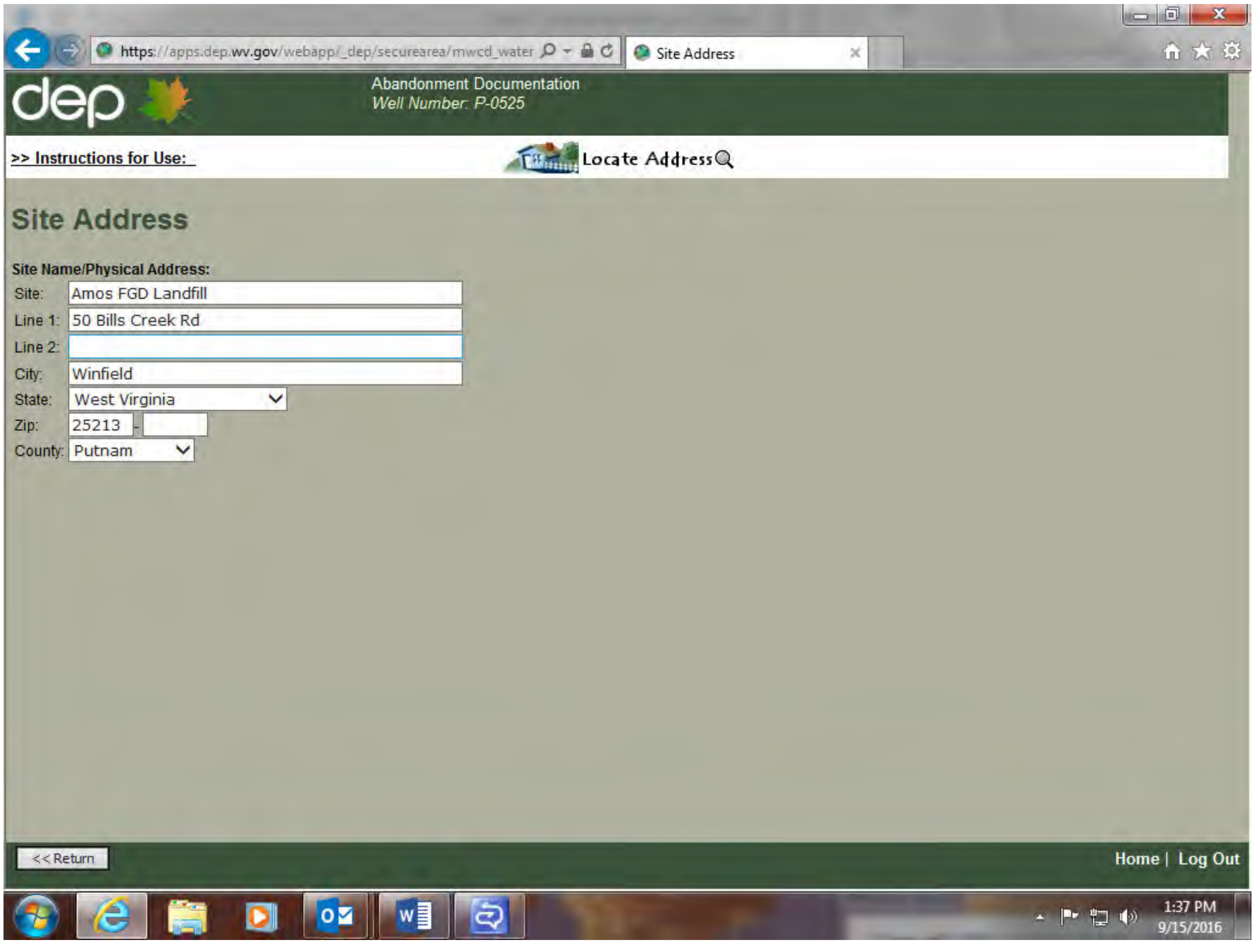
Abandonment Procedure:

Material Used: 1/4" Coated Bentonite Pellets 35 lbs
Procedure Used: Gravity - Dug down 3', cut off, installed clay cap
Total Well Depth: 96 ft. Height of Standing Water in Well: 23 ft. (if dry put 0)
Annular Space Type: Impermeable
Decontamination Procedure: None
Special Circumstances: No Number:

<< Return

Home | Log Out

1:37 PM
9/15/2016



https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Site Address

dep

Abandonment Documentation
Well Number: P-0525

>> Instructions for Use:

Locate Address

Site Address

Site Name/Physical Address:

Site: Amos FGD Landfill
Line 1: 50 Bills Creek Rd
Line 2:
City: Winfield
State: West Virginia
Zip: 25213 -
County: Putnam

<< Return

Home | Log Out

1:37 PM
9/15/2016

https://apps.dep.wv.gov/webapp/_dep/securearea/mwcd_water

Abandonment Information

dep

Abandonment Documentation
Well Number: P-0525

>> Instructions for Use:

Abandonment Information

Abandonment Type:

Borehole: ○
Monitoring Well: ● P-0525

Condition of Well: Good
Reason for Abandonment: No longer in use
Abandonment Date: 3/26/2015 (mm/dd/yyyy)

Abandonment Procedure:

Material Used: 1/4" Coated Bentonite Pellets 5 lbs
Procedure Used: Gravity - dug down 3', cut off, installed clay cap
Total Well Depth: 12 ft. Height of Standing Water in Well: 5 ft. (if dry put 0)
Annular Space Type: Impermeable
Decontamination Procedure: None
Special Circumstances: No Number:

<< Return

Home | Log Out

1:37 PM
9/15/2016

ARCADIS

WVDEP Monitoring Well & Piezometer Pending Closure Information

WVDEP Monitoring Well Piezometer Pending Closure Information
AEP Amos Generating Plant - FGD Landfill
Winfield, West Virginia

ARCADIS Design & Consultancy for natural and built assets

Facility	Reg #	Type	City	County	Well #	Latitude			Longitude			Method	Owner	Phone #	Date of Finish	Abandon Date	Reason for Install	Driller First Name	Driller Last Name	Certificate #
Proposed Landfill - Amos Power Plant	NA	AMW	Winfield	Putnam	B-0508	38	29	7.1	81	51	22.9	GPS	Amos Power Plant	304-759-3156	5/3/2005	8/22/2006	NA	Marvin	Roush	00015
Proposed Landfill - Amos Power Plant	NA	AMW	Winfield	Putnam	05639/05-28 MW 7	38	28	44.1	81	51	15.5	GPS	Amos Power Plant	304-759-3156	6/28/2005	8/22/2006	NA	Marvin	Roush	00015

Notes:
Information provided by West Virginia Department of Environmental Protection as pending database upload.
NA - Not Applicable
GPS - Global Positioning System

ARCADIS

WVDEP Oil & Gas Well Closure Information

WVDEP Office of Oil and Gas - Well Search

Disclaimer: Per §22-6-6. Permit required for all well work; permit fee; application; soil erosion control plan.

(a) It is unlawful for any person to commence any well work, including site preparation work, which involves any disturbance of land, without first securing a well work permit from the director of the WVDEP Office of Oil and Gas.

The appearance of an API number on the web page does not signify that a permit has been issued. The API number is used as a tracking mechanism until the permit has been issued. Under no circumstances should well work be commenced without a signed permit.

Well API	Operator	Surface Owner	Well Number	Well Status	Well Type	Last Permit Issue Date
4707900611	MEADOWS Jr, S. L. PRODUCTION Inc.	APPALACHIAN POWER COMPANY	616	Plugged	Vertical	09/21/2007

The operator listed above is the CURRENT operator of the well.

This operator may or may not have recorded production for this well for the years listed below.

The production listed below spans this well's 5 last years, regardless of the operator who originally recorded a particular year's production numbers.

Well Lifetime Gas Production

No Production Reported

Well Lifetime Oil Production

No Production Reported

Well Lifetime NGL Production

No Production Reported

Office of Oil and Gas
Department of Environmental Protection
601 57th St
Charleston, West Virginia 25304
Phone: (304) 926-0499
Fax: (304) 926-0452

WVDEP Office of Oil and Gas - Well Search

Well API	Operator	Surface Owner	Well Number	Well Status	Well Type	Last Permit Issue Date
4707900660	MEADOWS Jr, S. L. PRODUCTION Inc.	AMERICAN ELECTRIC POWER	2	Plugged	Vertical	09/08/2006

The operator listed above is the CURRENT operator of the well.

This operator may or may not have recorded production for this well for the years listed below.

The production listed below spans this well's 5 last years, regardless of the operator who originally recorded a particular year's production numbers.

Well Lifetime Gas Production

No Production Reported

Well Lifetime Oil Production

No Production Reported

Well Lifetime NGL Production

No Production Reported

Office of Oil and Gas
Department of Environmental Protection
601 57th St
Charleston, West Virginia 25304
Phone: (304) 926-0499
Fax: (304) 926-0452

WVDEP Office of Oil and Gas - Well Search

Disclaimer: Per §22-6-6. Permit required for all well work; permit fee; application; soil erosion control plan.

(a) It is unlawful for any person to commence any well work, including site preparation work, which involves any disturbance of land, without first securing a well work permit from the director of the WVDEP Office of Oil and Gas.

The appearance of an API number on the web page does not signify that a permit has been issued. The API number is used as a tracking mechanism until the permit has been issued. Under no circumstances should well work be commenced without a signed permit.

Well API	Operator	Surface Owner	Well Number	Well Status	Well Type	Last Permit Issue Date
4707900722	MEADOWS Jr, S. L. PRODUCTION Inc.	AMERICAN ELECTRIC POWER	3	Plugged	Vertical	09/08/2006

The operator listed above is the CURRENT operator of the well.

This operator may or may not have recorded production for this well for the years listed below.

The production listed below spans this well's 5 last years, regardless of the operator who originally recorded a particular year's production numbers.

Well Lifetime Gas Production

No Production Reported

Well Lifetime Oil Production

No Production Reported

Well Lifetime NGL Production

No Production Reported

Office of Oil and Gas
Department of Environmental Protection
601 57th St
Charleston, West Virginia 25304
Phone: (304) 926-0499
Fax: (304) 926-0452

Arcadis, Inc. 2018

Boring and Well Construction Logs

MW-1801 and MW-1802

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos - FGD Landfill**

COORDINATES **N 38.5 E 81.6**

GROUND ELEVATION **735.6** SYSTEM **NAVD88**

BORING NO. **MW-1801** DATE **5/3/19** SHEET **1** OF **5**

BORING START **8/7/18** BORING FINISH **8/8/18**

PIEZOMETER TYPE **PVC** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **2.8** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **50.4** BOTTOM **114.4**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	21.0		
TIME			
DATE	8/15/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									CL ML	0-5': SILTY CLAY; 2.5YR 5/6 (red); moist; backfill material.		0-49': Riser
		5.0	6.5	50/4	3.6		5			5-6': SANDSTONE.		
										6-6.3': SHALE; GLEY1 5/N (gray); dry; thin bedded; hard.		
		6.5	8.0	48-23-15	3.6				CL ML	6.3-6.5': SILTY CLAY; red; moist; hard		
									ML	6.5-8': SILT; 10YR 6/2 (tan); with sandstone and shale fragments; compacted fill material.		
		8.0	9.5	11-3-5	7.2				MH	8-9.5': CLAYEY SILT; 5YR 4/2 (brown); firm; moist; fill material.		
		9.5	11.0	4-4-7	10.8		10		CL ML	9.5-11': SILTY CLAY; 10YR 6/3 (brown) to brown clayey silt; dry; crumbly; fill material.		
		11.0	12.5	4-8-50/3	10.8				CL ML	11-12.5': SILTY CLAY; 5YR 4/2 (brown); moist; firm.		
										Note: Sandstone at 12-12.3'.		
		12.5	14.0	50/3					ML	12.5-14': SILT, compacted; 10YR 7/4 (tan); very hard; dry; fill material.		
		14.0	15.5	50/4						14-14.5': SILTY SHALE material, weathered; mottled tan and dark brown; dry; very hard.		
		14.9	19.9		51		15			14.5-14.9': SANDSTONE; strong field strength; 2.5Y 6/2; fine-grained texture; massive structure; slightly to moderately decomposed; moderately disintegrated with Fe staining; fracture at 14.3-14.5'.		
										14.9-19.9': SHALE; moderate field strength; GLEY1 5/GY; fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated along bedding planes and fracture; vertical fracture with Fe staining at 15.5-16.5'.		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **2** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		19.9	24.9	8-7-6	55					19.9-24.9': SHALE; moderate field strength; GLEY1 5/GY; fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated; moderately to intensely fractured. Transition to strong field strength, 2.5YR 4/4; fine-grained texture; massive structure to thinly bedded; slightly decomposed; slightly disintegrated; slightly to moderately fractured.		
		24.9	34.9	4-4-13	72		25			24.9-25.2': SHALE; strong field strength; fine-grained structure; massive structure to thinly bedded; slightly decomposed; slightly disintegrated; slightly to moderately fractured. 25.2-30.7': CLAYSTONE/MUDSTONE, highly weathered; very weak field strength; 10YR 5/3; very fine-grained texture with sandstone fragments; massive structure; highly decomposed; intensely disintegrated; unfractured.		
							30			30.7-32.5': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated; slightly to moderately fractured. 32.5-34.9': CLAYSTONE/MUDSTONE; moderate field strength; GLEY1 4/104; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately to intensely fractured.		
		34.9	38.3	4-5-8	36		35			34.9-38.3': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; moderately to highly decomposed; intensely disintegrated, mottling tan and gray; moderately to intensely fractured.		
		38.3	44.9	5-7-13-9-6-6	70		40			38.3-44.9': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; highly decomposed; intensely disintegrated; intensely fractured.		
		44.9	50.0	4-4-7-8	50		45			44.9-50': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **3** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		44.9	50.0	4-4-7-8	50					tan, black, and gray; fine-grained texture; massive structure; highly decomposed; intensely disintegrated; intensely fractured.		49-52': Bentonite Pellets
		50.0	55.0	4-4-5-4	50		50			50-56.7': CLAYSTONE/MUDSTONE; moderate field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; moderately to highly decomposed, becomes less weathered at 50.3'; highly disintegrated, highly mottled; moderately to intensely fractured.		52-53': Secondary Filter Pack 53-75': Primary Filter Pack
		55.0	59.8	5-7-5-36	52		55			56.7-58': SANDSTONE, interbedded; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture; moderately fractured at 56.7' and 57.1-57.5'. 58-58.8': SHALE, interbedded; strong field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture.		55-75': Screen
		59.8	64.8	8-5-4-4-7-5-5-4	60		60			58.8-59.2': SANDSTONE, interbedded; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture. 59.2-59.8': SHALE, interbedded; strong field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture.		
		64.8	74.8	4-5-4-6	76		65 70			59.8-60.7': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated; unfractured. 60.7-63.9': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintigrated with silt filled fractures; moderately fractured. 63.9-64.3': SANDSTONE; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated; unfractured. 64.3-64.8': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed; moderately		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **4** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										disintigrated; moderately fractured.		
		64.8	74.8	4-5-4-6	76					64.8-74.8': SHALE, highly weathered at base; moderate to weak field strength along some bedding planes; 2.5YR 3/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintigrated, becomes more limestone fragments last 1 ft, 3-5 cm; moderately to intensely fractured.		
		74.8	85.0				75, 80			74.8-85': SHALE, highly weathered; weak field strength; 2.5YR 4/4 (red) with tan and gray mottling; fine-grained texture; massive structure; highly decomposed; highly disintigrated, mottled; intensely fractured.		75-105': Bentonite
		85.0	95.0	5-4-4	120		85, 90			85-92.7': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintigrated, calcite in light colored beds/thin; slightly fractured.		
										92.7-94.6': SHALE; moderate field strength; fine-grained texture; massive structure; slightly decomposed; slightly disintigrated, some mottling; moderately fractured.		
										94.6-95': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintigrated, calcite in light colored beds/thin; slightly fractured at 94.6-95'.		
		95.0	105.0	7-4-4	120		95			95-100.1': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintigrated; slightly fractured at 95-95.2'.		

Continued Next Page

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos - FGD Landfill

BORING NO. MW-1801 DATE 5/3/19 SHEET 5 OF 5

BORING START 8/7/18 BORING FINISH 8/8/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		95.0	105.0	7-4-4	120		100			100.1-101.5': SHALE and sandstone interbedded; moderate field strength; fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated; slightly fractured at 100.2-100.5'.		
										101.5-105': SHALE; moderate to weak field strength; fine-grained texture; massive structure; highly decomposed; moderately to highly disintigrated mottling with silt filled fractures; highly fractured.		
							105					
							110					
							115					
							120					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos - FGD Landfill

COORDINATES N 38.5 E 81.9

GROUND ELEVATION 709.8 SYSTEM NAVD88

BORING NO. MW-1802 DATE 5/3/19 SHEET 1 OF 5

BORING START 8/20/18 BORING FINISH 8/21/18

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.91 DIA 2"

DEPTH TO TOP OF WELL SCREEN 50 BOTTOM 114.4

WELL DEVELOPMENT Surge/Purge BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) RIG Direct Circulation - Wireline Core

Water Level, ft	∇ 35.0	▼	▼
TIME			
DATE	8/21/2019		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									GW	0-3.5': GRAVEL backfill; large rip-rap and smaller compacted gravels.		0-41': Bentonite Grout
									CL	3.5-4.5': SILTY CLAY; brown; moist; soft; backfill material.		
		4.5	6.0	6-4-5	0		5			4.5-6': NO RECOVERY, due to gravel blocking cutting shoe.		
		6.0	7.5	4-3-4	3.6				CL	6-17': SILTY CLAY; 7.5YR 4/3 (brown); moist; firm; compacted backfill material; becomes wet at 12.5'.		
		7.5	9.0	3-4-5	7.2							
		9.0	10.5	4-4-6	18		10					
		10.5	12.0	5-4-5	13.2							
		12.0	13.5	3-4-6	15.6							
		13.5	15.0	3-5-8	14.4		15					
		15.0	16.5	4-7-9	15.6							
		16.5	18.0	6-25-8	16.8					17-17.5': SANDSTONE, weathered; GLEY1 7/N (gray); dry.		
		18.0	19.5	7-23-15	14.4				CL	17.5-19.5': SILTY CLAY; GLEY1 6/N (gray) mottled with brown, red, tan; moist; soft; crumbles easily.		
		19.5	21.0	20->50/4	10.8				CL			

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **2** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		19.5	21.0	20->50/4	10.8					19.5-22.5': SILTY CLAY; GLEY1 6/N (gray) mottled with brown, tan; dry; soft; crumbles easily.		
		21.0	22.5	27-50/5	9.6							
		22.5	24.4	4	23					22.5-24': SILTSTONE; moderate to weak field strength; GLEY1 6/N; fine-grained texture; massive structure; highly decomposed; moderately to highly disintegrated with tan/brown mottling; moderately to intensely fractured.		
		24.4	29.4		22		25			24-24.4': SILTSTONE; weak field strength; 10R 4/4 (red) mottled; fine-grained texture; massive structure; highly decomposed; moderately to intensely fractured. 24.4-29.4': SILTSTONE; weak field strength; 10R 4/4 (red) mottled with tan, gray, and black; fine-grained texture; massive structure; highly decomposed; highly disintegrated, highly mottled; moderately fractured.		
		29.4	33.7	5-11-6	40		30			29.4-32.8': SHALE, weathered; moderate field strength; 10YR 4/4 (red) mottled; fine-grained texture; massive structure; moderately decomposed; moderately to intensely disintegrated; moderately fractured. 32.8-33.7': SHALE; moderate field strength; 5YR 5/4 (tan) mottled; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; moderately to intensely fractured.		
		33.7	39.4	5-4-4-7-5	59		35			33.7-39.4': SHALE; moderate field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; intensely fractured.		
		39.4	44.4	4-6-4-4	57		40			39.4-44.4': SHALE; moderate field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; intensely fractured.		41-44': Bentonite Pellets
		44.4	54.4	7-8-7-5-5-24-5	120		45			44.4-47.8': SHALE, highly weathered; weak field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure;		44-45': Secondary Filter Pack 45-71': Primary Filter Pack

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **3** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		44.4	54.4	7-8-7-5-5-24-5	120					highly decomposed; intensely disintegrated; intensely fractured.		
										47.8-49.9': SHALE, less weathered; moderate field strength; 10R 3/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		
							50			49.9-50.8': SHALE, interbedded with sandstone; moderate field strength; GLEY1 4/N; fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; moderately fractured.		50-70': Screen
										50.8-52.8': SHALE; moderate to strong field strength; 10R 4/3 (red); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated; slightly fractured.		
										52.8-53.1': SHALE, interbedded with sandstone; strong field strength; GLEY1 4/5GY; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
		54.4	64.4	8-12-5-6-7-4-4-4	114		55			53.1-54.4': SHALE; moderate field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		
										54.4-55.4': SANDSTONE, interbedded with shale; moderate field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; slightly to moderately fractured.		
							60			55.4-57.1': SHALE, interbedded with sandstone; moderate field strength; GLEY1 4/3, 10R 4/3; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
										57.1-64.4': SHALE, weathered; moderate to weak field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated with intense gray mottling; intensely fractured.		
		64.4	74.4	4-6-8-6-4-5-4-4-5	117		65			64.4-70.5': SHALE, highly weathered; moderate to weak field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately to intensely disintegrated with gray mottling; intensely fractured.		
							70			70.5-74.4': SHALE, interbedded with sandstone; strong field strength; 10R 4/3 (red) interbedded with GLEY1 4/N (gray-green); fine-grained		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **4** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		64.4	74.4	4-6-8-6-4-5-4-4-5	117					texture; thinly bedded; slightly to moderately decomposed along some bedding planes; moderately disintegrated with silt filled fractures; moderately fractured.		
		74.4	84.4	8-7-5-5-14-8-7-22-12	120		75			74.4-77.1': SHALE, with some interbedded sandstone lenses; moderate field strength; 10R 4/3 (red); fine-grained texture; thinly bedded; slightly to moderately decomposed at some bedding planes; slightly disintegrated; moderately fractured.		
							80			77.1-82.7': SANDSTONE, with some red shale lenses; strong field strength; GLEY1 4/N; fine-grained texture; thinly bedded; fresh; moderately disintegrated, calcite reacts to HCl in light colored bands within 0.5' of surrounding contact lines, no HCl/calcite in fractures, no Fe staining; moderately fractured.		
										82.7-84.4': SHALE, with some interbedded sandstone lenses; moderate field strength; 10R 4/3 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
		84.4	94.4	10-11-6-7-7-8-9-8-7-6-6-7-10	120		85			84.4-86.7': SHALE, with sandstone lenses; moderate field strength; 10R 4/2 (red) with GLEY1 4/N lenses; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
										86.7-89.2': SANDSTONE, with shale lenses; moderate field strength; GLEY1 4/N with 10R 4/2 lenses; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
							90			89.2-94.4': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded, micaceous; fresh; slightly disintegrated, some calcite in light bands, no staining, no calcite in fractures; slightly to moderately fractured along bedding planes; fracture at 92.8'.		
		94.4	104.4	7-4-5-4-9-9-8-5-11-5-6-10-19	120		95			94.4-104.4': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded, micaceous, cross-bedding at 94.4-94.8; fresh; slightly disintegrated, calcite in some light bedded planes, no calcite or Fe staining noted in fractures; slightly to moderately fractured along bedding planes.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **5** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		94.4	104.4	7-4-5-4-9-9-8-5-11-5-6-10-19	120		100					
		104.4	114.4	15-6-21-6-4-4-8-8-6-4-13-5-7	120		105			104.4-108': SANDSTONE; strong field strength; GLEY1 6/N; fine to medium-grained texture; thinly bedded, micaceous, shale fragments; fresh; moderately disintegrated, calcite along entire sandstone void and shale fragments at base, calcite in void; slightly fractured.		
							110			108-108.9': SHALE, with interbedded sandstone; moderate field strength; GLEY1 4/N, 10R 4/3 bands; thinly bedded; moderately decomposed between bedding planes; moderately disintegrated along bedding planes; moderately fractured.		
										108.9-114.4': SHALE; moderate field strength; 10R 4/3 (red) with GLEY1 4/N mottling; fine-grained texture; massive structure; moderately decomposed; moderately to intensely disintegrated, mottling; moderately fractured.		
							115					
							120					

APPENDIX C

Well Survey

Prepared for:

ARCADIS U.S., INC.-Columbus
630 Plaza Drive, Suite 600
Highlands Ranch, CO 80129

BANKS
ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report

FGD LANDFILL

WV

PO #: WV015976.0004

ES-124909

Thursday, July 20, 2017

Banks Environmental Data, Inc. - 1601 Rio Grande, Ste. 331 - Austin, TX 78701 - 800.531.5255 P - 512.478.1433 F
www.banksenvdata.com

Table of Contents

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Banks Environmental Data, Inc. - 1601 Rio Grande, Ste. 331 - Austin, TX 78701 - 800.531.5255 P - 512.478.1433 F
www.banksenvdata.com

Geographic Summary

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Location
WV
Target location is 0.405 square miles and has a 3.4 mile perimeter

Coordinates	
Longitude & Latitude in Degrees Minutes Seconds	NA
Longitude & Latitude in Decimal Degrees	NA
X and Y in UTM	NA

Elevation
NA

Zip Codes Searched

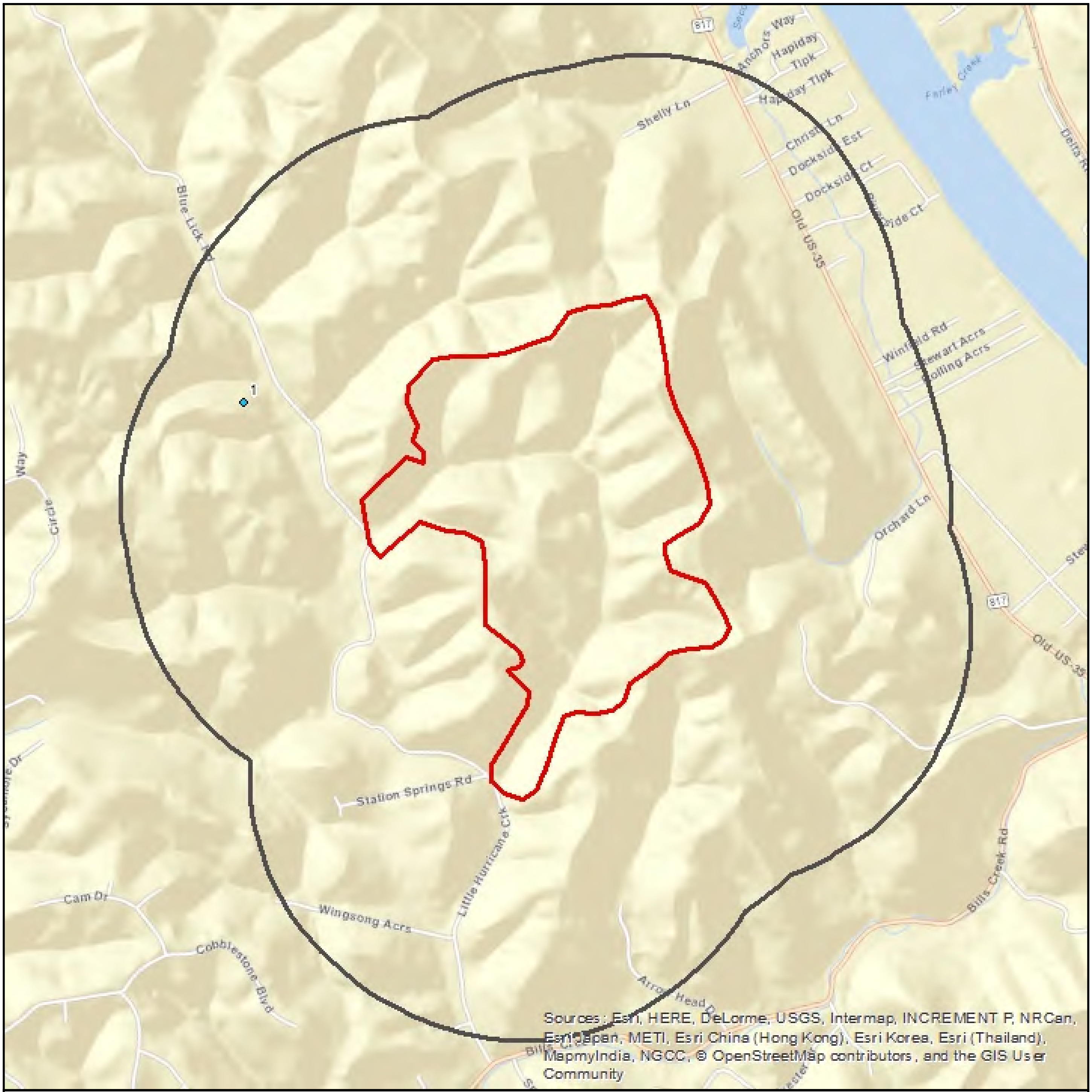
Search Distance	Zip Codes (historical zip codes included)
Target Property	25213, 25070, 25109, 25124, 25560
0.5 miles	25213, 25070, 25109, 25124, 25560

Topos Searched

Search Distance	Topo Name
Target Property	Saint Albans (1980)
0.5 miles	Saint Albans (1980)

Summary Map - 0.5 Mile Buffer

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP



FGD LANDFILL

Well
Well Cluster
Target Property
Search Buffer

1 : 19,000
1 inch = 0.300 miles
1 inch = 1583 feet
1 centimeter = 0.190 kilometers
1 centimeter = 190 meters

N

Lambert Conformal Conic Projection
1983 North American Datum
First Standard Parallel: 33 0' 00" North
Second Standard Parallel: 45 0' 00" North
Central Meridian: 96 0' 00" West
Latitude of Origin: 39 0' 00" North

Topographic Overlay Map - 0.5 Mile Buffer

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

FGD LANDFILL

Well

Well Cluster

Target Property

Search Buffer

Target Property Quad Name(s)
Saint Albans (1980)

1 : 19,000

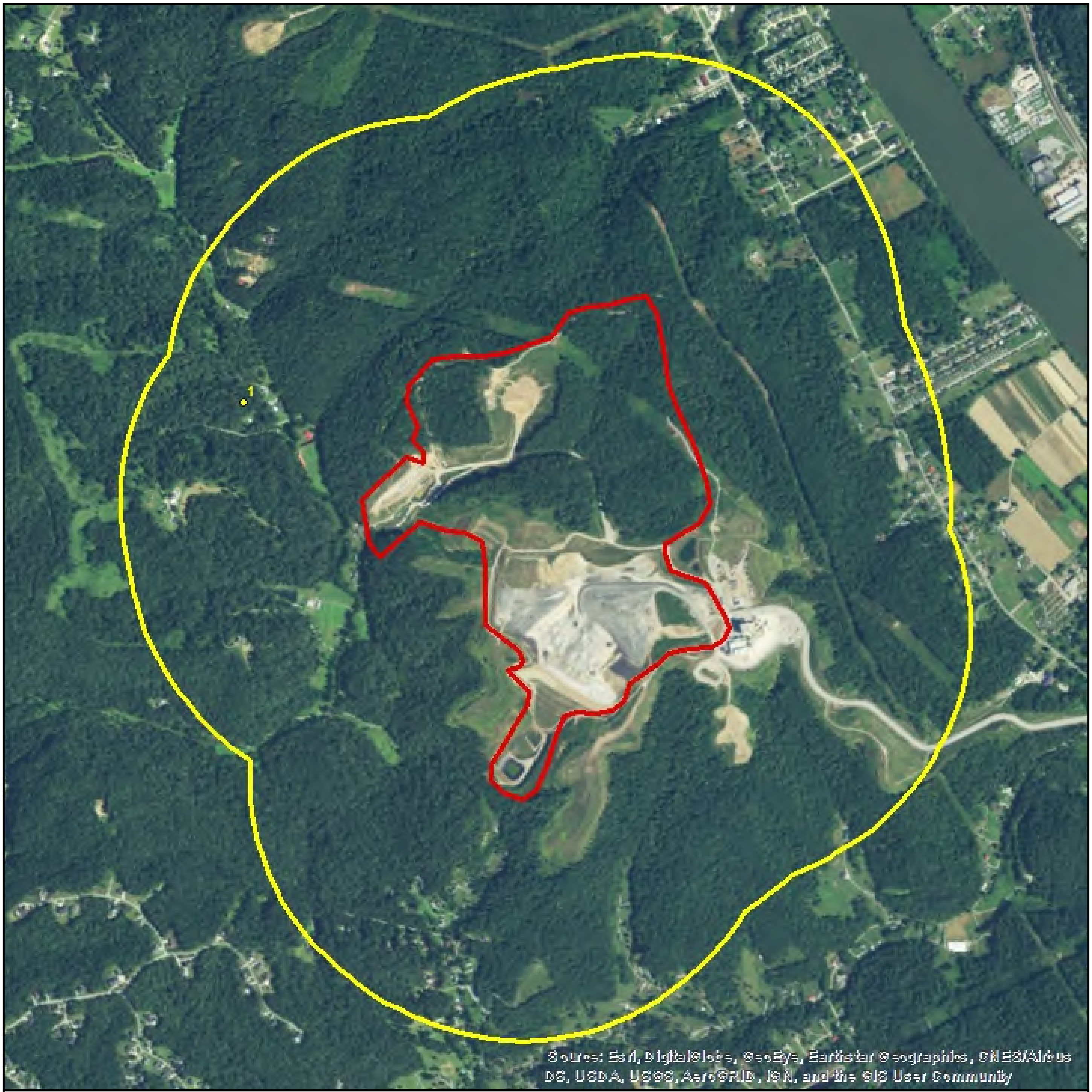
1 inch = 0.300 miles
1 inch = 1583 feet

Lambert Conformal Conic Projection
1983 North American Datum
First Standard Parallel: 33 0' 00" North
Second Standard Parallel: 45 0' 00" North
Central Meridian: 96 0' 00" West
Latitude of Origin: 39 0' 00" North

N

Current Imagery Overlay Map - 0.5 Mile Buffer

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP



FGD LANDFILL

Well

Well Cluster

Target Property

Search Buffer

1 : 19,000

1 inch = 0.300 miles
1 inch = 1583 feet
1 centimeter = 0.190 kilometers
1 centimeter = 190 meters

N

Lambert Conformal Conic Projection
1983 North American Datum
First Standard Parallel: 33 0' 00" North
Second Standard Parallel: 45 0' 00" North
Central Meridian: 96 0' 00" West
Latitude of Origin: 39 0' 00" North

Water Well Details

Map ID	Source ID	Dataset	Owner of Well	Type of Well	Depth Drilled	Completion Date	Longitude	Latitude	Elevation	Driller's Logs
1	USGS-382926081520101	WW USGS	USGS	Not Reported	91	01/01/1953	-81.8668	38.490646	763 ft	N/A

Well Summary

Water Well Dataset	# of Wells
WW USGS	1
Total Count	**1**

Banks Environmental Data, Inc. - 1601 Rio Grande, Ste. 331 - Austin, TX 78701 - 800.531.5255 P - 512.478.1433 F
www.banksenvdata.com

Dataset Descriptions and Sources

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Dataset	Source	Dataset Description	Update Schedule	Data Requested	Data Obtained	Data Updated	Source Updated
WV WW - West Virginia Water Wells	West Virginia Department of Health and Human Resources	This dataset contains groundwater well information provided by West Virginia Department of Health and Human Resources.	As requested	N/A	N/A	N/A	N/A
WW USGS - USGS Water Wells	U.S. Geological Survey	This dataset contains groundwater well records from the U.S. Geological Survey.	Semi-annually	04/18/2017	04/18/2017	05/07/2017	04/18/2017

Disclaimer

The Banks Environmental Data Water Well Report was prepared from existing state water well databases and/or additional file data/records research conducted at the state agency and the U.S. Geological Survey. Banks Environmental Data has performed a thorough and diligent search of all groundwater well information provided and recorded. All mapped locations are based on information obtained from the source. Although Banks performs quality assurance and quality control on all research projects, we recognize that any inaccuracies of the records and mapped well locations could possibly be traced to the appropriate regulatory authority or the actual driller. It may be possible that some water well schedules and logs have never been submitted to the regulatory authority by the water driller and, thus, may explain the possible unaccountability of privately drilled wells. It is uncertain if the above listing provides 100% of the existing wells within the area of review. Therefore, Banks Environmental Data cannot fully guarantee the accuracy of the data or well location(s) of those maps and records maintained by the regulatory authorities.

Banks Environmental Data, Inc. - 1601 Rio Grande, Ste. 331 - Austin, TX 78701 - 800.531.5255 P - 512.478.1433 F
www.banksenvdata.com

APPENDIX D

Hydrographs and Hydraulic Testing Results

ARCADIS

Well Development Field Logs

WELL DEVELOPMENT LOG

Site/Well No. MW-1801

Project AEP Amos Plant - FGD Landfill   Project No. WV015976   Page 1 of 1

Site Location Winfield, WV   Date 8/17/2018

Weather NR   Development Time Begin 9:45   End 1:45

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	NR
MP Elevation (ft)	NA	Pumping Rate (gpm)	Average
Land Surface Elevation (ft)	NA	Evacuation Method	Submersible Pump
Sounded Well Depth (ft bmp)	78.50	Volumes Purged	6
Depth to Water (ft bmp)	29.15		
Water-Level Elevation (ft)	NA	**Field Parameters**	
Water Column in Well (ft)	49.35	Color	Red
Casing Diameter/Type	2" PVC	Odor	NR
Gallons in Well	7.90	Appearance	Cloudy

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)	Remarks
9:45	0	NA	34.00	1400	NR	NR	NR	NR	NR	NR	NA	Dark Red
10:00	15	6	42.00	1400	NR	NR	NR	NR	NR	NR	5.84	Dark Red
10:15	30	8	46.70	600	NR	NR	NR	NR	NR	NR	5.09	Surge/Dark Red
10:30	45	13	59.00	1400	NR	NR	NR	NR	NR	NR	3.12	Dark Red
10:45	60	19	58.70	1400	NR	NR	NR	NR	NR	NR	3.17	Dark Red
11:00	75	25	63.40	1400	NR	NR	NR	NR	NR	NR	2.42	Dark Red
11:15	90	28	65.10	750	NR	NR	NR	NR	NR	NR	2.14	Red Cloudy
11:30	105	31	65.10	750	NR	NR	NR	NR	NR	NR	2.14	Surge/Red Cloudy
11:45	120	33	65.80	750	NR	NR	NR	NR	NR	NR	2.03	Red Cloudy
12:00	135	36	66.70	750	NR	NR	NR	NR	NR	NR	1.89	Red Cloudy
12:15	150	39	67.30	600	NR	NR	NR	NR	NR	NR	1.79	Red Cloudy
12:30	165	40	67.30	300	NR	NR	NR	NR	NR	NR	1.79	Red Cloudy
12:45	180	41	67.59	300	NR	NR	NR	NR	NR	NR	1.75	Surge/Red Cloudy
1:00	195	42	68.00	300	NR	NR	NR	NR	NR	NR	1.68	Red Cloudy
1:15	210	44	68.60	300	NR	NR	NR	NR	NR	NR	1.58	Red Cloudy
1:30	225	45	69.65	300	NR	NR	NR	NR	NR	NR	1.42	Red Cloudy
1:45	240	N/A	70.01	NR	NR	NR	NR	NR	NR	NR	1.36	NR

Development Personnel: AEP Staff: Rick Baker

Notes: Water Quality Parameters collected during yield testing on 9/12/2018 by Arcadis

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

WELL DEVELOPMENT LOG

Site/Well No. MW-1802

Project AEP Amos Plant - FGD Landfill Project No. WV015976 Page 1 of 2

Site Location Winfield, WV Date 8/23/2018

Weather Fog in AM, cool, sunny, 58-78°F Development Time Begin 8:00 End 15:47

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	NR
MP Elevation (ft)	NA	Pumping Rate (gpm)	Average
Land Surface Elevation (ft)	NA	Evacuation Method	Submersible Bladder
Sounded Well Depth (ft bmp)	73.60	Volumes Purged	36
Depth to Water (ft bmp)	49.07		
Water-Level Elevation (ft)	NA	**Field Parameters**	
Water Column in Well (ft)	24.53	Color	NR
Casing Diameter/Type	2" PVC	Odor	NR
Gallons in Well	3.92	Appearance	NR

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)	Remarks
8:00	0	NA	49.07	1500	NR	NR	NR	NR	NR	NR	N/A	
8:15	15	3	57.30	800	NR	NR	NR	NR	NR	NR	2.61	
8:30	30	6	57.85	800	NR	>1,000	NR	NR	NR	NR	2.52	Surge
8:40	40	8	59.30	800	NR	>1,000	NR	NR	NR	NR	2.29	
8:50	50	11	60.10	800	NR	>1,000	NR	NR	NR	NR	2.16	
9:00	60	13	60.50	800	NR	>1,000	NR	NR	NR	NR	2.10	
9:15	75	16	60.91	800	NR	NR	NR	NR	NR	NR	2.03	
9:30	90	19	61.74	800	NR	>1,000	NR	NR	NR	NR	1.90	
9:35	95	20	NR	1100	NR	NR	NR	NR	NR	NR	NA	Surge
9:45	105	NA	63.18	NR	NR	>1,000	NR	NR	NR	NR	1.67	
10:00	120	28	64.01	1100	NR	NR	NR	NR	NR	NR	1.53	
10:05	125	NA	64.45	NR	NR	NR	NR	NR	NR	NR	1.46	
13:15	315	110	51.83	1600	NR	NR	NR	NR	NR	NR	3.48	Surge
13:25	325	114	57.98	1600	NR	>1,000	NR	NR	NR	NR	2.50	
13:30	330	116	59.99	1100	NR	NR	NR	NR	NR	NR	2.18	

Development Personnel: AEP Staff: Rick Baker

Notes: Water Quality Parameters collected during yield testing on 9/11/2018 by Arcadis

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

WELL DEVELOPMENT LOG

Site/Well No. MW-1802

Project AEP Amos Plant - FGD Landfill Project No. WV015976 Page 2 of 2

Site Location Winfield, WV Date 8/23/2018

Weather Fog in AM, cool, sunny, 58-78°F Development Time Begin 8:00 End 15:47

Evacuation Data

Measuring Point	TOC	Sample Pump Intake Setting (ft bmp)	NR
MP Elevation (ft)	NA	Pumping Rate (gpm)	Average
Land Surface Elevation (ft)	NA	Evacuation Method	Submersible Bladder
Sounded Well Depth (ft bmp)	73.60	Volumes Purged	36
Depth to Water (ft bmp)	49.07		
Water-Level Elevation (ft)	NA	**Field Parameters**	
Water Column in Well (ft)	24.53	Color	NR
Casing Diameter/Type	2" PVC	Odor	NR
Gallons in Well	3.92	Appearance	NR

Time	Min Elapsed	Total Gallons Removed	Depth To Water (ft btoc)	Rate (mL/min)	Conductivity (mS/cm or umhos/cm)	Turbidity (NTU)	Temperature (°F/°C)	pH (s.u.)	ORP (mV)	Dissolved Oxygen (g/mL)	Well Volume (Gal)	Remarks
13:35	335	117	50.91	1100	NR	>1,000	NR	NR	NR	NR	3.63	
13:40	340	119	61.45	1100	NR	NR	NR	NR	NR	NR	1.94	
13:45	345	120	NR	700	NR	>1,000	NR	NR	NR	NR	NA	
13:50	350	121	61.73	700	NR	NR	NR	NR	NR	NR	1.90	
14:00	360	122	60.65	700	NR	NR	NR	NR	NR	NR	2.07	
14:10	370	NA	NR	NR	NR	NR	NR	NR	NR	NR	NA	
14:15	375	125	58.45	700	NR	NR	NR	NR	NR	NR	2.42	
14:20	380	126	58.95	700	NR	NR	NR	NR	NR	NR	2.34	
14:30	390	128	60.50	700	NR	NR	NR	NR	NR	NR	2.10	
14:35	395	129	NR	600	NR	NR	NR	NR	NR	NR	NA	Surge
14:40	400	130	61.49	600	NR	>1,000	NR	NR	NR	NR	1.94	
14:50	410	131	60.80	600	NR	NR	NR	NR	NR	NR	2.05	
15:00	420	133	60.78	600	NR	>1,000	NR	NR	NR	NR	2.05	
15:10	430	134	61.24	600	NR	>1,000	NR	NR	NR	NR	1.98	
15:25	445	137	61.30	600	NR	NR	NR	NR	NR	NR	1.97	
15:27	447	137	NR	1100	NR	>1,000	NR	NR	NR	NR	NA	Surge
15:30	450	138	61.91	1100	NR	>1,000	NR	NR	NR	NR	1.87	
15:40	460	141	63.51	1100	NR	>1,000	NR	NR	NR	NR	1.61	
15:47	467	N/A	64.30	NR	NR	NR	NR	NR	NR	NR	1.49	

Development Personnel: AEP Staff: Rick Baker

Notes: Water Quality Parameters collected during yield testing on 9/11/2018 by Arcadis

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS

Packer Test Logs

BEDROCK INJECTION PACKER TESTING LOG

Boring No.	MW-1801	Contractor	AEP	Page	1 of 1
Project	AEP Amos FGD Landfill Well Install	Project No.	WV015976.0012	Arcadis Staff	Allan Gillespie
Site Location	Winfield, WV			Date	8/13/2018

Base of Top Packer (ft bgs/ft amsl)	55.00	Surface Elevation (ft amsl)	N/A
Top of Bottom Packer (ft bgs/ft amsl)	65.00	Distance from Gauge to Ground Surface (ft)	6.60
Depth to Water Prior to Install (ft bgs/ft amsl)	17.10	Diameter of Boring (inches)	2.98
Depth to Water After Install (ft bgs/ft amsl)	17.10	used reading from 8/14, no data recorded for 8/13	

Test 1

Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	968.0	0.0	N/A
1	969.9	1.9	N/A
2	971.9	1.9	N/A
3	974.2	2.1	N/A
4	976.5	2.1	N/A
5	979.0	2.2	N/A
10	991.3	2.3	N/A
15	1004.6	2.4	N/A
20	1018.3	2.5	N/A
25	1032.2	2.6	N/A
30			

Test 2

Constant Pressure (psi)

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =	5.7E-03	ft^3/s
h1 =	23.7	ft
h2 =	138.4	ft
H =	162.1	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	7.9E-05	cm/s

Zone 3
Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No. MW-1801 | Contractor AEP | Page 1 of 1

Project AEP Amos FGD Landfill Well Install | Project No. WV015976.0012 | Arcadis Staff Allan Gillespie

Site Location Winfield, WV | Date 8/9/2018

Base of Top Packer (ft bgs/ft amsl) 65.0

Top of Bottom Packer (ft bgs/ft amsl) 75.0

Depth to Water Prior to Install (ft bgs/ft amsl) 13.0

Depth to Water After Install (ft bgs/ft amsl) 13.0

Surface Elevation (ft amsl) NA

Distance from Gauge to Ground Surface (ft) 6.6

Diameter of Boring (inches) 3.0

Test 1
Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	886.90	0	N/A
1	886.90	0.000	N/A
2	886.90	0.000	N/A
3	886.90	0.000	N/A
4	886.90	0.000	N/A
5	886.90	0.000	N/A
10	886.90	0.000	N/A
15	886.90	0.000	N/A
20			
25			
30			

Test 2
Constant Pressure (psi) 100

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	887.00	0.0	N/A
1	887.00	0.0	N/A
2	887.10	0.1	N/A
3	887.20	0.1	N/A
4	887.25	0.1	N/A
5	887.40	0.1	N/A
10	887.90	0.1	N/A
15	888.60	0.1	N/A
20	889.50	0.1	N/A
25	890.80	0.2	N/A
30			

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Zone 3
Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =	3.4E-04	ft^3/s
h1 =	19.6	ft
h2 =	230.7	ft
H =	250.3	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	3.02E-06	cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No. MW-1802 | Contractor AEP | Page 1 of 1

Project AEP Amos FGD Landfill Well Install | Project No. WV015976.0012 | Arcadis Staff Allan Gillespie

Site Location Winfield, WV | Date 8/21/2018

Base of Top Packer (ft bgs/ft amsl) 48.0 | Surface Elevation (ft amsl) N/A

Top of Bottom Packer (ft bgs/ft amsl) 58.0 | Distance from Gauge to Ground Surface (ft) 8.6

Depth to Water Prior to Install (ft bgs/ft amsl) 35.1 | Diameter of Boring (inches) 3.0

Depth to Water After Install (ft bgs/ft amsl) 35.1 used reading from 8/14, no data recorded for 8/13

Test 1

Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	146.80	0	N/A
1	146.80	0.000	N/A
2	146.90	0.050	N/A
3	147.00	0.067	N/A
4	147.10	0.075	N/A
5	147.15	0.070	N/A
10	148.00	0.120	N/A
15	149.00	0.147	N/A
20	149.60	0.140	N/A
25	150.50	0.148	N/A
30			

Test 2

Constant Pressure (psi)

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0			
1			
2			
3			
4			
5			
10			
15			
20			
25			
30			

Pre-Test 1

Duration ____ (mins) Pressure ____ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ____ (mins) Pressure ____ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =	3.3E-04	ft^3/s
h1 =	43.7	ft
h2 =	138.4	ft
H =	182.1	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	4.0E-06	cm/s

Zone 3

Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No.	MW-1802	Contractor	AEP	Page	1 of 1
Project	AEP Amos FGD Landfill Well Install	Project No.	WV015976.0012	Arcadis Staff	Allan Gillespie
Site Location	Winfield, WV			Date	8/21/2018

Base of Top Packer (ft bgs/ft amsl)	65.0	Surface Elevation (ft amsl)	N/A
Top of Bottom Packer (ft bgs/ft amsl)	75.0	Distance from Gauge to Ground Surface (ft)	6.6
Depth to Water Prior to Install (ft bgs/ft amsl)	35.1	Diameter of Boring (inches)	3.0
Depth to Water After Install (ft bgs/ft amsl)	35.1		

Test 1
Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	140.05	0	
1	140.05	0.000	
2	140.05	0.000	
3	140.05	0.000	
4	140.05	0.000	
5	140.05	0.000	
10	140.05	0.000	
15	140.05	0.000	
20			
25			
30			

Test 2
Constant Pressure (psi) 100

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	140.10	0	
1	140.10	0.000	
2	140.10	0.000	
3	140.10	0.000	
4	140.10	0.000	
5	140.10	0.000	
10	140.10	0.000	
15	140.10	0.000	
20			
25			
30			

Pre-Test 1
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2
Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Test 2

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No. MW-1802 | Contractor AEP | Page 1 of 1

Project AEP Amos FGD Landfill Well Install | Project No. WV015976.0012 | Arcadis Staff Allan Gillespie

Site Location Winfield, WV | Date 8/21/2018

Base of Top Packer (ft bgs/ft amsl) 89.0

Top of Bottom Packer (ft bgs/ft amsl) 99.0

Depth to Water Prior to Install (ft bgs/ft amsl) 35.1

Depth to Water After Install (ft bgs/ft amsl) 35.1

Surface Elevation (ft amsl) N/A

Distance from Gauge to Ground Surface (ft) 7.6

Diameter of Boring (inches) 3.0

Test 1

Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	75.90	0	
1	75.90	0.000	
2	75.90	0.000	
3	75.90	0.000	
4	75.90	0.000	
5	75.90	0.000	
10	75.90	0.000	
15	75.90	0.000	
20			
25			
30			

Test 2

Constant Pressure (psi) 100

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	79.00	0.0	
1	79.50	0.5	
2	80.00	0.5	
3	80.50	0.5	
4	81.00	0.5	
5	82.00	0.6	
10	93.50	1.5	
15	106.50	1.8	
20	118.90	2.0	
25	129.60	2.0	
30			

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Zone 3

Method 2

$$K = \frac{Q}{C_s r H}$$

Test 2

Q =	4.5E-03	ft^3/s
h1 =	42.7	ft
h2 =	230.7	ft
H =	273.4	ft
r =	0.1	ft
A =	10.0	ft
A/r =	80.5	unitless
Cs =~	110	unitless
K =	3.7E-05	cm/s

Q= flow rate
H = h1+h2 = effective head
Cs = conductivity coefficient
h1 = distance between gage and water table
r = radius of test hole
h2 = applied pressure at gage
A = length of test section

Reference
US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

BEDROCK INJECTION PACKER TESTING LOG

Boring No. MW-1802 Contractor AEP Page 1 of 1

Project AEP Amos FGD Landfill Well Install Project No. WV015976.0012 Arcadis Staff Allan Gillespie

Site Location Winfield, WV Date 8/21/2018

Base of Top Packer (ft bgs/ft amsl) 99.0

Top of Bottom Packer (ft bgs/ft amsl) 109.0

Depth to Water Prior to Install (ft bgs/ft amsl) 35.1

Depth to Water After Install (ft bgs/ft amsl) 35.1

Surface Elevation (ft amsl) N/A

Distance from Gauge to Ground Surface (ft) 7.6

Diameter of Boring (inches) 3.0

Test 1

Constant Pressure (psi) 60

Elapsed Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	73.20	0	
1	73.20	0.000	
2	73.20	0.000	
3	73.20	0.000	
4	73.20	0.000	
5	73.20	0.000	
10	73.20	0.000	
15	73.20	0.000	
20			
25			
30			

Test 2

Constant Pressure (psi) 100

Time (mins)	Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)
0	73.50	0	
1	73.50	0.000	
2	73.50	0.000	
3	73.50	0.000	
4	73.50	0.000	
5	73.50	0.000	
10	73.50	0.000	
15	73.50	0.000	
20			
25			
30			

Pre-Test 1

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Pre-Test 2

Duration ______ (mins) Pressure ______ (psi)

Flow Totalizer Readings (gallons)	Flow Rate (gpm)	Borehole Water Level (ft)

Notes:
ft bgs- feet below ground surface
gpm - gallons per minute
cm/s - centimeters per second
psi - pounds per square inch
ft amls - feet above mean sea level
NA - not available
N/A - not applicable
NR - not recorded

Test 1

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Test 2

Q =		ft^3/s
h1 =		ft
h2 =		ft
H =		ft
r =		ft
A =		ft
A/r =		unitless
Cs =~		unitless
K =	N/A	cm/s

Q= flow rate

h1 = distance between gage and water table

h2 = applied pressure at gage

H = h1+h2 = effective head

r = radius of test hole

A = length of test section

Cs = conductivity coefficient

Reference

US Department of Interior, Ground Water Manual, 1977, Packer Test Solution

ARCADIS

Well Yield Tests

Field Logs

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976.0012 | Well ID MW-1801 | Date 9/12/2018

Project Name/Location AEP Amos Plant - FGD Landfill | Weather Cloudy, 66°F

Measuring Pt. Description TOC | Screen Setting (ft-bmp) NR | Casing Diameter (in.) 2 | Well Material X PVC ___ SS

Static Water Level (ft-bmp) 36.33 | Total Depth (ft-bmp) 78.5 | Water Column 42.17

Gallons in Well 6.75

MP Elevation NA | Pump Intake (ft-bmp) 75

Purge Method: Pump

Pump On/Off 10:45/13:45 | Volumes Purged 3 | Centrifugal ___ | Submersible X

Transducer SN NR | Observation Wells None | Other ___

Transducer Depth ~71 feet | Completed by A. Gillespie

Time	Min Elapsed	Rate (gpm) **(mL/min)**	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mMhos) (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. **(°C)** (°F)	Redox (mV)	Comments
10:45	0	NR	NA	36.33	NR	NR	NR	NR	NR	NR	
10:50	5	300	0	36.76	8.63	0.895	>1,000	8.32	21.63	63.1	Very turbid, no odors
10:55	10	300	1	38.59	8.76	0.826	>1,000	5.32	18.28	43.1	
11:05	20	300	2	39.85	8.85	0.822	>1,000	2.64	18.76	25.7	Very turbid, no odors
11:17	32	300	3	41.18	8.88	0.821	859	2.33	18.98	23.2	Turbidity decrease, no odors
11:25	40	300	3	43.08	8.86	0.820	663	2.42	18.70	23.6	
11:35	50	300	4	43.41	8.80	0.814	410	1.86	18.24	25.8	
11:45	60	NR	NA	NR	NR	NR	NR	NR	NR	NR	Loss of power to controller
11:48	63	NR	NA	NR	NR	NR	NR	NR	NR	NR	
11:52	67	450	6	46.62	8.78	0.813	280	1.90	17.29	28.6	
12:00	75	450	7	48.71	8.72	0.805	238	1.08	16.98	30.0	Moderately turbid, no odors
12:10	85	450	8	50.71	8.80	0.806	232	1.17	17.50	23.7	Moderately turbid, no odors
12:20	95	450	9	52.13	8.83	0.807	261	1.12	17.88	22.1	Moderately turbid, no odors
12:30	105	450	11	53.61	8.80	0.805	192	1.01	17.48	23.4	Turbidity decrease, no odors
12:40	115	450	12	55.14	8.82	0.806	172	1.01	17.55	21.7	
12:50	125	450	13	56.25	8.83	0.807	180	0.97	17.80	20.6	Moderately turbid, no odors
12:55	130	NR	NA	NR	NR	NR	NR	NR	NR	NR	
13:00	135	700	15	58.88	8.80	0.806	160	1.00	17.05	21.6	Moderately turbid, no odors
13:10	145	700	17	60.42	8.77	0.812	164	0.92	16.94	20.8	
13:25	160	700	19	63.21	8.77	0.829	152	0.93	17.05	19.2	No odors
13:30	165	700	20	64.00	8.84	0.830	156	0.89	17.30	15.3	Moderately turbid, no odors
13:32	167	NR	NA	NR	NR	NR	NR	NR	NR	NR	
13:36	171	NR	NA	62.61	NR	NR	NR	NR	NR	NR	
13:40	175	NR	NA	62.05	NR	NR	NR	NR	NR	NR	
13:45	180	NR	NA	61.45	NR	NR	NR	NR	NR	NR	

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

ARCADIS Design & Consultancy for natural and built assets

Well Yield - Pumping Drawdown/Recovery Log

Project No. WV015976.0012 Well ID MW-1802 Date 9/11/2018

Project Name/Location AEP Amos Plant - FGD Landfill Weather Cloudy, cool, 68°F

Measuring Pt. Description TOC

Screen Setting (ft-bmp) NR

Casing Diameter (in.) 2

Well Material X PVC ___ SS

Static Water Level (ft-bmp) 51.84

Total Depth (ft-bmp) 76.4

Water Column 24.56

Gallons in Well 4

MP Elevation NA

Pump Intake (ft-bmp) 71

Purge Method: Pump
Centrifugal ___
Submersible x
Other ___

Pump On/Off NR

Volumes Purged 7

Transducer SN NR

Observation Wells None

Transducer Depth ~68 feet

Completed by A. Gillespie

Time	Min Elapsed	Rate (gpm) (mL/min)	Total Gallons Purged	Depth to Water (ft)	pH (s.u.)	Cond. (mMhos) (mS/cm)	Turbidity (NTU)	Dissolved Oxygen (mg/L)	Temp. (°C) (°F)	Redox (mV)	Comments
13:30	0	NR	NA	51.84	NR	NR	NR	NR	NR	NR	
13:35	5	650	1	NR	NR	NR	NR	NR	NR	NR	
13:40	10	300	1	54.31	8.97	NR	>500	NR	NR	NR	No odors, high turbidity
13:50	20	350	2	54.54	8.81	0.770	160	6.21	16.78	81.1	Moderately turbid, rust color
14:00	32	350	3	54.63	8.71	0.757	145	4.05	16.65	43.4	Turbidity decrease, no odors
14:10	40	350	4	54.81	8.85	0.754	133	2.15	16.19	14.6	
14:20	50	350	5	54.98	8.95	0.754	120	0.94	16.27	-8.5	Turbidity decrease, no odors
14:35	60	350	6	55.44	8.89	0.752	120	0.58	16.19	-16.1	
14:38	63	NR	NA	NR	NR	NR	NR	NR	NR	NR	
14:40	67	700	8	56.13	9.01	0.757	118	2.43	16.87	-17.9	
14:50	75	700	10	56.40	8.94	0.752	159	1.14	15.86	-12.8	
15:00	85	700	11	57.51	8.92	0.750	175	1.31	15.48	-9.4	
15:10	95	700	13	57.91	8.97	0.749	170	1.50	15.47	-10.5	
15:20	105	700	15	58.72	8.96	0.753	168	1.52	15.00	-9.2	Moderately turbid, rust color
15:35	115	700	17	59.42	8.99	0.756	178	1.38	15.03	-11.8	
15:40	125	NR	NA	60.12	NR	NR	NR	NR	NR	NR	
15:45	130	1100	21	61.21	8.97	0.759	122	0.72	14.38	-12.4	Moderately turbid, rust color
15:50	135	1100	23	62.01	8.95	0.759	124	0.50	14.30	-13.5	
16:00	145	1000	25	63.41	8.99	0.764	192	0.53	14.50	-19.1	
16:05	160	1000	29	64.03	9.00	0.765	191	1.04	14.46	17.7	
16:06	165	NR	NA	NR	NR	NR	NR	NR	NR	NR	
16:10	167	NR	NA	61.50	NR	NR	NR	NR	NR	NR	
16:15	171	NR	NA	60.15	NR	NR	NR	NR	NR	NR	
16:20	175	NR	NA	58.56	NR	NR	NR	NR	NR	NR	

Well Casing Volumes (gallon/feet)

1-¼" = 0.06	2" = 0.16	3" = 0.37	4" = 0.65
1-½" = 0.09	2-½" = 0.26	3-½" = 0.50	6" = 1.47

bmp	below measuring point	ml	mililiter	NTU	Nephelometric Turbidity Units	ORP	Oxidation-Reduction Potential
°C	Degrees Celsius	mS/cm	Milisiemens per centimeter	PVC	Polyvinyl chloride	mV	millivolts
ft	feet	msl	mean sea-level	s.u.	Standard units	NA	Not Available
gpm	Gallons per minute	N/A	Not Applicable	umhos/cm	Micromhos per centimeter	NR	Not Recorded
mg/L	Miligrams per liter	NM	Not Measured	VOC	Volatile Organic Compounds		

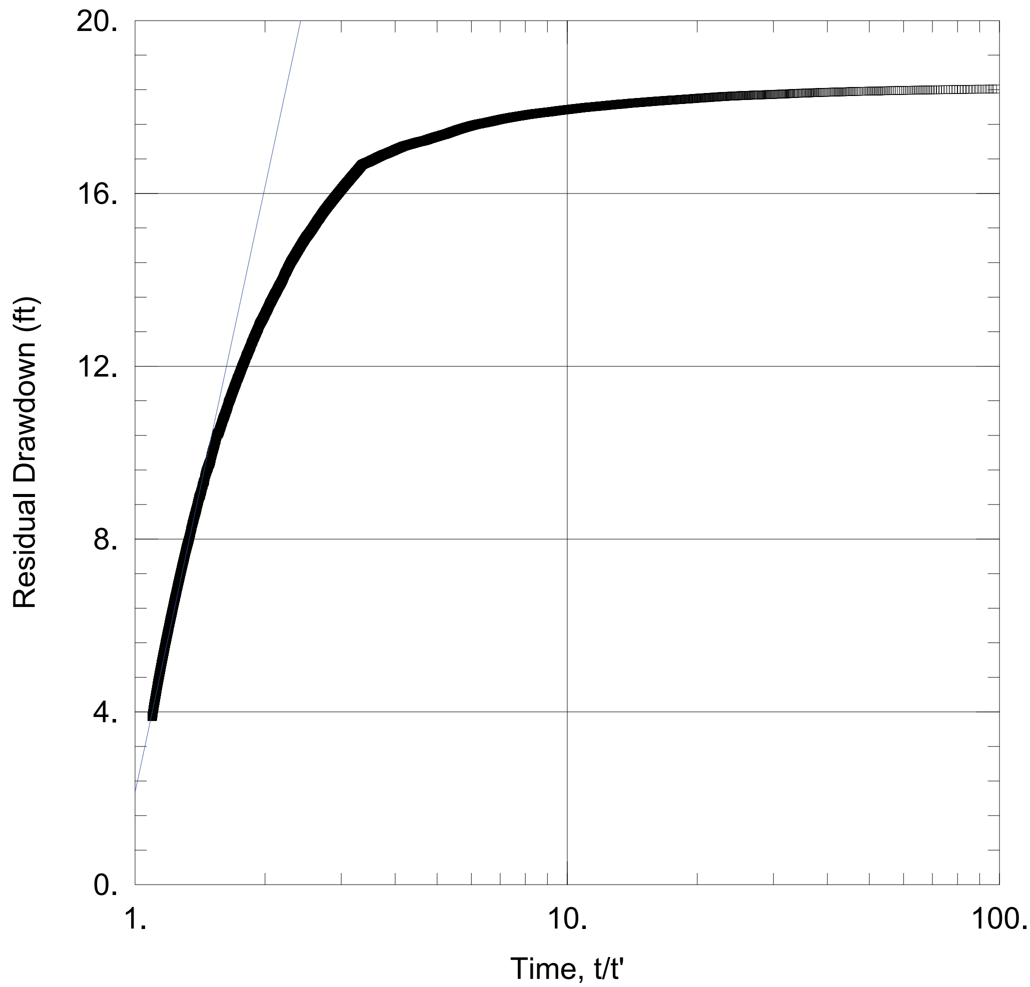
ARCADIS

Well Yield Tests

AQTESOLV Plots

MW-1801 Recovery

Prepared By: Arcadis	Prepared For: AEP
Project: WV015976.0012	Location: Winfield, WV



SOLUTION

Aquifer Model: Confined
Solution Method: Theis (Recovery)

T = 0.14 ft^2/day S/S' = 0.9

AQUIFER DATA

Saturated Thickness: 42.17 ft

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1801	0	0

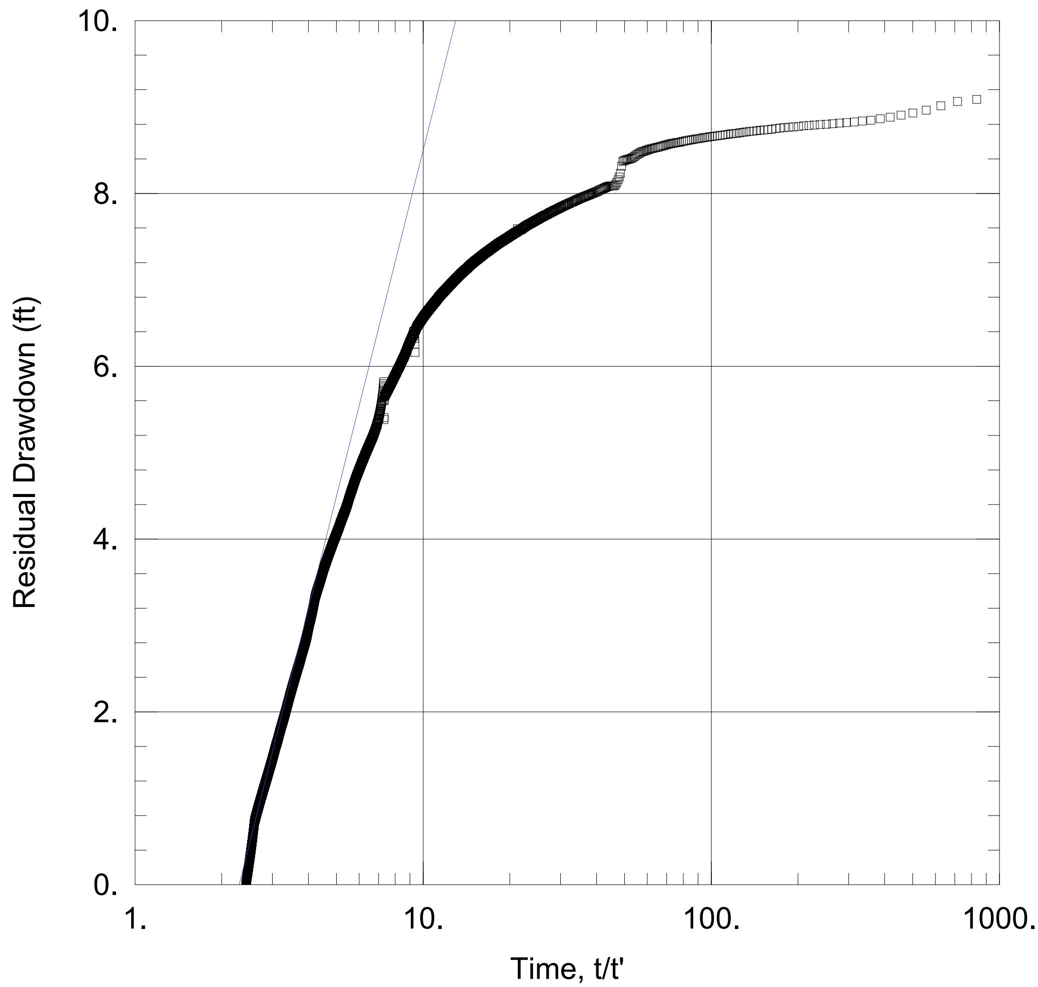
Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-1801	0	0

ARCADIS

MW-1802 Recovery

Prepared By: Arcadis	Prepared For: AEP
Project: WV015976.0012	Location: Winfield, WV



SOLUTION

Aquifer Model: Confined

Solution Method: Theis (Recovery)

T = 0.7 ft^2/day S/S' = 2.3

AQUIFER DATA

Saturated Thickness: 24.5

WELL DATA

Pumping Wells

Well Name	X (ft)	Y (ft)
MW-1802	0	0

Observation Wells

Well Name	X (ft)	Y (ft)
□ MW-1802	0	0

ARCADIS

High-Resolution Water Level Monitoring Evaluation

HIGH-RESOLUTION WATER LEVEL MONITORING EVALUATION

INTRODUCTION

Arcadis U.S., Inc. (Arcadis) completed a high-resolution water level monitoring field event from May 7 to August 11, 2018 at the American Electric Power Service Corporation (AEP) Generating Plant (Plant) FGD Landfill located in Winfield, West Virginia. The objectives of the monitoring and evaluation were to better characterize hydrogeologic conditions and permeability within the stress relief fracture system (SRF) and shallow alluvium.

HIGH-RESOLUTION WATER LEVEL MONITORING

Introduction and Methods

Continuous water levels collected in high-resolution in the SRF and shallow alluvial zone monitoring wells were collected from May 7 through August 11, 2018 by installation of Solinst® Levelogger® Junior Edge (model 3001 M5/F15) absolute (non-vented) pressure transducers at each hydraulic monitoring location. Other information collected included Site barometric pressure with a barometric pressure logger. The pressure transducers were set to a 5-minute linear logging interval for background monitoring. The barometric pressure logger was set in the outer casing of MW-5 and also set to a 5-minute linear logging interval. Pressure transducers were installed at each of the seven hydraulic monitoring locations (**Table D-1** and **Figure D-1**) that included three SRF monitoring wells located upgradient on ridges in the north valley (MW-8, MW-9 and MW-10), two downgradient SRF monitoring wells with one in the south valley (MW-2) and north valley (MW-4), and two downgradient shallow alluvium monitoring wells with one in the south valley (MW-1) and one north valley (MW-5). Note that pressure transducers within wells MW-1 and MW-2 were installed at a later date on June 20, 2019. Precipitation data was also obtained from www.ncdc.noaa.gov from the closest weather station to the Site (US1WVKN0021) located approximately 9 miles southeast of the Site to aid in the evaluation.

Pressure transducer and barometric pressure data were downloaded by AEP personnel on a bi-weekly basis in May 2018 and then monthly during June through August 2018. In addition, a manual groundwater level measurement to the top of casing survey point was obtained during each download event. After data collection, raw files were transferred and checked for quality control.

After downloading the data, the groundwater levels were processed and corrected for barometric pressure influences. Groundwater levels exhibit fluctuations due to a variety of influences, making hydrographs a good tool for understanding long-, mid- and short-term trends at any study site. Typical influences can include for example: recharge from precipitation events and/or bank storage, local or regional pumping, seasonal or long-term trends, barometric pressure fluctuations, surface water fluctuations, and ocean and/or earth tides. Of these external hydraulic influences, the following were observed at the Site during the monitoring period: precipitation events, barometric pressure fluctuations, and responses to groundwater sampling. Post-processing of the water level data included barometric compensation of the absolute data to obtain true water column, shift correction due to manual movement of pressure transducers that may occur when accessed, elevation calibration, and barometric correction using a set estimated barometric efficiency. The elevation calibration involved converting the water column data to groundwater elevations by comparison to manual measurements from the surveyed reference point.

Following elevation calibration, a correction factor for barometric efficiency (BE) was estimated for each hydrograph to remove barometric effects on water levels. The BE is defined as the water-level change caused by a barometric-pressure change divided by that barometric pressure change (Clark 1967). The BE was determined using both a visual corrected and a graphical elliptical method (Gonthier 2007). Barometric efficiency varies between 0 and 1 where low values typically indicates unconfined groundwater zones while higher values typically indicates confined groundwater zones. All BE values were low ranging from 0.05 to 0.2 that indicate a level of confinement for the SRF. In the north valley, shallow alluvium well MW-5 did not have an observed barometric effect (unconfined shallow water table) and a correction was not applied; whereas, in the south valley, shallow alluvium well MW-1 did have observed barometric effects and a correction was applied with a BE of 0.2, which is likely due to the finer grained nature of the deposits at MW-1 within the vadose zone compared to coarser grained deposits at MW-5.

Hydrographs

Long-term groundwater hydrographs were competed that depict observations in water level changes in **Figures D-2** through **D-8**. Recharge occurs when precipitation infiltrates the unsaturated zones and reaches the capillary fringe in shallow groundwater systems. Deeper groundwater systems receive recharge via shallower groundwater zones and upgradient areas over longer periods of time. The presence of low permeability materials such as clay within the unsaturated zone can retard the rate of recharge and time lags occur depending on the thickness and vertical hydraulic conductivity (Fetter 2001). Additionally, the observed water level elevations confirm a vertical sequence separating the shallow alluvium and SRF indicating a level of hydraulic separation of the two zones (e.g. MW-1/MW-2 [south valley **Figures D-2** and **D-3**] and MW-4/5 [north valley **Figures D-4** and **D-5**]).

Several of the monitoring wells responded to precipitation events resulting in water level increases including MW-2, MW-4, MW-5 as well as MW-9, to a lesser extent. Sudden drops followed by recovery in water levels due to groundwater sampling were also observed in wells MW-5, MW-8, MW-9, and MW-10. The largest precipitation event that occurred during the monitoring period was on June 22, 2018 with almost 2 inches of rainfall in a 24-hour period. Monitoring well MW-5 had the highest magnitude of increase in response to precipitation of approximately 2-feet during this event. Following groundwater sampling events and an anomalous water level drop at MW-1, several wells had a recovery response that was more rapid at MW-5, MW-8, and MW-9 while other wells took several days or weeks to return to pre-pumping levels (MW-1, MW-10). The more rapid recharge response is reflective of a higher permeability of the materials at the respective locations.

SUMMARY

Continuous water level data in the SRF and shallow alluvial zone was collected in May through August 2018 in order to better characterize hydrogeologic conditions and permeability within the SRF system and shallow alluvium at the FGD Landfill. Pressure transducers were installed at each of the seven hydraulic monitoring locations that included three SRF monitoring wells located upgradient on ridges in the north valley (MW-8, MW-9 and MW-10), two downgradient SRF monitoring wells with one in the south valley (MW-2) and north valley (MW-4), and two downgradient shallow alluvium monitoring wells with one in the south valley (MW-1) and one north valley (MW-5).

The following external hydraulic influences were observed at the FGD Landfill during the monitoring period: precipitation events, barometric pressure fluctuations and responses to groundwater sampling. Water-levels were post-processed that included barometric compensation, shift correction, water-level elevation and barometric correction. Barometric efficiency was estimated for each monitoring well and varied from 0.05 to 0.2 and indicates a level of confinement for the SRF. In the north valley, shallow alluvium well MW-5 did not have a barometric effect reflecting unconfined shallow water table conditions. Shallow alluvium well MW-1 did have a barometric effect with a resulting barometric efficiency of 0.2, which is likely due to shallower finer grained material in the vadose zone compare to coarser deposits observed at MW-5. Additionally, the observed water level elevations confirm a vertical sequence separating the shallow alluvium and SRF indicating a level of hydraulic separation of the two zones (e.g. MW-1/MW-2 [south valley **Figures D-2** and **D-3**] and MW-4/5 [north valley **Figures D-4** and **D-5**]).

Several of the monitoring wells responded to precipitation events resulting in water level increases including MW-2, MW-4, MW-5 as well as MW-9, to a lesser extent. Sudden declines followed by recovery in water levels due to groundwater sampling were also observed in wells MW-5, MW-8, MW-9, and MW-10. Following groundwater sampling events and an anomalous decrease at MW-1, several wells showed a more rapid recharge such as MW-5, MW-8, and MW-9 (see **Figure D-7**) while other wells took several days or weeks to return to pre-pumping levels such as MW-10 (see **Figure D-8**). The more rapid recharge response is reflective of a higher permeability of the materials at the respective locations.

LIMITATIONS

Arcadis is not responsible for the independent conclusions, opinions, or recommendations made by others based on the data presented in this report. This report includes a limited set of data within the project site. The conclusions drawn from this investigation are considered reliable; however, there may exist localized variations in the subsurface conditions that have not been completely defined at this time. It should be noted that subsurface conditions may be better delineated with additional subsurface exploration and laboratory testing.

REFERENCES

Clark, W.E. 1967. Computing the barometric efficiency of a well. *Journal of the Hydraulics Division*, *93*(4), pp.93-98.

Fetter, C.W. 2001. Applied Hydrogeology. 4th Edition, Prentice Hall, Upper Saddle River.

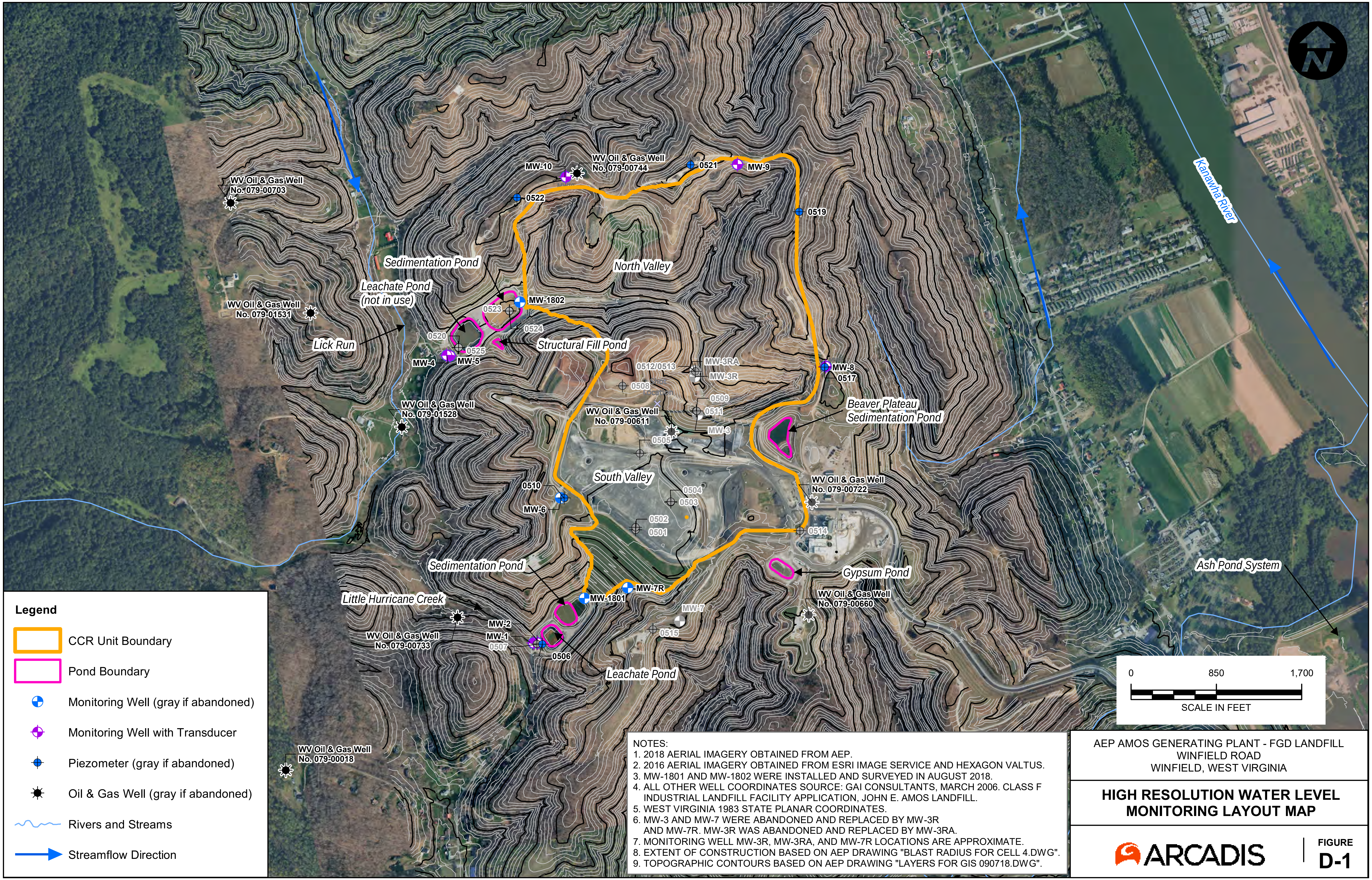
Gonthier, G.J. 2007. A graphical method for estimation of barometric efficiency from continuous data– concepts and application to a site in the Piedmont. *Air Force Plant*, *6*.

Table D-1
High-Resolution Water Level Monitoring Well Construction Details
AEP Amos Generating Plant - FGD Landfill
Winfield, West Virginia

Well ID	Location Description to CCR Unit	Northing [a]	Easting [a]	Ground Surface Elevation ft amsl	Top of Casing Elevation ft amsl	Borehole Depth ft bls	Date Installed	Screen Material	Well Diameter inches	Top of Filter Pack		Bottom of Filter Pack		Top of Screen		Bottom of Screen	
										Depth ft bls	Elevation ft amsl	Depth ft bls	Elevation ft amsl	Depth ft bls	Elevation ft amsl	Depth ft bls	Elevation ft amsl
Monitor Wells																	
Downgradient																	
MW-1 [b]	Southwest	539438.68	1722490.93	709.57	711.57	19.0	7/12/2005	screened PVC	2.00	6.0	703.57	19.0	690.57	8.0	701.57	18.0	691.57
MW-2 [b]	Southwest	539438.31	1722530.69	709.41	711.41	62.5	7/12/2005	screened PVC	2.00	37.0	672.41	62.5	646.91	42.0	667.41	62.0	647.41
MW-4 [b]	West	542302.52	1721626.94	674.76	676.76	78.5	7/7/2005	screened PVC	2.00	53.0	621.76	78.5	596.26	58.0	616.76	78.0	596.76
MW-5 [b]	West	542299.18	1721658.72	674.84	676.84	10.2	7/7/2005	screened PVC	2.00	4.0	670.84	10.2	664.64	5.0	669.84	10.0	664.84
MW-8 [b]	East	542193.80	1725402.80	945.01	947.01	60.5	7/11/2005	screened PVC	2.00	30.0	915.01	60.5	884.51	40.0	905.01	60.0	885.01
MW-9 [b]	Northeast	544204.89	1724522.80	933.39	935.39	62.5	6/30/2005	screened PVC	2.00	37.0	896.39	62.5	870.89	42.0	891.39	62.0	871.39
MW-10 [b]	Northwest	544079.05	1722812.23	909.43	911.43	157.0	7/6/2005	screened PVC	2.00	85.0	824.43	157.0	752.43	133.0	776.43	153.0	756.43

NOTES:
Elevation in feet above mean sea level
a. 1983 West Virginia State Planar Coordinates
b. Source: GAI Consultants. March 2006. Class F Industrial Landfill Facility Application, John E. Amos Landfill, Volume 1, Appendix K - Monitor Well Construction Diagrams.
amsl = above mean sea level
bls = Below land surface
ft = feet

DRAFT
PRIVILEGED AND CONFIDENTIAL



NOTES:
1. 2018 AERIAL IMAGERY OBTAINED FROM AEP.
2. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE AND HEXAGON VALTUS.
3. MW-1801 AND MW-1802 WERE INSTALLED AND SURVEYED IN AUGUST 2018.
4. ALL OTHER WELL COORDINATES SOURCE: GAI CONSULTANTS, MARCH 2006. CLASS F INDUSTRIAL LANDFILL FACILITY APPLICATION, JOHN E. AMOS LANDFILL.
5. WEST VIRGINIA 1983 STATE PLANAR COORDINATES.
6. MW-3 AND MW-7 WERE ABANDONED AND REPLACED BY MW-3R AND MW-7R. MW-3R WAS ABANDONED AND REPLACED BY MW-3RA.
7. MONITORING WELL MW-3R, MW-3RA, AND MW-7R LOCATIONS ARE APPROXIMATE.
8. EXTENT OF CONSTRUCTION BASED ON AEP DRAWING "BLAST RADIUS FOR CELL 4.DWG".
9. TOPOGRAPHIC CONTOURS BASED ON AEP DRAWING "LAYERS FOR GIS 090718.DWG".

AEP AMOS GENERATING PLANT - FGD LANDFILL
WINFIELD ROAD
WINFIELD, WEST VIRGINIA

HIGH RESOLUTION WATER LEVEL MONITORING LAYOUT MAP

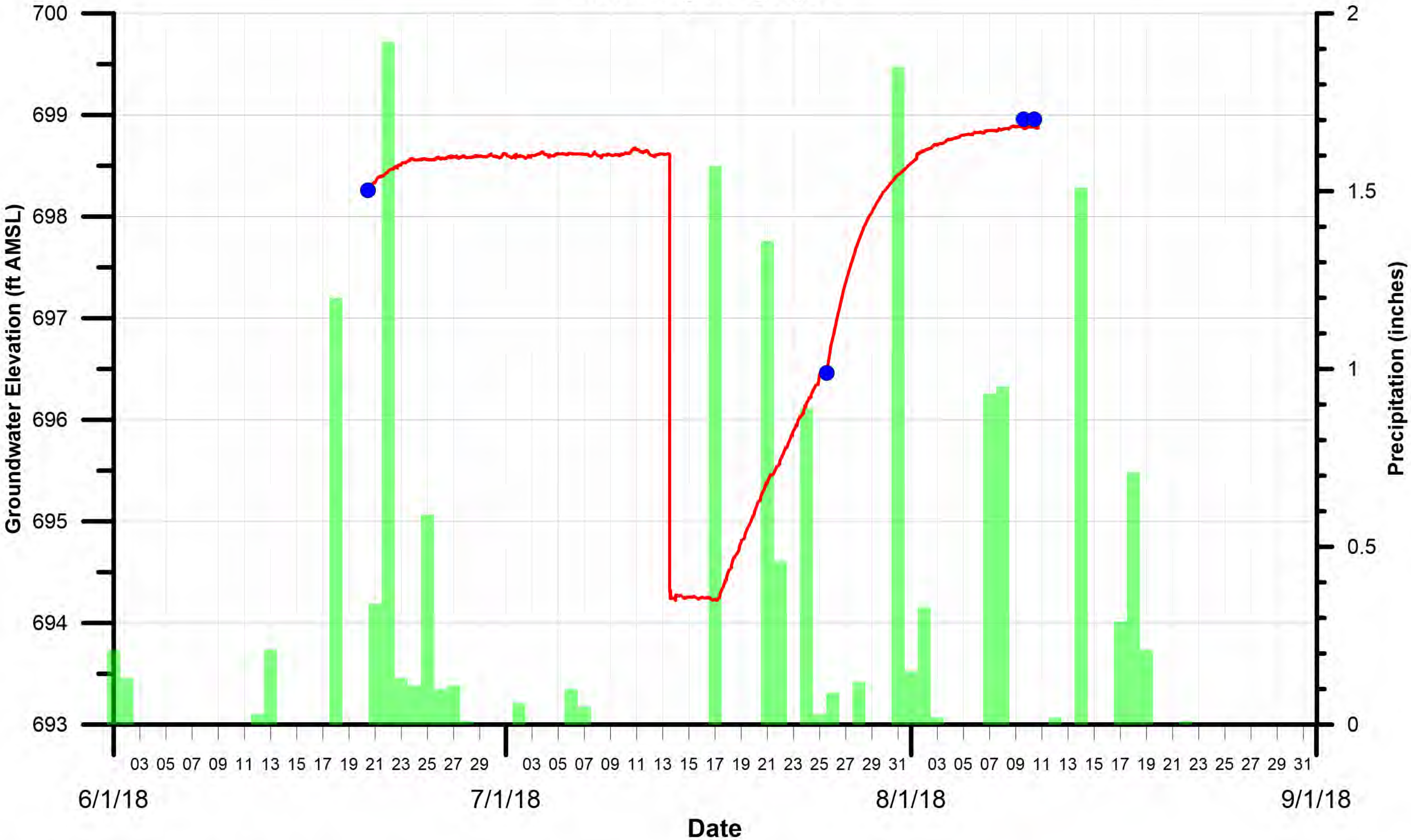
ARCADIS

FIGURE
D-1

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\Landfill Report\May2019\F_D1_FGDLandfill_aerial_v2.mxd 4/23/2020 10:08:45 AM

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/13/2018
Prepared by: CB
Checked by: TF

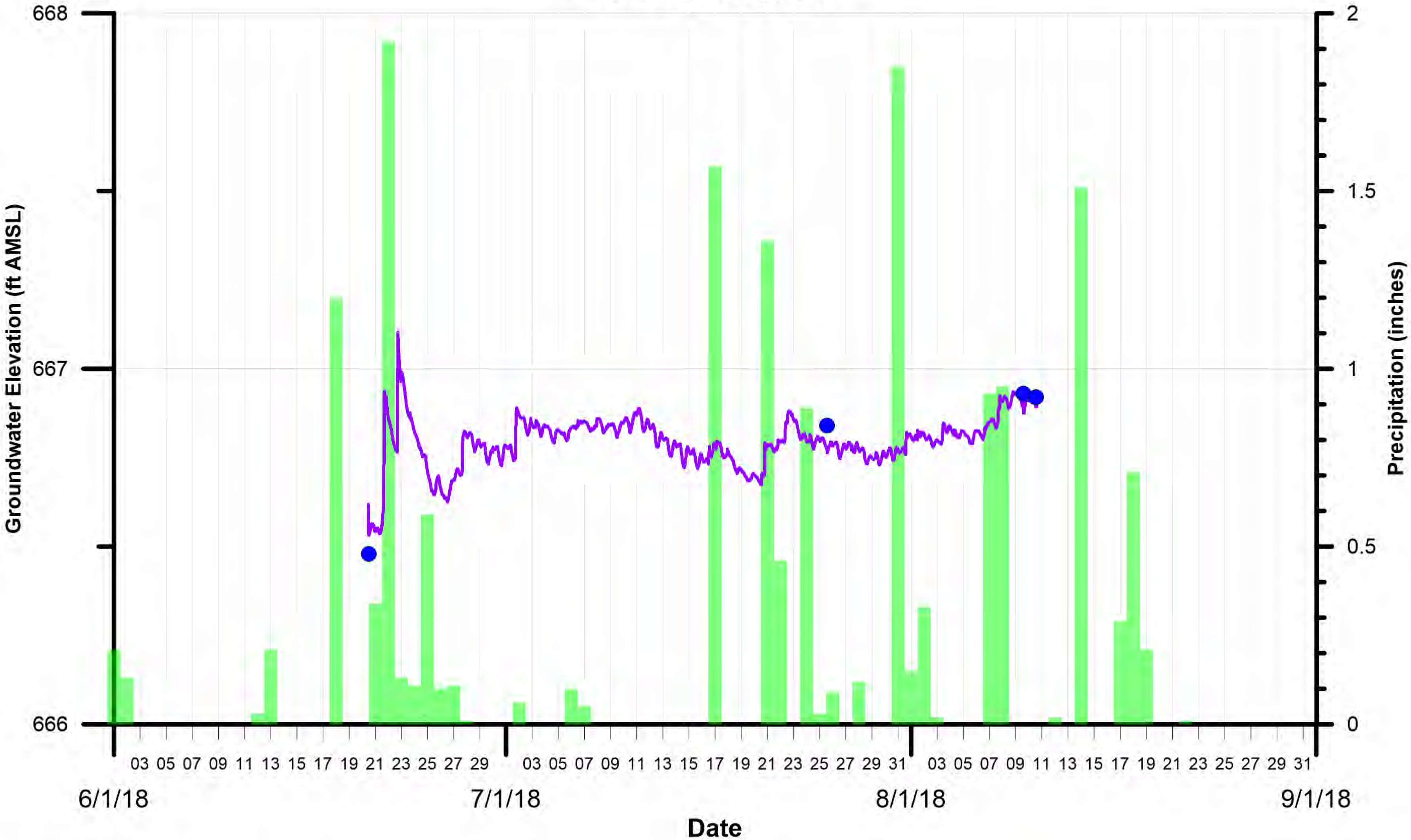
Figure D-2:
MW-1 Hydrograph



-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 8-18 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has been applied. BE = 0.2.
-AMSL = above mean sea level

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/13/2018
Prepared by: CB
Checked by: TF

Figure D-3:
MW-2 Hydrograph

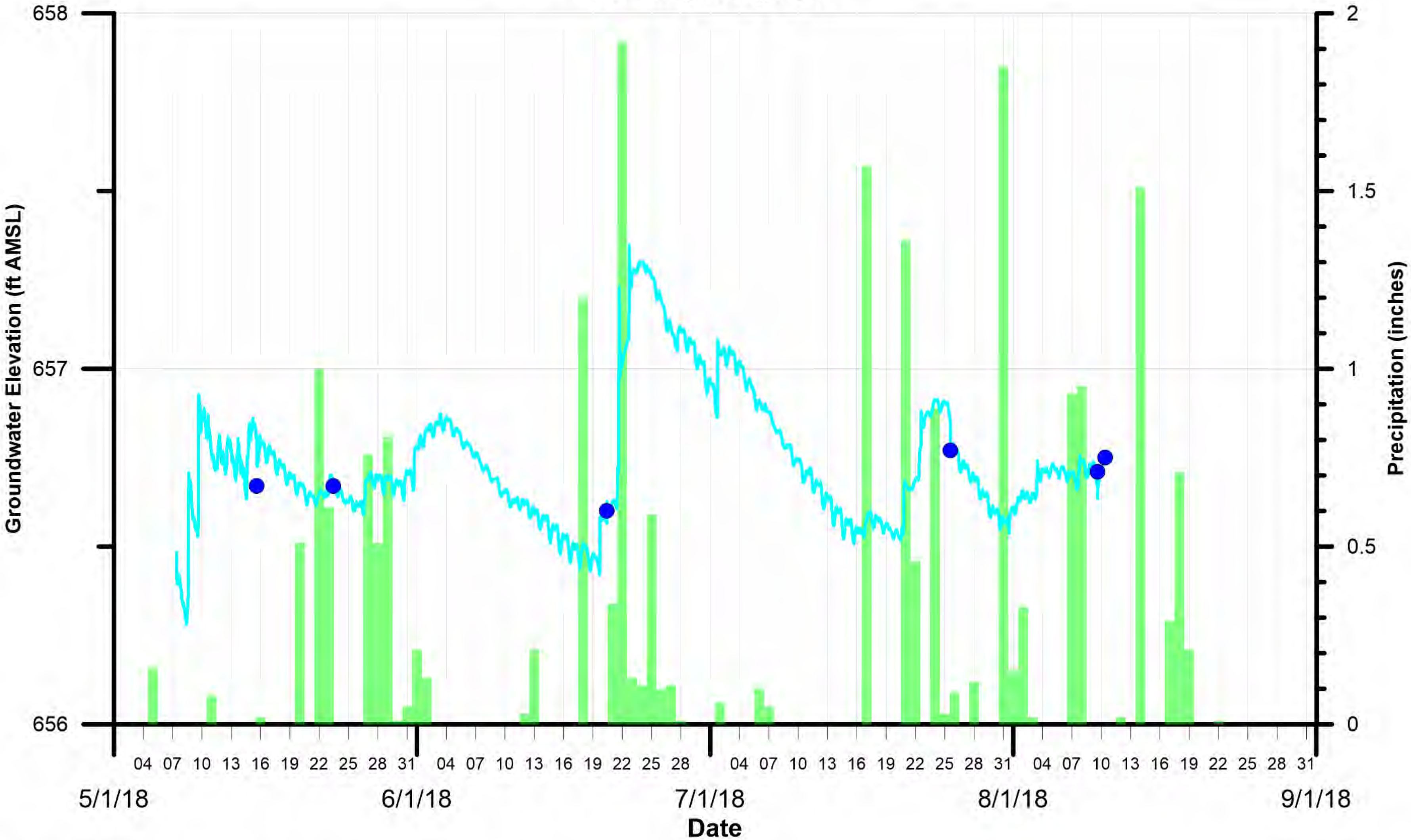


-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 42-62 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has been applied. BE = 0.2.
-AMSL = above mean sea level

Groundwater Elevation (ft AMSL)
Manual Groundwater Measurements (ft AMSL)
Precipitation (inches)

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/13/2018
Prepared by: CB
Checked by: TF

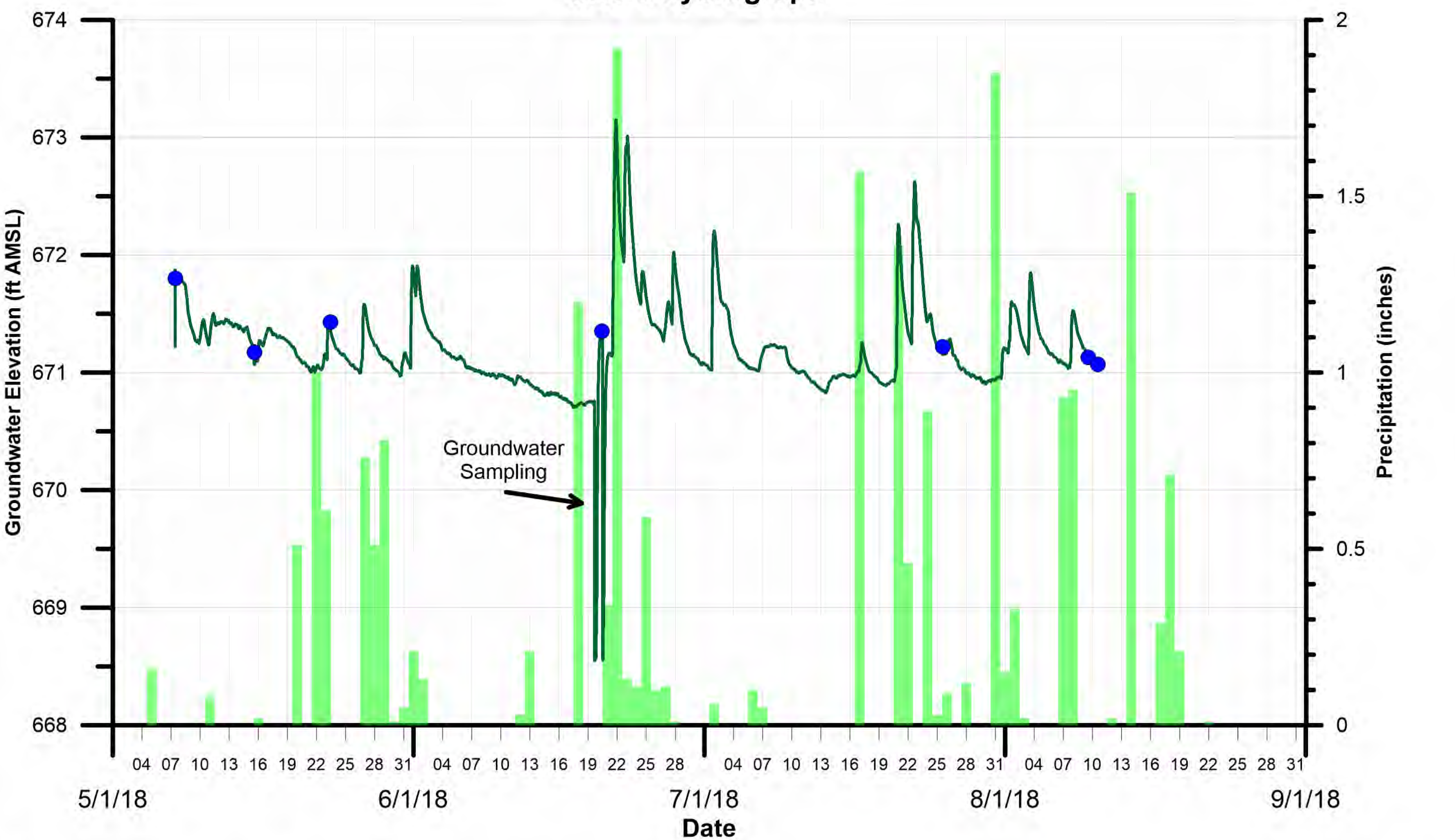
Figure D-4:
MW-4 Hydrograph



-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 58-78 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has been applied. BE = 0.2.
-AMSL = above mean sea level

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/20/2018
Prepared by: CB
Checked by: TF

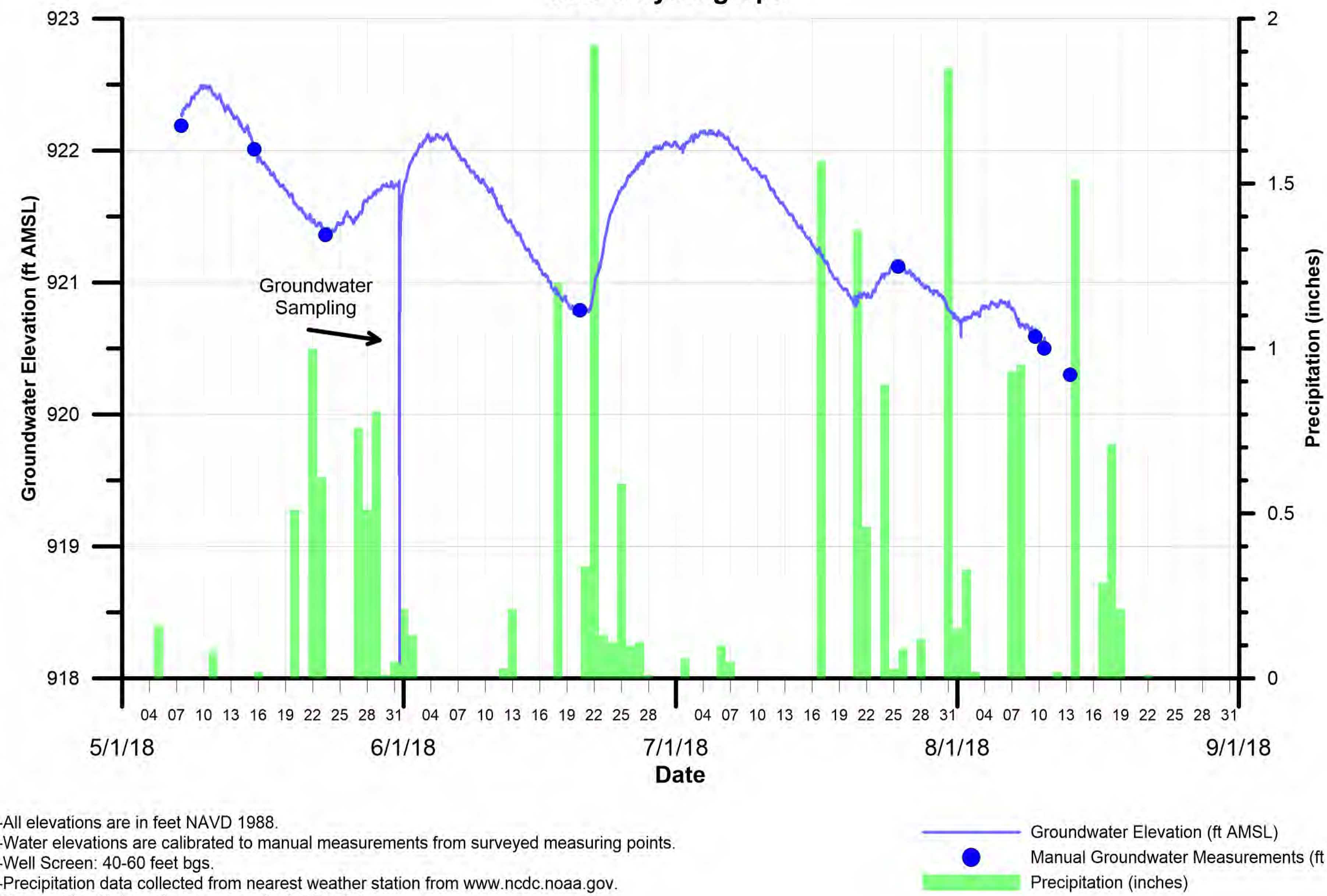
Figure D-5:
MW-5 Hydrograph



-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 5-10 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has not been applied.
-AMSL = above mean sea level

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/20/2018
Prepared by: CB
Checked by: TF

Figure D-6:
MW-8 Hydrograph

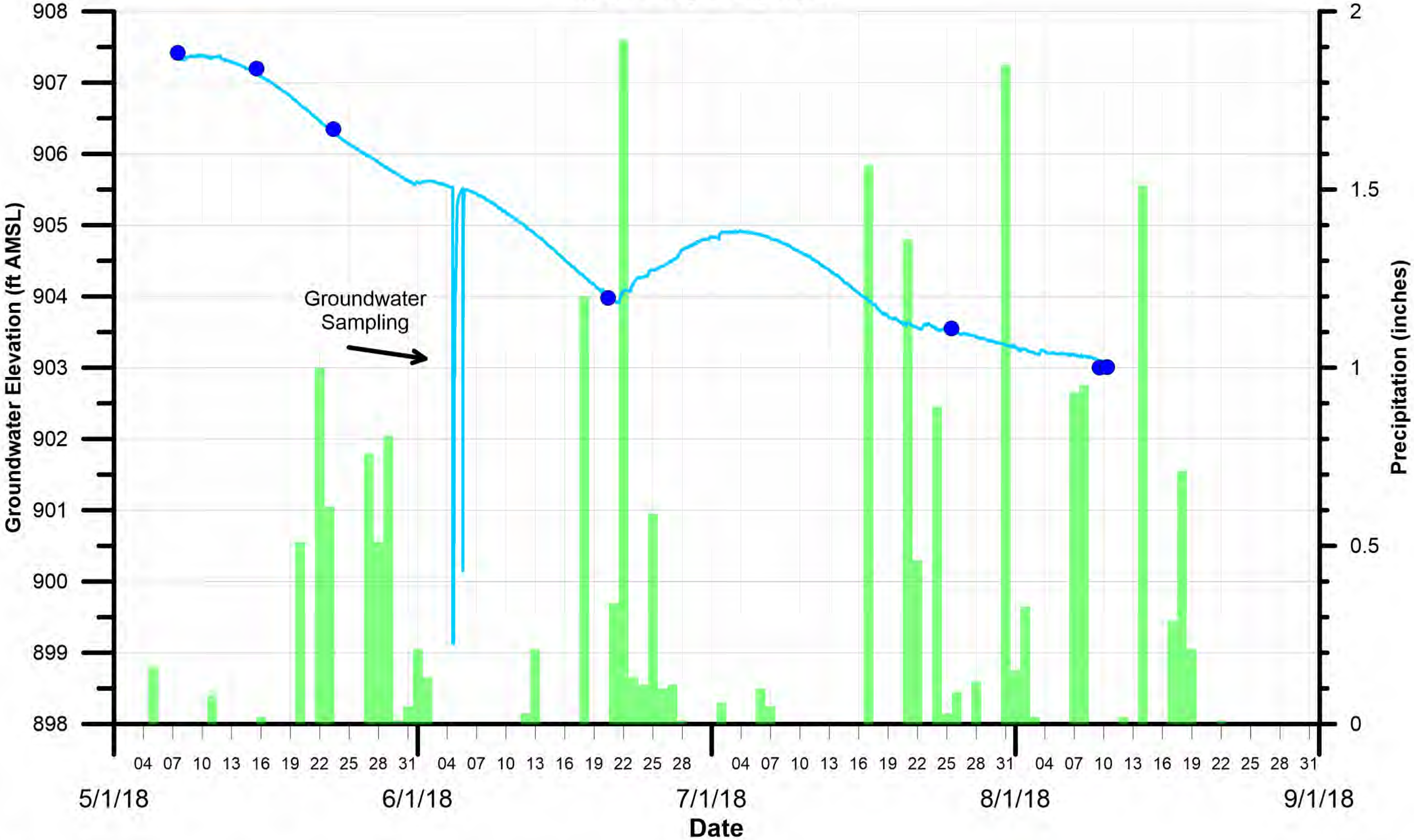


-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 40-60 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has been applied. BE = 0.2.
-AMSL = above mean sea level

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/20/2018
Prepared by: CB
Checked by: TF

ARCADIS Design & Consultancy for natural and built assets

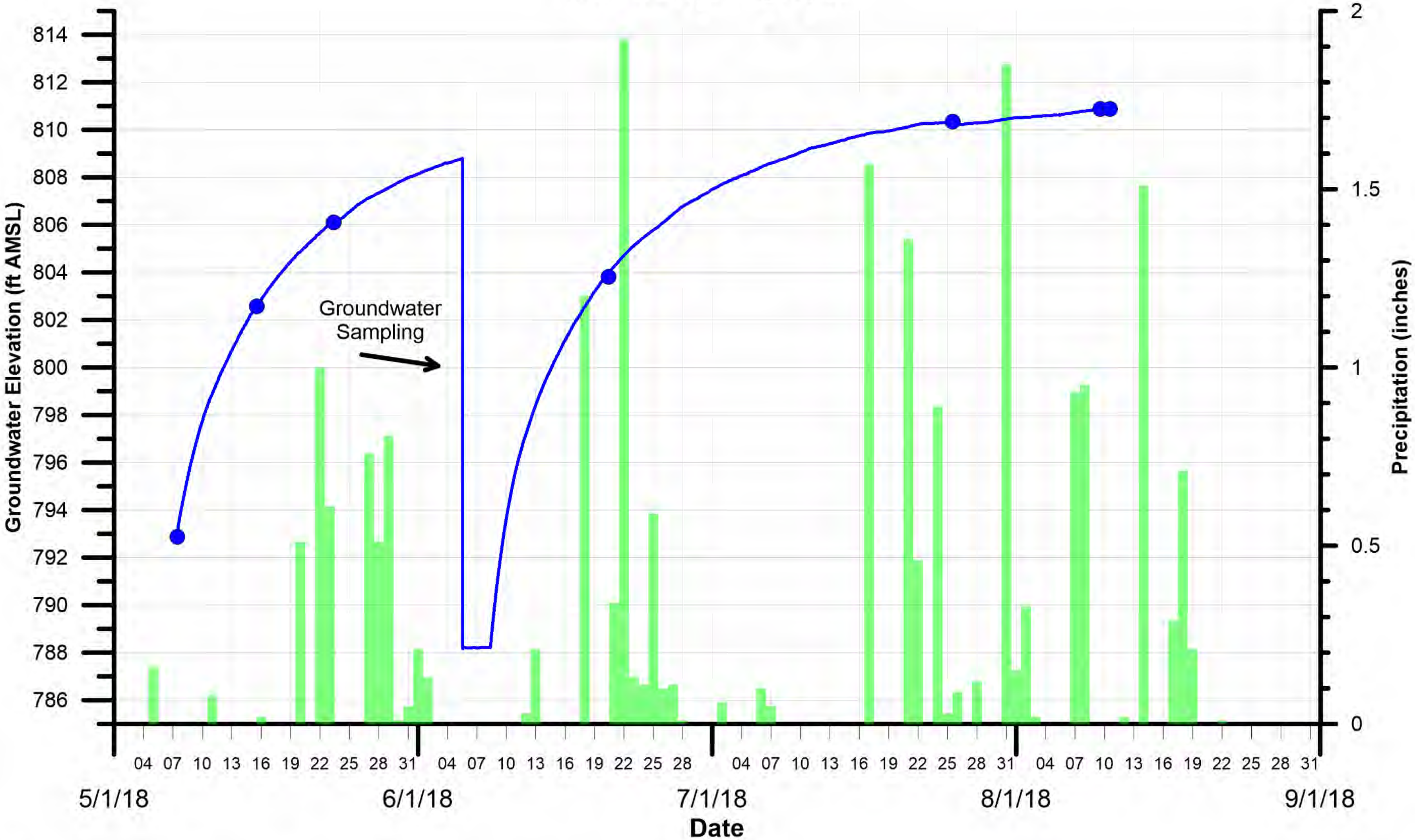
Figure D-7: MW-9 Hydrograph



-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 42-62 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has been applied. BE = 0.1.
-AMSL = above mean sea level

AEP Amos Landfill
Winfield, WV
Data Graph Prepared: 09/20/2018
Prepared by: CB
Checked by: TF

Figure D-8:
MW-10 Hydrograph



-All elevations are in feet NAVD 1988.
-Water elevations are calibrated to manual measurements from surveyed measuring points.
-Well Screen: 133-153 feet bgs.
-Precipitation data collected from nearest weather station from www.ncdc.noaa.gov.
-Barometric efficiency has been applied. BE = 0.05.
-AMSL = above mean sea level

Appendix E

Annual Groundwater Monitoring and Corrective Action Report

Annual Groundwater Monitoring Report

Appalachian Power Company

John E. Amos Plant

Bottom Ash Pond CCR Management Unit

Winfield, West Virginia

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

Table of Contents   Page

I. <u>Overview</u>

This *Annual Groundwater Monitoring* (Report) has been prepared to report the status of activities for the preceding year for an existing Bottom Ash Pond (BAP) CCR unit at Appalachian Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP) John E. Amos Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31.

In general, the following activities were completed:

- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Statistical analysis of assessment monitoring samples analyzed in November 2018, April 2019, and November 2019 were completed in 2019;
- As required by the CCR assessment monitoring program, two rounds of sampling that included all the Appendix III and detected Appendix IV parameters were performed in March and July 2019 in accordance with 40 CFR §§257.95(d)(1). A "screening" sample was obtained in accordance with 40 CFR §§257.95(b) and completed in June 2019. All detected parameters from the analysis of the June 2019 samples were included in the March and July 2019 sampling events. No statistically significant levels (SSL's) above groundwater protection standards (GWPS) occurred. The Amos BAP CCR Unit remains in the Assessment Monitoring Program per the federal CCR Rule.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map/aerial photograph showing the BAP Complex CCR management unit, all groundwater monitoring wells, and monitoring well identification numbers.
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened, if applicable (**Appendix 5**).
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (**Appendix 1**).
- Results of the required statistical analysis of groundwater monitoring results (**Appendix 2**).
- Discussion of any alternative source demonstrations completed (**Appendix 3**).

- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations, if applicable (**Appendix 4**).
- Other information required to be included in the annual report such as assessment of corrective measures, if applicable.

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification numbers. The monitoring well distribution adequately covers downgradient and upgradient areas as detailed in the *Groundwater Monitoring Network Evaluation Report* that was placed in the American Electric Power CCR public internet site on March 9, 2017. The CCR groundwater quality monitoring network includes the following:

- Four upgradient wells MW-6, MW-1601, MW-1602A, and MW-1603A; and
- Six downgradient wells MW-1, MW-4, MW-5, MW-1604, MW-1605, and MW-1606.

Legend

Monitoring Well Network

- Upgradient Sampling Location
- Downgradient Sampling Location
- Ash Pond System

Notes
- Monitoring well coordinates provided by AEP.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.
- Rev. 1: Updated CCR Unit boundary. September 13, 2018

1,000 500 0 1,000 Feet

Site Layout
Ash Pond System

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure 1

Columbus, Ohio | 2018/12/24

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2018\AEP-Amos_BAP_Site_Layout.mxd. ARevezzo. 12/24/2018. CHA8423.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2019 at the Amos Plant Bottom Ash Pond Complex. The network design, as summarized in the *Groundwater Monitoring Network Evaluation Report* (*March 2017*) and as posted at the CCR web site for John E. Amos Plant, did not change. That evaluation report, viewable on the AEP CCR web site, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, and the design of the groundwater monitoring well network including downgradient and upgradient monitoring well locations.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction Calculations and Discussion

Appendix 1 contains tables showing the groundwater quality data collected during the establishment of background quality and the groundwater monitoring samples collected during 2019. Static water elevation data from each monitoring event in 2019 are also shown in **Appendix 1**, along with the groundwater velocity calculations, groundwater flow direction and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the assessment monitoring samples taken in November 2018 was completed in January 2019. No SSLs above a GWPS were identified. That report has been placed on the publicly accessible CCR website for John E. Amos Plant at https://www.aep.com/requiredpostings/ccr/Amos and is included in **Appendix 2**. Groundwater monitoring samples collected in March and July 2019 underwent statistical analysis. Those statistical analysis reports are also included in **Appendix 2**. No SSLs above a GWPS were identified in 2019. Therefore, the Amos BAP will remain in Assessment Monitoring.

VI. Alternative Source Demonstration

No alternative source demonstrations were performed in 2019.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

There have been no transitions between monitoring requirements at the Amos BAP since the transition to Assessment Monitoring in 2018.

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production are high enough at this facility that no modification to the monitoring frequency is needed.

VIII. Other Information Required

The BAP has progressed from detection monitoring to its current status in assessment monitoring. All required information has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support the 2019 annual groundwater report preparation covering the year 2019 groundwater monitoring activities.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Remain in assessment monitoring and sample all CCR wells at the BAP semi-annually for the Appendix III and IV parameters in accordance with 40 CFR §§257.95. Perform statistical analysis on the sampling results and compare the results of Appendix IV concentrations in downgradient wells to the GWPSs.
- If a GWPS is exceeded in a downgradient well the following activities will be undertaken:
    - Characterize the nature and extent of a release by installing additional GW wells as necessary, estimate the quantity of material released and the concentrations of Appendix IV parameters that are in the material, and sample all wells to characterize the nature and extent of the release.
    - If contaminants have migrated off-site, notify all persons who own land that directly overlies any part of the plume of contamination.
    - Perform an alternate source demonstration (ASD) investigating whether the exceedance was caused by a source other than the BAP or was a result of an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

    - If a successful ASD cannot be made, initiate an assessment of corrective measures and follow all of those requirements.
- Responding to any new data received in light of what the CCR rule requires.
- Preparation of the 2020 annual groundwater report.

APPENDIX 1 - GW Quality Data, GW Flow Directions, GW Flow Rates

Tables follow, showing the groundwater monitoring data collected in 2019, groundwater monitoring data collected during background sampling, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Table 1 - Groundwater Data Summary: MW-1
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.042	41.6	61.6	<0.05 U	5.0	320	146
8/22/2016	Background	0.051	41.6	60.3	<0.05 U	4.9	320	148
10/19/2016	Background	0.031	43.7	64.9	<0.05 U	5.1	348	150
11/7/2016	Background	- -	- -	- -	- -	5.1	- -	- -
12/13/2016	Background	0.053	42.9	69.0	<0.05 U	5.0	318	153
2/7/2017	Background	0.056	40.4	62.9	0.03 J	5.5	314	139
3/13/2017	Background	0.108	38.1	64.2	0.02 J	5.2	330	140
5/22/2017	Background	0.082	35.7	62.6	0.03 J	6.1	316	138
6/20/2017	Background	0.092	38.2	65.1	<0.02 U	5.2	348	147
11/1/2017	Detection	0.039	43.7	75.8	0.03 J	5.0	358	156
1/9/2018	Detection	- -	43.2	83.2	- -	4.9	362	164
5/3/2018	Assessment	0.095	39.9	71.8	0.02 J	7.3	328	154
9/4/2018	Assessment	0.094	38.3	67.9	0.03 J	5.1	338	145
3/14/2019	Assessment	0.2 J	38.4	55.2	0.03 J	5.2	321	138
6/10/2019	Assessment	0.08 J	35.9	64.4	0.03 J	10.2	330	141
7/22/2019	Assessment	0.05 J	36.8	57.4	0.02 J	4.9	362	143

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.02 J	0.13	30.2	0.107	2.09	0.1	10.7	0.528	<0.05 U	0.134	0.004	<0.002 U	1.67	0.09 J	0.04 J
8/22/2016	Background	0.01 J	0.12	28.5	0.105	2.02	0.1	12.3	0.725	<0.05 U	0.081	0.003	<0.002 U	1.48	0.1	0.04 J
10/19/2016	Background	0.02 J	0.15	31.1	0.119	2.33	0.510	13.9	1.86	<0.05 U	0.133	0.0008 J	<0.002 U	2.33	0.1	0.066
11/7/2016	Background	- -	- -	- -	- -	- -	- -	- -	0.615	- -	- -	- -	- -	- -	- -	- -
12/13/2016	Background	0.01 J	0.16	28.9	0.115	2.55	1.24	14.6	0.136	<0.05 U	0.102	0.014	<0.002 U	1.38	0.2	0.04 J
2/7/2017	Background	0.01 J	0.20	25.4	0.115	2.43	0.141	14.9	0.609	0.03 J	0.093	0.004	<0.002 U	0.79	0.1	0.056
3/13/2017	Background	0.02 J	0.14	26.3	0.112	2.36	0.566	12.5	0.675	0.02 J	0.129	0.002	<0.002 U	1.15	0.1	0.03 J
5/22/2017	Background	0.03 J	0.09	25.8	0.114	2.54	0.113	9.69	0.707	0.03 J	0.066	0.006	0.002 J	0.31	0.1 J	0.04 J
6/20/2017	Background	0.02 J	0.10	27.7	0.123	2.65	0.173	9.38	0.587	<0.02 U	0.062	0.005	<0.002 U	0.34	0.09 J	0.04 J
5/3/2018	Assessment	0.01 J	0.13	27.8	0.143	3.12	0.093	15.1	1.74	0.02 J	0.068	0.004	<0.002 U	0.62	0.2	0.04 J
9/4/2018	Assessment	0.22	0.18	29.4	0.130	2.97	0.548	17.7	0.575	0.03 J	1.16	0.003	- -	0.34	0.2	0.05 J
3/14/2019	Assessment	0.05 J	0.12	26.9	0.131	3.48	0.255	10.3	0.887	0.03 J	0.252	<0.09 U	- -	0.5 J	0.09 J	<0.1 U
6/10/2019	Assessment	0.02 J	0.11	27.5	0.125	2.14	0.2 J	12.8	0.998	0.03 J	0.08 J	<0.009 U	<0.002 U	<0.4 U	0.1 J	<0.1 U
7/22/2019	Assessment	<0.02 U	0.09 J	26.4	0.136	2.47	0.06 J	13.5	0.825	0.02 J	0.08 J	0.00257	- -	<0.4 U	0.2 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-4
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2016	Background	0.074	16.2	11.7	0.07 J	5.9	190	44.8
8/23/2016	Background	0.054	17.9	10.9	0.04 J	5.5	184	39.2
10/18/2016	Background	0.07	15.2	12.2	<0.05 U	5.7	206	44.5
11/8/2016	Background	- -	- -	12.8	0.03 J	5.7	170	47.3
12/12/2016	Background	0.079	16.3	14.0	0.04 J	5.5	348	48
2/8/2017	Background	0.087	15.3	13.4	0.06 J	5.6	176	46.1
3/14/2017	Background	0.093	15.8	12.9	0.05 J	5.8	185	43.5
5/22/2017	Background	0.099	15.3	13.2	0.04 J	6.3	192	43.9
6/19/2017	Background	0.097	15.0	13.3	0.03 J	5.5	196	50.9
11/1/2017	Detection	0.073	14.2	12.3	0.06	5.5	210	43.0
5/3/2018	Assessment	0.100	15.9	14.4	0.06 J	5.9	178	49.2
9/5/2018	Assessment	0.067	13.3	13.4	0.06	7.0	179	42.4
3/15/2019	Assessment	<0.2 U	14.5	13.3	0.06 J	5.5	184	42.8
6/10/2019	Assessment	0.06 J	14.4	13.0	0.06	6.8	172	43.3
7/23/2019	Assessment	0.06 J	14.8	13.4	0.04 J	5.4	186	44.5

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-4
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/25/2016	Background	0.05 J	13.6	101	0.068	0.18	0.5	26.6	0.539	0.07 J	0.502	0.007	<0.002 U	11.1	0.07 J	0.055
8/23/2016	Background	0.02 J	4.34	90.8	0.051	0.03	0.3	5.55	0.405	0.04 J	0.275	0.002	<0.002 U	19.2	0.08 J	0.01 J
10/18/2016	Background	0.11	15.8	84.1	0.055	0.53	0.600	85.9	1.884	<0.05 U	0.395	0.002	<0.002 U	2.44	0.1	0.156
11/8/2016	Background	- -	- -	- -	- -	- -	- -	- -	0.457	0.03 J	- -	- -	- -	- -	- -	- -
12/12/2016	Background	0.03 J	3.35	96.0	0.049	0.09	1.18	10.9	2.116	0.04 J	0.255	0.012	<0.002 U	0.75	0.1 J	0.090
2/8/2017	Background	0.02 J	8.17	82.5	0.045	0.12	0.290	18.9	0.46	0.06 J	0.306	0.001	<0.002 U	0.93	0.07 J	0.099
3/14/2017	Background	0.03 J	5.36	91.0	0.043	0.16	0.327	23.3	1.339	0.05 J	0.192	0.0005 J	<0.002 U	0.51	0.07 J	0.072
5/22/2017	Background	0.04 J	6.38	96.2	0.053	0.09	0.226	20.8	0.55	0.04 J	0.188	0.008	<0.002 U	0.49	0.08 J	0.068
6/19/2017	Background	0.02 J	5.65	88.5	0.049	0.08	0.216	22.1	0.929	0.03 J	0.247	0.002	<0.002 U	0.31	0.1	0.069
5/3/2018	Assessment	<0.01 U	1.15	93.1	0.046	0.04	0.175	7.93	1.569	0.06 J	0.153	0.0008 J	<0.002 U	0.31	0.06 J	0.01 J
9/5/2018	Assessment	0.05 J	11.0	89.1	0.037	0.21	0.200	25.8	0.623	0.06	0.083	0.003	- -	0.28	0.06 J	0.109
3/15/2019	Assessment	<0.02 U	1.63	80.4	0.05 J	0.05	0.2 J	9.81	0.501	0.06 J	0.219	<0.09 U	- -	<0.4 U	0.06 J	<0.1 U
6/10/2019	Assessment	<0.02 U	2.5	90.5	0.06 J	0.07	0.274	10.5	0.787	0.06	0.406	<0.009 U	<0.002 U	<0.4 U	0.08 J	<0.1 U
7/23/2019	Assessment	0.03 J	2.48	84.6	0.07 J	0.05	0.236	7.24	0.486	0.04 J	0.430	0.00162	- -	<0.4 U	0.1 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-5
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.051	19.7	21.4	0.04 J	5.8	156	57.7
8/23/2016	Background	0.014	18.4	21.3	0.04 J	5.4	136	57.5
10/18/2016	Background	0.018	18.6	20.0	<0.05 U	5.9	188	56
11/8/2016	Background	- -	- -	20.1	0.05 J	5.8	176	56.5
12/12/2016	Background	0.002 J	18.1	20.4	0.03 J	5.7	154	54.1
2/8/2017	Background	0.032	16.3	19.6	0.05 J	5.8	158	51.1
3/14/2017	Background	0.028	16.5	19.5	0.03 J	5.9	172	51.5
5/22/2017	Background	0.046	16.8	18.9	0.04 J	6.6	180	51.1
6/19/2017	Background	0.06	11.4	19.1	0.03 J	5.6	170	57.3
11/1/2017	Detection	0.033	15.7	17.5	0.05 J	5.7	190	53.9
5/3/2018	Assessment	0.156	16.6	17.8	0.04 J	6.3	166	51.9
9/4/2018	Assessment	0.028	15.2	17.8	0.05 J	5.8	151	45.4
3/15/2019	Assessment	<0.2 U	16.2	18.5	0.05 J	5.7	180	51.3
6/10/2019	Assessment	0.04 J	15.7	16.9	0.05 J	5.9	178	48.4
7/23/2019	Assessment	<0.04 U	14.9	15.3	0.04 J	5.6	162	45.2

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-5
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.03 J	2.71	170	0.039	0.01 J	0.2	0.966	1.264	0.04 J	0.123	0.0005 J	<0.002 U	2.15	<0.03 U	0.04 J
8/23/2016	Background	0.01 J	2.42	157	0.029	0.007 J	0.2	1.01	0.406	0.04 J	0.056	0.004	<0.002 U	2.57	<0.03 U	0.01 J
10/18/2016	Background	0.05	4.00	166	0.079	0.007 J	0.841	1.45	1.123	<0.05 U	0.667	0.004	<0.002 U	2.20	0.09 J	0.01 J
11/8/2016	Background	- -	- -	- -	- -	- -	- -	- -	1.099	0.05 J	- -	- -	- -	- -	- -	- -
12/12/2016	Background	0.08	3.41	166	0.053	0.006 J	0.892	1.14	1.46	0.03 J	0.264	0.006	<0.002 U	1.01	0.04 J	0.02 J
2/8/2017	Background	0.04 J	3.26	141	0.051	0.006 J	0.237	0.981	3.676	0.05 J	0.216	0.003	<0.002 U	0.99	<0.03 U	0.01 J
3/14/2017	Background	0.03 J	2.79	152	0.033	0.007 J	0.170	0.949	1.055	0.03 J	0.022	0.002	<0.002 U	0.49	<0.03 U	0.01 J
5/22/2017	Background	0.04 J	2.74	151	0.052	0.007 J	0.195	1.11	1.062	0.04 J	0.236	0.013	<0.002 U	0.31	0.03 J	<0.01 U
6/19/2017	Background	0.02 J	3.25	155	0.053	0.006 J	0.237	0.997	1.099	0.03 J	0.207	0.002	<0.002 U	0.22	0.05 J	<0.01 U
5/3/2018	Assessment	0.02 J	3.18	149	0.049	0.006 J	0.237	1.03	1.631	0.04 J	0.147	0.0004 J	<0.002 U	0.31	0.05 J	<0.01 U
9/4/2018	Assessment	0.02 J	2.34	157	0.034	0.01 J	0.122	1.03	0.3383	0.05 J	0.038	0.002	- -	0.15	<0.03 U	0.03 J
3/15/2019	Assessment	0.02 J	3.63	162	0.06 J	<0.01 U	0.344	1.21	0.853	0.05 J	0.124	<0.09 U	- -	<0.4 U	<0.03 U	<0.1 U
6/10/2019	Assessment	<0.02 U	2.85	155	0.04 J	<0.01 U	0.1 J	1.13	0.89	0.05 J	0.04 J	<0.009 U	<0.002 U	<0.4 U	<0.03 U	<0.1 U
7/23/2019	Assessment	0.10	6.74	158	0.121	<0.01 U	0.291	1.12	0.811	0.04 J	0.762	0.00153	- -	<0.4 U	0.08 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-6
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.117	12.2	8.88	0.08 J	6.2	204	2.8
8/24/2016	Background	0.023	12.2	10.7	0.03 J	5.5	244	6.1
10/19/2016	Background	0.006	11.3	8.67	0.04 J	6.1	196	3.7
11/8/2016	Background	- -	- -	- -	- -	6.0	- -	- -
12/13/2016	Background	<0.002 U	12.4	9.79	0.04 J	5.9	190	2.1
2/8/2017	Background	0.051	11.6	10.3	0.06 J	6.0	170	2.8
3/14/2017	Background	0.048	11.5	9.90	0.05 J	6.1	203	2.1
5/23/2017	Background	0.037	11.9	11.5	0.04 J	6.2	238	4.4
6/20/2017	Background	0.183	11.6	9.61	0.07	6.0	222	2.5
11/1/2017	Detection	0.017	12.2	11.6	0.07	5.9	258	5.5
5/3/2018	Assessment	0.056	12	10.1	0.07	6.3	188	2.9
9/4/2018	Assessment	<0.002 U	11.3	8.97	0.09	6.0	176	1.3
3/15/2019	Assessment	<0.2 U	12.4	10.4	0.05 J	5.9	226	1.6
6/10/2019	Assessment	<0.02 U	11.8	9.68	0.08	9.3	205	2.2
7/24/2019	Assessment	0.04 J	12.1	9.71	0.05 J	5.9	199	2.2

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-6
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.03 J	33.6	191	0.065	0.01 J	1.5	13.6	1.3779	0.08 J	1.25	0.002	<0.002 U	1.77	0.2	0.075
8/24/2016	Background	0.01 J	33.4	185	0.037	0.01 J	1.0	12.4	0.961	0.03 J	0.581	0.003	<0.002 U	0.97	0.2	0.070
10/19/2016	Background	0.01 J	34.4	171	0.026	0.006 J	0.647	11.0	1.941	0.04 J	0.281	0.0005 J	<0.002 U	0.78	0.2	0.185
11/8/2016	Background	- -	- -	- -	- -	- -	- -	- -	1.026	- -	- -	- -	- -	- -	- -	- -
12/13/2016	Background	0.02 J	33.9	169	0.038	0.007 J	1.88	10.6	1.635	0.04 J	0.515	0.006	<0.002 U	0.53	0.2	0.060
2/8/2017	Background	0.02 J	32.8	157	0.038	0.007 J	0.817	12.3	20.83	0.06 J	0.574	0.004	<0.002 U	0.60	0.2	0.055
3/14/2017	Background	0.02 J	36.3	168	0.037	0.006 J	1.54	12.0	1.178	0.05 J	0.416	<0.0002 U	<0.002 U	0.62	0.2	0.054
5/23/2017	Background	0.04 J	33.6	183	0.032	0.006 J	0.748	13.1	1.013	0.04 J	0.305	0.006	<0.002 U	0.41	0.2	0.053
6/20/2017	Background	0.02 J	32.4	169	0.022	<0.005 U	0.496	10.7	1.345	0.07	0.157	0.0003 J	<0.002 U	0.44	0.1	0.055
5/3/2018	Assessment	0.01 J	34.1	163	0.028	<0.005 U	0.455	11.9	2.0087	0.07	0.216	<0.0002 U	<0.002 U	0.50	0.2	0.092
9/4/2018	Assessment	0.16	29.8	147	0.01 J	0.03	0.38	9.16	0.769	0.09	0.214	<0.0002 U	- -	0.46	0.1	0.084
3/15/2019	Assessment	0.06 J	32.0	184	0.106	0.02 J	1.82	14.0	0.865	0.05 J	1.72	<0.09 U	- -	0.5 J	0.4	0.1 J
6/10/2019	Assessment	0.03 J	34.3	161	<0.02 U	<0.01 U	0.309	9.72	0.688	0.08	0.104	<0.009 U	<0.002 U	0.5 J	0.1 J	<0.1 U
7/24/2019	Assessment	<0.02 U	34.2	164	0.03 J	<0.01 U	0.418	8.97	0.657	0.05 J	0.2 J	0.00114	- -	0.4 J	0.1 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1601
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.07	11.8	7.17	0.06 J	5.8	120	54.5
8/24/2016	Background	0.035	10.9	6.54	0.05 J	5.6	142	49.1
10/18/2016	Background	<0.002 U	10.1	6.56	0.05 J	6.0	136	39.6
11/7/2016	Background	- -	- -	6.79	0.05 J	5.9	122	39.7
12/13/2016	Background	<0.002 U	10.4	7.79	0.04 J	5.8	140	43.6
2/7/2017	Background	0.109	11.6	9.09	0.05 J	6.0	168	55.6
3/13/2017	Background	0.107	11.2	9.89	0.04 J	6.0	169	57.4
5/23/2017	Background	0.17	11.2	9.75	0.04 J	5.9	182	52.8
6/20/2017	Background	0.107	10.4	8.59	0.04 J	5.9	184	51.3
11/2/2017	Detection	0.087	8.91	9.91	0.05 J	5.8	164	39.1
5/4/2018	Assessment	0.070	11.0	10.3	0.05 J	6.1	159	53.0
9/5/2018	Assessment	<0.002 U	11.6	10.4	0.04 J	7.8	157	52.2
3/19/2019	Assessment	0.05 J	11.9	8.80	<0.01 U	5.8	176	52.7
6/12/2019	Assessment	<0.02 U	11.0	10.0	0.05 J	6.7	185	48.8
7/24/2019	Assessment	<0.04 U	10.3	10.3	0.05 J	5.9	154	44.6

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1601
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.01 J	4.57	128	0.03	0.02	0.4	7.24	0.106	0.06 J	0.366	0.003	<0.002 U	0.32	0.07 J	0.01 J
8/24/2016	Background	<0.01 U	5.14	120	0.02 J	0.02 J	0.3	6.19	0.975	0.05 J	0.109	0.007	<0.002 U	0.62	0.09 J	0.02 J
10/18/2016	Background	0.01 J	5.64	118	0.027	0.02 J	0.688	4.04	2.413	0.05 J	0.265	0.003	<0.002 U	0.26	0.1 J	0.065
11/7/2016	Background	- -	- -	- -	- -	- -	- -	- -	0.842	0.05 J	- -	- -	- -	- -	- -	- -
12/13/2016	Background	0.02 J	5.38	113	0.027	0.02 J	1.35	4.67	1.101	0.04 J	0.272	0.009	<0.002 U	0.16	0.1	0.02 J
2/7/2017	Background	<0.01 U	5.09	107	0.025	0.02 J	0.224	6.20	35.021	0.05 J	0.227	0.004	<0.002 U	0.21	0.1	0.01 J
3/13/2017	Background	<0.01 U	5.54	117	0.023	0.02 J	0.588	6.47	0.7405	0.04 J	0.161	0.004	<0.002 U	0.16	0.05 J	0.01 J
5/23/2017	Background	0.02 J	7.08	122	0.051	0.02	0.740	5.48	0.573	0.04 J	0.687	0.007	<0.002 U	0.21	0.2	0.02 J
6/20/2017	Background	0.02 J	5.57	113	0.02 J	0.02 J	0.215	4.72	1.037	0.04 J	0.142	0.003	<0.002 U	0.17	0.06 J	0.02 J
5/4/2018	Assessment	0.01 J	6.44	112	0.038	0.02	0.353	4.43	1.723	0.05 J	0.397	0.010	<0.002 U	0.20	0.1	0.02 J
9/5/2018	Assessment	0.02 J	5.39	90.4	0.01 J	0.02	0.270	6.73	0.252	0.04 J	0.045	0.002	- -	0.08 J	<0.03 U	0.02 J
3/19/2019	Assessment	<0.02 U	6.55	122	0.02 J	0.01 J	0.1 J	3.41	0.666	<0.01 U	0.105	0.02 J	- -	<0.4 U	0.04 J	<0.1 U
6/12/2019	Assessment	<0.02 U	6.02	118	0.04 J	0.02 J	0.2 J	2.75	0.533	0.05 J	0.154	<0.009 U	<0.002 U	<0.4 U	0.08 J	<0.1 U
7/24/2019	Assessment	<0.02 U	6.63	130	0.02 J	0.01 J	0.2 J	3.01	1.005	0.05 J	0.2 J	0.00141	- -	<0.4 U	0.06 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1602A
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.063	18.2	38.4	0.18	7.0	172	18.7
8/24/2016	Background	0.015	18.2	37.9	0.17	6.1	200	17.7
10/19/2016	Background	0.003 J	17.3	37.2	0.1 J	6.7	242	15.0
11/9/2016	Background	- -	- -	- -	- -	6.3	- -	- -
12/13/2016	Background	<0.002 U	18.8	39.1	0.1 J	6.5	170	10.7
2/8/2017	Background	0.051	17.7	37.3	0.1 J	6.7	144	9.8
3/15/2017	Background	0.039	16.1	38.1	0.1 J	6.8	209	11.4
5/23/2017	Background	0.081	18.5	38.8	0.1 J	6.7	224	11.4
6/20/2017	Background	0.09	18.5	38.3	0.1 J	6.5	178	13.5
11/2/2017	Detection	0.05	18.6	38	0.1 J	6.5	254	12.8
5/10/2018	Assessment	0.127	19.5	39.1	0.16	7.2	184	13.2
9/5/2018	Assessment	<0.002 U	18.1	40.0	0.14	6.4	176	12.7
3/19/2019	Assessment	0.03 J	19.6	41.0	0.14	6.6	232	13.2
6/11/2019	Assessment	<0.02 U	18.8	41.9	0.16	9.5	217	13.8
7/23/2019	Assessment	<0.04 U	16.7	39.4	0.13	6.3	201	10.3

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1602A
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.12	17.6	220	0.085	0.02 J	1.7	4.19	7.914	0.18	7.94	0.004	<0.002 U	3.62	0.2	0.02 J
8/24/2016	Background	0.04 J	18.1	209	0.036	0.006 J	1.1	3.04	0.569	0.17	2.8	0.003	<0.002 U	2.8	0.2	0.01 J
10/19/2016	Background	0.10	18.3	213	0.064	0.01 J	1.46	2.38	2.65	0.1 J	6.56	0.003	0.003 J	2.0	0.2	0.063
11/9/2016	Background	- -	- -	- -	- -	- -	- -	- -	0.874	- -	- -	- -	- -	- -	- -	- -
12/13/2016	Background	0.08	19.3	217	0.048	0.01 J	2.24	2.00	0.989	0.1 J	4.53	0.006	0.002 J	1.90	0.2	0.02 J
2/8/2017	Background	0.05	19.1	194	0.051	0.009 J	0.981	1.87	6.853	0.1 J	4.07	0.005	<0.002 U	1.68	0.2	0.224
3/15/2017	Background	0.04 J	21.5	198	0.055	0.008 J	0.951	1.47	1.094	0.1 J	2.65	0.0005 J	0.002 J	1.22	0.2	0.01 J
5/23/2017	Background	0.04 J	20.8	221	0.029	0.006 J	0.568	1.23	1.833	0.1 J	2.11	0.005	<0.002 U	1.22	0.1	<0.01 U
6/20/2017	Background	0.07	20.3	224	0.043	0.01 J	0.807	1.30	0.901	0.1 J	2.68	<0.0002 U	<0.002 U	1.55	0.2	0.01 J
5/10/2018	Assessment	0.03 J	20.4	223	0.022	<0.005 U	0.437	0.940	0.438	0.16	0.982	0.004	<0.002 U	0.91	0.1	<0.01 U
9/5/2018	Assessment	0.08	20.5	223	0.055	0.01 J	0.855	1.05	0.941	0.14	5.99	0.001	- -	0.71	0.2	0.03 J
3/19/2019	Assessment	0.04 J	19.7	217	0.04 J	<0.01 U	0.472	0.691	0.5231	0.14	2.64	<0.009 U	- -	0.7 J	0.09 J	<0.1 U
6/11/2019	Assessment	<0.04 U	20.6	229	<0.04 U	<0.02 U	0.3 J	0.523	1.144	0.16	0.677	<0.009 U	<0.002 U	<0.8 U	<0.06 U	<0.2 U
7/23/2019	Assessment	<0.02 U	21.7	213	<0.02 U	<0.01 U	0.297	0.545	0.888	0.13	1.08	0.000908	- -	0.7 J	0.06 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1603A
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.051	17.4	4.76	0.29	7.3	116	0.9
8/24/2016	Background	0.012	16.9	5.62	0.28	6.2	84	0.1
10/19/2016	Background	<0.002 U	17.2	5.11	0.29	7.0	168	<0.04 U
11/9/2016	Background	- -	- -	5.6	0.28	6.5	90	<0.04 U
12/13/2016	Background	<0.002 U	16.6	5.41	0.20	6.7	93	<0.04 U
2/9/2017	Background	0.038	15.5	5.00	0.22	7.0	80	<0.04 U
3/15/2017	Background	0.025	15.6	5.12	0.24	7.1	102	<0.04 U
5/24/2017	Background	0.061	15.2	5.35	0.23	6.8	108	<0.04 U
6/20/2017	Background	0.069	14.6	4.93	0.23	6.7	100	<0.04 U
11/2/2017	Detection	0.035	15.2	5.61	0.24	6.7	150	<0.04 U
5/2/2018	Assessment	0.051	17.2	5.18	0.28	6.8	100	<0.04 U
9/5/2018	Assessment	<0.002 U	15.8	4.99	0.28	6.7	89	<0.04 U
3/15/2019	Assessment	<0.2 U	15.5	5.65	0.27	7.1	95	<0.06 U
6/11/2019	Assessment	<0.02 U	15.5	5.7	0.31	8.8	95	<0.06 U
7/24/2019	Assessment	<0.04 U	14.4	5.73	0.28	6.8	102	<0.06 U

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1603A
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.04 J	78	303	0.052	0.01 J	1.2	1.04	1.619	0.29	1.35	0.002	<0.002 U	2.11	0.09 J	0.01 J
8/24/2016	Background	0.03 J	77.6	264	0.044	0.008 J	1.0	0.725	0.726	0.28	1.07	0.007	<0.002 U	1.36	0.1 J	<0.01 U
10/19/2016	Background	0.04 J	73.7	258	0.096	0.01 J	1.94	1.23	2.39	0.29	2.18	<0.0002 U	<0.002 U	1.34	0.2	0.02 J
11/9/2016	Background	- -	- -	- -	- -	- -	- -	- -	1.039	0.28	- -	- -	- -	- -	- -	- -
12/13/2016	Background	0.05 J	78.3	270	0.102	0.01 J	3.27	1.13	0.524	0.20	1.81	0.009	<0.002 U	1.22	0.2	0.03 J
2/9/2017	Background	0.01 J	78.3	229	0.055	0.008 J	0.915	0.746	0.693	0.22	1.19	0.0005 J	<0.002 U	1.15	0.2	0.075
3/15/2017	Background	0.04 J	83.4	245	0.070	0.01 J	1.42	1.02	0.974	0.24	1.25	0.002	0.002 J	1.27	0.1	0.01 J
5/24/2017	Background	0.05	63.3	233	0.033	0.009 J	0.999	0.619	0.72	0.23	0.900	0.011	<0.002 U	1.56	0.09 J	<0.01 U
6/20/2017	Background	0.03 J	81.3	257	0.054	0.02	1.12	0.846	0.603	0.23	0.970	0.004	<0.002 U	1.11	0.1	0.01 J
5/2/2018	Assessment	0.04 J	80.0	251	0.093	0.01 J	1.82	1.52	0.23065	0.28	1.60	0.0008 J	<0.002 U	1.21	0.3	0.02 J
9/5/2018	Assessment	0.02 J	87.1	242	0.006 J	0.007 J	0.180	0.246	0.577	0.28	0.045	0.002	- -	1.07	0.04 J	0.01 J
3/15/2019	Assessment	<0.02 U	89.9	252	<0.02 U	<0.01 U	0.407	0.360	1.261	0.27	0.232	<0.09 U	- -	1 J	0.05 J	<0.1 U
6/11/2019	Assessment	<0.02 U	90.3	255	<0.02 U	<0.01 U	0.28	0.288	0.3562	0.31	0.163	<0.009 U	<0.002 U	1 J	0.04 J	<0.1 U
7/24/2019	Assessment	<0.02 U	85.8	249	0.04 J	<0.01 U	0.650	0.517	0.439	0.28	0.580	0.00087	- -	1 J	0.07 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1604
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.116	20.5	23	0.1 J	6.2	236	2.2
8/22/2016	Background	0.074	18.0	22.9	0.05 J	6.2	168	0.3
10/18/2016	Background	0.059	18.2	22.6	0.05 J	6.3	196	0.3
11/8/2016	Background	- -	- -	22.5	0.05 J	6.2	206	0.3
12/13/2016	Background	0.042	17.9	24.0	0.05 J	6.1	182	0.9
2/8/2017	Background	0.094	16.6	23.1	0.09	6.2	172	0.7
3/14/2017	Background	0.083	16.1	24.1	0.08	6.4	204	0.9
5/23/2017	Background	0.129	17.4	26.1	0.08	6.1	222	2.2
6/20/2017	Background	0.152	16.2	25.2	0.09	6.2	224	1.2
11/1/2017	Detection	0.153	16.8	23.4	0.1	6.1	228	0.5
5/3/2018	Assessment	0.200	17.8	25.5	0.13	6.4	210	<0.04 U
9/5/2018	Assessment	0.043	15.1	22.8	0.12	7.2	180	<0.04 U
3/15/2019	Assessment	<0.2 U	13.1	16.6	0.09	6.3	170	<0.06 U
6/10/2019	Assessment	0.09 J	16.5	24.4	0.11	8.7	60	<0.06 U
7/24/2019	Assessment	0.132	18.7	27.0	0.07	5.9	242	<0.06 U

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1604
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.05 J	4.43	139	0.087	0.007 J	1.9	2.06	3.5822	0.1 J	1.58	0.002	<0.002 U	0.74	0.2	0.02 J
8/22/2016	Background	0.04 J	5.15	147	0.063	0.02 J	1.4	1.06	0.695	0.05 J	1.14	0.004	0.002 J	0.64	0.2	0.02 J
10/18/2016	Background	0.03 J	4.60	134	0.048	0.005 J	1.27	0.805	1.387	0.05 J	0.869	<0.0002 U	<0.002 U	0.30	0.2	0.01 J
11/8/2016	Background	- -	- -	- -	- -	- -	- -	- -	0.512	0.05 J	- -	- -	- -	- -	- -	- -
12/13/2016	Background	0.02 J	4.58	137	0.038	<0.004 U	1.20	0.632	1.743	0.05 J	0.603	0.004	<0.002 U	0.25	0.2	0.02 J
2/8/2017	Background	0.02 J	4.52	125	0.039	<0.004 U	0.814	0.638	1.239	0.09	0.719	0.004	<0.002 U	0.32	0.2	0.05 J
3/14/2017	Background	0.02 J	4.46	132	0.038	<0.004 U	0.824	0.570	0.892	0.08	0.482	0.0008 J	<0.002 U	0.22	0.2	<0.01 U
5/23/2017	Background	0.04 J	3.90	142	0.042	<0.005 U	0.836	0.647	0.859	0.08	0.444	0.006	<0.002 U	0.21	0.2	<0.01 U
6/20/2017	Background	0.02 J	4.44	146	0.040	<0.005 U	0.706	0.601	1.459	0.09	0.406	0.003	<0.002 U	0.20	0.2	<0.01 U
5/3/2018	Assessment	0.02 J	6.33	146	0.047	<0.005 U	0.556	0.494	1.334	0.13	0.230	<0.0002 U	<0.002 U	0.25	0.2	0.01 J
9/5/2018	Assessment	0.03 J	6.11	135	0.043	<0.005 U	0.649	0.533	0.248	0.12	0.349	0.0008 J	- -	0.22	0.3	0.01 J
3/15/2019	Assessment	0.04 J	6.78	118	0.07 J	<0.01 U	0.931	0.406	0.596	0.09	1.19	<0.09 U	- -	<0.4 U	0.2	<0.1 U
6/10/2019	Assessment	0.05 J	4.88	142	0.142	<0.01 U	0.360	0.306	0.831	0.11	0.148	<0.009 U	<0.002 U	<0.4 U	0.1 J	<0.1 U
7/24/2019	Assessment	<0.02 U	4.76	170	0.06 J	<0.01 U	1.33	0.415	0.943	0.07	0.294	0.000485	- -	0.4 J	0.1 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1605
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.091	63.6	111	0.09	6.2	490	170
8/22/2016	Background	0.038	50.8	114	0.08	5.9	440	174
10/17/2016	Background	0.025	57.5	108	0.06 J	6.1	446	161
11/8/2016	Background	- -	- -	116	0.06 J	5.9	456	162
12/12/2016	Background	<0.002 U	53.9	125	<0.05 U	5.8	920	164
2/7/2017	Background	0.055	47.6	110	<0.05 U	5.9	472	161
3/13/2017	Background	0.039	45.7	106	0.03 J	5.8	455	173
5/22/2017	Background	0.071	46.4	109	0.03 J	6.6	458	171
6/19/2017	Background	0.103	48.1	111	<0.02 U	5.5	462	193
11/1/2017	Detection	0.076	50.0	113	0.03 J	5.6	488	212
1/9/2018	Detection	- -	45.9	108	- -	5.5	462	202
5/3/2018	Assessment	0.109	47.0	97.7	<0.02 U	6.1	434	246
9/5/2018	Assessment	<0.002 U	49.4	97.1	0.03 J	5.6	483	213
3/14/2019	Assessment	<0.2 U	45.4	92.5	<0.01 U	5.6	507	222
6/11/2019	Assessment	0.06 J	45.5	91.8	0.02 J	5.7	530	226
7/24/2019	Assessment	0.06 J	46.5	91.6	0.02 J	5.4	517	226

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1605
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.04 J	5.7	83.2	0.035	<0.004 U	0.4	32.1	1.722	0.09	0.201	0.008	<0.002 U	0.66	0.05 J	<0.01 U
8/22/2016	Background	0.03 J	4.96	69.1	0.027	<0.004 U	0.1	24.5	0.683	0.08	0.062	0.004	<0.002 U	0.39	0.06 J	<0.01 U
10/17/2016	Background	0.02 J	4.98	67.3	0.034	<0.004 U	0.244	15.8	5.063	0.06 J	0.038	0.005	<0.002 U	0.27	0.06 J	<0.01 U
11/8/2016	Background	- -	- -	- -	- -	- -	- -	- -	1.249	0.06 J	- -	- -	- -	- -	- -	- -
12/12/2016	Background	0.03 J	4.33	73.8	0.060	0.005 J	0.645	11.5	0.853	<0.05 U	0.159	0.011	<0.002 U	0.30	0.1	0.062
2/7/2017	Background	0.03 J	4.03	68.8	0.063	<0.004 U	0.381	10.3	0.586	<0.05 U	0.298	0.004	<0.002 U	0.36	0.1	0.04 J
3/13/2017	Background	0.01 J	3.70	75.1	0.056	<0.004 U	0.456	9.14	1.073	0.03 J	0.059	0.005	<0.002 U	0.12	0.03 J	<0.01 U
5/22/2017	Background	0.03 J	3.38	80.5	0.062	<0.005 U	0.193	8.77	0.852	0.03 J	0.071	0.003	<0.002 U	0.15	0.04 J	0.02 J
6/19/2017	Background	0.01 J	3.64	82.2	0.061	<0.005 U	0.250	9.07	0.746	<0.02 U	0.050	0.004	<0.002 U	0.12	0.08 J	<0.01 U
5/3/2018	Assessment	0.01 J	3.34	80.4	0.069	0.009 J	0.176	9.75	1.068	<0.02 U	0.148	0.006	<0.002 U	0.10	0.1	0.01 J
9/5/2018	Assessment	0.02 J	3.19	103	0.074	0.02 J	0.260	10.7	0.916	0.03 J	0.080	0.003	- -	0.1 J	0.07 J	0.02 J
3/14/2019	Assessment	<0.02 U	2.95	88.1	0.08 J	<0.01 U	0.2 J	8.83	0.3036	<0.01 U	0.161	<0.09 U	- -	<0.4 U	0.05 J	<0.1 U
6/11/2019	Assessment	<0.02 U	3.01	93.2	0.07 J	0.01 J	0.2 J	9.09	1.061	0.02 J	0.06 J	<0.009 U	<0.002 U	<0.4 U	0.06 J	<0.1 U
7/24/2019	Assessment	<0.02 U	2.82	108	0.09 J	<0.01 U	0.306	8.57	0.739	0.02 J	0.2 J	0.00255	- -	<0.4 U	0.08 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1606
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2016	Background	0.084	43.4	55.5	0.03 J	5.7	410	189
8/23/2016	Background	0.023	45.6	56.8	<0.05 U	5.3	372	186
10/17/2016	Background	0.013	47.3	61.5	<0.05 U	5.6	390	202
11/7/2016	Background	- -	- -	- -	- -	5.5	- -	- -
12/12/2016	Background	<0.002 U	50.4	27.0	<0.02 U	5.3	418	215
2/7/2017	Background	0.048	42.2	57.9	<0.05 U	5.7	370	179
3/14/2017	Background	0.036	42.2	59.5	<0.05 U	5.6	384	180
5/23/2017	Background	0.061	49.2	75.0	<0.05 U	5.6	442	199
6/19/2017	Background	0.108	48.3	78.8	<0.05 U	5.3	440	219
11/1/2017	Detection	0.055	51.6	91.4	<0.05 U	5.3	462	227
1/8/2018	Detection	- -	43.9	88.3	- -	8.4	400	190
5/4/2018	Assessment	0.077	53.0	119	0.03 J	7.5	478	232
9/5/2018	Assessment	0.032	51.7	133	<0.02 U	5.4	507	202
3/15/2019	Assessment	<0.2 U	59.0	157	<0.01 U	5.4	597	232
6/11/2019	Assessment	0.04 J	56.6	177	0.02 J	6.7	571	204
7/24/2019	Assessment	0.04 J	52.8	186	0.02 J	5.4	597	191

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1606
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/25/2016	Background	0.04 J	2.89	71.8	0.112	0.12	1.3	14.9	0.2045	0.03 J	1.01	0.005	<0.002 U	0.26	0.09 J	0.03 J
8/23/2016	Background	0.02 J	2.58	67.2	0.087	0.14	0.6	14.5	1.039	<0.05 U	0.483	0.007	<0.002 U	0.14	0.1 J	0.01 J
10/17/2016	Background	0.03 J	2.58	69.5	0.131	0.14	1.58	13.1	1.347	<0.05 U	1.20	0.006	0.002 J	0.15	0.2	0.02 J
11/7/2016	Background	- -	- -	- -	- -	- -	- -	- -	1.331	- -	- -	- -	- -	- -	- -	- -
12/12/2016	Background	0.03 J	2.55	65.8	0.100	0.17	1.03	13.9	0.651	<0.02 U	0.588	0.010	<0.002 U	0.12	0.2	0.04 J
2/7/2017	Background	0.03 J	3.50	57.5	0.134	0.31	1.76	14.2	0.886	<0.05 U	1.55	0.003	<0.002 U	0.29	0.3	0.05 J
3/14/2017	Background	0.02 J	3.52	56.3	0.091	0.16	0.920	13.4	2.45	<0.05 U	0.572	0.003	<0.002 U	0.14	0.1	0.01 J
5/23/2017	Background	0.02 J	2.83	59.8	0.085	0.12	0.286	14.2	0.236	<0.05 U	0.448	0.007	<0.002 U	0.1 J	0.1	0.01 J
6/19/2017	Background	0.03 J	3.42	61.8	0.097	0.13	0.596	13.7	0.769	<0.05 U	0.666	<0.0002 U	<0.002 U	0.13	0.09 J	0.02 J
5/4/2018	Assessment	0.01 J	2.81	58.7	0.088	0.15	0.289	16.9	1.012	0.03 J	0.286	0.003	<0.002 U	0.07 J	0.1	0.02 J
9/5/2018	Assessment	0.01 J	2.21	61.0	0.073	0.17	0.249	16.4	0.1805	<0.02 U	0.088	0.003	- -	0.04 J	0.06 J	0.01 J
3/15/2019	Assessment	0.03 J	2.94	74.6	0.152	0.19	1.24	18.2	0.295	<0.01 U	1.06	<0.09 U	- -	<0.4 U	0.2 J	<0.1 U
6/11/2019	Assessment	<0.02 U	2.44	64.1	0.08 J	0.18	0.2 J	16.5	0.4433	0.02 J	0.181	<0.009 U	<0.002 U	<0.4 U	0.06 J	<0.1 U
7/24/2019	Assessment	0.03 J	3.44	72.9	0.14	0.21	1.14	16.2	0.743	0.02 J	1.11	0.0034	- -	<0.4 U	0.2 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 2: Residence Time Calculation Summary
Amos Bottom Ash Pond

			2019-03		2019-06		2019-07	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Pond	MW-1 [2]	2.0	27.5	2.2	22.1	2.7	23.7	2.6
	MW-4 [2]	2.0	72.9	0.8	100	0.6	64.5	0.9
	MW-5 [2]	2.0	40.0	1.5	39.6	1.5	41.6	1.5
	MW-6 [1]	2.0	74.1	0.8	157	0.4	75.7	0.8
	MW-1601 [1]	2.0	20.4	3.0	17.6	3.5	16.6	3.7
	MW-1602A [1]	2.0	7.7	7.9	8.7	7.0	7.2	8.5
	MW-1603A [1]	2.0	138	0.4	131	0.5	131	0.5
	MW-1604 [2]	2.0	84.2	0.7	78.1	0.8	86.8	0.7
	MW-1605 [2]	2.0	29.7	2.1	24.8	2.5	25.5	2.4
	MW-1606 [2]	2.0	29.7	2.0	28.7	2.1	23.8	2.6

Notes:
[1] - Background Well
[2] - Downgradient Well

Legend
- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on March 14, 2019) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
March 2019

AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/01/24

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_BAP_GW_2019-03_March.mxd. ARevezzo. 1/24/2020. CHA8423/04/08.

Legend
- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on June 10, 2019) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

1,000 500 0 1,000
Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2019

AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/12/26

Figure 2

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_BAP_GW_2019-06_June.mxd. ARevezzo. 12/26/2019. CHA8423/04/08.

Legend
- Monitoring Well Location
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on July 22, 2019) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

1,000 500 0 1,000 Feet

Potentiometric Surface Map - Uppermost Aquifer
July2019

AEP Amos Generating Plant - Ash Pond System
Winfield, West Virginia

Geosyntec
consultants

Columbus, Ohio | 2020/01/14

Figure
3

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_BAP_GW_2019-07_July.mxd. ARevezzo. 1/14/2020. CHA8423/04/08.

APPENDIX 2 - Statistical Analysis

Statistical analysis reports completed in 2019 follow.

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Amos Plant
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

January 8, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for calcium, chloride, total dissolved solids (TDS), and sulfate at the BAP. An alternate source was not identified at the time, so two assessment monitoring events were conducted at the BAP in 2018, in accordance with 40 CFR 257.95.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified, but Appendix III concentrations for calcium, chloride, pH, sulfate, and TDS remained above background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. A summary of data collected during assessment monitoring may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.5 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(b) and 257.95(d)(1) were screened for potential outliers. No outliers were identified. Outliers identified from the background and detection monitoring events conducted through January 2018 were summarized in a previous report (Geosyntec, 2018).

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or regional screening level (RSL) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events.

Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for arsenic, cadmium, fluoride, selenium, and thallium due to apparent non-normal distributions and for mercury due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Amos BAP.

2.2.3 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for fluoride and pH, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS.

Prediction limits for the interwell tests were recalculated using data collected during the 2018 assessment monitoring events. Eight data points (i.e., two samples from four background wells) were added to the background dataset for each interwell test. New data were tested for outliers prior to being added to the background dataset. The updated prediction limits were calculated for a one-of-two retesting procedure, as during detection monitoring. The values of the updated prediction limits were similar to the values of the prediction limits calculated during detection monitoring. The revised prediction limits were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS.

For the intrawell tests, limited data made it possible to add only two data points (i.e., two samples from each compliance well) to each background dataset. Because two sample results are insufficient to compare against the existing background dataset, the prediction limits were not updated for the intrawell tests at this time. The prediction limits calculated during detection monitoring were used to evaluate potential SSIs for fluoride and pH.

Data collected during the second assessment monitoring event from each compliance well were compared to the prediction limits to evaluate SSIs. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Calcium concentrations exceeded the interwell UPL of 19.5 mg/L at MW-1 (39.9 mg/L and 38.3 mg/L), MW-1605 (47.0 mg/L and 49.4 mg/L), and MW-1606 (53.0 mg/L and 51.7 mg/L).

- Chloride concentrations exceeded the interwell UPL of 40 mg/L at MW-1 (71.9 mg/L and 67.9 mg/L), MW-1605 (97.1 mg/L for both events), and MW-1606 (119 mg/L and 133 mg/L).

- Sulfate concentrations exceeded the interwell UPL of 57.4 mg/L at MW-1 (154 mg/L and 145 mg/L), MW-1605 (246 mg/L and 213 mg/L), and MW-1606 (232 mg/L and 202 mg/L).

- TDS concentrations exceeded the interwell UPL of 250 mg/L at MW-1 (328 mg/L and 338 mg/L), MW-1605 (434 mg/L and 483 mg/L), and MW-1606 (478 mg/L and 507 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Amos BAP during assessment monitoring. As a result, the Amos BAP CCR unit will remain in assessment monitoring.

2.3 Conclusions

Two assessment monitoring events were conducted in 2018 in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the 2018 data. GWPSs were established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS, and intrawell tests were used to evaluate potential SSIs for fluoride and pH. The prediction limits for the interwell tests were updated with additional data collected from the background wells. Prediction limits were recalculated using a one-of-two retesting procedure. The prediction limits calculated during detection monitoring were used for the intrawell tests. Calcium, chloride, pH, sulfate, and TDS results exceeded background levels.

Based on this evaluation, the Amos BAP CCR unit will either remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Amos Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, John E. Amos Plant, Winfield, West Virginia. January 15, 2018.

TABLES

Table 1 – Groundwater Data Summary
Amos – Bottom Ash Pond

Parameter	Unit	BAP-MW-1		BAP-MW-4		BAP-MW-5		BAP-MW-6		BAP-MW-1601		BAP-MW-1602A		BAP-MW-1603A		BAP-MW-1604		BAP-MW-1605		BAP-MW-1606	
		5/3/2018	9/4/2018	5/3/2018	9/5/2018	5/3/2018	9/4/2018	5/3/2018	9/4/2018	5/4/2018	9/5/2018	5/10/2018	9/5/2018	5/2/2018	9/5/2018	5/3/2018	9/5/2018	5/3/2018	9/5/2018	5/4/2018	9/5/2018
Antimony	µg/L	0.0100 J	0.220	0.05 U	0.0500 J	0.0200 J	0.0200 J	0.0100 J	0.160	0.0100 J	0.0200 J	0.0300 J	0.0800	0.0400 J	0.0200 J	0.0200 J	0.0300 J	0.0100 J	0.0200 J	0.0100 J	0.0100 J
Arsenic	µg/L	0.130	0.180	1.15	11.0	3.18	2.34	34.1	29.8	6.44	5.39	20.4	20.5	80.0	87.1	6.33	6.11	3.34	3.19	2.81	2.21
Barium	µg/L	27.8	29.4	93.1	89.1	149	157	163	147	112	90.4	223	223	251	242	146	135	80.4	103	58.7	61.0
Beryllium	µg/L	0.143	0.130	0.0460	0.0370	0.0490	0.0340	0.0280	0.0100 J	0.0380	0.0100 J	0.0220	0.0550	0.0930	0.00600 J	0.0470	0.0430	0.0690	0.0740	0.0880	0.0730
Boron	mg/L	0.0950	0.0940	0.100	0.0670	0.156	0.0280	0.0560	0.005 U	0.0700	0.005 U	0.127	0.005 U	0.0510	0.005 U	0.200	0.0430	0.109	0.005 U	0.0770	0.0320
Cadmium	µg/L	3.12	2.97	0.0400	0.210	0.00600 J	0.0100 J	0.02 U	0.0300	0.0200	0.0200	0.02 U	0.0100 J	0.0100 J	0.00700 J	0.02 U	0.02 U	0.00900 J	0.0200 J	0.150	0.170
Calcium	mg/L	39.9	38.3	15.9	13.3	16.6	15.2	12.0	11.3	11.0	11.6	19.5	18.1	17.2	15.8	17.8	15.1	47.0	49.4	53.0	51.7
Chloride	mg/L	71.8	67.9	14.4	13.4	17.8	17.8	10.1	8.97	10.3	10.4	39.1	40.0	5.18	4.99	25.5	22.8	97.7	97.1	119	133
Chromium	µg/L	0.0930	0.548	0.175	0.200	0.237	0.122	0.455	0.380	0.353	0.270	0.437	0.855	1.82	0.180	0.556	0.649	0.176	0.260	0.289	0.249
Cobalt	µg/L	15.1	17.7	7.93	25.8	1.03	1.03	11.9	9.16	4.43	6.73	0.940	1.05	1.52	0.246	0.494	0.533	9.75	10.7	16.9	16.4
Combined Radium	pCi/L	1.74	0.575	1.57	0.623	1.63	0.338	2.01	0.769	1.72	0.252	0.438	0.941	0.231	0.577	1.33	0.248	1.07	0.916	1.01	0.181
Fluoride	mg/L	0.0200 J	0.0300 J	0.0600 J	0.0600	0.0400 J	0.0500 J	0.0700	0.0900	0.0500 J	0.0400 J	0.160	0.140	0.280	0.280	0.130	0.120	0.06 U	0.0300 J	0.0300 J	0.06 U
Lead	µg/L	0.0680	1.16	0.153	0.0830	0.147	0.0380	0.216	0.214	0.397	0.0450	0.982	5.99	1.60	0.0450	0.230	0.349	0.148	0.0800	0.286	0.0880
Lithium	mg/L	0.00400	0.00300	0.000800 J	0.00300	0.000400 J	0.00200	0.001 U	0.001 U	0.0100	0.00200	0.00400	0.00100	0.000800 J	0.00200	0.001 U	0.000800 J	0.00600	0.00300	0.00300	0.00300
Mercury	µg/L	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-
Molybdenum	µg/L	0.620	0.340	0.310	0.280	0.310	0.150	0.500	0.460	0.200	0.0800 J	0.910	0.710	1.21	1.07	0.250	0.220	0.100	0.100 J	0.0700 J	0.0400 J
Selenium	µg/L	0.200	0.200	0.0600 J	0.0600 J	0.0500 J	0.1 U	0.200	0.100	0.100	0.1 U	0.100	0.200	0.300	0.0400 J	0.200	0.300	0.100	0.0700 J	0.100	0.0600 J
Total Dissolved Solids	mg/L	328	338	178	179	166	151	188	176	159	157	184	176	100	89.0	210	180	434	483	478	507
Sulfate	mg/L	154	145	49.2	42.4	51.9	45.4	2.90	1.30	53.0	52.2	13.2	12.7	0.1 U	0.1 U	0.1 U	0.1 U	246	213	232	202
Thallium	µg/L	0.0400 J	0.0500 J	0.0100 J	0.109	0.05 U	0.0300 J	0.0920	0.0840	0.0200 J	0.0200 J	0.05 U	0.0300 J	0.0200 J	0.0100 J	0.0100 J	0.0100 J	0.0100 J	0.0200 J	0.0200 J	0.0100 J
pH	SU	7.31	5.11	5.88	7.00	6.33	5.75	6.34	6.04	6.14	7.76	7.24	6.42	6.76	6.71	6.43	7.20	6.11	5.62	7.49	5.43

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not analyzed

Table 2: Groundwater Protection Standards
Amos Plant - Bottom Ash Pond

Constituent Name	MCL	RSL	Calculated UTL
Antimony, Total (mg/L)	0.006		0.0001
Arsenic, Total (mg/L)	0.01		0.087
Barium, Total (mg/L)	2		0.31
Beryllium, Total (mg/L)	0.004		0.000092
Cadmium, Total (mg/L)	0.005		0.00003
Chromium, Total (mg/L)	0.1		0.0026
Cobalt, Total (mg/L)	n/a	0.006	0.031
Combined Radium, Total (pCi/L)	5		5.2
Fluoride, Total (mg/L)	4		0.29
Lead, Total (mg/L)	n/a	0.015	0.0066
Lithium, Total (mg/L)	n/a	0.04	0.012
Mercury, Total (mg/L)	0.002		0.000005
Molybdenum, Total (mg/L)	n/a	0.1	0.003
Selenium, Total (mg/L)	0.05		0.0003
Thallium, Total (mg/L)	0.002		0.00022

Notes:
Grey cell indicates calculated UTL is higher than MCL.
MCL = Maximum Contaminant Level
RSL = Regional Screening Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/RSL is used as the GWPS.

Table 3: Appendix III Data Evaluation
Amos Plant - Bottom Ash Pond

Parameter	Units	Description	MW-1		MW-4		MW-5		MW-1604		MW-1605		MW-1606	
			5/3/2018	9/4/2018	5/3/2018	9/5/2018	5/3/2018	9/4/2018	5/3/2018	9/5/2018	5/3/2018	9/5/2018	5/4/2018	9/5/2018
Boron	mg/L	Interwell Background Value (UPL)	0.165											
		Assessment Monitoring Result	0.095	0.094	0.1	0.067	0.156	0.028	**0.200**	0.043	0.109	0.002	0.077	0.032
Calcium	mg/L	Interwell Background Value (UPL)	19.5											
		Assessment Monitoring Result	**39.9**	**38.3**	15.9	13.3	16.6	15.2	17.8	15.1	**47.0**	**49.4**	**53.0**	**51.7**
Chloride	mg/L	Interwell Background Value (UPL)	40											
		Assessment Monitoring Result	**71.8**	**67.9**	14.4	13.4	17.8	17.8	25.5	22.8	**97.7**	**97.1**	**119**	**133**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.06		0.247		0.2		0.127		0.108		0.2	
		Assessment Monitoring Result	0.02	0.03	0.06	0.06	0.04	0.05	**0.13**	0.12	0.02	0.03	0.03	0.02
pH	SU	Intrawell Background Value (UPL)	6.13		6.39		6.66		6.43		6.74		5.97	
		Intrawell Background Value (LPL)	4.90		5.04		4.96		6.00		5.18		5.03	
		Assessment Monitoring Result	**7.31**	5.11	5.88	**7.00**	6.33	5.75	6.43	**7.20**	6.11	5.62	**7.49**	5.43
Sulfate	mg/L	Interwell Background Value (UPL)	57											
		Assessment Monitoring Result	**154**	**145**	49.2	42.4	51.9	45.4	0.04	0.04	**246**	**213**	**232**	**202**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	250											
		Assessment Monitoring Result	**328**	**338**	178	179	166	151	210	180	**434**	**483**	**478**	**507**

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
NA: Not analyzed
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

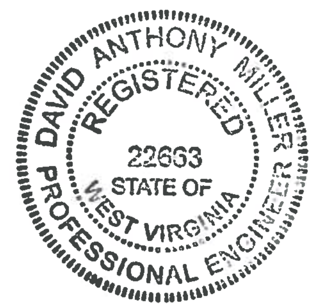
I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Amos Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature



22663	WEST VIRGINIA	01.08.19
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

November 11, 2018

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
150 E. Wilson Bridge Rd., #232
Worthington, OH 43085

Re: Amos Bottom Ash Pond
Assessment Monitoring Event – September 2018

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the evaluation of groundwater data for the September 2018 Assessment Monitoring event for American Electric Power Company's Amos Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** BAP-MW-1601, BAP-MW-1602A, BAP-MW-1603A, and BAP-MW-6; and
- **Downgradient wells:** BAP-MW-1, BAP-MW-1604, BAP-MW-1605, BAP-MW-1606, BAP-MW-4, and BAP-MW-5.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;
- **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record. Values in background which have previously been flagged as outliers may be seen in a lighter font and disconnected symbol on the graphs.

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron, calcium, chloride, sulfate and TDS; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for fluoride and pH. In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result and, therefore, no further action is necessary. SSIs were noted for some of the Appendix III parameters and the results of those findings may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether data are statistically increasing, decreasing or stable. No statistically significant trends were found except for a statistically significant increasing trend for chloride in upgradient well MW-BAP-1601 and in downgradient well MW-BAP-1606. The Trend Test Summary Table follows this letter. Typically when trends are noted in upgradient wells, it is an indication of changing groundwater quality unrelated to the facility.

Evaluation of Appendix IV Parameters

Parametric tolerance limits were used to calculate background limits from pooled upgradient well data for Appendix IV parameters with a target of 95% confidence and

95% coverage to determine the Alternate Contaminant Level (ACL). The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and Regional Screening Levels (RSLs) in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons.

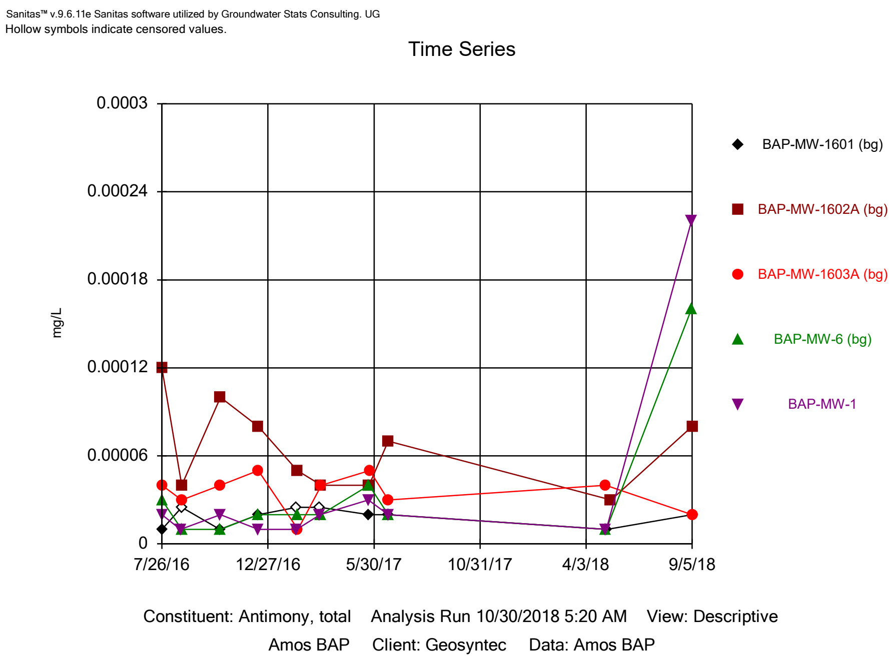
Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, RSL, or ACL as discussed above. Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No exceedances were noted for any of the well/constituent pairs. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Amos Bottom Ash Pond. If you have any questions or comments, please feel free to contact me.

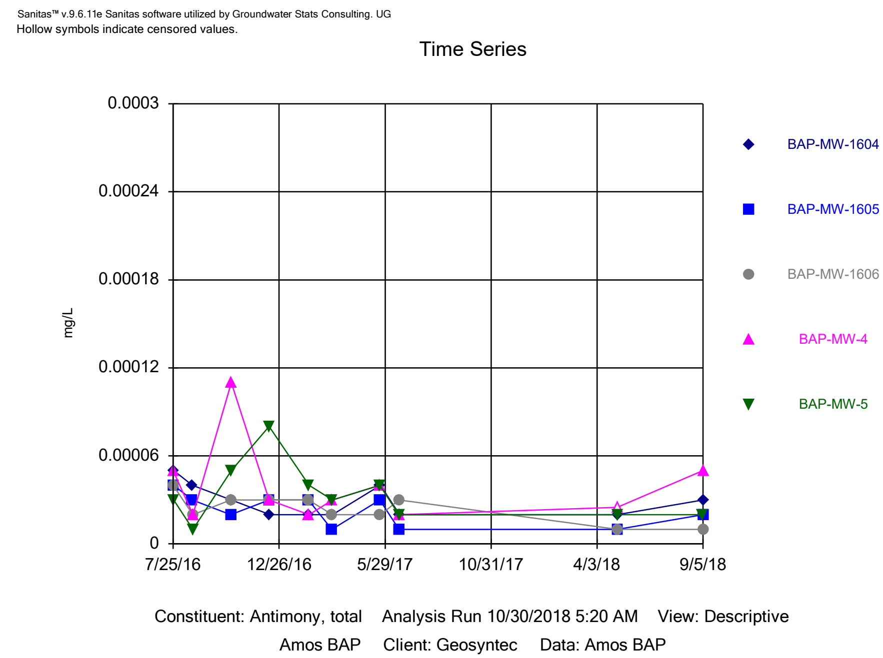
For Groundwater Stats Consulting,

Kristina Rayner

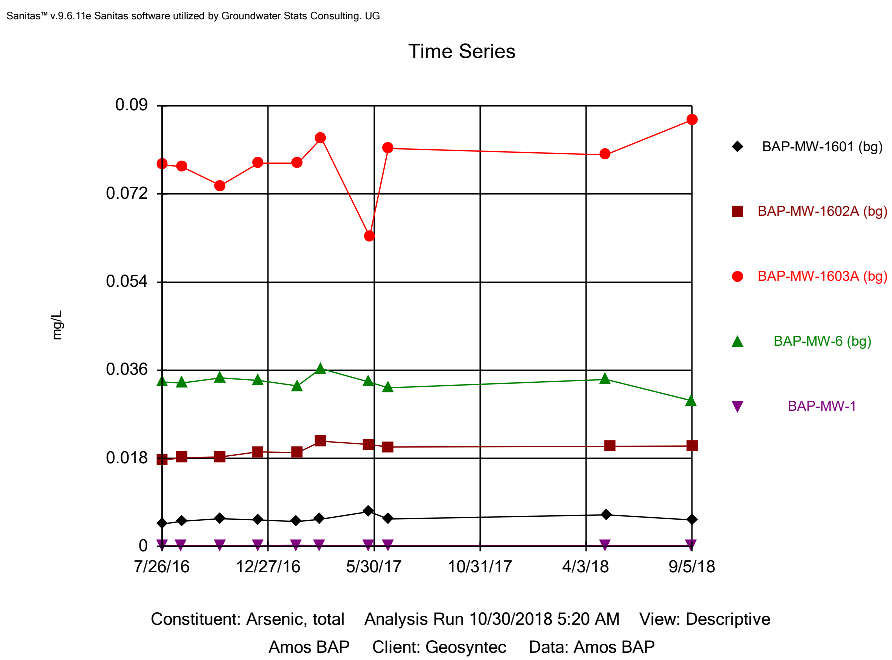
Kristina L. Rayner
Groundwater Statistician



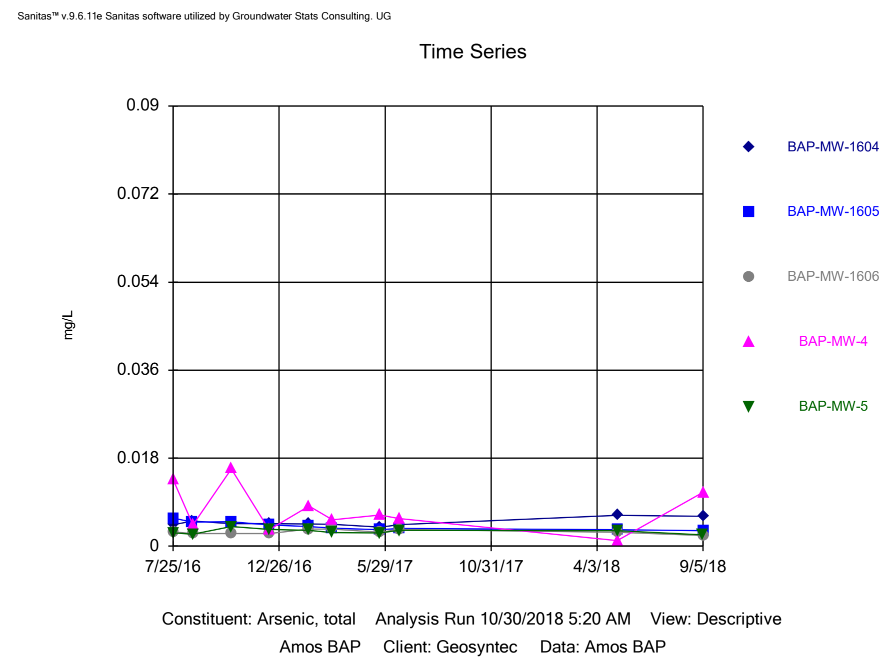
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0003
0.00024
0.00018
0.00012
0.00006
0
mg/L
7/26/16
12/27/16
5/30/17
10/31/17
4/3/18
9/5/18
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
Constituent: Antimony, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0003
0.00024
0.00018
0.00012
0.00006
0
mg/L
7/25/16
12/26/16
5/29/17
10/31/17
4/3/18
9/5/18
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Antimony, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

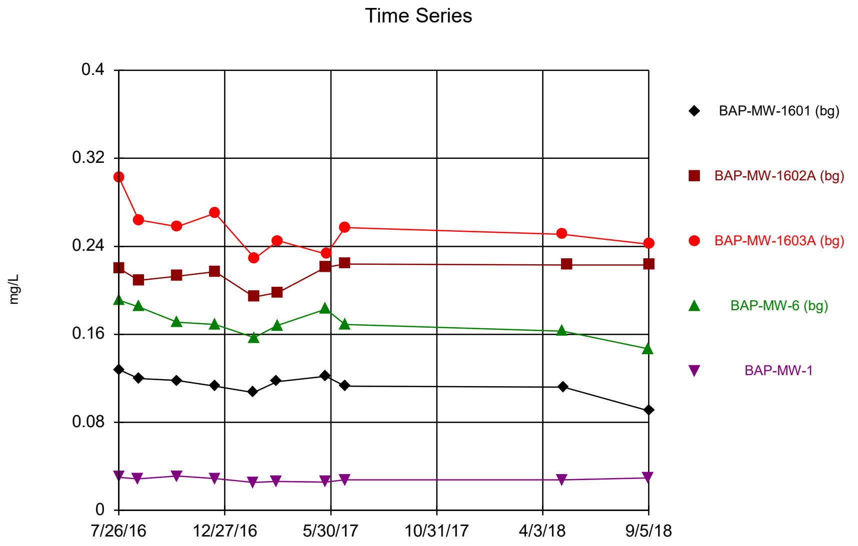


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/26/16
12/27/16
5/30/17
10/31/17
4/3/18
9/5/18
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
Constituent: Arsenic, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



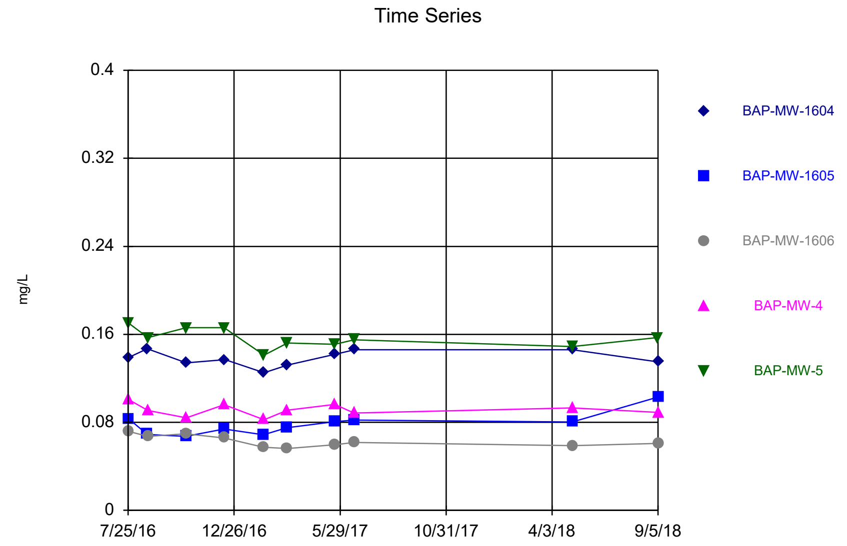
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/25/16
12/26/16
5/29/17
10/31/17
4/3/18
9/5/18
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Arsenic, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



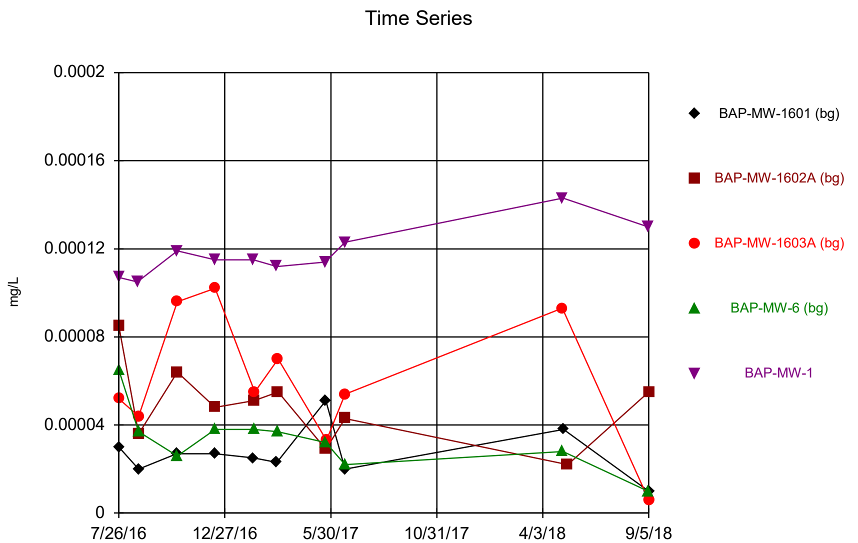
Constituent: Barium, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



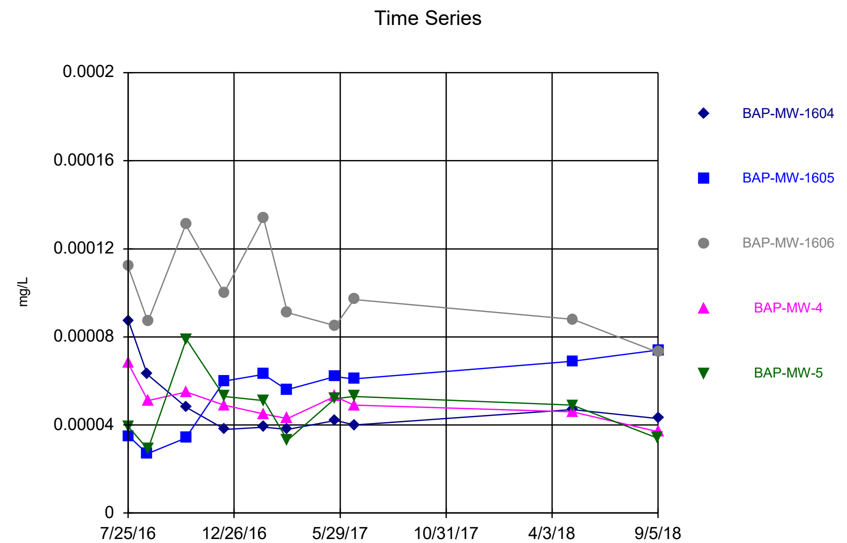
Constituent: Barium, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



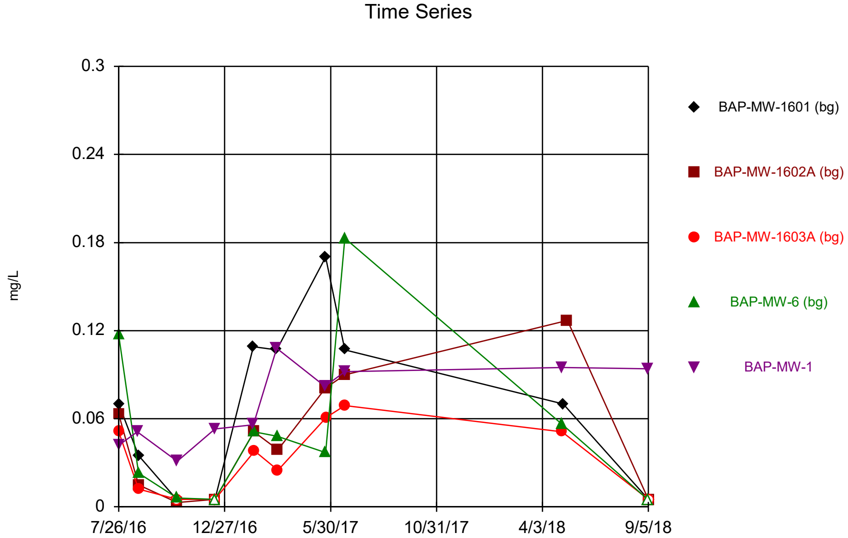
Constituent: Beryllium, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



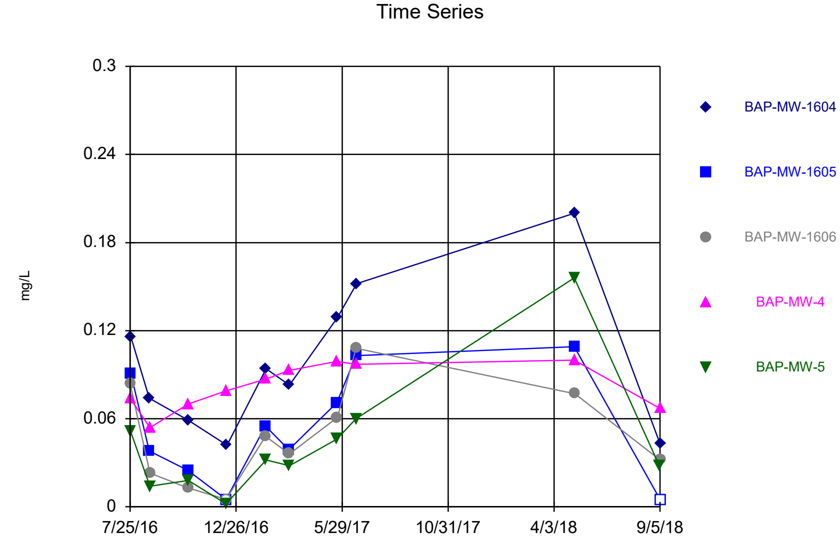
Constituent: Beryllium, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



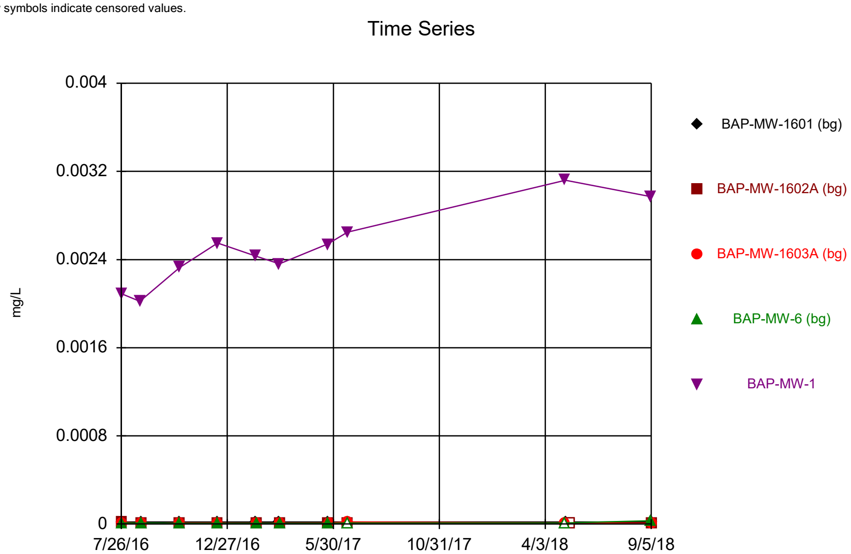
Constituent: Boron, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



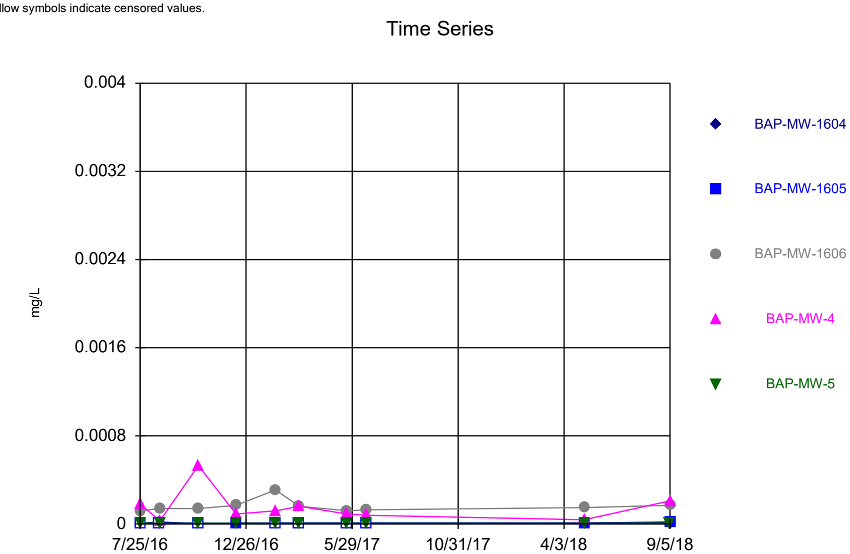
Constituent: Boron, total Analysis Run 10/30/2018 5:20 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

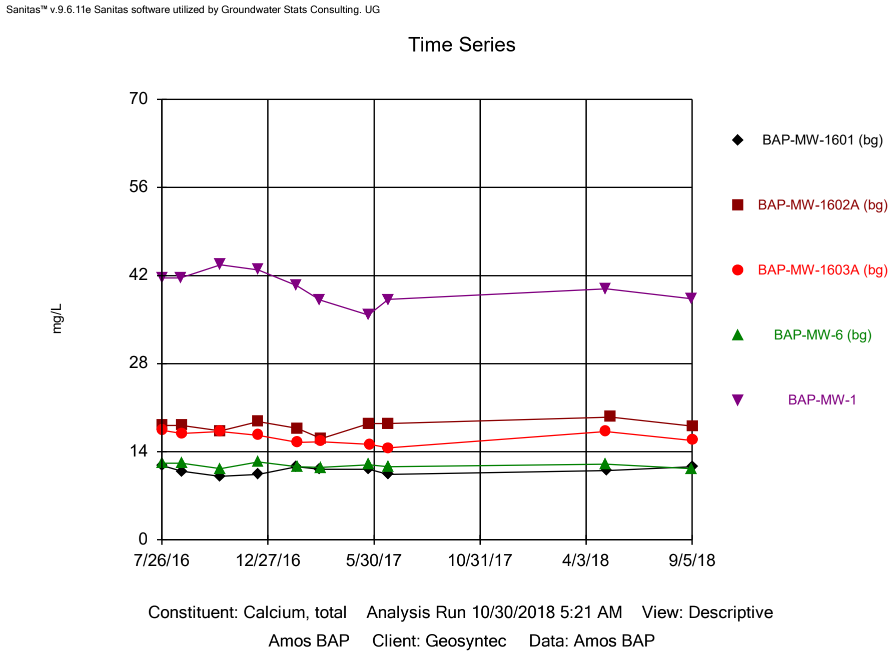


Constituent: Cadmium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

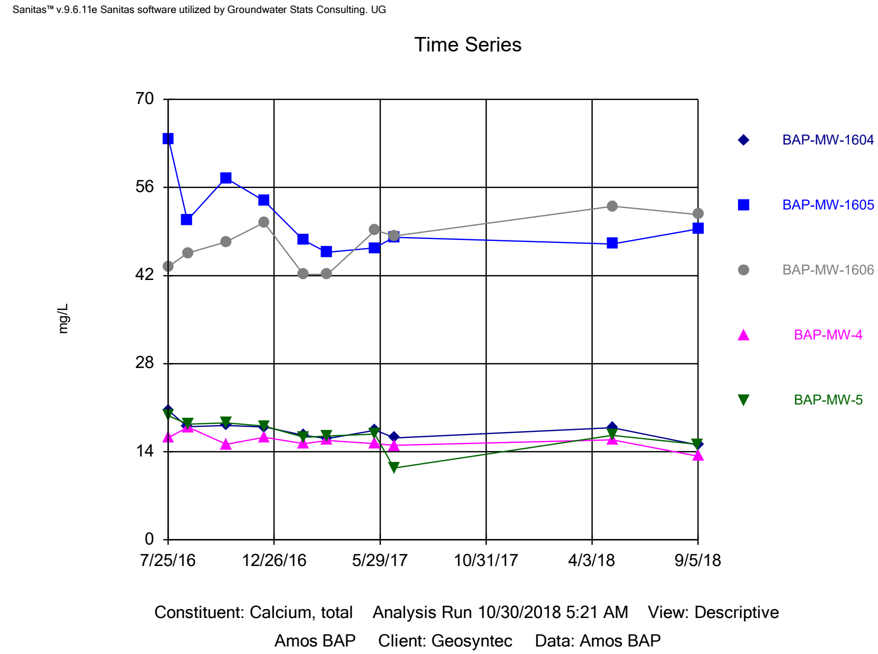
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



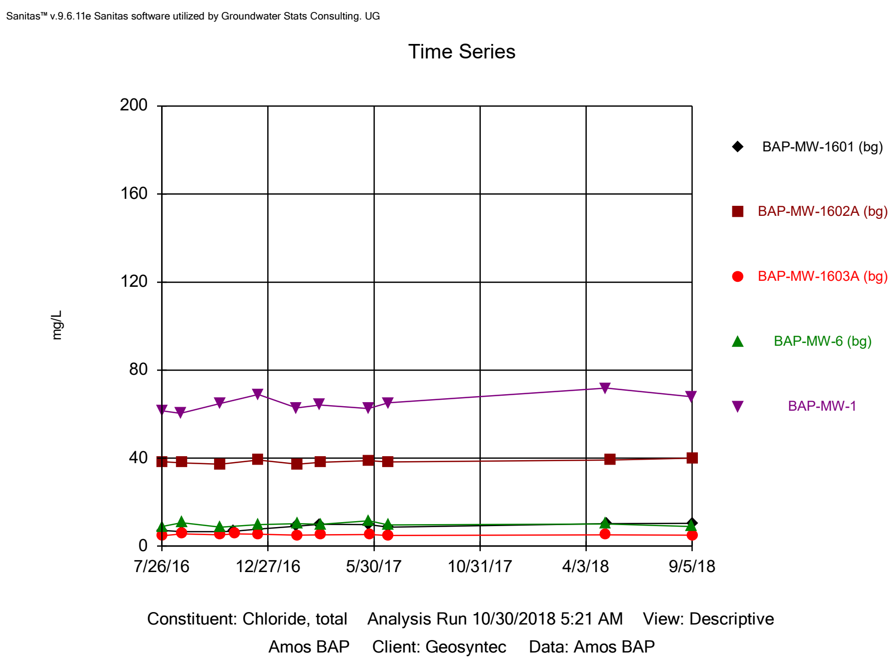
Constituent: Cadmium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



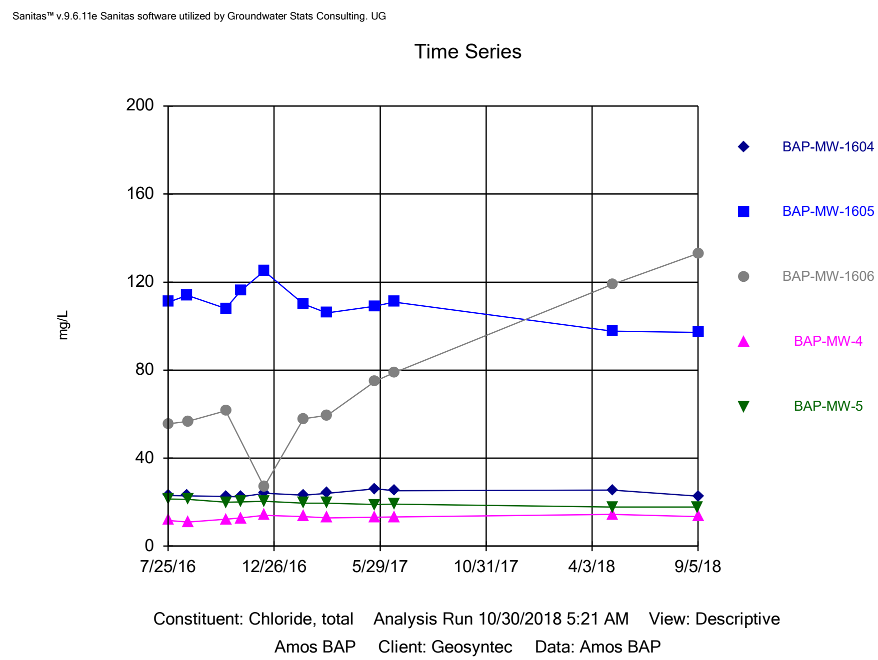
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
70
56
42
28
14
0
7/26/16
12/27/16
5/30/17
10/31/17
4/3/18
9/5/18
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
Constituent: Calcium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
70
56
42
28
14
0
7/25/16
12/26/16
5/29/17
10/31/17
4/3/18
9/5/18
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Calcium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

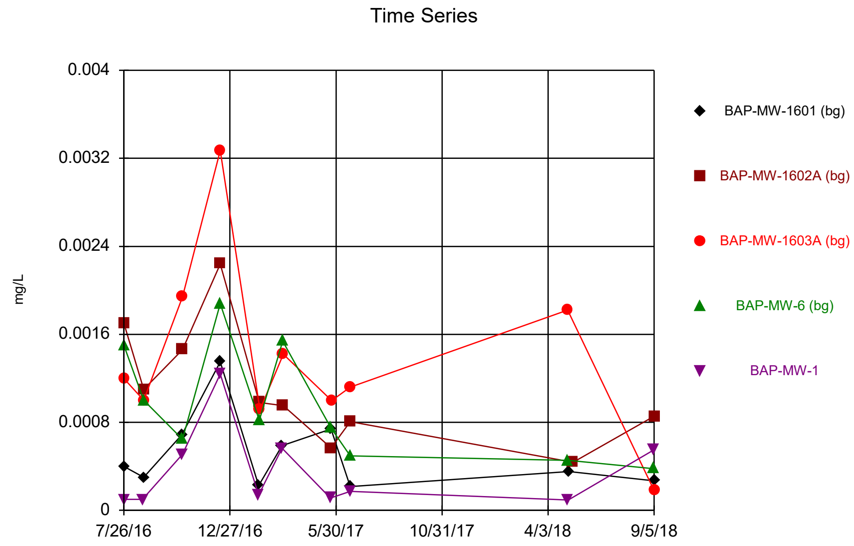


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
7/26/16
12/27/16
5/30/17
10/31/17
4/3/18
9/5/18
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
Constituent: Chloride, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



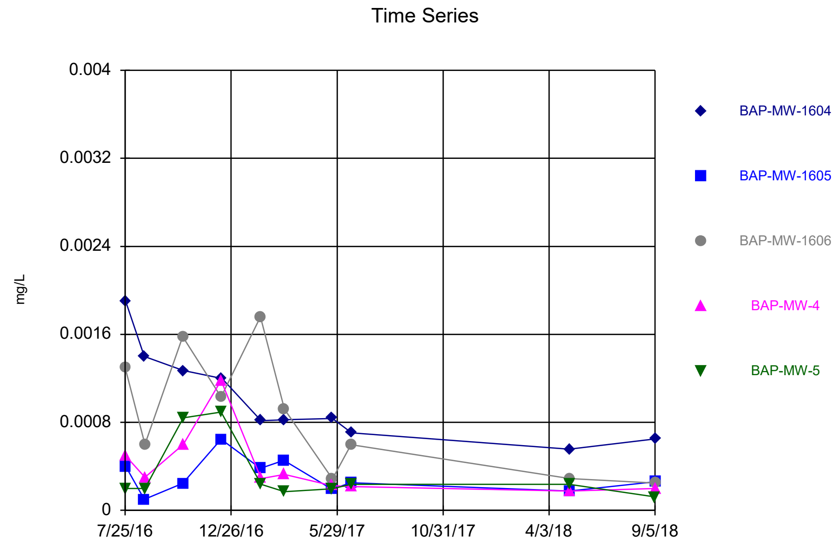
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
7/25/16
12/26/16
5/29/17
10/31/17
4/3/18
9/5/18
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Chloride, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



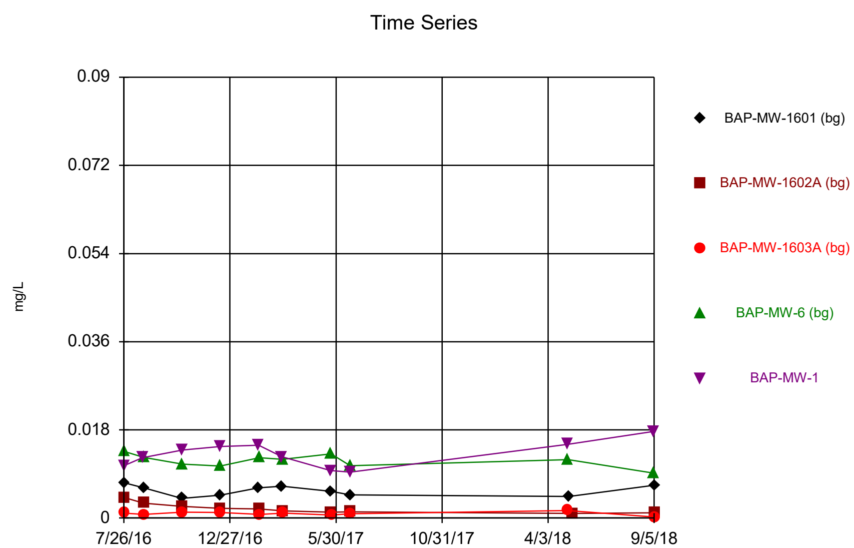
Constituent: Chromium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



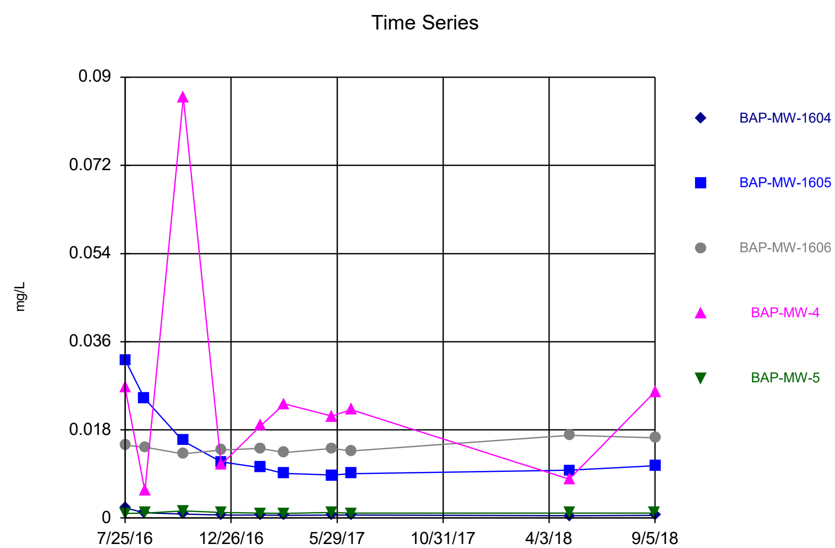
Constituent: Chromium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



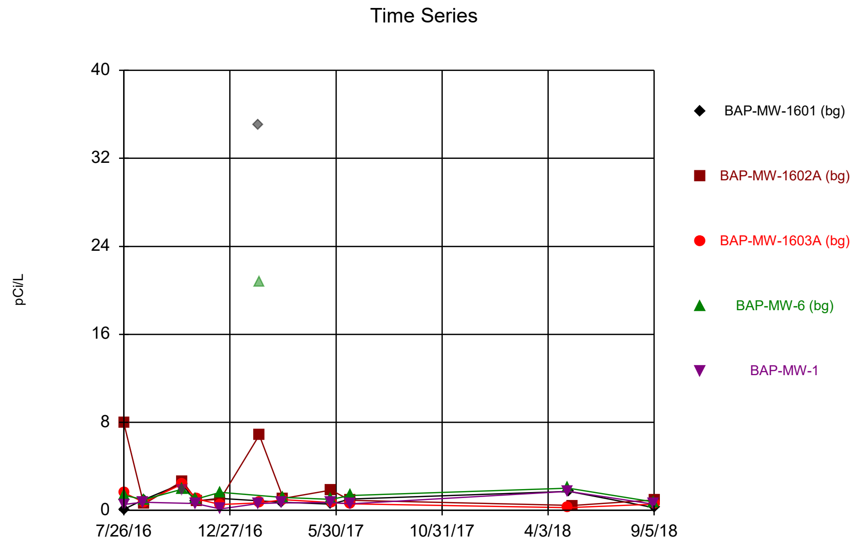
Constituent: Cobalt, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



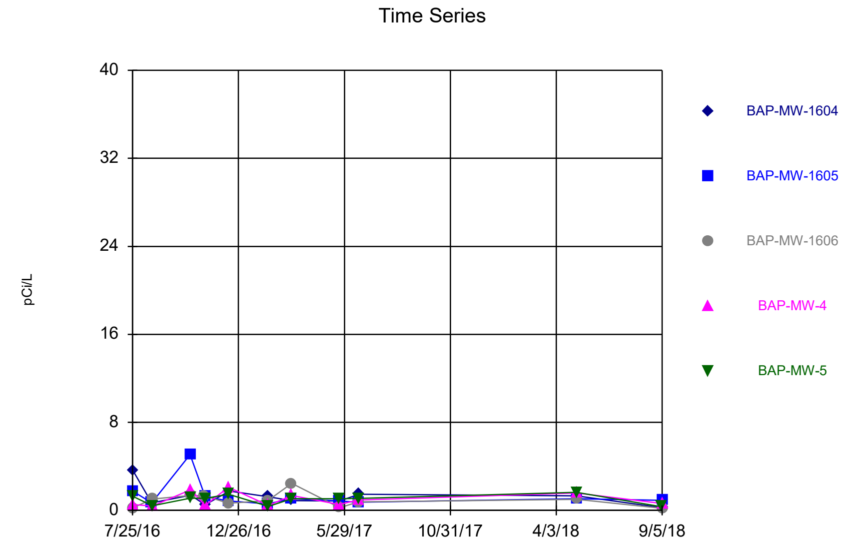
Constituent: Cobalt, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



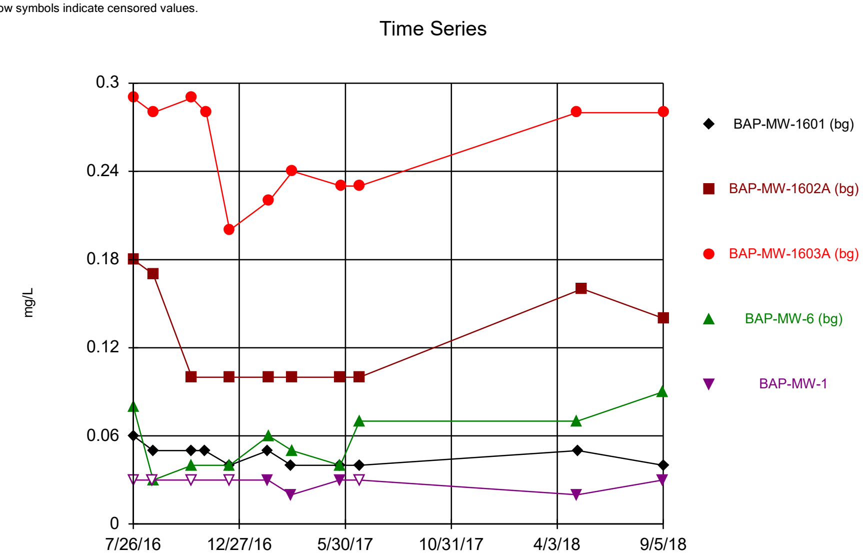
Constituent: Combined Radium 226 + 228 Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



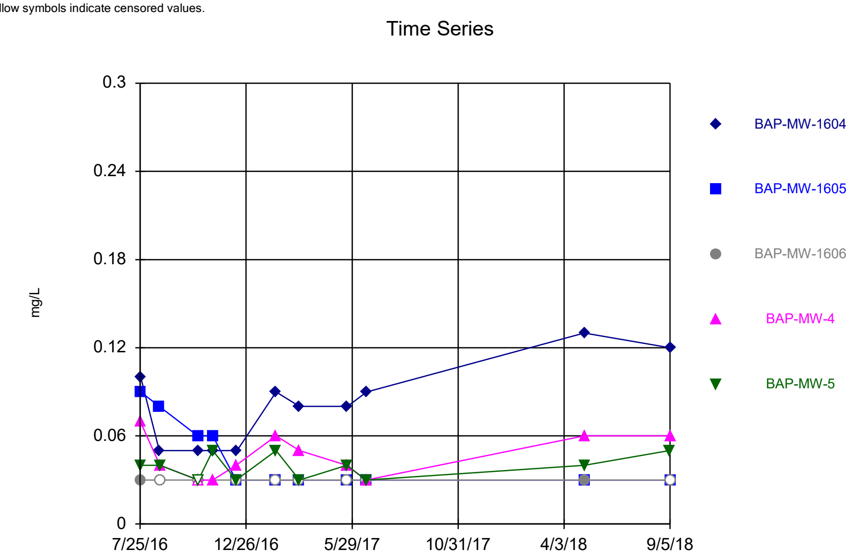
Constituent: Combined Radium 226 + 228 Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

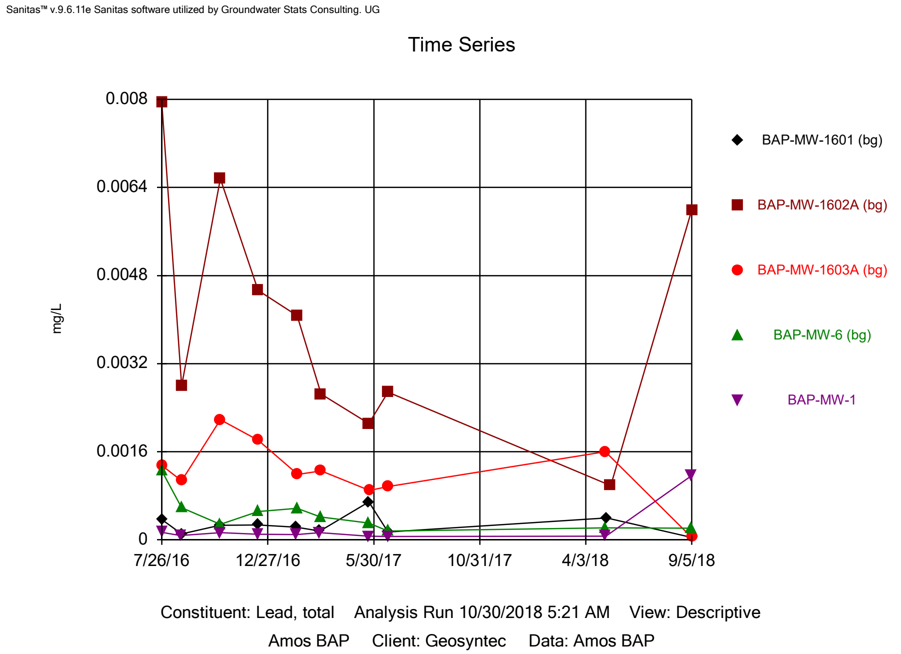


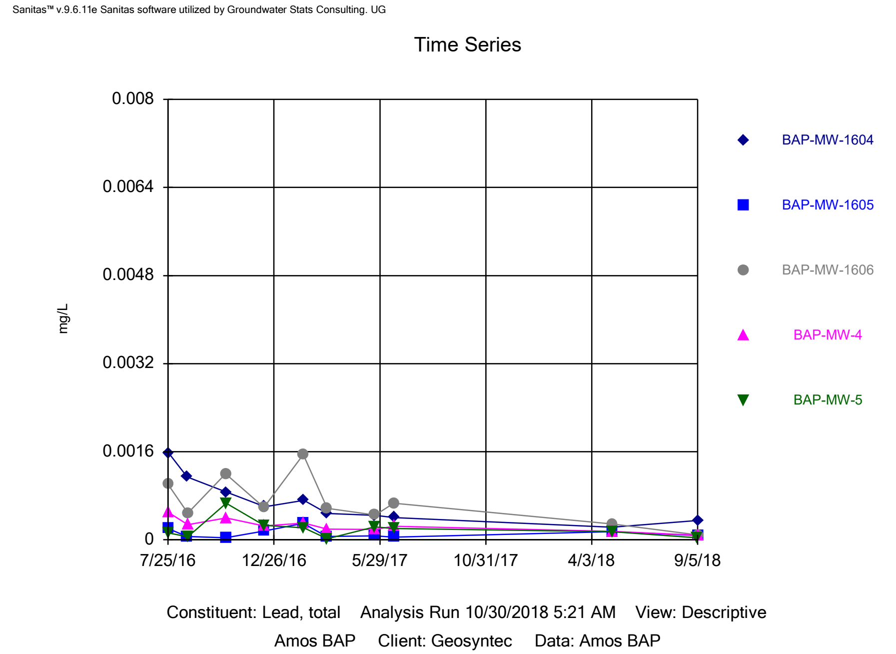
Constituent: Fluoride, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

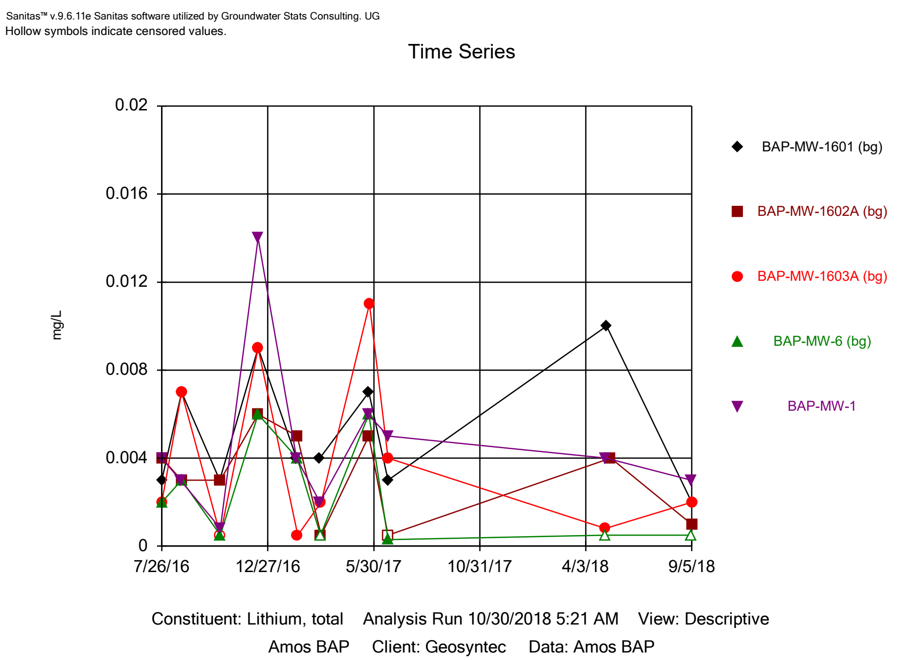
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

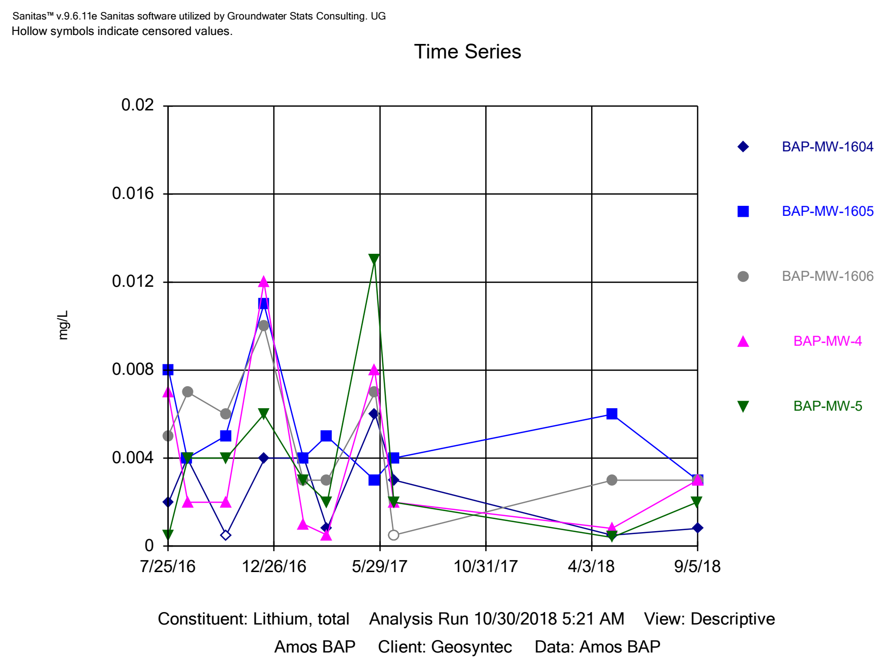


Constituent: Fluoride, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

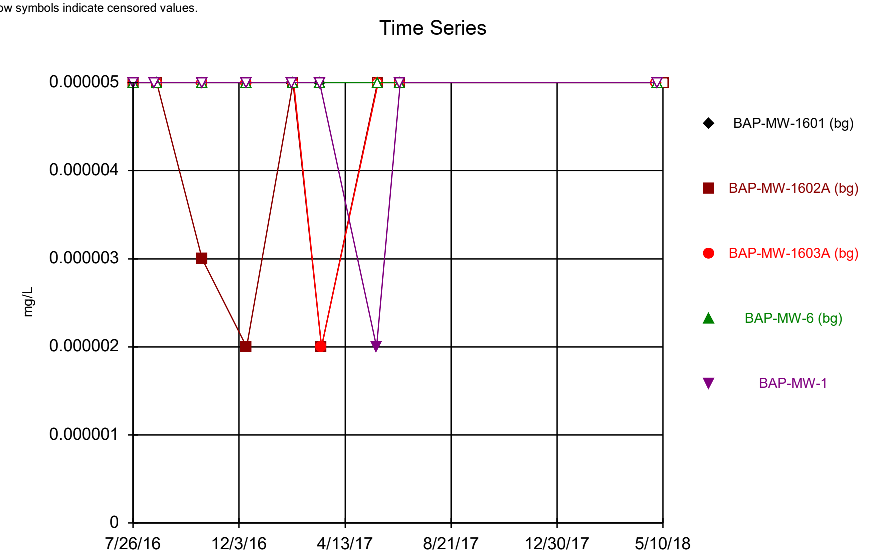

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
0.008
0.0064
0.0048
0.0032
0.0016
0
mg/L
7/26/16
12/27/16
5/30/17
10/31/17
4/3/18
9/5/18
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
Constituent: Lead, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
0.008
0.0064
0.0048
0.0032
0.0016
0
mg/L
7/25/16
12/26/16
5/29/17
10/31/17
4/3/18
9/5/18
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Lead, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.02
0.016
0.012
0.008
0.004
0
mg/L
7/26/16
12/27/16
5/30/17
10/31/17
4/3/18
9/5/18
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
Constituent: Lithium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

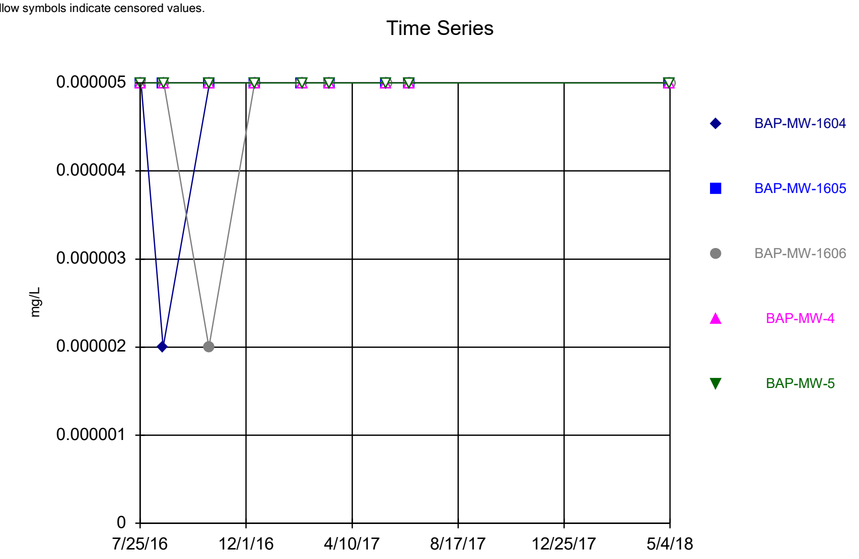

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.02
0.016
0.012
0.008
0.004
0
mg/L
7/25/16
12/26/16
5/29/17
10/31/17
4/3/18
9/5/18
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Lithium, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



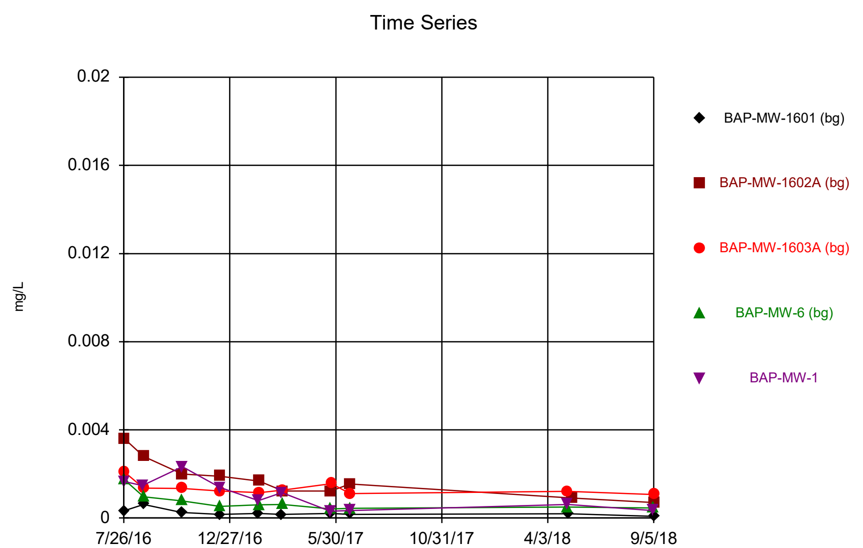
Constituent: Mercury, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



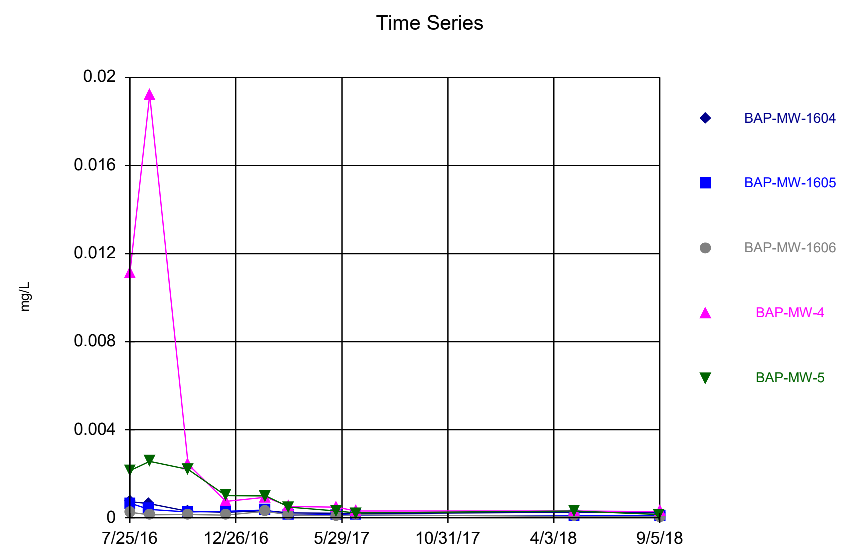
Constituent: Mercury, total Analysis Run 10/30/2018 5:21 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Molybdenum, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

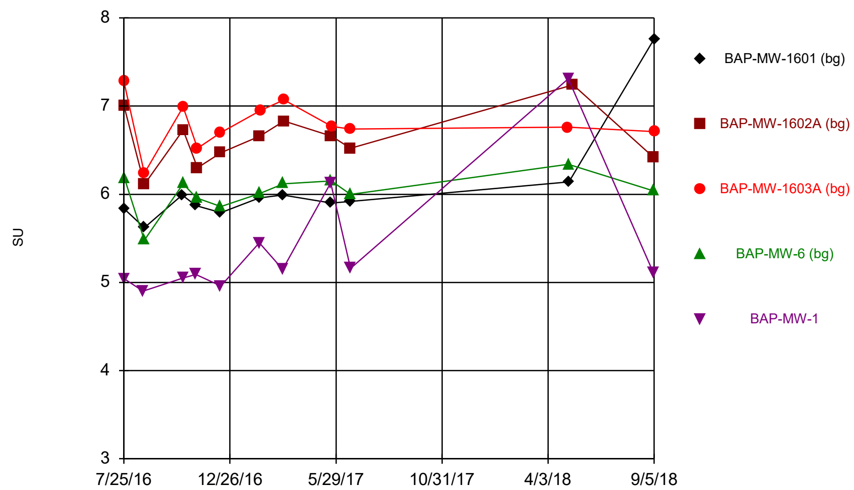
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Molybdenum, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

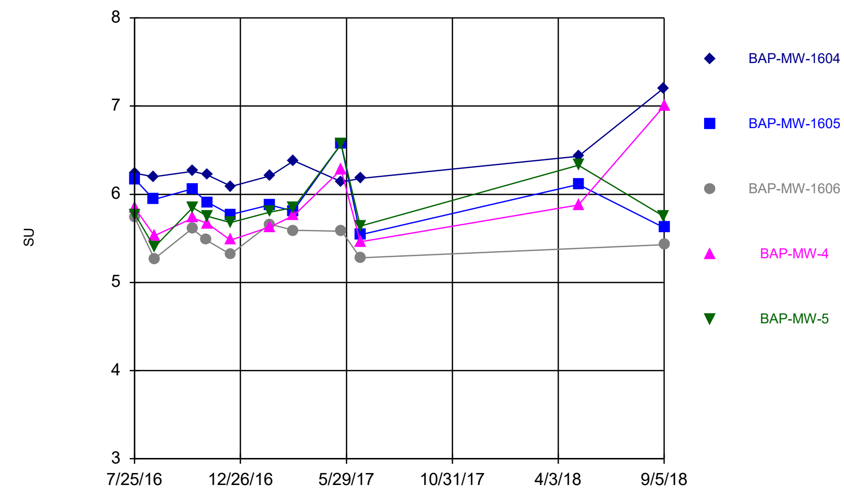
Time Series



Constituent: pH, field Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

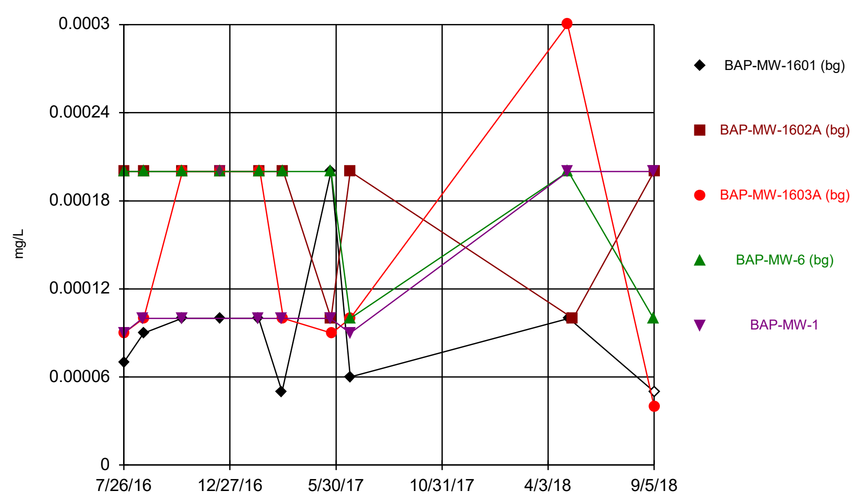
Time Series



Constituent: pH, field Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

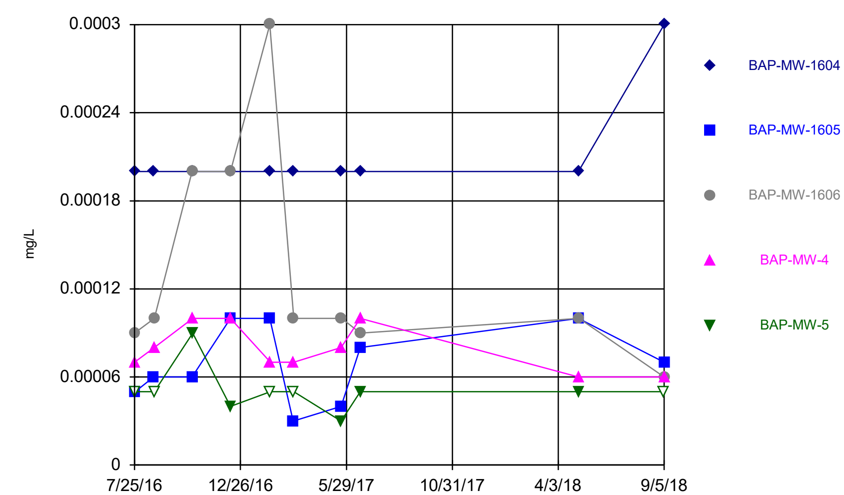
Time Series



Constituent: Selenium, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

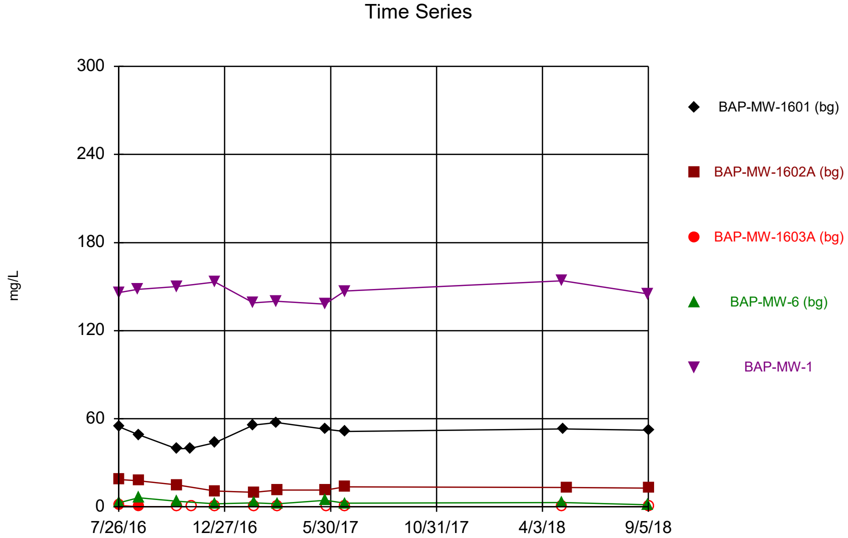
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



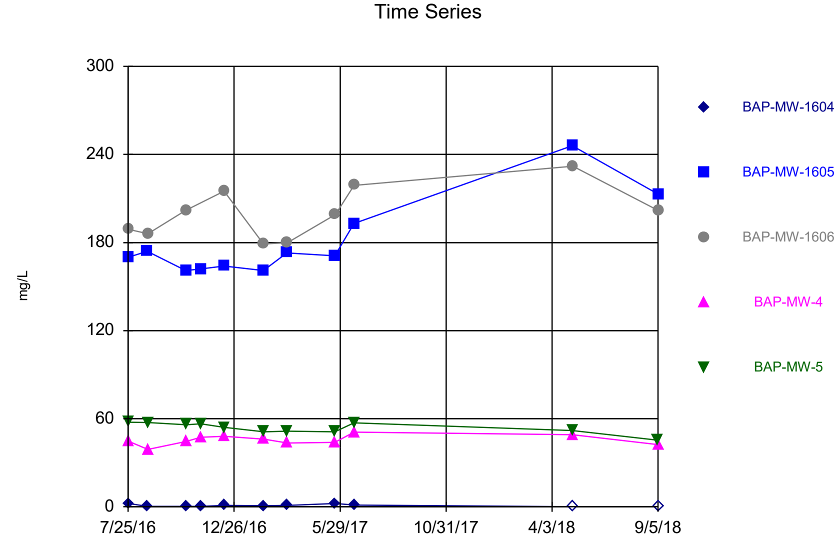
Constituent: Selenium, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



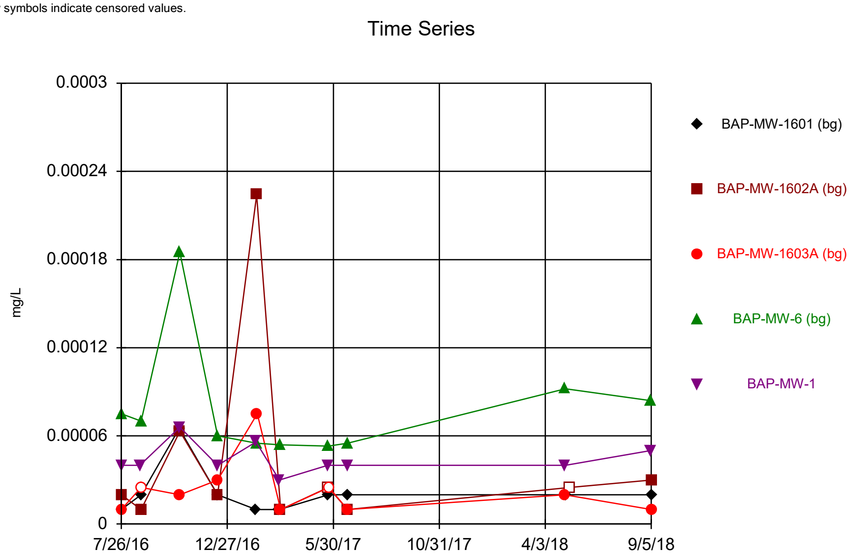
Constituent: Sulfate, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



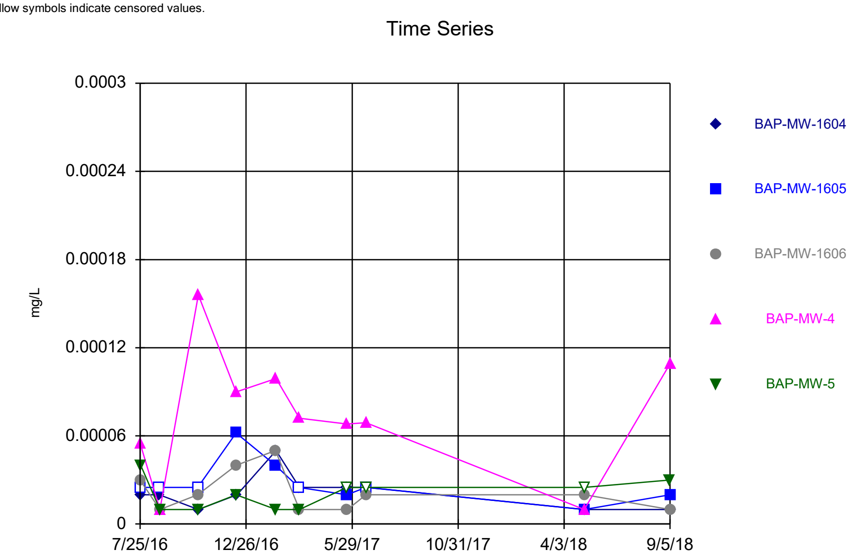
Constituent: Sulfate, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



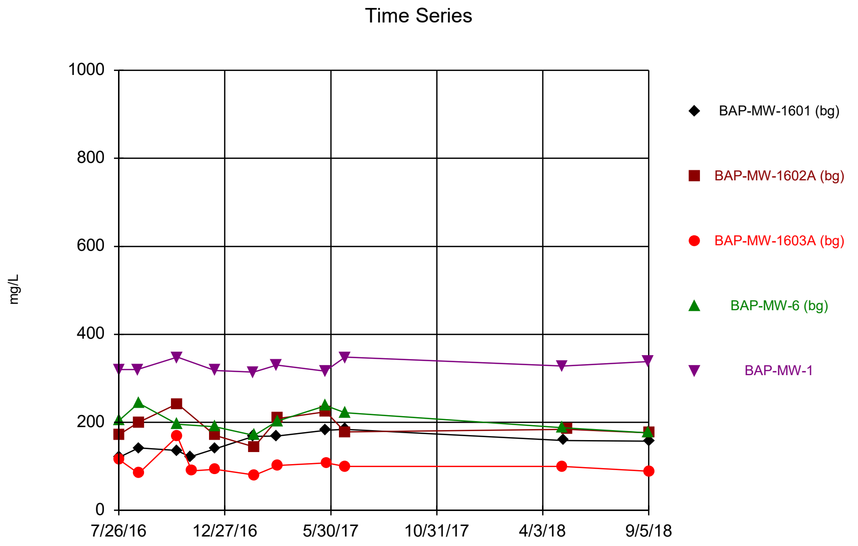
Constituent: Thallium, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



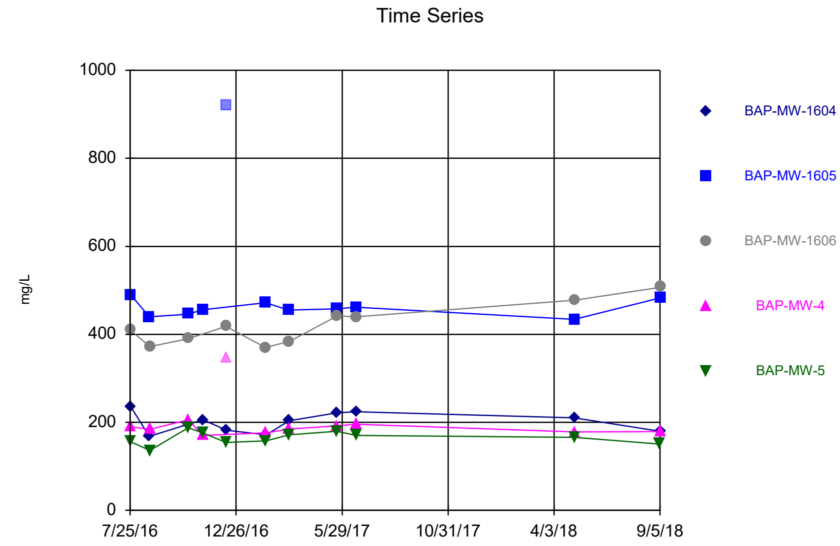
Constituent: Thallium, total Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/30/2018 5:22 AM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Interwell Prediction Limit Summary Table - Significant Results

Amos BAP Client: Geosyntec Data: Amos BAP Printed 10/29/2018, 8:51 AM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	**BAP-MW-1**	**19.5**	**9/4/2018**	**38.3**	**Yes**	**40**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001129**	**NP Inter (normality) ...**
Calcium, total (mg/L)	**BAP-MW-1605**	**19.5**	**9/5/2018**	**49.4**	**Yes**	**40**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001129**	**NP Inter (normality) ...**
Calcium, total (mg/L)	**BAP-MW-1606**	**19.5**	**9/5/2018**	**51.7**	**Yes**	**40**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001129**	**NP Inter (normality) ...**
Chloride, total (mg/L)	**BAP-MW-1**	**40**	**9/4/2018**	**67.9**	**Yes**	**42**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Chloride, total (mg/L)	**BAP-MW-1605**	**40**	**9/5/2018**	**97.1**	**Yes**	**42**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Chloride, total (mg/L)	**BAP-MW-1606**	**40**	**9/5/2018**	**133**	**Yes**	**42**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Sulfate, total (mg/L)	**BAP-MW-1**	**57.4**	**9/4/2018**	**145**	**Yes**	**42**	**n/a**	**n/a**	**21.43**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Sulfate, total (mg/L)	**BAP-MW-1605**	**57.4**	**9/5/2018**	**213**	**Yes**	**42**	**n/a**	**n/a**	**21.43**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Sulfate, total (mg/L)	**BAP-MW-1606**	**57.4**	**9/5/2018**	**202**	**Yes**	**42**	**n/a**	**n/a**	**21.43**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1**	**249.7**	**9/4/2018**	**338**	**Yes**	**42**	**160.5**	**46.33**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1605**	**249.7**	**9/5/2018**	**483**	**Yes**	**42**	**160.5**	**46.33**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1606**	**249.7**	**9/5/2018**	**507**	**Yes**	**42**	**160.5**	**46.33**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary Table - All Results

Amos BAP Client: Geosyntec Data: Amos BAP Printed 10/29/2018, 8:51 AM

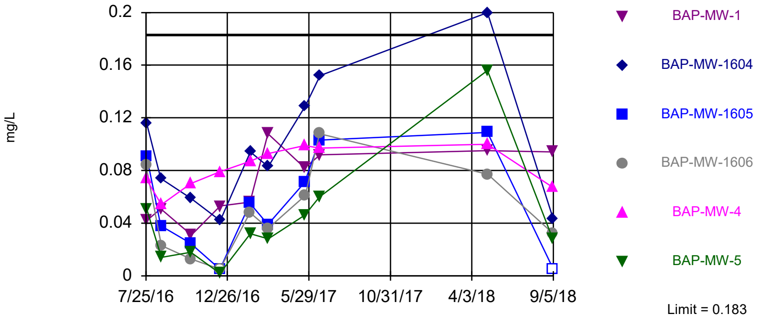
Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	BAP-MW-1	0.183	9/4/2018	0.094	No	40	n/a	n/a	25	n/a	n/a	0.001129	NP Inter (normality) ...
Boron, total (mg/L)	BAP-MW-1604	0.183	9/5/2018	0.043	No	40	n/a	n/a	25	n/a	n/a	0.001129	NP Inter (normality) ...
Boron, total (mg/L)	BAP-MW-1605	0.183	9/5/2018	0.005ND	No	40	n/a	n/a	25	n/a	n/a	0.001129	NP Inter (normality) ...
Boron, total (mg/L)	BAP-MW-1606	0.183	9/5/2018	0.032	No	40	n/a	n/a	25	n/a	n/a	0.001129	NP Inter (normality) ...
Boron, total (mg/L)	BAP-MW-4	0.183	9/5/2018	0.067	No	40	n/a	n/a	25	n/a	n/a	0.001129	NP Inter (normality) ...
Boron, total (mg/L)	BAP-MW-5	0.183	9/4/2018	0.028	No	40	n/a	n/a	25	n/a	n/a	0.001129	NP Inter (normality) ...
Calcium, total (mg/L)	**BAP-MW-1**	**19.5**	**9/4/2018**	**38.3**	**Yes**	**40**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001129**	**NP Inter (normality) ...**
Calcium, total (mg/L)	BAP-MW-1604	19.5	9/5/2018	15.1	No	40	n/a	n/a	0	n/a	n/a	0.001129	NP Inter (normality) ...
Calcium, total (mg/L)	**BAP-MW-1605**	**19.5**	**9/5/2018**	**49.4**	**Yes**	**40**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001129**	**NP Inter (normality) ...**
Calcium, total (mg/L)	**BAP-MW-1606**	**19.5**	**9/5/2018**	**51.7**	**Yes**	**40**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001129**	**NP Inter (normality) ...**
Calcium, total (mg/L)	BAP-MW-4	19.5	9/5/2018	13.3	No	40	n/a	n/a	0	n/a	n/a	0.001129	NP Inter (normality) ...
Calcium, total (mg/L)	BAP-MW-5	19.5	9/4/2018	15.2	No	40	n/a	n/a	0	n/a	n/a	0.001129	NP Inter (normality) ...
Chloride, total (mg/L)	**BAP-MW-1**	**40**	**9/4/2018**	**67.9**	**Yes**	**42**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Chloride, total (mg/L)	BAP-MW-1604	40	9/5/2018	22.8	No	42	n/a	n/a	0	n/a	n/a	0.001052	NP Inter (normality) ...
Chloride, total (mg/L)	**BAP-MW-1605**	**40**	**9/5/2018**	**97.1**	**Yes**	**42**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Chloride, total (mg/L)	**BAP-MW-1606**	**40**	**9/5/2018**	**133**	**Yes**	**42**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Chloride, total (mg/L)	BAP-MW-4	40	9/5/2018	13.4	No	42	n/a	n/a	0	n/a	n/a	0.001052	NP Inter (normality) ...
Chloride, total (mg/L)	BAP-MW-5	40	9/4/2018	17.8	No	42	n/a	n/a	0	n/a	n/a	0.001052	NP Inter (normality) ...
Sulfate, total (mg/L)	**BAP-MW-1**	**57.4**	**9/4/2018**	**145**	**Yes**	**42**	**n/a**	**n/a**	**21.43**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Sulfate, total (mg/L)	BAP-MW-1604	57.4	9/5/2018	0.1ND	No	42	n/a	n/a	21.43	n/a	n/a	0.001052	NP Inter (normality) ...
Sulfate, total (mg/L)	**BAP-MW-1605**	**57.4**	**9/5/2018**	**213**	**Yes**	**42**	**n/a**	**n/a**	**21.43**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Sulfate, total (mg/L)	**BAP-MW-1606**	**57.4**	**9/5/2018**	**202**	**Yes**	**42**	**n/a**	**n/a**	**21.43**	**n/a**	**n/a**	**0.001052**	**NP Inter (normality) ...**
Sulfate, total (mg/L)	BAP-MW-4	57.4	9/5/2018	42.4	No	42	n/a	n/a	21.43	n/a	n/a	0.001052	NP Inter (normality) ...
Sulfate, total (mg/L)	BAP-MW-5	57.4	9/4/2018	45.4	No	42	n/a	n/a	21.43	n/a	n/a	0.001052	NP Inter (normality) ...
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1**	**249.7**	**9/4/2018**	**338**	**Yes**	**42**	**160.5**	**46.33**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1604	249.7	9/5/2018	180	No	42	160.5	46.33	0	None	No	0.001254	Param Inter 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1605**	**249.7**	**9/5/2018**	**483**	**Yes**	**42**	**160.5**	**46.33**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1606**	**249.7**	**9/5/2018**	**507**	**Yes**	**42**	**160.5**	**46.33**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-4	249.7	9/5/2018	179	No	42	160.5	46.33	0	None	No	0.001254	Param Inter 1 of 2
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-5	249.7	9/4/2018	151	No	42	160.5	46.33	0	None	No	0.001254	Param Inter 1 of 2

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 40 background values. 25% NDs. Annual per-constituent alpha = 0.01347. Individual comparison alpha = 0.001129 (1 of 2). Comparing 6 points to limit.

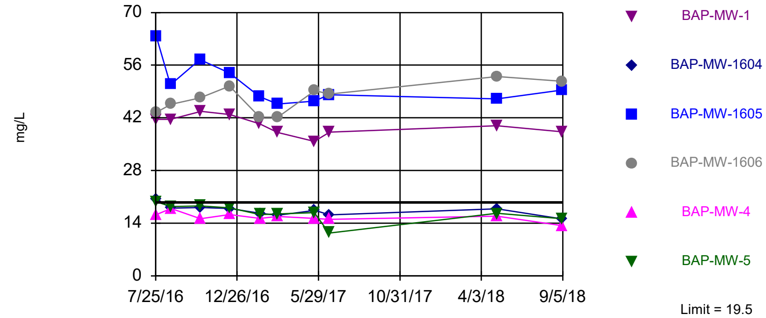
Constituent: Boron, total Analysis Run 10/29/2018 8:49 AM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 40 background values. Annual per-constituent alpha = 0.01347. Individual comparison alpha = 0.001129 (1 of 2). Comparing 6 points to limit.

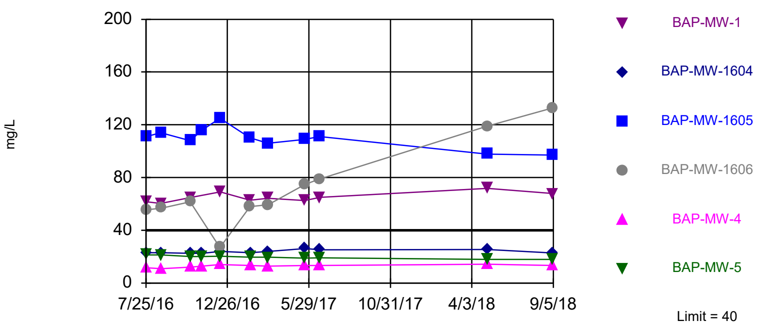
Constituent: Calcium, total Analysis Run 10/29/2018 8:49 AM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 42 background values. Annual per-constituent alpha = 0.01255. Individual comparison alpha = 0.001052 (1 of 2). Comparing 6 points to limit.

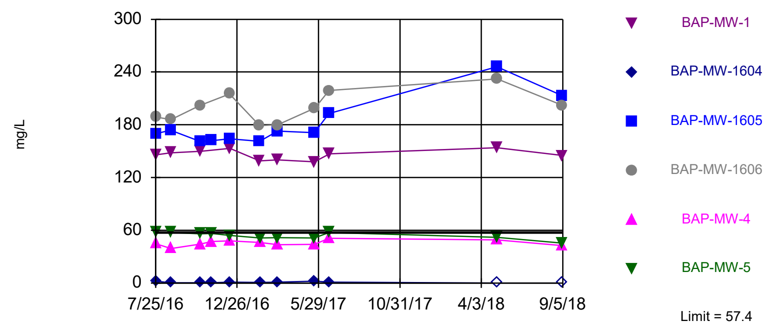
Constituent: Chloride, total Analysis Run 10/29/2018 8:49 AM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Non-parametric



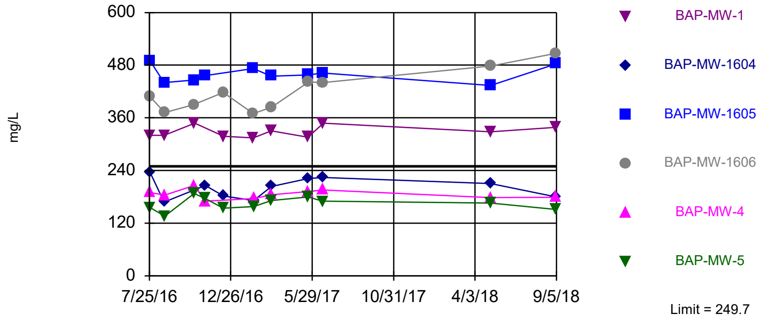
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 42 background values. 21.43% NDs. Annual per-constituent alpha = 0.01255. Individual comparison alpha = 0.001052 (1 of 2). Comparing 6 points to limit.

Constituent: Sulfate, total Analysis Run 10/29/2018 8:49 AM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=160.5, Std. Dev.=46.33, n=42. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9476, critical = 0.922. Kappa = 1.926 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001254. Comparing 6 points to limit.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:49 AM View: PL's - Interwell

Amos BAP Client: Geosyntec Data: Amos BAP

Intrawell Prediction Limit Summary Table - Significant Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 10/30/2018, 10:43 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
pH, field (SU)	**BAP-MW-1601**	**6.191**	**5.558**	**9/5/2018**	**7.76**	**Yes**	**9**	**5.874**	**0.1176**	**0**	**None**	**No**	**0.0006268**	Param 1 of 2
pH, field (SU)	**BAP-MW-1604**	**6.431**	**5.995**	**9/4/2018**	**7.2**	**Yes**	**9**	**6.213**	**0.08109**	**0**	**None**	**No**	**0.0006268**	Param 1 of 2
pH, field (SU)	**BAP-MW-4**	**6.385**	**5.035**	**9/5/2018**	**7**	**Yes**	**9**	**5.71**	**0.2508**	**0**	**None**	**No**	**0.0006268**	Param 1 of 2

Intrawell Prediction Limit Summary Table - All Results

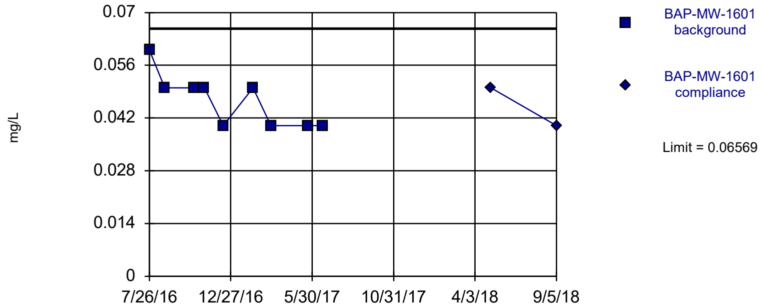
Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 10/29/2018, 8:54 AM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride, total (mg/L)	BAP-MW-1601	0.06569	9/5/2018	0.04	No	9	0.04667	0.007071	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1602A	0.18	9/5/2018	0.14	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1603A	0.3428	9/5/2018	0.28	No	9	0.2511	0.03408	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-6	0.1001	9/4/2018	0.09	No	8	0.05125	0.01727	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1	0.06	9/4/2018	0.03	No	8	n/a	n/a	62.5	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1604	0.1273	9/5/2018	0.12	No	9	0.07111	0.02088	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1605	0.1078	9/5/2018	0.03	No	9	0.04556	0.02315	33.33	Kapla...	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1606	0.06	9/5/2018	0.06ND	No	8	n/a	n/a	87.5	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	BAP-MW-4	0.1119	9/5/2018	0.06	No	9	0.05111	0.02261	11.11	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-5	0.1109	9/4/2018	0.05	No	9	0.351	0.04812	11.11	None	x^(1/3)	0.001254	Param 1 of 2
pH, field (SU)	**BAP-MW-1601**	**6.191**	**9/5/2018**	**7.76**	**Yes**	**9**	**5.874**	**0.1176**	**0**	**None**	**No**	**0.0006268**	Param 1 of 2
pH, field (SU)	BAP-MW-1602A	7.323	9/4/2018	6.42	No	9	6.588	0.2732	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1603A	7.64	9/5/2018	6.71	No	9	6.807	0.3098	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-6	6.568	9/4/2018	6.04	No	9	5.987	0.2162	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1	6.13	9/4/2018	5.11	No	9	n/a	n/a	0	n/a	n/a	0.03619	NP (normality) 1 of 2
pH, field (SU)	**BAP-MW-1604**	**6.431**	**9/4/2018**	**7.2**	**Yes**	**9**	**6.213**	**0.08109**	**0**	**None**	**No**	**0.0006268**	Param 1 of 2
pH, field (SU)	BAP-MW-1605	6.74	9/5/2018	5.62	No	9	5.961	0.2895	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1606	5.973	9/5/2018	5.43	No	9	5.503	0.1746	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	**BAP-MW-4**	**6.385**	**9/5/2018**	**7**	**Yes**	**9**	**5.71**	**0.2508**	**0**	**None**	**No**	**0.0006268**	Param 1 of 2
pH, field (SU)	BAP-MW-5	6.663	9/4/2018	5.75	No	9	5.812	0.3162	0	None	No	0.0006268	Param 1 of 2

Within Limit

Prediction Limit

Intrawell Parametric



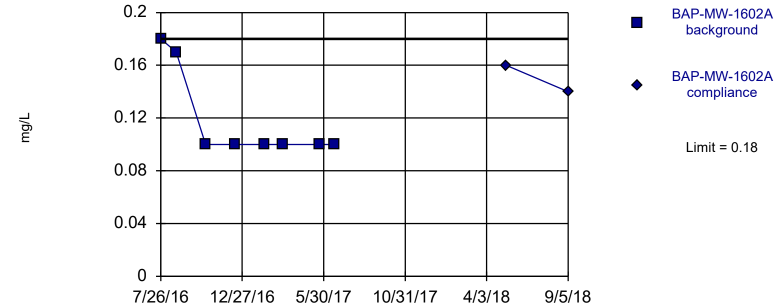
Background Data Summary: Mean=0.04667, Std. Dev.=0.007071, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8049, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Within Limit

Prediction Limit

Intrawell Non-parametric



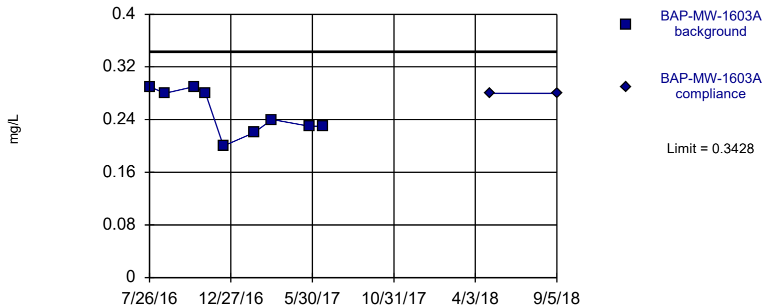
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Within Limit

Prediction Limit

Intrawell Parametric



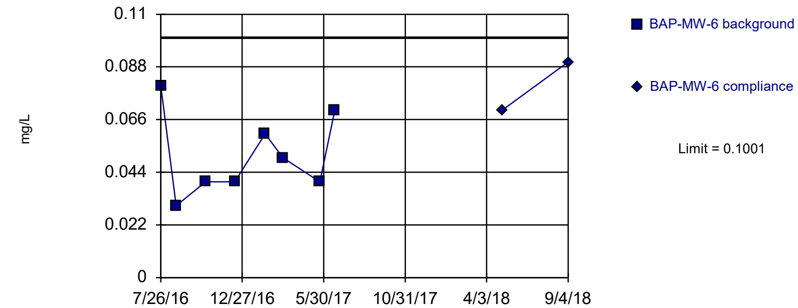
Background Data Summary: Mean=0.2511, Std. Dev.=0.03408, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8781, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Within Limit

Prediction Limit

Intrawell Parametric

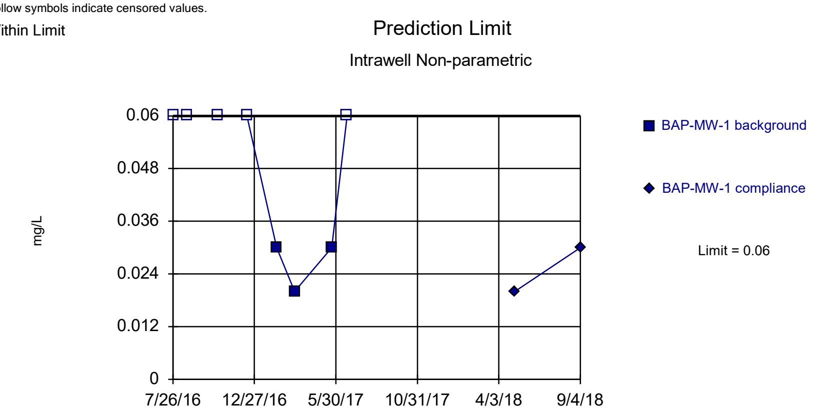


Background Data Summary: Mean=0.05125, Std. Dev.=0.01727, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.919, critical = 0.749. Kappa = 2.831 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

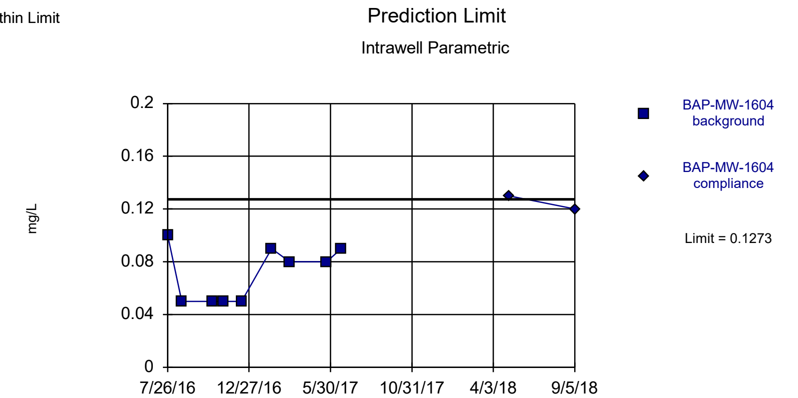


Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 62.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

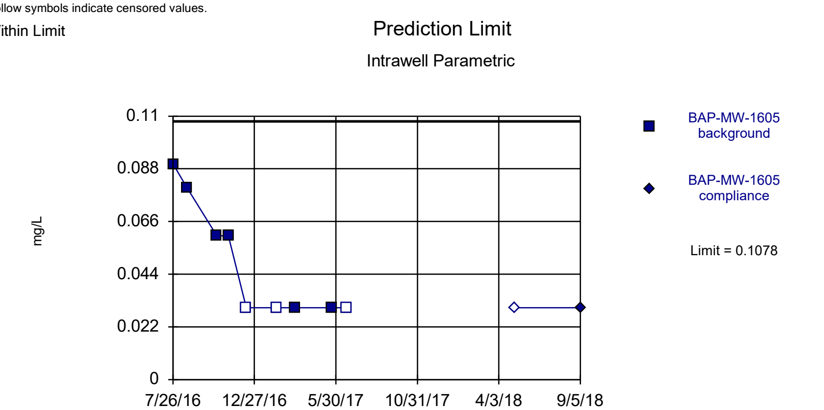


Background Data Summary: Mean=0.07111, Std. Dev.=0.02088, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.81, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

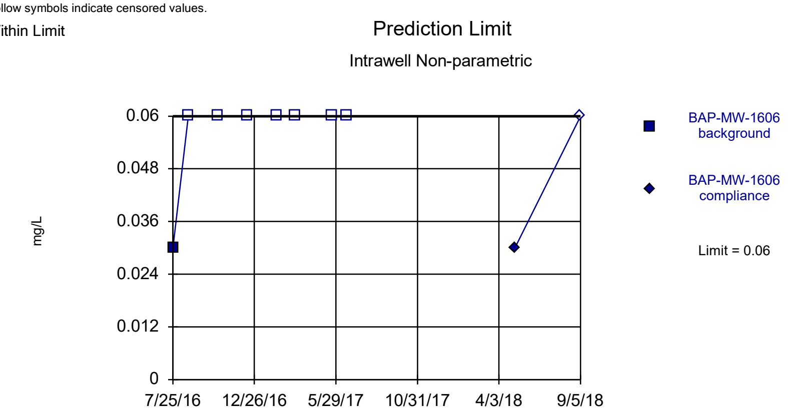


Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.04556, Std. Dev.=0.02315, n=9, 33.33% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8602, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 87.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

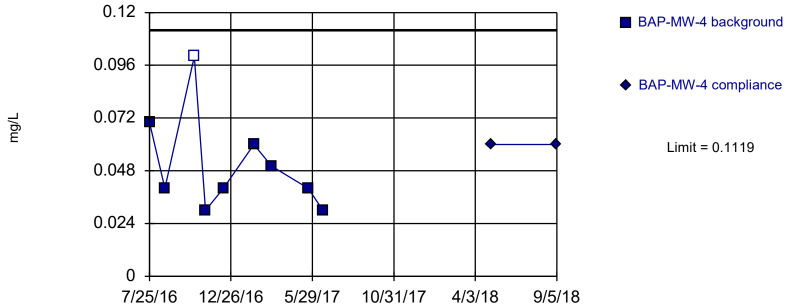
Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.05111, Std. Dev.=0.02261, n=9, 11.11% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.854, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

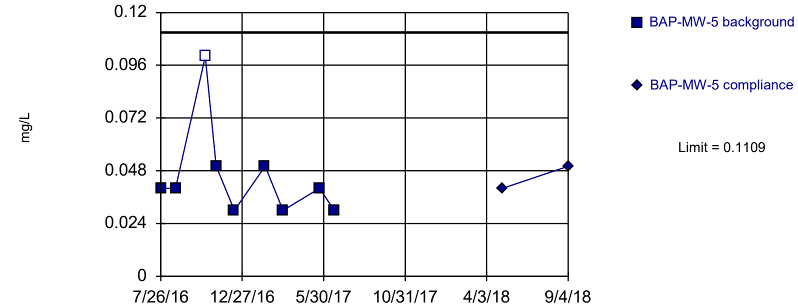
Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on cube root transformation): Mean=0.351, Std. Dev.=0.04812, n=9, 11.11% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7834, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

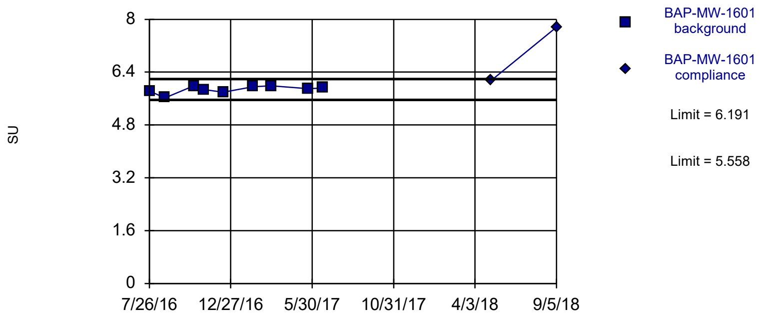
Constituent: Fluoride, total Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.874, Std. Dev.=0.1176, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8865, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

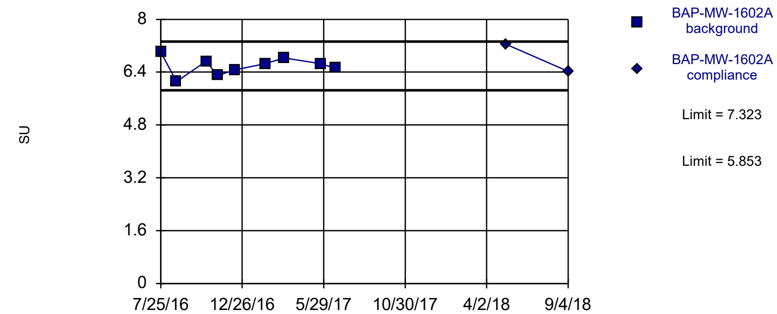
Constituent: pH, field Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=6.588, Std. Dev.=0.2732, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9838, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

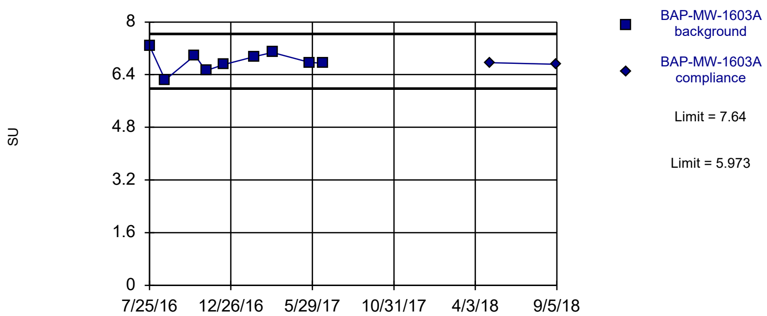
Constituent: pH, field Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=6.807, Std. Dev.=0.3098, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9809, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

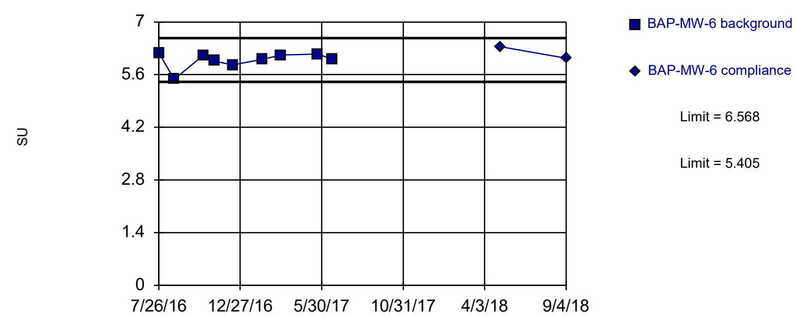
Constituent: pH, field Analysis Run 10/29/2018 8:52 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.987, Std. Dev.=0.2162, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.807, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

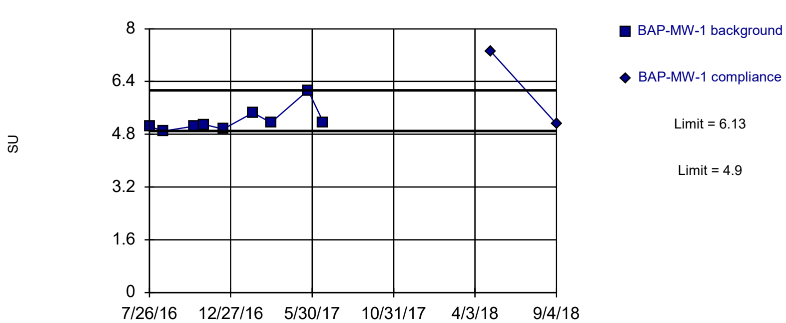
Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 9 background values. Well-constituent pair annual alpha = 0.07172. Individual comparison alpha = 0.03619 (1 of 2).

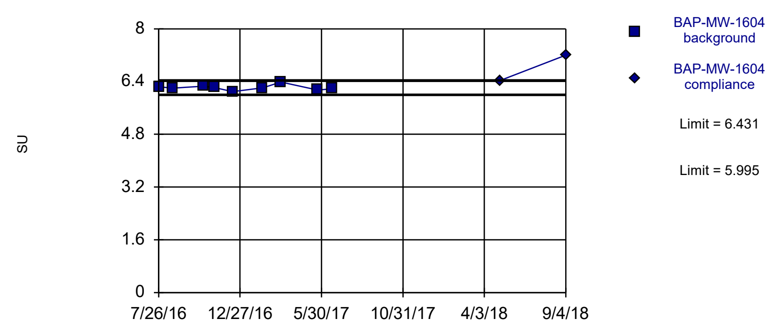
Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=6.213, Std. Dev.=0.08109, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9491, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

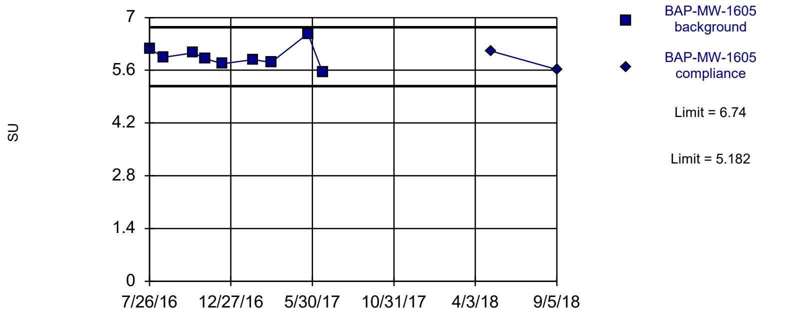
Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.961, Std. Dev.=0.2895, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9339, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

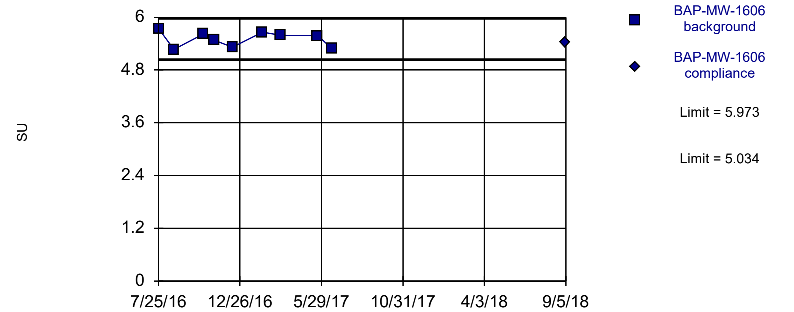
Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.503, Std. Dev.=0.1746, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8973, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

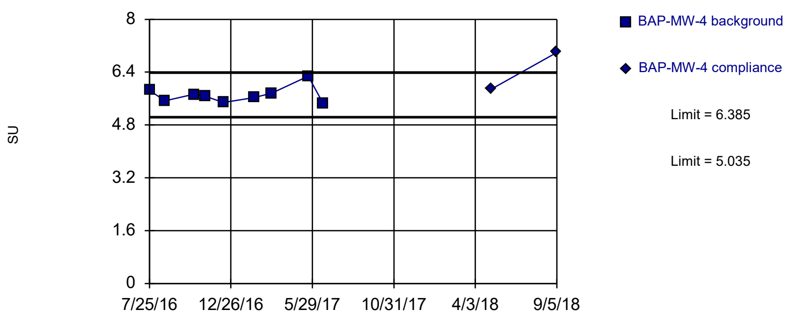
Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.71, Std. Dev.=0.2508, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8598, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

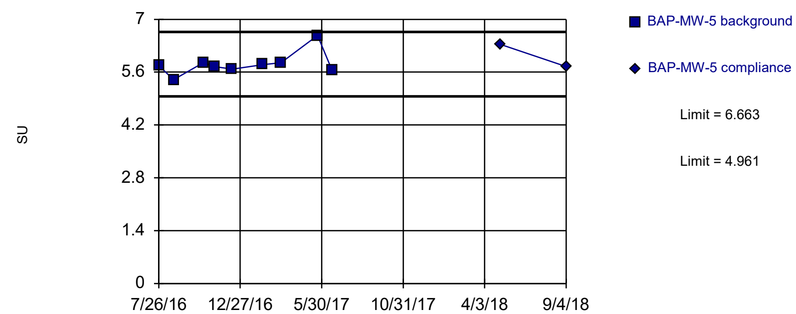
Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.812, Std. Dev.=0.3162, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7908, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: pH, field Analysis Run 10/29/2018 8:53 AM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Trend Test Summary Table - Significant Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 10/29/2018, 8:59 AM

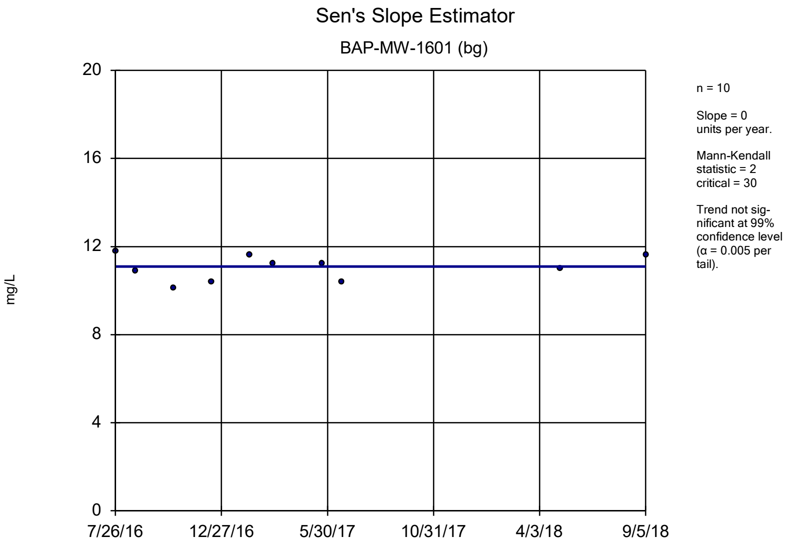
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Chloride, total (mg/L)	**BAP-MW-1601 (bg)**	**2.04**	**41**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**BAP-MW-1606**	**37.21**	**35**	**30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Test Summary Table - All Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 10/29/2018, 8:59 AM

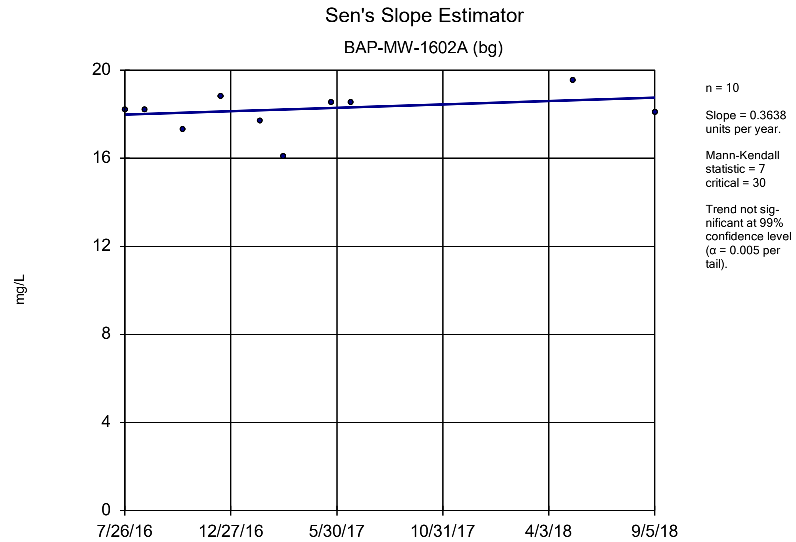
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Calcium, total (mg/L)	BAP-MW-1601 (bg)	0	2	30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1602A (bg)	0.3638	7	30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1603A (bg)	-2.086	-20	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-6 (bg)	-0.2483	-12	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1	-2.592	-20	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1605	-5.883	-19	-30	No	10	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1606	3.689	20	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**BAP-MW-1601 (bg)**	**2.04**	**41**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	BAP-MW-1602A (bg)	0.7575	20	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-1603A (bg)	-0.1662	-11	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-6 (bg)	0.1599	3	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-1	3.318	21	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-1605	-7.282	-24	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**BAP-MW-1606**	**37.21**	**35**	**30**	**Yes**	**10**	**0**	**n/a**	**n/a**	**0.01**	**NP**
pH, field (SU)	BAP-MW-1601 (bg)	0.2525	30	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	BAP-MW-1602A (bg)	0.09656	4	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	BAP-MW-1603A (bg)	-0.0467	-5	-34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	BAP-MW-6 (bg)	0.0904	12	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	BAP-MW-1604	0.1104	11	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	BAP-MW-4	0.2067	13	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1601 (bg)	2.048	11	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1602A (bg)	-2.244	-12	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1603A (bg)	0	-10	-34	No	11	81.82	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-6 (bg)	-0.8295	-13	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1	-0.474	-1	-30	No	10	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1605	25.59	26	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1606	14.6	16	30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-1601 (bg)	43.91	29	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-1602A (bg)	-1.652	-1	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-1603A (bg)	-2.314	-6	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-6 (bg)	-10.66	-13	-30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-1	5.407	7	30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-1605	9.821	5	30	No	10	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	BAP-MW-1606	54.07	25	30	No	10	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



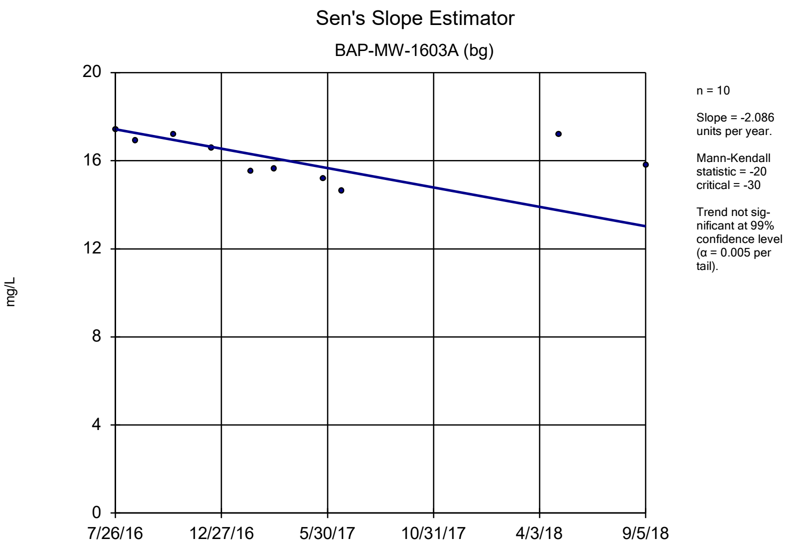
Constituent: Calcium, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



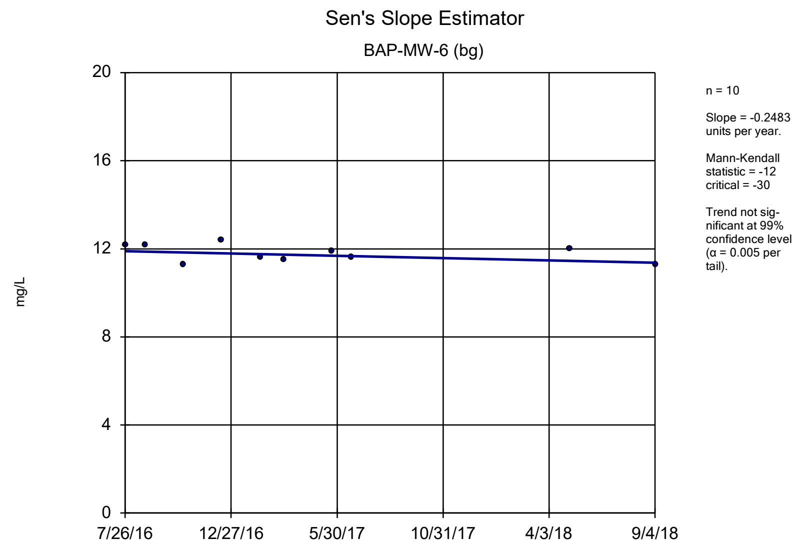
Constituent: Calcium, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



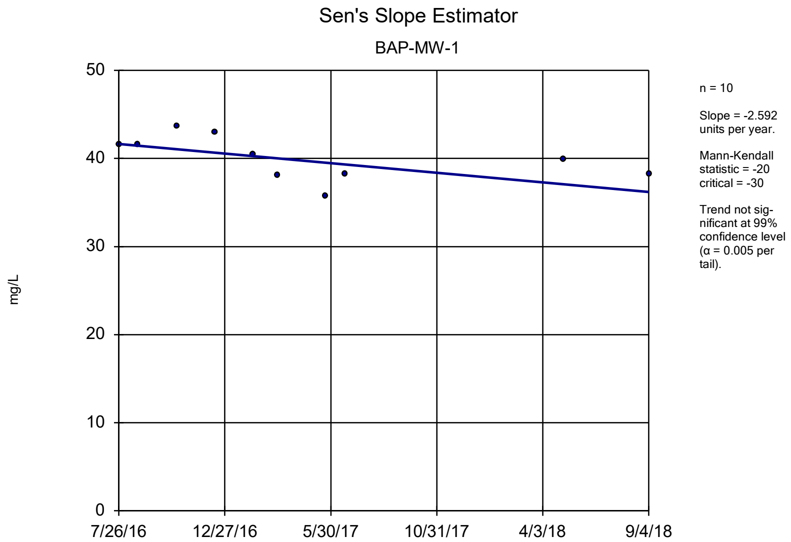
Constituent: Calcium, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



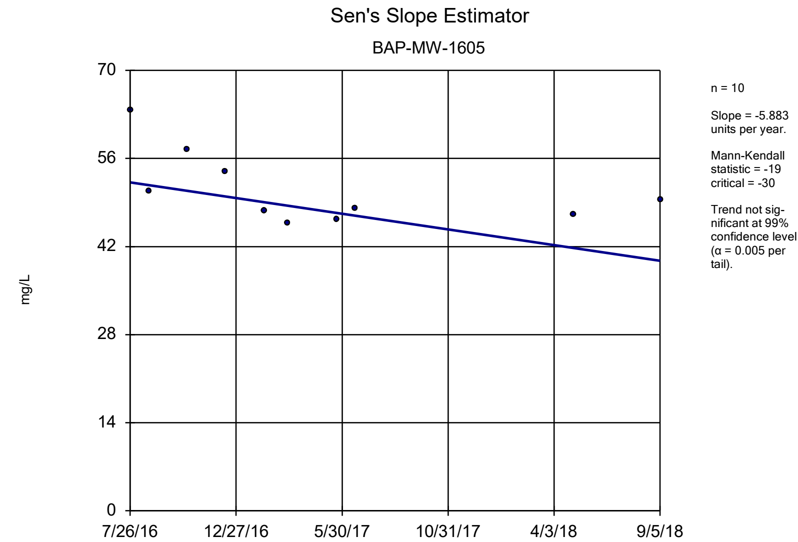
Constituent: Calcium, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



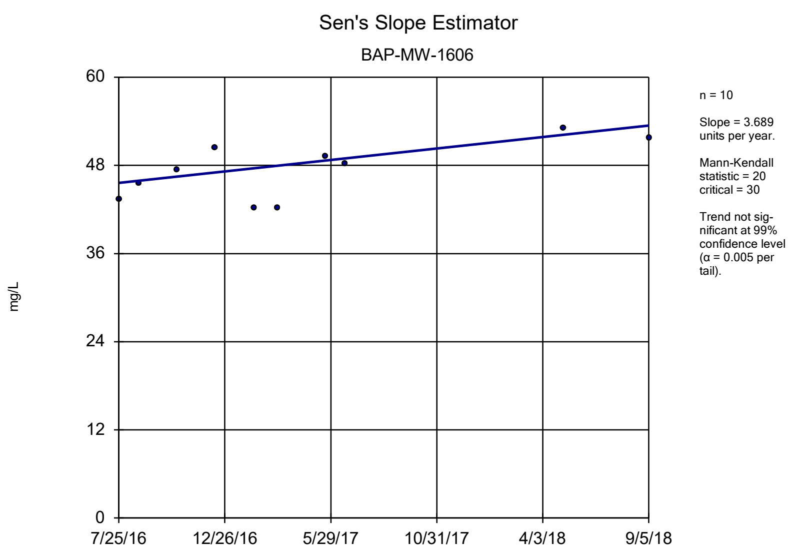
Constituent: Calcium, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



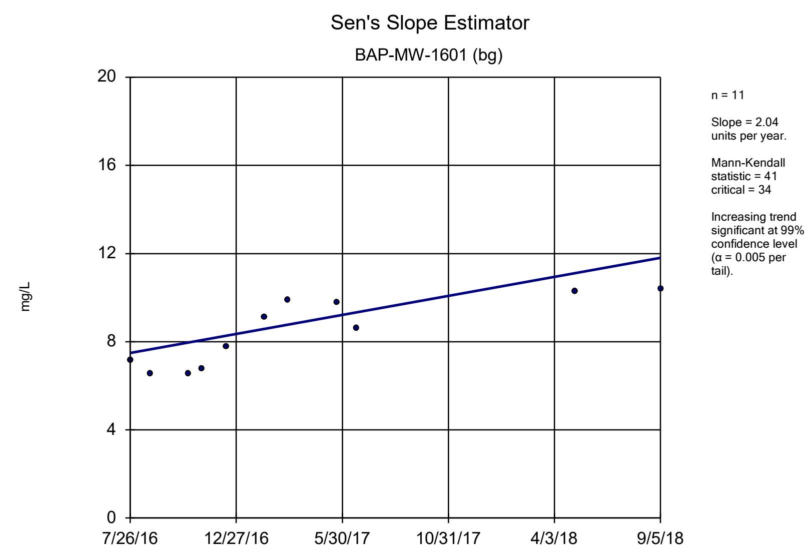
Constituent: Calcium, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



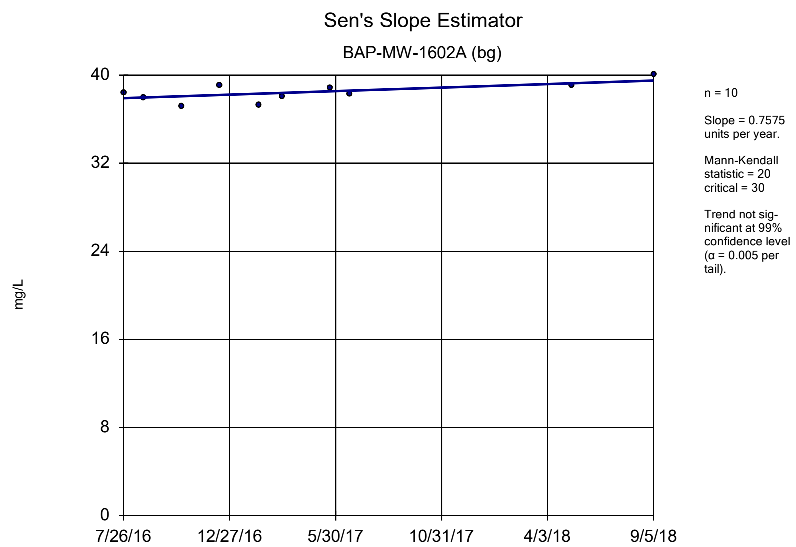
Constituent: Calcium, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



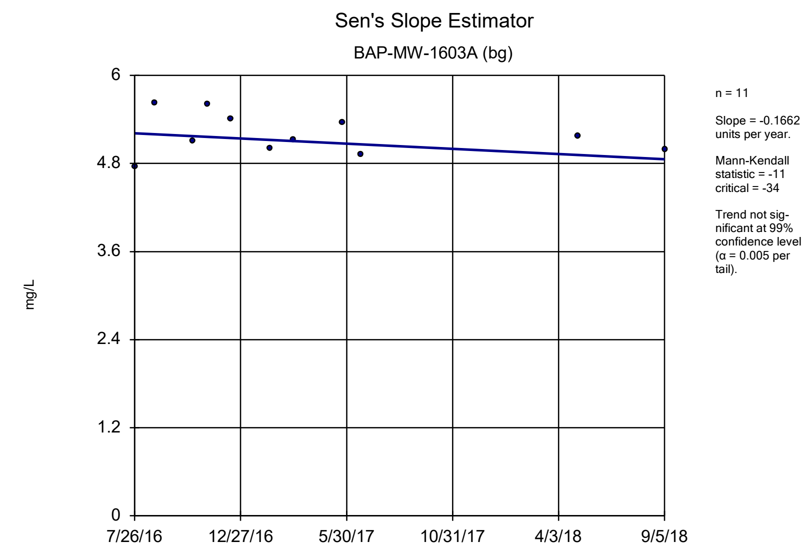
Constituent: Chloride, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



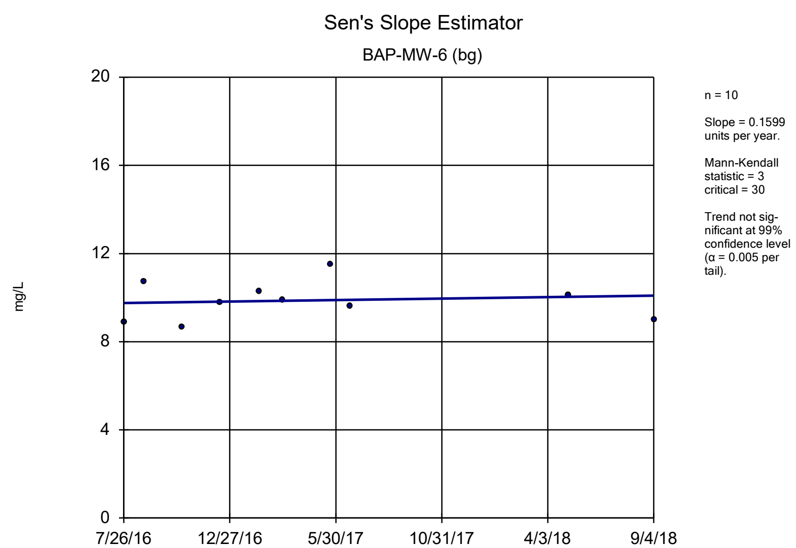
Constituent: Chloride, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



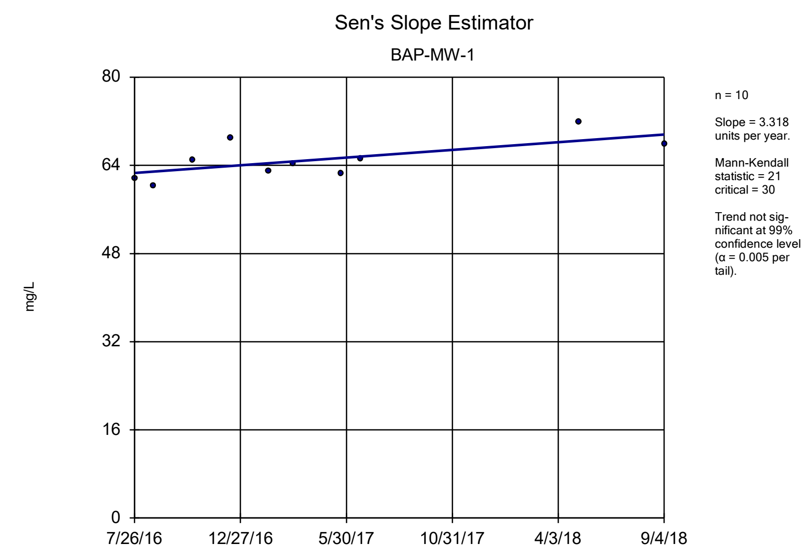
Constituent: Chloride, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



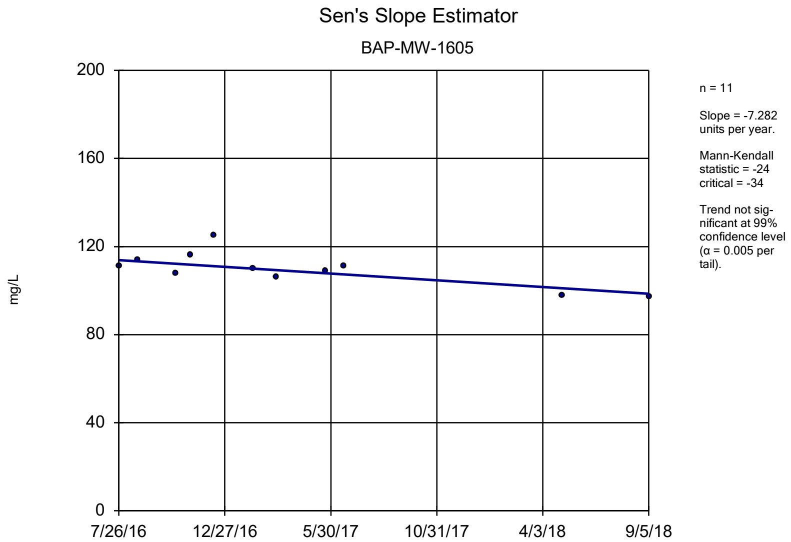
Constituent: Chloride, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



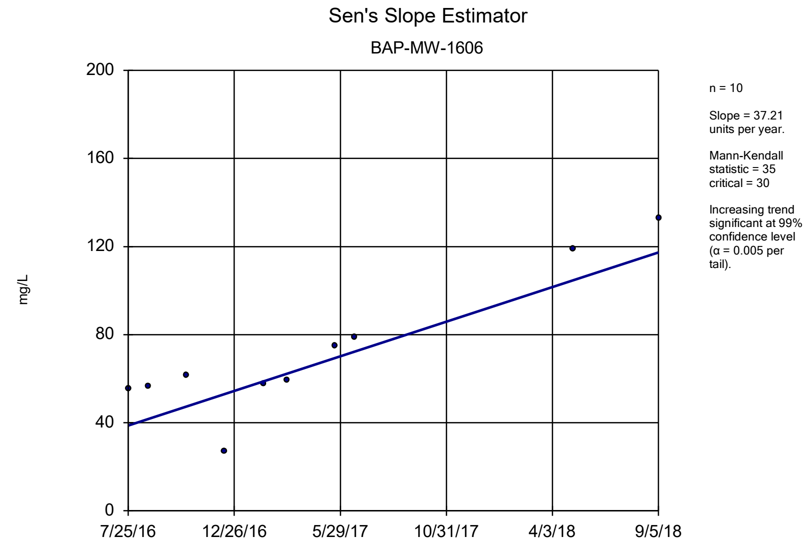
Constituent: Chloride, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



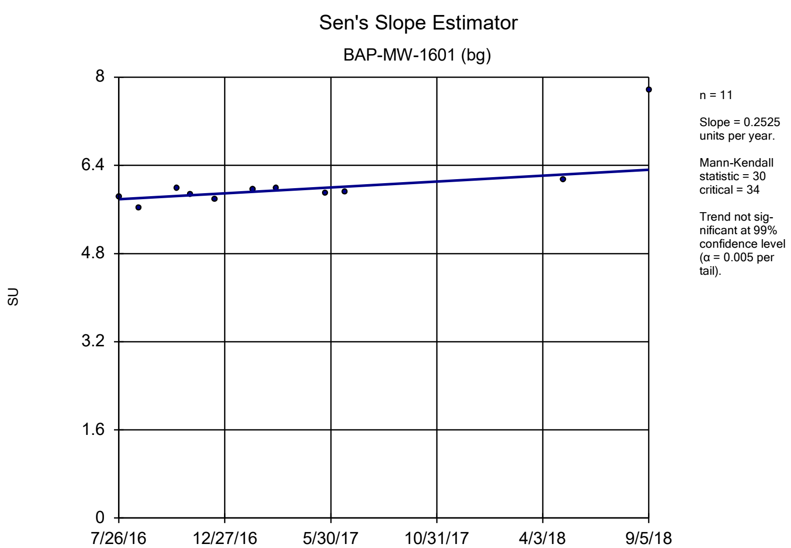
Constituent: Chloride, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



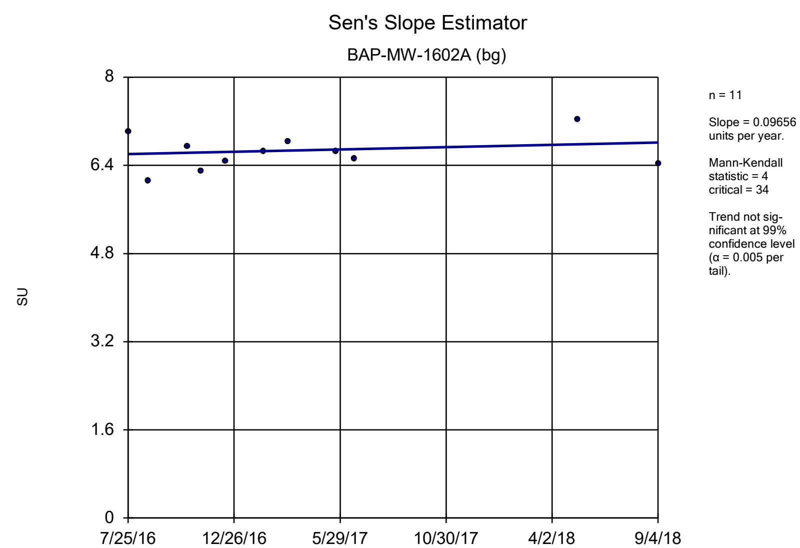
Constituent: Chloride, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: pH, field Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

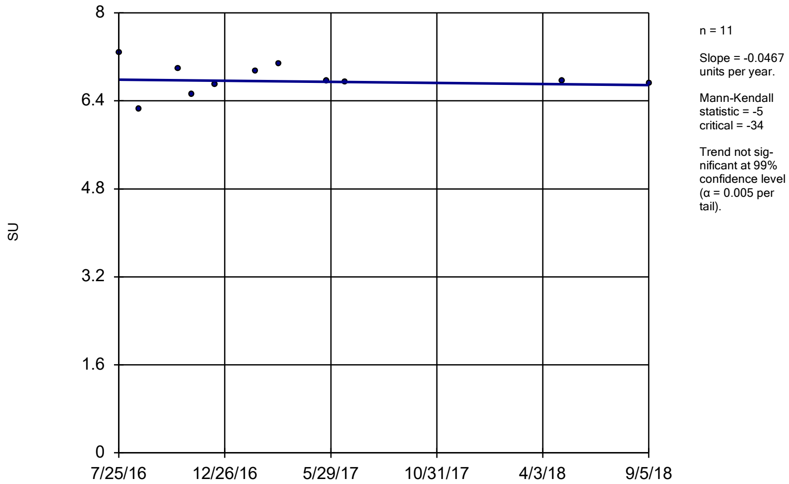


Constituent: pH, field Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-1603A (bg)



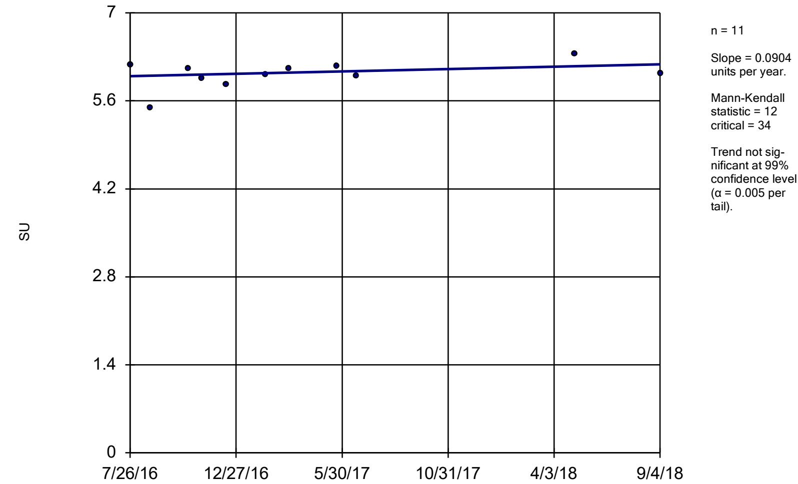
Constituent: pH, field   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-6 (bg)



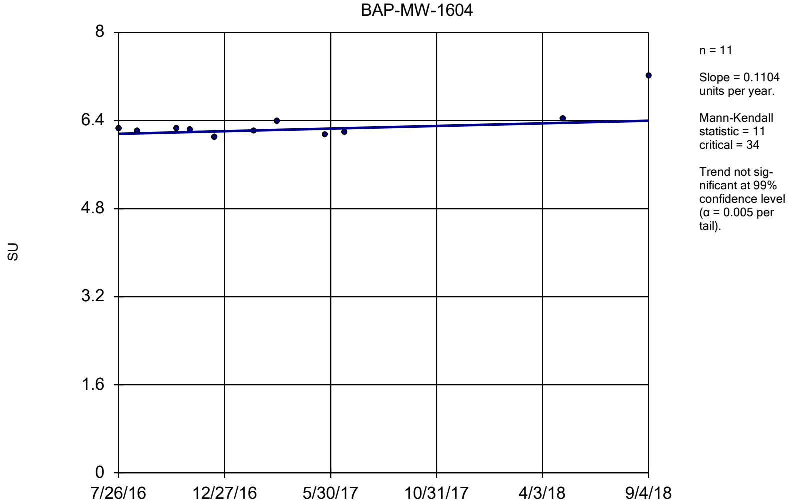
Constituent: pH, field   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-1604



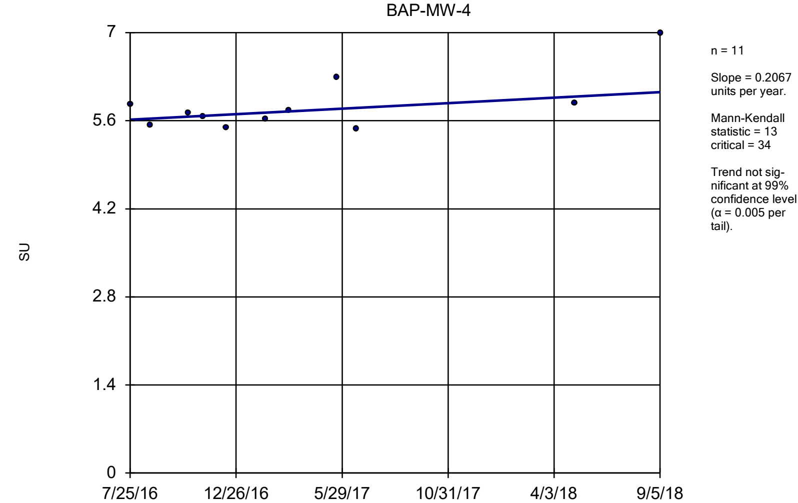
Constituent: pH, field   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

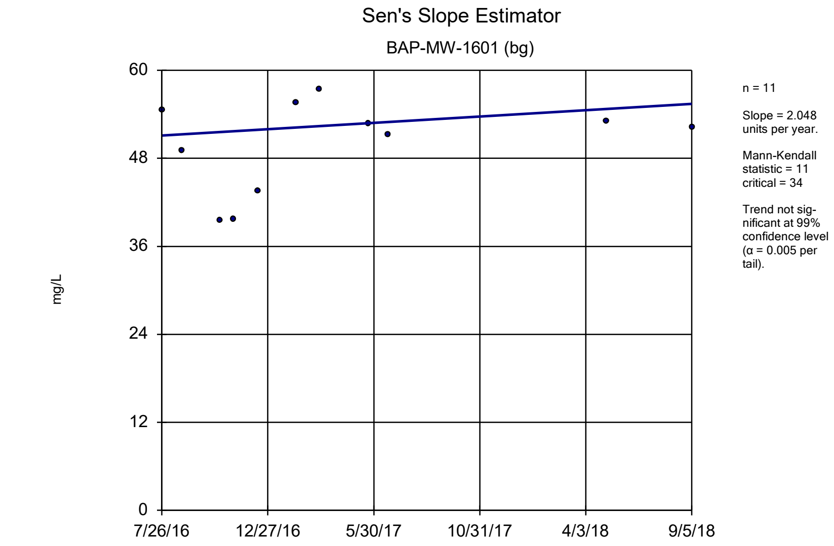
BAP-MW-4



Constituent: pH, field   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III

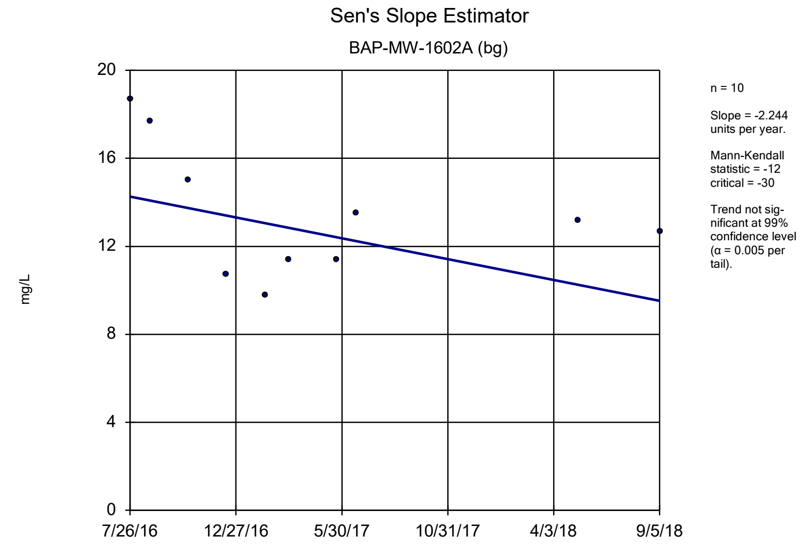
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



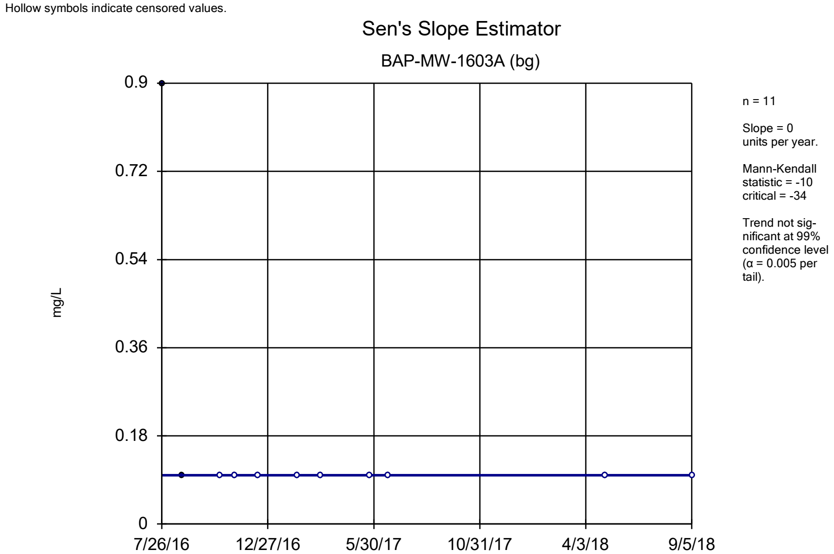
Constituent: Sulfate, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



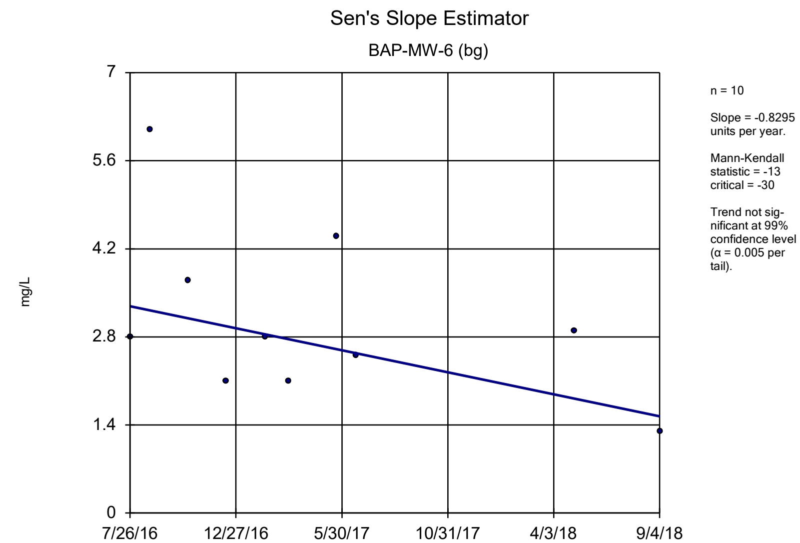
Constituent: Sulfate, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



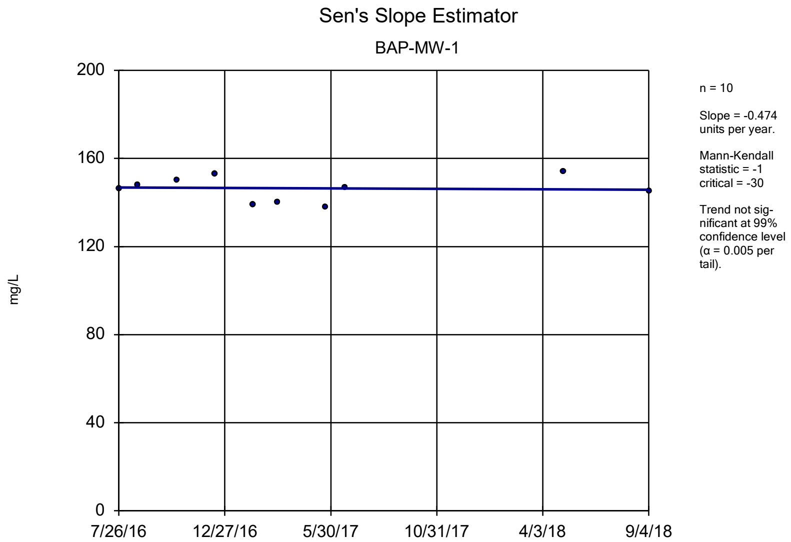
Constituent: Sulfate, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



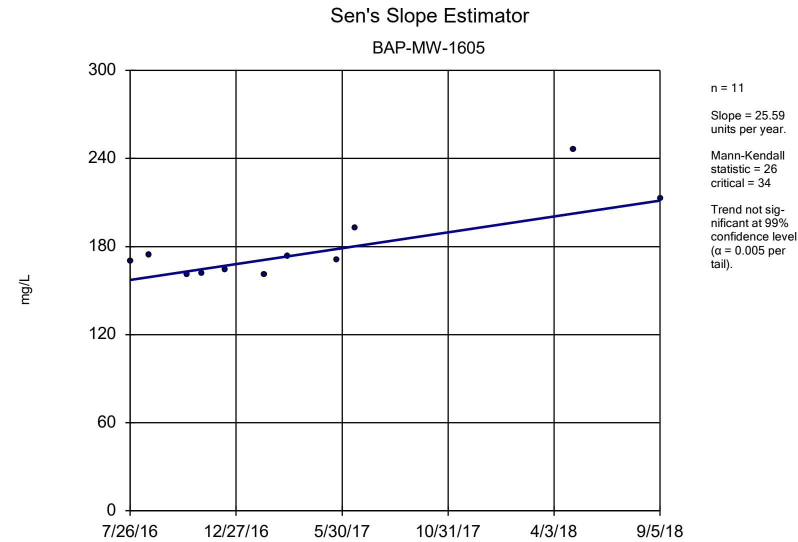
Constituent: Sulfate, total Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendix III
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



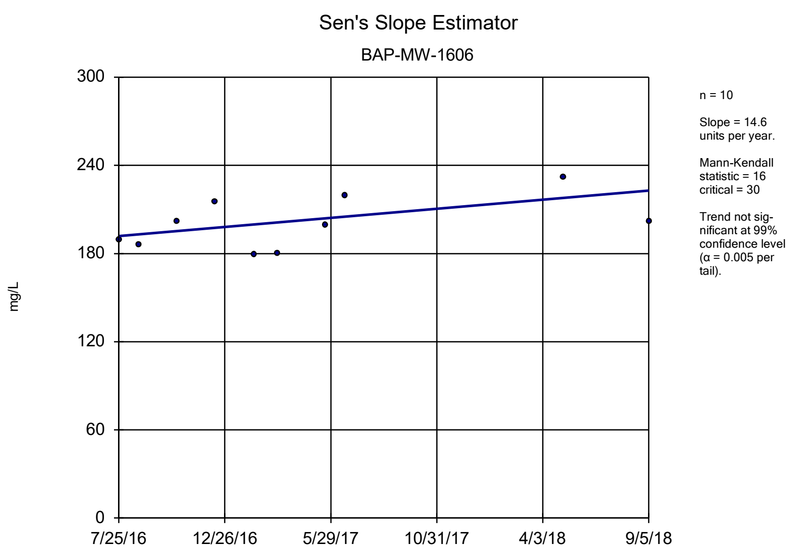
Constituent: Sulfate, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



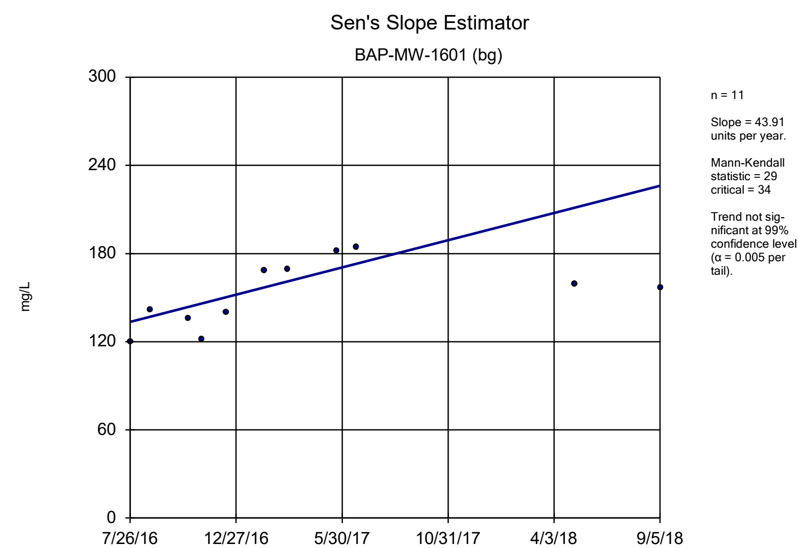
Constituent: Sulfate, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

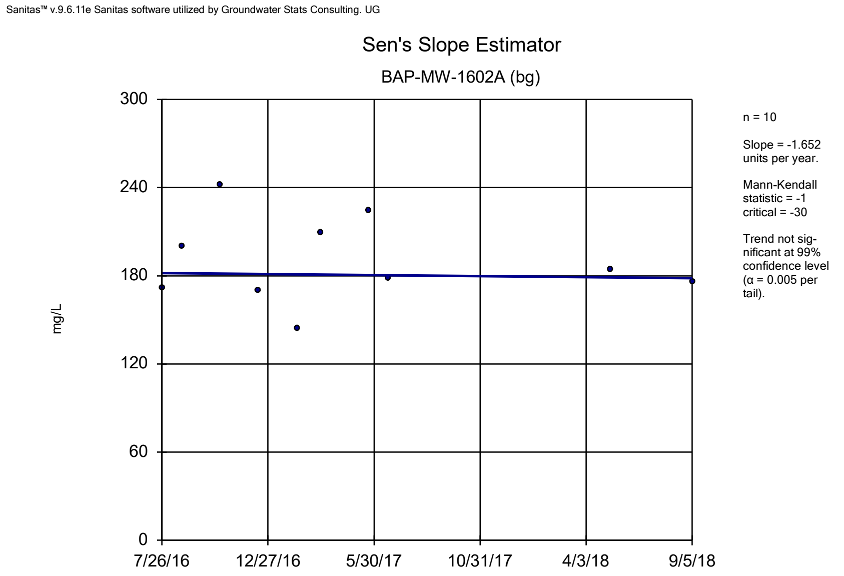


Constituent: Sulfate, total   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendix III
Amos BAP   Client: Geosyntec   Data: Amos BAP

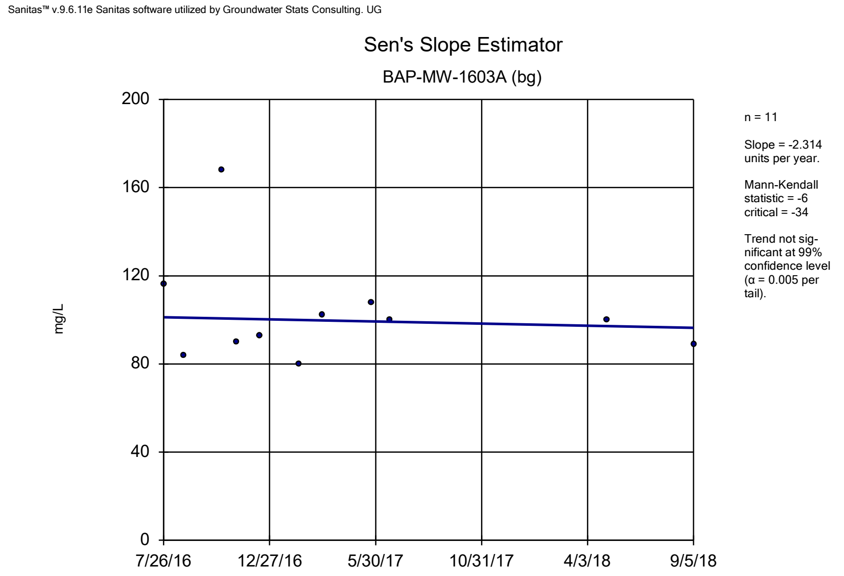
Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



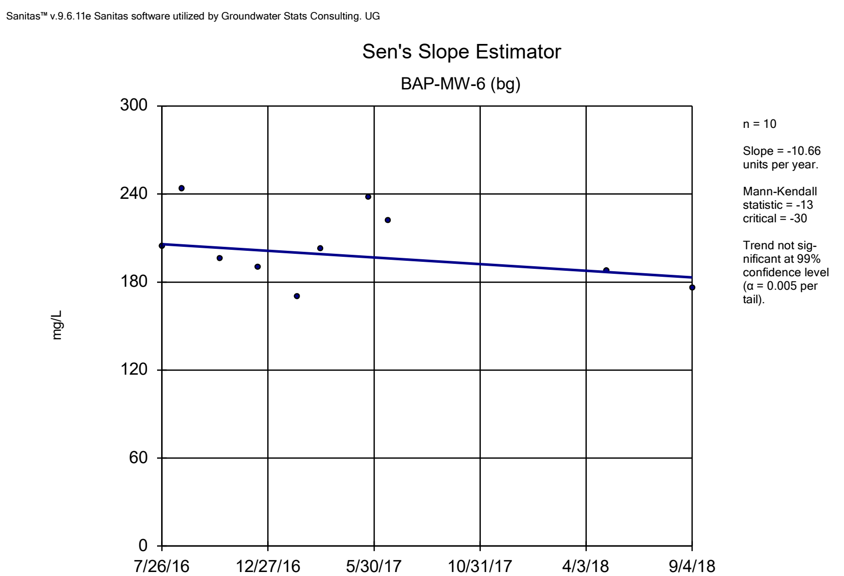
Constituent: Total Dissolved Solids [TDS]   Analysis Run 10/29/2018 8:57 AM   View: Trend Tests - Appendi
Amos BAP   Client: Geosyntec   Data: Amos BAP



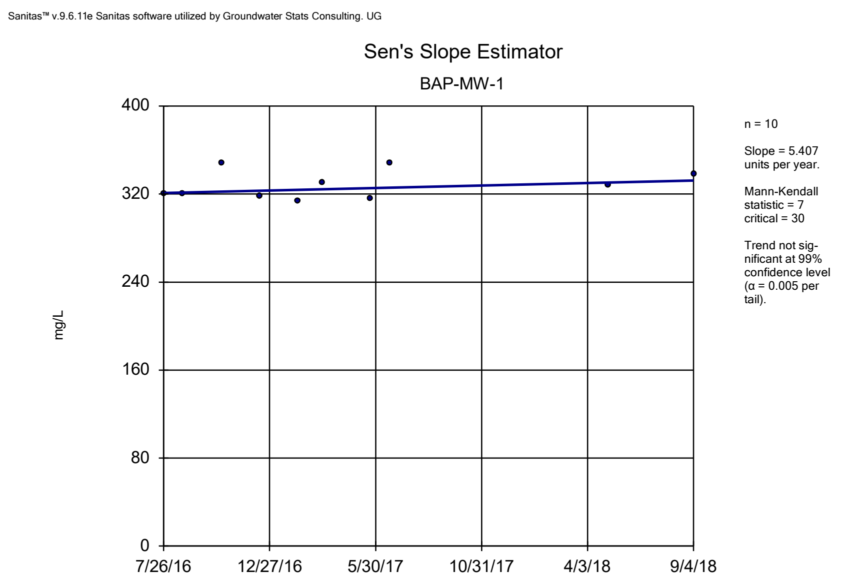
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendi
Amos BAP Client: Geosyntec Data: Amos BAP



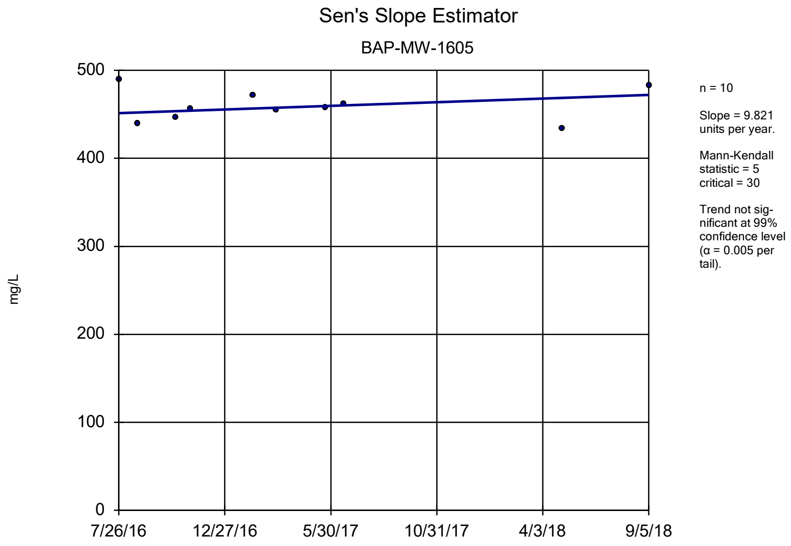
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendi
Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendi
Amos BAP Client: Geosyntec Data: Amos BAP



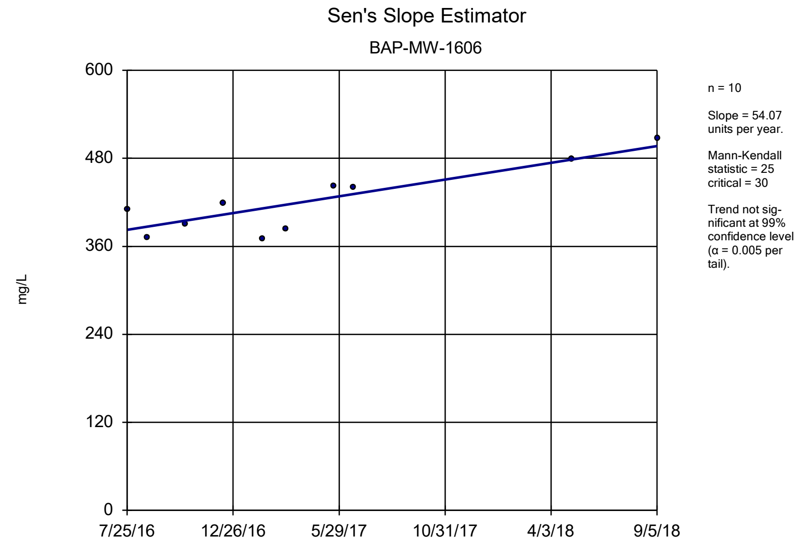
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendi
Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendi

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/29/2018 8:57 AM View: Trend Tests - Appendi

Amos BAP Client: Geosyntec Data: Amos BAP

Tolerance Limits - All Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 10/29/2018, 1:57 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.0001355	n/a	n/a	n/a	n/a	40	-10.44	0.7208	7.5	None	ln(x)	0.05	Inter
Arsenic, total (mg/L)	n/a	0.0871	n/a	n/a	n/a	n/a	40	n/a	n/a	0	n/a	n/a	0.1285	NP Inter(normal...
Barium, total (mg/L)	n/a	0.3051	n/a	n/a	n/a	n/a	40	0.1884	0.05488	0	None	No	0.05	Inter
Beryllium, total (mg/L)	n/a	0.00009176	n/a	n/a	n/a	n/a	40	0.00004243	0.0000...	0	None	No	0.05	Inter
Cadmium, total (mg/L)	n/a	0.00003	n/a	n/a	n/a	n/a	40	n/a	n/a	7.5	n/a	n/a	0.1285	NP Inter(normal...
Chromium, total (mg/L)	n/a	0.002601	n/a	n/a	n/a	n/a	40	0.02988	0.009935	0	None	sqrt(x)	0.05	Inter
Cobalt, total (mg/L)	n/a	0.03144	n/a	n/a	n/a	n/a	40	-5.775	1.089	0	None	ln(x)	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	n/a	5.202	n/a	n/a	n/a	n/a	42	0.009383	0.7762	0	None	ln(x)	0.05	Inter
Fluoride, total (mg/L)	n/a	0.29	n/a	n/a	n/a	n/a	42	n/a	n/a	0	n/a	n/a	0.116	NP Inter(normal...
Lead, total (mg/L)	n/a	0.006603	n/a	n/a	n/a	n/a	40	0.09786	0.04221	0	None	x^(1/3)	0.05	Inter
Lithium, total (mg/L)	n/a	0.01172	n/a	n/a	n/a	n/a	40	0.05518	0.02496	12.5	None	sqrt(x)	0.05	Inter
Mercury, total (mg/L)	n/a	0.000005	n/a	n/a	n/a	n/a	36	n/a	n/a	88.89	n/a	n/a	0.1578	NP Inter(NDs)
Molybdenum, total (mg/L)	n/a	0.003033	n/a	n/a	n/a	n/a	40	0.02951	0.01202	0	None	sqrt(x)	0.05	Inter
Selenium, total (mg/L)	n/a	0.0003	n/a	n/a	n/a	n/a	40	n/a	n/a	2.5	n/a	n/a	0.1285	NP Inter(normal...
Thallium, total (mg/L)	n/a	0.000224	n/a	n/a	n/a	n/a	40	n/a	n/a	10	n/a	n/a	0.1285	NP Inter(normal...

Confidence Interval - All Results (No Significant Results)

Amos BAP Client: Geosyntec Data: Amos BAP Printed 10/29/2018, 2:10 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	BAP-MW-1	0.00003	0.00001	0.006	No	10	0	No	0.011	NP (normality)
Antimony, total (mg/L)	BAP-MW-1604	0.00004	0.00002	0.006	No	10	0	No	0.011	NP (normality)
Antimony, total (mg/L)	BAP-MW-1605	0.00003245	0.00001355	0.006	No	10	0	No	0.01	Param.
Antimony, total (mg/L)	BAP-MW-1606	0.00003262	0.00001538	0.006	No	10	0	No	0.01	Param.
Antimony, total (mg/L)	BAP-MW-4	0.00005506	0.00002082	0.006	No	10	10	ln(x)	0.01	Param.
Antimony, total (mg/L)	BAP-MW-5	0.00005194	0.00001606	0.006	No	10	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1	0.0001703	0.0001097	0.087	No	10	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1604	0.005498	0.00419	0.087	No	10	0	ln(x)	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1605	0.004879	0.003371	0.087	No	10	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1606	0.003291	0.002487	0.087	No	10	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-4	0.01164	0.003321	0.087	No	10	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-5	0.003461	0.002559	0.087	No	10	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1	0.02979	0.02643	2	No	10	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1604	0.1447	0.1319	2	No	10	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1605	0.08767	0.06901	2	No	10	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1606	0.06768	0.0582	2	No	10	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-4	0.09626	0.0862	2	No	10	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-5	0.1643	0.1485	2	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1	0.0001284	0.0001082	0.004	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1604	0.000063	0.000038	0.004	No	10	0	No	0.011	NP (normality)
Beryllium, total (mg/L)	BAP-MW-1605	0.00006851	0.00003969	0.004	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1606	0.0001177	0.00008191	0.004	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-4	0.000057	0.0000422	0.004	No	10	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-5	0.00006014	0.00003426	0.004	No	10	0	No	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1	0.002816	0.002196	0.005	No	10	0	No	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1604	0.00001	0.000005	0.005	No	10	70	No	0.011	NP (normality)
Cadmium, total (mg/L)	BAP-MW-1605	0.00001	0.000005	0.005	No	10	70	No	0.011	NP (normality)
Cadmium, total (mg/L)	BAP-MW-1606	0.00017	0.00012	0.005	No	10	0	No	0.011	NP (normality)
Cadmium, total (mg/L)	BAP-MW-4	0.0002523	0.00004855	0.005	No	10	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-5	0.00001	0.000006	0.005	No	10	0	No	0.011	NP (normality)
Chromium, total (mg/L)	BAP-MW-1	0.0005457	0.0001008	0.1	No	10	0	ln(x)	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1604	0.001389	0.0006417	0.1	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1605	0.000454	0.000167	0.1	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1606	0.001352	0.0003704	0.1	No	10	0	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-4	0.0005991	0.0001856	0.1	No	10	0	x^(1/3)	0.01	Param.
Chromium, total (mg/L)	BAP-MW-5	0.000841	0.000122	0.1	No	10	0	No	0.011	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1	0.01545	0.01071	0.031	No	10	0	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1604	0.00106	0.000494	0.031	No	10	0	No	0.011	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1605	0.0245	0.00877	0.031	No	10	0	No	0.011	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1606	0.01563	0.01341	0.031	No	10	0	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-4	0.0388	0.009215	0.031	No	10	0	x^(1/3)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-5	0.00114	0.000949	0.031	No	10	0	No	0.011	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1	0.725	0.136	5.2	No	10	0	No	0.011	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1604	1.889	0.5899	5.2	No	11	0	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1605	1.722	0.586	5.2	No	11	0	No	0.006	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1606	1.467	0.3698	5.2	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-4	1.452	0.4849	5.2	No	11	0	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-5	1.356	0.6261	5.2	No	11	0	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1	0.03	0.02	4	No	10	50	No	0.011	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1604	0.1049	0.05691	4	No	11	0	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1605	0.08	0.03	4	No	11	36.36	No	0.006	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1606	0.03	0.03	4	No	10	80	No	0.011	NP (NDs)
Fluoride, total (mg/L)	BAP-MW-4	0.05831	0.03442	4	No	11	9.091	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-5	0.05	0.03	4	No	11	9.091	No	0.006	NP (normality)
Lead, total (mg/L)	BAP-MW-1	0.000134	0.000062	0.015	No	10	0	No	0.011	NP (normality)

Confidence Interval - All Results (No Significant Results)

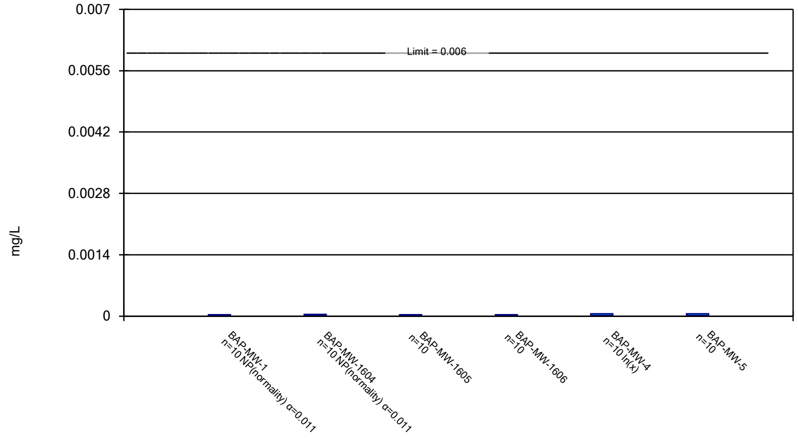
Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 10/29/2018, 2:10 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Lead, total (mg/L)	BAP-MW-1604	0.001052	0.0003123	0.015	No	10	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1605	0.0001913	0.00004187	0.015	No	10	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1606	0.001083	0.0002952	0.015	No	10	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-4	0.0003676	0.0001516	0.015	No	10	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-5	0.0003333	0.00005414	0.015	No	10	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1	0.007208	0.001837	0.04	No	10	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1604	0.004321	0.0004802	0.04	No	10	20	No	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1605	0.007278	0.00327	0.04	No	10	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1606	0.007232	0.002268	0.04	No	10	10	No	0.01	Param.
Lithium, total (mg/L)	BAP-MW-4	0.006619	0.0008654	0.04	No	10	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-5	0.006293	0.0009319	0.04	No	10	0	sqrt(x)	0.01	Param.
Mercury, total (mg/L)	BAP-MW-1	0.0000025	0.000002	0.002	No	9	88.89	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1604	0.0000025	0.000002	0.002	No	9	88.89	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1605	0.0000025	0.0000025	0.002	No	9	100	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1606	0.0000025	0.000002	0.002	No	9	88.89	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-4	0.0000025	0.0000025	0.002	No	9	100	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-5	0.0000025	0.0000025	0.002	No	9	100	No	0.002	NP (NDs)
Molybdenum, total (mg/L)	BAP-MW-1	0.001646	0.0004363	0.1	No	10	0	No	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-1604	0.00064	0.0002	0.1	No	10	0	No	0.011	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-1605	0.0004174	0.00009656	0.1	No	10	0	No	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-1606	0.000213	0.00007499	0.1	No	10	0	No	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-4	0.0111	0.00028	0.1	No	10	0	No	0.011	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-5	0.001773	0.0002631	0.1	No	10	0	sqrt(x)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-1	0.0002	0.00009	0.05	No	9	0	No	0.002	NP (normality)
Selenium, total (mg/L)	BAP-MW-1604	0.0002	0.0002	0.05	No	10	0	No	0.011	NP (normality)
Selenium, total (mg/L)	BAP-MW-1605	0.00009182	0.00004618	0.05	No	10	0	No	0.01	Param.
Selenium, total (mg/L)	BAP-MW-1606	0.0001843	0.0000772	0.05	No	10	0	ln(x)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-4	0.00009323	0.00006477	0.05	No	10	0	No	0.01	Param.
Selenium, total (mg/L)	BAP-MW-5	0.00005	0.00003	0.05	No	10	50	No	0.011	NP (normality)
Thallium, total (mg/L)	BAP-MW-1	0.00005297	0.00003532	0.002	No	10	0	sqrt(x)	0.01	Param.
Thallium, total (mg/L)	BAP-MW-1604	0.000025	0.00001	0.002	No	10	30	No	0.011	NP (Cohens/xfrm)
Thallium, total (mg/L)	BAP-MW-1605	0.00004	0.00001	0.002	No	10	50	No	0.011	NP (Cohens/xfrm)
Thallium, total (mg/L)	BAP-MW-1606	0.00003315	0.00001043	0.002	No	10	0	sqrt(x)	0.01	Param.
Thallium, total (mg/L)	BAP-MW-4	0.0001131	0.00003452	0.002	No	10	0	No	0.01	Param.
Thallium, total (mg/L)	BAP-MW-5	0.00005358	0.00001078	0.002	No	10	30	No	0.01	Param.

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

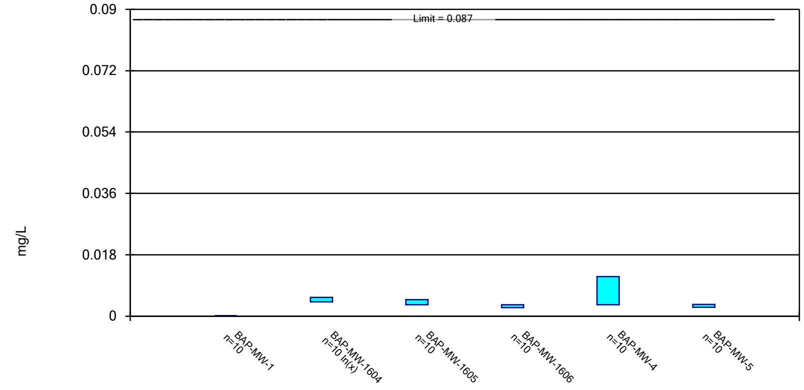


Constituent: Antimony, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

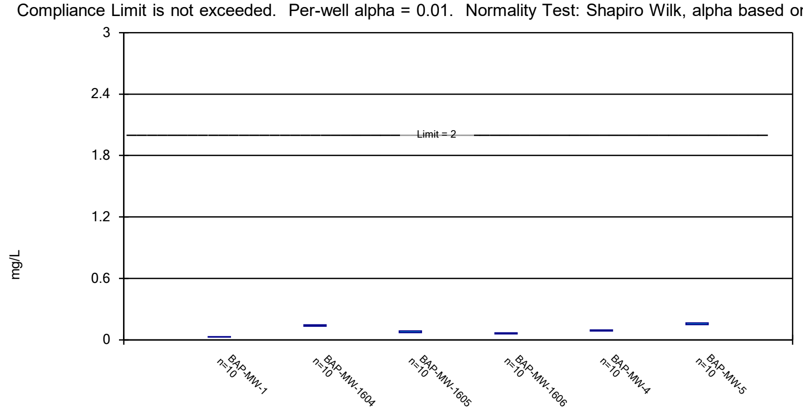


Constituent: Arsenic, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

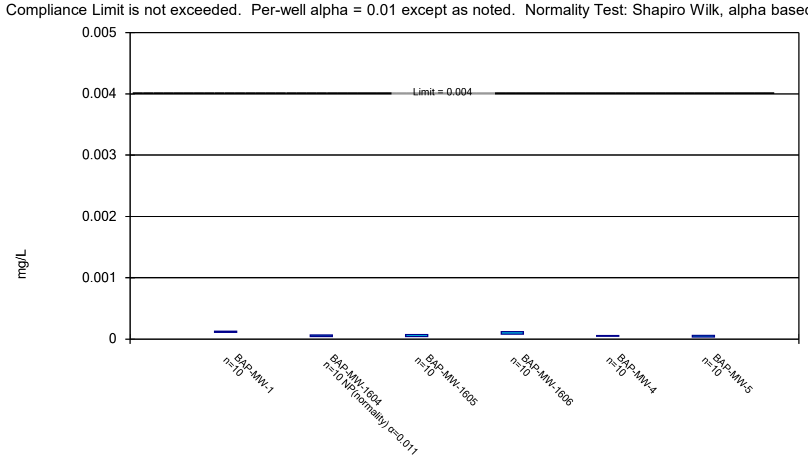


Constituent: Barium, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

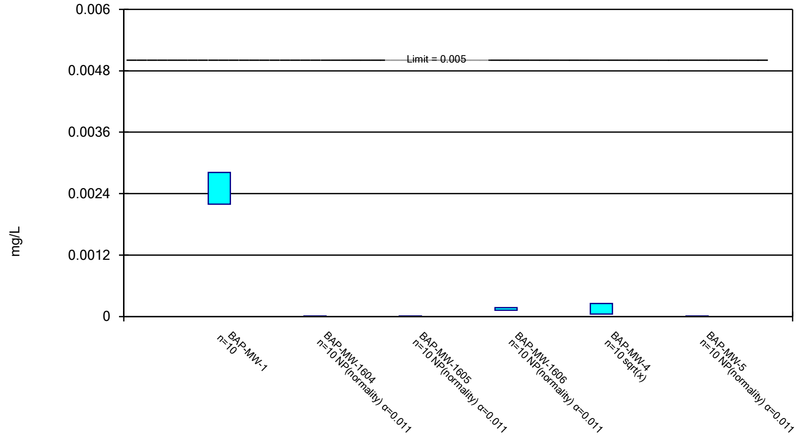


Constituent: Beryllium, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



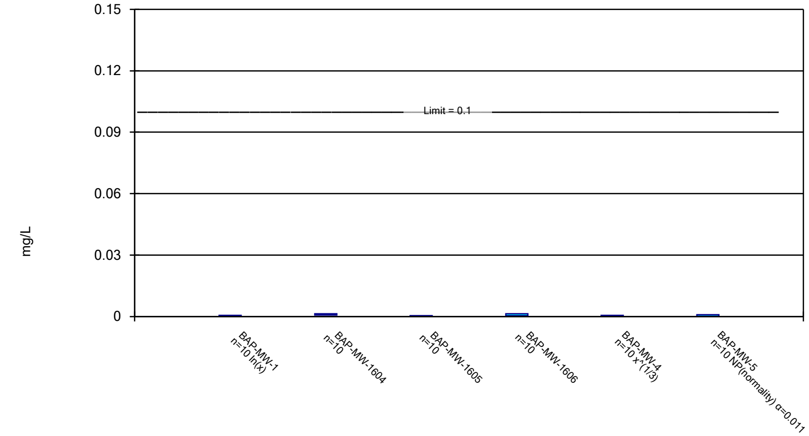
Constituent: Cadmium, total   Analysis Run 10/29/2018 2:08 PM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



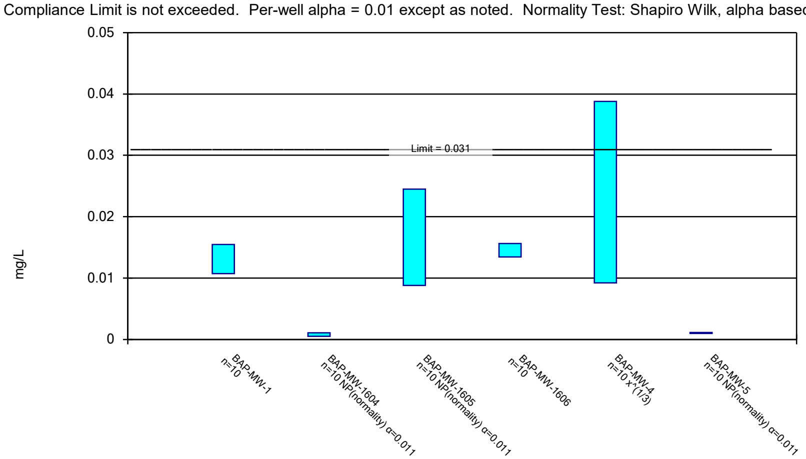
Constituent: Chromium, total   Analysis Run 10/29/2018 2:08 PM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



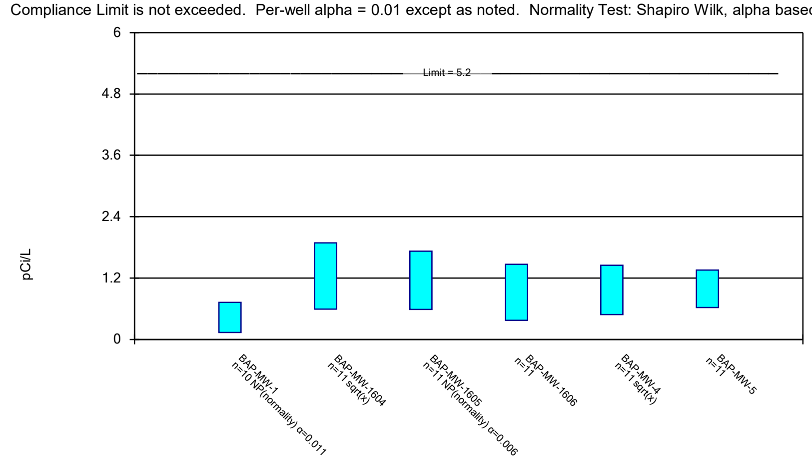
Constituent: Cobalt, total   Analysis Run 10/29/2018 2:08 PM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



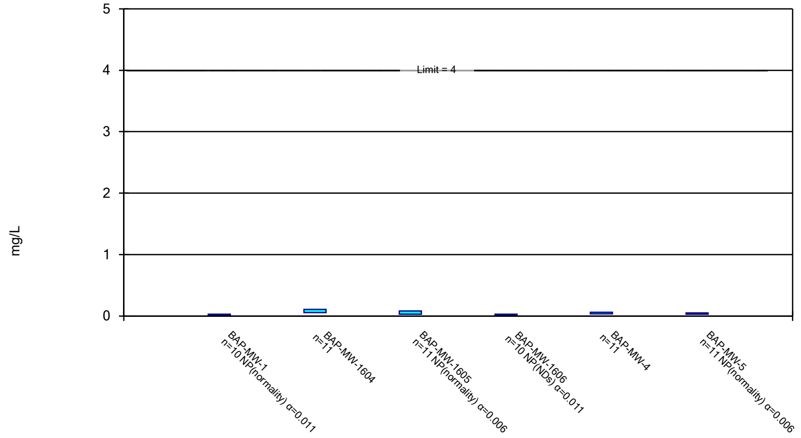
Constituent: Combined Radium 226 + 228   Analysis Run 10/29/2018 2:08 PM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



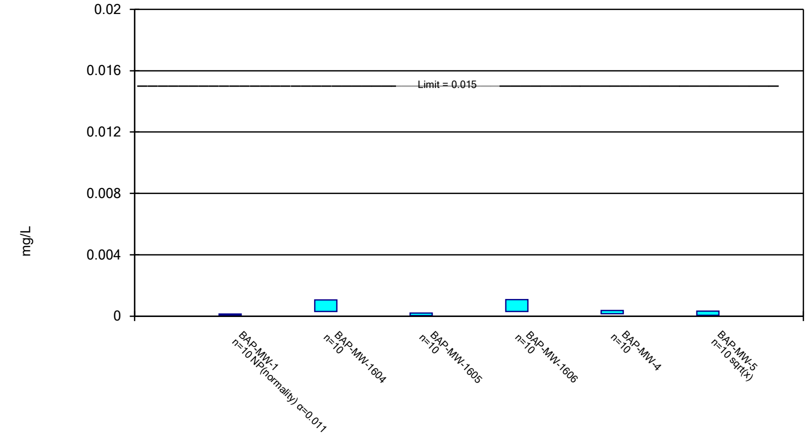
Constituent: Fluoride, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



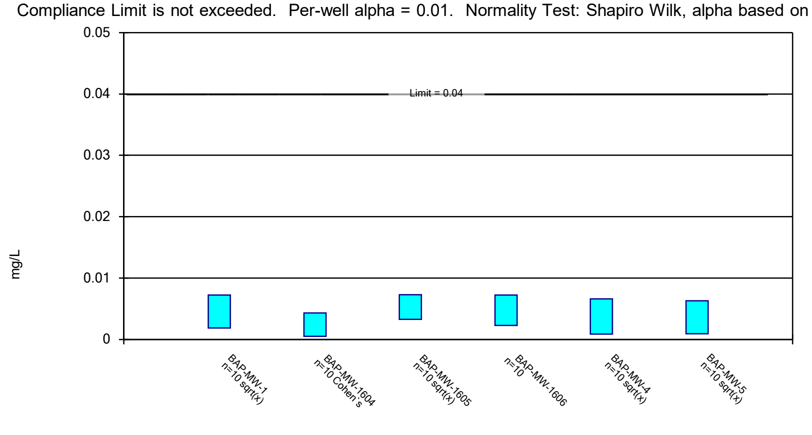
Constituent: Lead, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



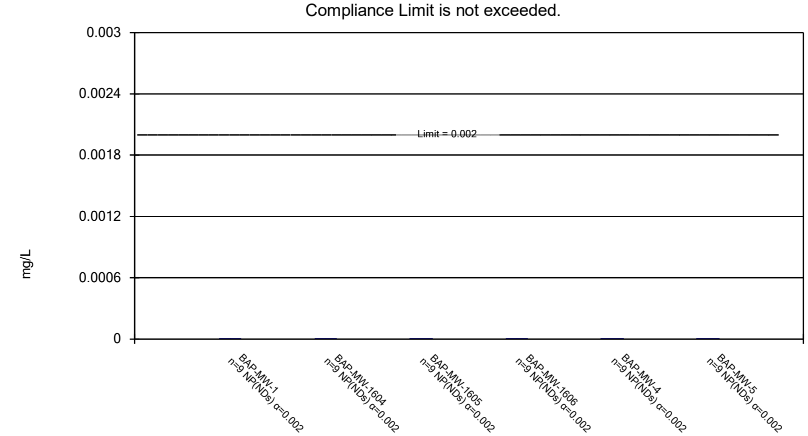
Constituent: Lithium, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.



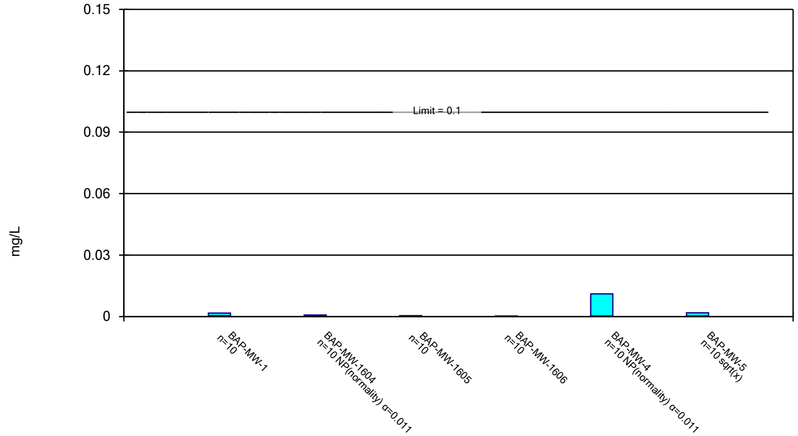
Constituent: Mercury, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



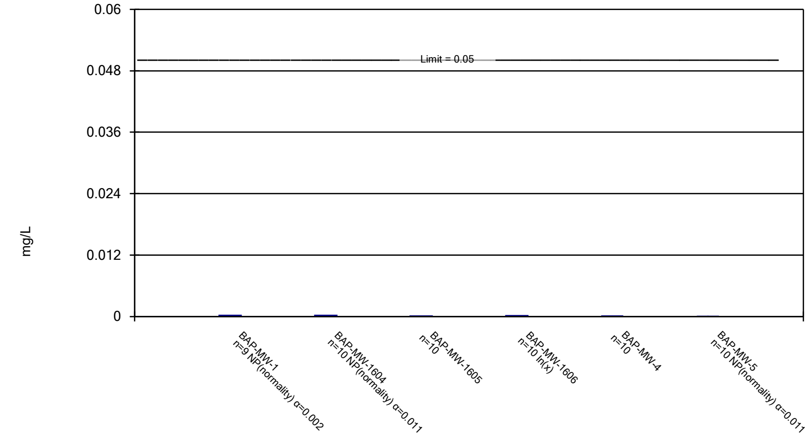
Constituent: Molybdenum, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



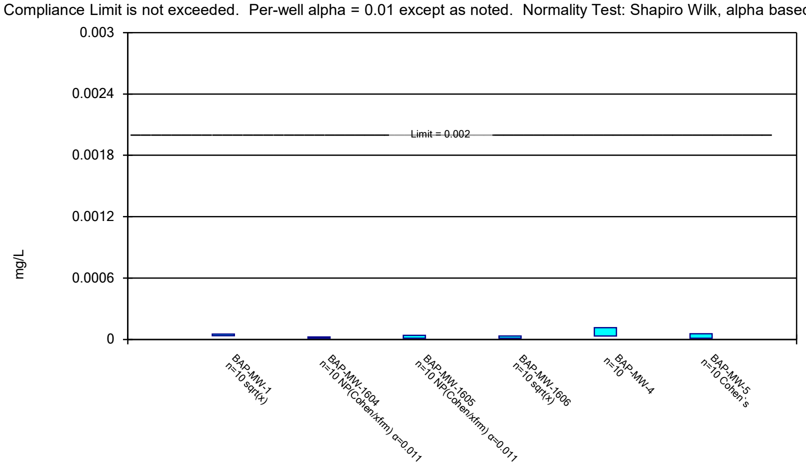
Constituent: Selenium, total Analysis Run 10/29/2018 2:08 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.11e Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Thallium, total Analysis Run 10/29/2018 2:09 PM View: UTL's - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Amos Plant
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

July 10, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for calcium, chloride, total dissolved solids (TDS), and sulfate at the BAP. An alternative source was not identified at the time, so two assessment monitoring events were conducted at the BAP in 2018, in accordance with 40 CFR 257.95. No SSLs were identified during these events, and the unit remained in assessment monitoring. A semi-annual assessment monitoring event was also completed in March 2019, with the results of the March 2019 event documented in this report.

Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at a statistically significant level (SSL) above the GWPS. No SSLs were identified, but Appendix III concentrations for boron, calcium, chloride, pH, sulfate, and TDS remained above background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, one set of samples was collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(d)(1). Samples from the March 2019 semi-annual sampling event were analyzed for the Appendix III and Appendix IV parameters detected during the 40 CFR 257.95(b) event completed in May 2018. A summary of data collected during this assessment monitoring event may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.14 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017). Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained to meet the requirements of 40 CFR 257.95(d)(1) were screened for potential outliers. No outliers were identified.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for arsenic, cadmium, fluoride, selenium, and thallium due to apparent non-normal distributions and for mercury due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Amos BAP.

2.2.3 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters are at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Prediction limits were calculated for the Appendix III parameters to represent background values. As described in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018), intrawell tests were used to evaluate potential SSIs for fluoride and pH, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS.

Prediction limits for the interwell tests were recalculated using data collected during the March 2019 assessment monitoring event. Four data points (i.e., one samples from four background wells) were added to the background dataset for each interwell test. New data were tested for outliers prior to being added to the background dataset. The updated prediction limits were calculated for a one-of-two retesting procedure, as during detection monitoring. The values of the updated prediction limits were similar to the values of the prediction limits calculated during detection monitoring. The revised interwell prediction limits were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS.

For the intrawell tests, limited data made it possible to add only one data point (i.e., one sample from each compliance well) to each background dataset. Because one sample result is insufficient to compare against the existing background dataset, the prediction limits were not updated for the intrawell tests at this time. The intrawell prediction limits calculated during detection monitoring were used to evaluate potential SSIs for fluoride and pH.

Data collected during the September 2018 and March 2019 assessment monitoring events from each compliance well were compared to the prediction limits to evaluate if results were above background values. The results from this event and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.183 mg/L at MW-1 (0.20 mg/L), MW-1604 (<0.2 mg/L), MW-1605 (<0.2 mg/L), MW-1606 (<0.2 mg/L), MW-4 (<0.2 mg/L), and MW-4 (<0.2 mg/L). However, boron was not detected at any of these wells except for MW-1, and so is reported as the method detection limit (0.2 mg/L).

- Calcium concentrations exceeded the interwell UPL of 19.6 mg/L at MW-1 (38.3 mg/L and 38.4 mg/L), MW-1605 (49.4 mg/L and 45.4 mg/L), and MW-1606 (51.7 mg/L and 59.0 mg/L).

- Chloride concentrations exceeded the interwell UPL of 41.0 mg/L at MW-1 (67.9 mg/L and 55.2 mg/L), MW-1605 (97.1 mg/L and 92.5 mg/L), and MW-1606 (133 mg/L and 157 mg/L).

- pH exceeded the intrawell background value (UPL) of 6.4 SU at MW-1604 (7.2 SU) and MW-4 (7.0 SU) during the September 2018 event.

- Sulfate concentrations exceeded the interwell UPL of 57.4 mg/L at MW-1 (145 mg/L and 138 mg/L), MW-1605 (213 mg/L and 222 mg/L), and MW-1606 (202 mg/L and 232 mg/L).

- TDS concentrations exceeded the interwell UPL of 253 mg/L at MW-1 (338 mg/L and 321 mg/L), MW-1605 (483 mg/L and 507 mg/L), and MW-1606 (507 mg/L and 597 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Amos BAP during assessment monitoring. As a result, the Amos BAP CCR unit will remain in assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the March 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS, and intrawell tests were used to evaluate potential SSIs for fluoride and pH. The prediction limits for the interwell tests were updated with additional data collected from the background wells. Prediction limits were recalculated using a one-of-two retesting procedure. The prediction limits calculated during detection monitoring were used for the intrawell tests. Boron, calcium, chloride, pH, sulfate, and TDS results exceeded background levels.

Based on this evaluation, either the Amos BAP CCR unit will remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Amos Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, John E. Amos Plant, Winfield, West Virginia. January 15, 2018.

TABLES

Table 1 - Groundwater Data Summary
Amos - Bottom Ash Pond

Parameter	Unit	BAP-MW-1	BAP-MW-4	BAP-MW-5	BAP-MW-6	BAP-MW-1601	BAP-MW-1602A	BAP-MW-1603A	BAP-MW-1604	BAP-MW-1605	BAP-MW-1606
		3/14/2019	3/15/2019	3/15/2019	3/15/2019	3/19/2019	3/19/2019	3/15/2019	3/15/2019	3/14/2019	3/15/2019
Antimony	µg/L	0.0500 J	0.100 U	0.0200 J	0.0600 J	0.100 U	0.0400 J	0.100 U	0.0400 J	0.100 U	0.0300 J
Arsenic	µg/L	0.120	1.63	3.63	32.0	6.55	19.7	89.9	6.78	2.95	2.94
Barium	µg/L	26.9	80.4	162	184	122	217	252	118	88.1	74.6
Beryllium	µg/L	0.131	0.0500 J	0.0600 J	0.106	0.0200 J	0.0400 J	0.100 U	0.0700 J	0.0800 J	0.152
Boron	mg/L	0.200 J	1.00 U	1.00 U	1.00 U	0.0500 J	0.0300 J	1.00 U	1.00 U	1.00 U	1.00 U
Cadmium	µg/L	3.48	0.0500	0.0500 U	0.0200 J	0.0100 J	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.190
Calcium	mg/L	38.4	14.5	16.2	12.4	11.9	19.6	15.5	13.1	45.4	59.0
Chloride	mg/L	55.2	13.3	18.5	10.4	8.80	41.0	5.65	16.6	92.5	157
Chromium	µg/L	0.255	0.200 J	0.344	1.82	0.100 J	0.472	0.407	0.931	0.200 J	1.24
Cobalt	µg/L	10.3	9.81	1.21	14.0	3.41	0.691	0.360	0.406	8.83	18.2
Combined Radium	pCi/L	0.887	0.501	0.853	0.865	0.666	0.523	1.26	0.596	0.304	0.295
Fluoride	mg/L	0.0300 J	0.0600 J	0.0500 J	0.0500 J	0.0600 U	0.140	0.270	0.0900	0.0600 U	0.0600 U
Lead	µg/L	0.252	0.219	0.124	1.72	0.105	2.64	0.232	1.19	0.161	1.06
Lithium	mg/L	0.300 U	0.300 U	0.300 U	0.300 U	0.0200 J	0.0300 U	0.300 U	0.300 U	0.300 U	0.300 U
Mercury	µg/L	-	-	-	-	-	-	-	-	-	-
Molybdenum	µg/L	0.500 J	2.00 U	2.00 U	0.500 J	2.00 U	0.700 J	1.00 J	2.00 U	2.00 U	2.00 U
Selenium	µg/L	0.0900 J	0.0600 J	0.200 U	0.400	0.0400 J	0.0900 J	0.0500 J	0.200	0.0500 J	0.200 J
Total Dissolved Solids	mg/L	321	184	180	226	176	232	95.0	170	507	597
Sulfate	mg/L	138	42.8	51.3	1.60	52.7	13.2	0.400 U	0.400 U	222	232
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.100 J	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
pH	SU	5.17	5.52	5.68	5.92	5.76	6.55	7.10	6.30	5.56	5.40

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not analyzed

Table 2: Groundwater Protection Standards
Amos Plant - Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Background Limit
Antimony, Total (mg/L)	0.006		0.0001
Arsenic, Total (mg/L)	0.01		0.09
Barium, Total (mg/L)	2		0.31
Beryllium, Total (mg/L)	0.004		0.0001
Cadmium, Total (mg/L)	0.005		0.00003
Chromium, Total (mg/L)	0.1		0.0026
Cobalt, Total (mg/L)	n/a	0.006	0.032
Combined Radium, Total (pCi/L)	5		4.7
Fluoride, Total (mg/L)	4		0.29
Lead, Total (mg/L)	n/a	0.015	0.0064
Lithium, Total (mg/L)	n/a	0.04	0.013
Mercury, Total (mg/L)	0.002		0.000005
Molybdenum, Total (mg/L)	n/a	0.1	0.003
Selenium, Total (mg/L)	0.05		0.0004
Thallium, Total (mg/L)	0.002		0.0005

Notes:
Grey cell indicates calculated UTL is higher than MCL.
MCL = Maximum Contaminant Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Appendix III Data Summary
Amos Plant - Bottom Ash Pond

Parameter	Units	Description	MW-1		MW-1604		MW-1605		MW-1606		MW-4		MW-5	
			9/4/2018	3/14/2019	9/5/2018	3/15/2019	9/5/2018	3/14/2019	9/5/2018	3/15/2019	9/5/2018	3/15/2019	9/4/2018	3/15/2019
Boron	mg/L	Interwell Background Value (UPL)	0.183											
		Detection Monitoring Result	0.09	**0.20**	0.04	**<0.2***	0.002	**<0.2***	0.03	**<0.2***	0.07	**<0.2***	0.03	**<0.2***
Calcium	mg/L	Interwell Background Value (UPL)	19.6											
		Detection Monitoring Result	**38.3**	**38.4**	15.1	13.1	**49.4**	**45.4**	**51.7**	**59.0**	13.3	14.5	15.2	16.2
Chloride	mg/L	Interwell Background Value (UPL)	41.0											
		Detection Monitoring Result	**67.9**	**55.2**	22.8	16.6	**97.1**	**92.5**	**133**	**157**	13.4	13.3	17.8	18.5
Fluoride	mg/L	Intrawell Background Value (UPL)	0.060		0.127		0.108		0.060		0.112		0.111	
		Detection Monitoring Result	0.030	0.030	0.120	0.090	0.030	<0.01	0.02	<0.01	0.060	0.060	0.050	0.050
pH	SU	Intrawell Background Value (UPL)	6.1		6.4		6.7		6.0		6.4		6.7	
		Intrawell Background Value (LPL)	4.9		6.0		5.2		5.0		5.0		5.0	
		Detection Monitoring Result	5.1	5.2	**7.2**	6.3	5.6	5.6	5.4	5.4	**7.0**	5.5	5.8	5.7
Sulfate	mg/L	Interwell Background Value (UPL)	57.4											
		Detection Monitoring Result	**145**	**138**	0.04	0.06	**213**	**222**	**202**	**232**	42.4	42.8	45.4	51.3
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	253											
		Detection Monitoring Result	**338**	**321**	180	170	**483**	**507**	**507**	**597**	179	184	151	180

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
*: < represents a value below the method detection limit.
-: Not Sampled
Bold values exceed the background value.
Background values are shaded gray.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Amos Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663

License Number

WEST VIRGINIA

Licensing State

07.10.19

Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

July 9, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Amos Bottom Ash Pond
Assessment Monitoring Event – March 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the evaluation of groundwater data for the March 2019 Assessment Monitoring event for American Electric Power Company's Amos Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** BAP-MW-1601, BAP-MW-1602A, BAP-MW-1603A, and BAP-MW-6; and
- **Downgradient wells:** BAP-MW-1, BAP-MW-1604, BAP-MW-1605, BAP-MW-1606, BAP-MW-4, and BAP-MW-5.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) - boron, calcium, chloride, fluoride, pH, sulfate, and TDS;
- **Appendix IV** (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figure A). Values in background which have previously been flagged as outliers may be seen in a lighter font and disconnected symbol on the graphs. Additionally, a summary of flagged values follows this letter (Figure B).

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 verification strategy were constructed for boron, calcium, chloride, sulfate and TDS; and intrawell prediction limits combined with a 1-of-2 verification strategy were constructed for fluoride and pH (Figures C and D, respectively). The statistical method selected for each parameter was determined based on the results of the evaluation performed in December 2017; and all proposed background data were screened for outliers and trends at that time. The findings of those reports were submitted with that analysis.

Interwell prediction limits utilize all upgradient well data for construction of statistical limits. During each sample event, upgradient well data are screened for any newly suspected outliers or obvious trending patterns using time series plots. All values flagged as outliers may be seen on the Outlier Summary report following this letter. No obvious trending patterns were observed in the upgradient wells.

Intrawell prediction limits utilize the background data set that was originally screened in 2017. As recommended in the EPA Unified Guidance (2009), the background data set will be tested for the purpose of updating statistical limits using the Mann-Whitney two-sample test when an additional four to eight measurements are available.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of one additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified, and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered a false positive result, and, therefore, no further action is necessary.

Prediction limit exceedances were noted for calcium, sulfate and TDS in at least one downgradient well. The results of those findings may be found in the Prediction Limit Summary tables following this letter.

When a statistically significant increase is identified, the data are further evaluated using the Sen's Slope/Mann Kendall trend test to determine whether data are statistically increasing, decreasing or stable (Figure E). Upgradient wells are included to determine whether similar patterns exist upgradient of the facility which is an indication of naturally changing groundwater. Statistically significant increasing trends were found for chloride in upgradient well BAP-MW-1601 and in downgradient well BAP-MW-1606; and for total dissolved solids in downgradient well BAP-MW-1606. The Trend Test Summary Table follows this letter.

Evaluation of Appendix IV Parameters

Interwell Tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the Alternate Contaminant Level (ACL) for each constituent (Figure F). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter.

Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure G).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of either the MCL, CCR-Rule specified levels, or background as discussed above (Figure H). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No exceedances were noted for any of the well/constituent pairs. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for Amos Bottom Ash Pond. If you have any questions or comments, please feel free to contact me.

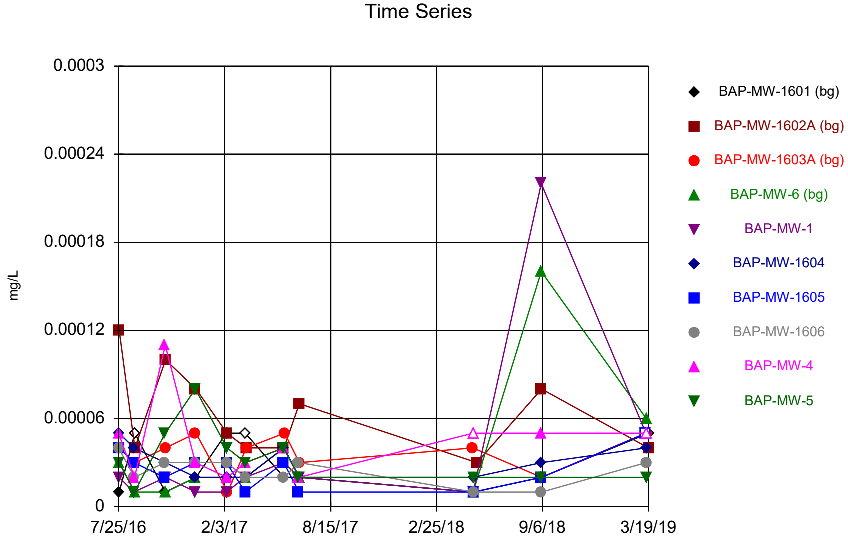
For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner, Groundwater Statistician

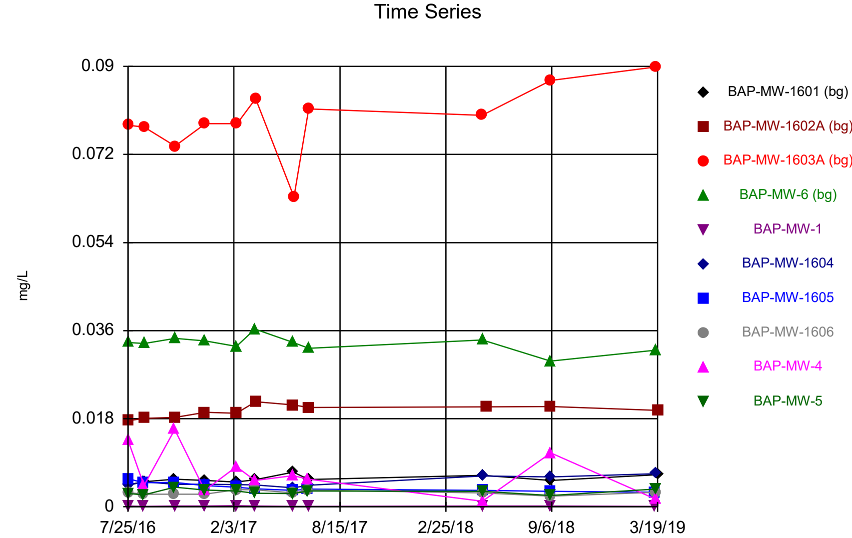
FIGURE A: TIME SERIES

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



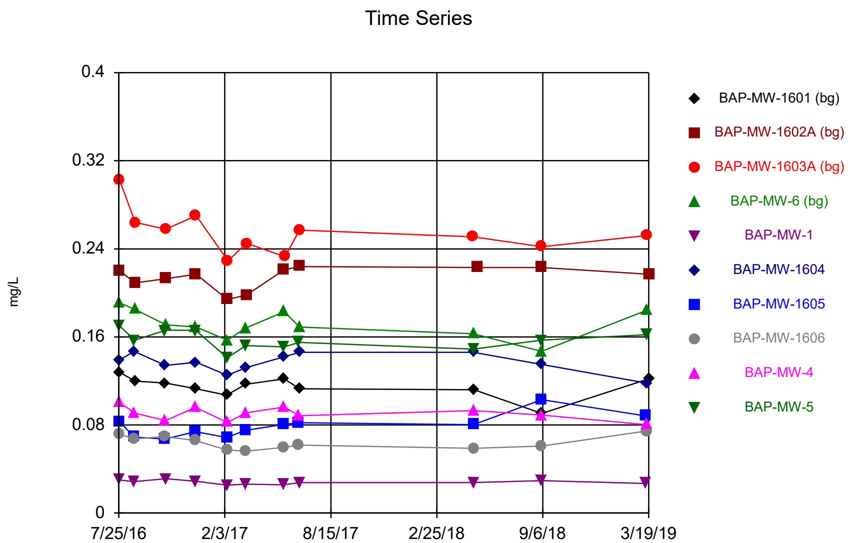
Constituent: Antimony, total Analysis Run 7/8/2019 4:28 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



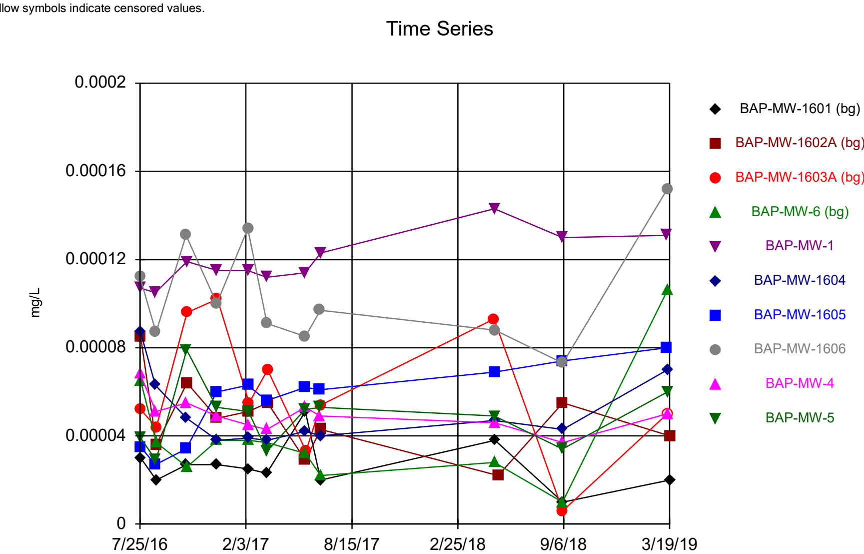
Constituent: Arsenic, total Analysis Run 7/8/2019 4:28 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

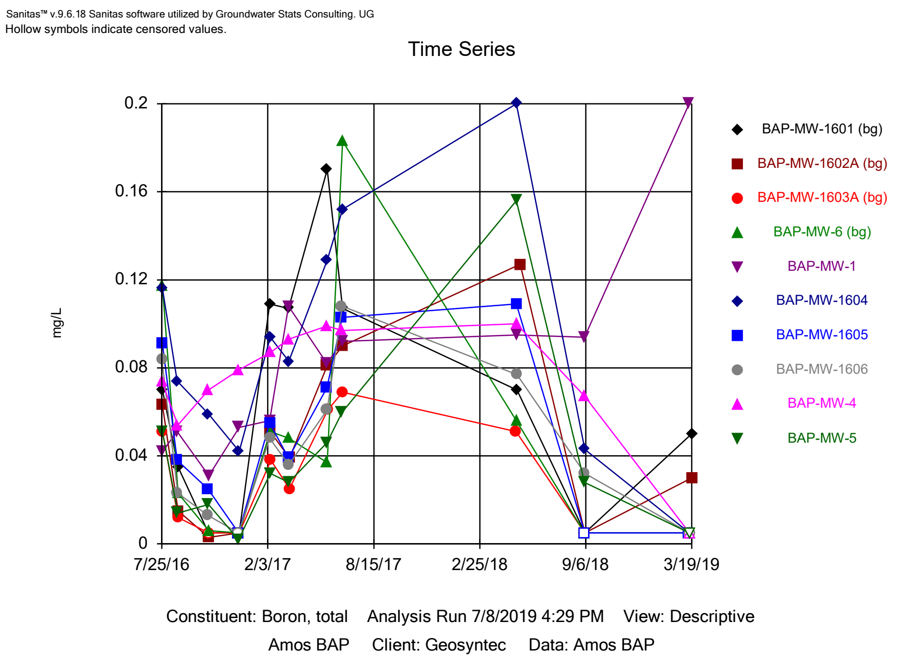


Constituent: Barium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

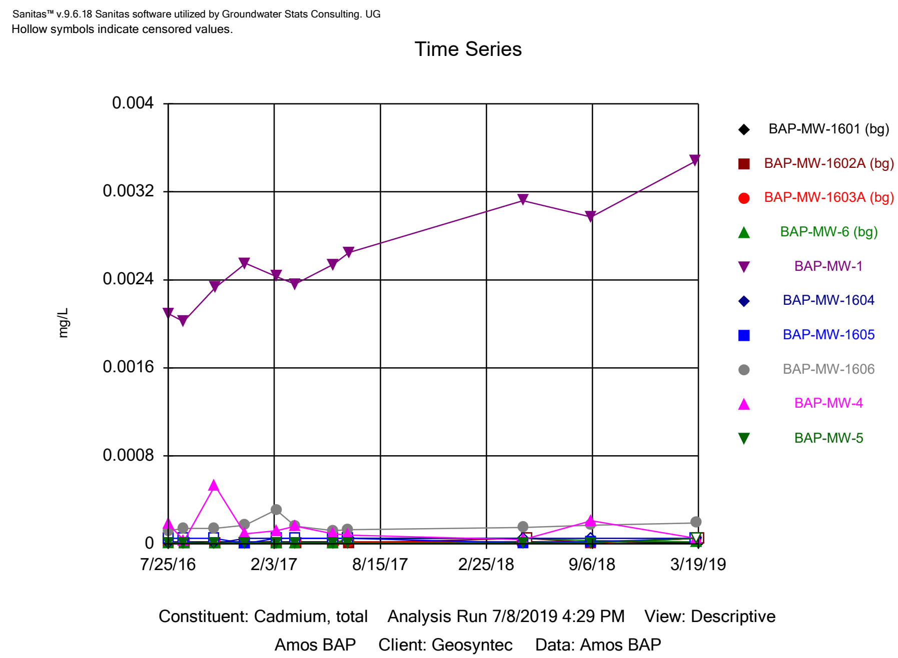
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



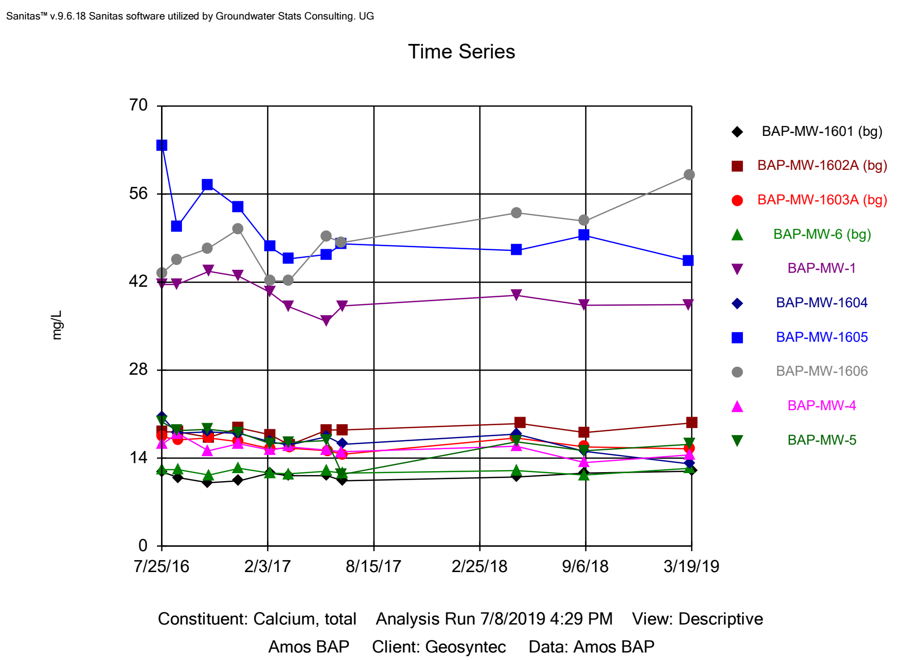
Constituent: Beryllium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



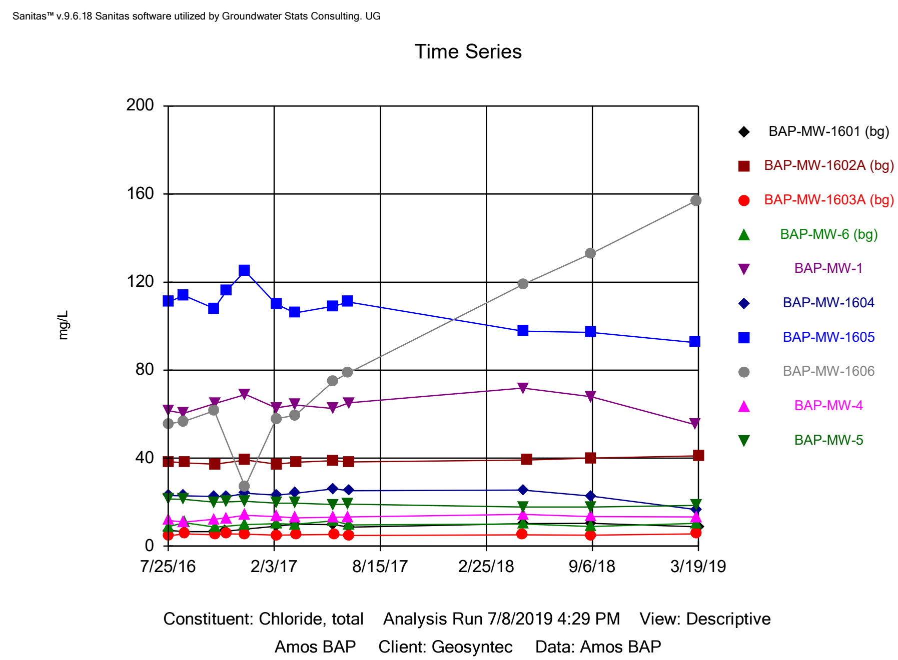
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.2
0.16
0.12
0.08
0.04
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Boron, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.004
0.0032
0.0024
0.0016
0.0008
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Cadmium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

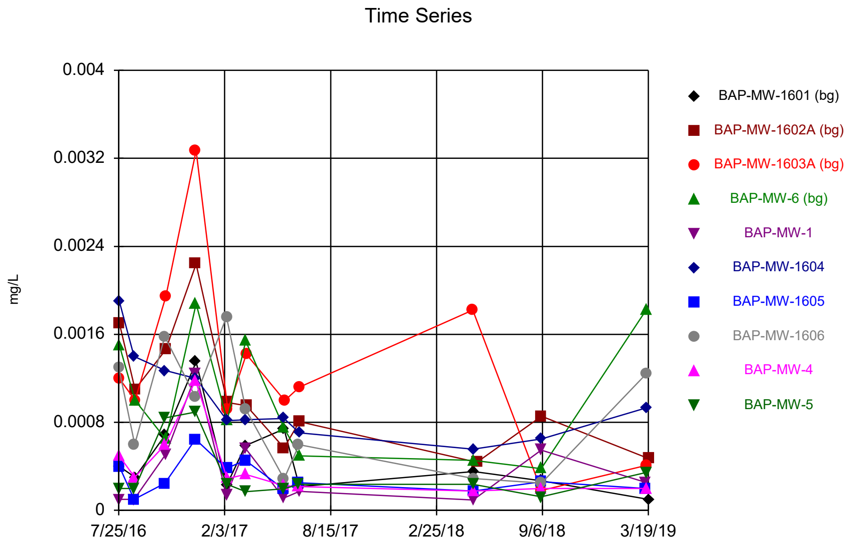


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
70
56
42
28
14
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Calcium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP



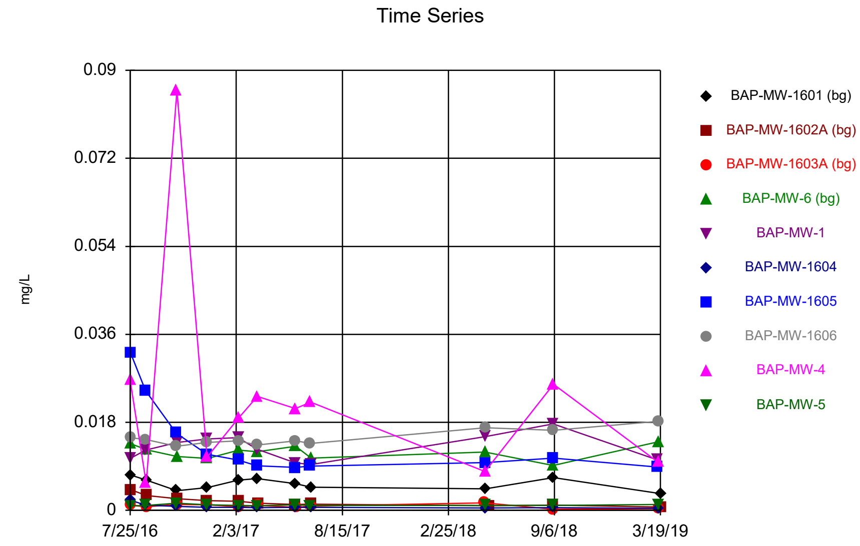
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Chloride, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



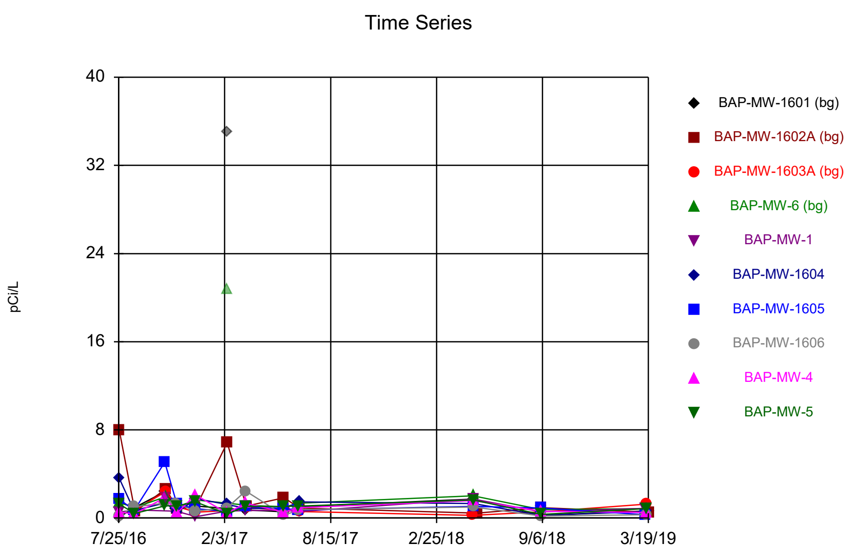
Constituent: Chromium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



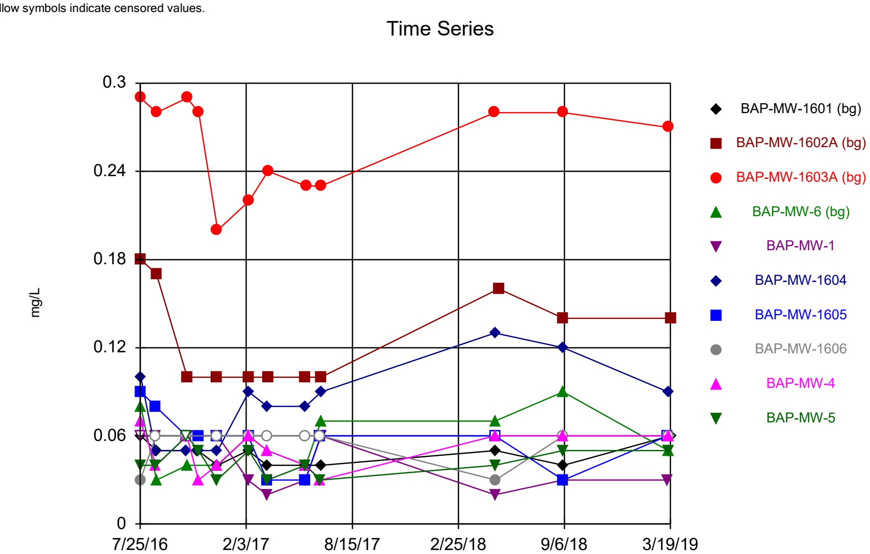
Constituent: Cobalt, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



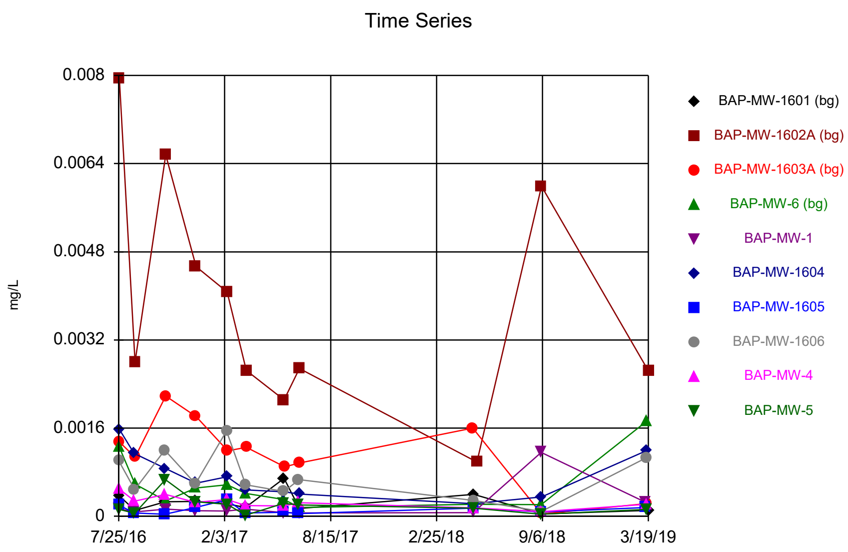
Constituent: Combined Radium 226 + 228 Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



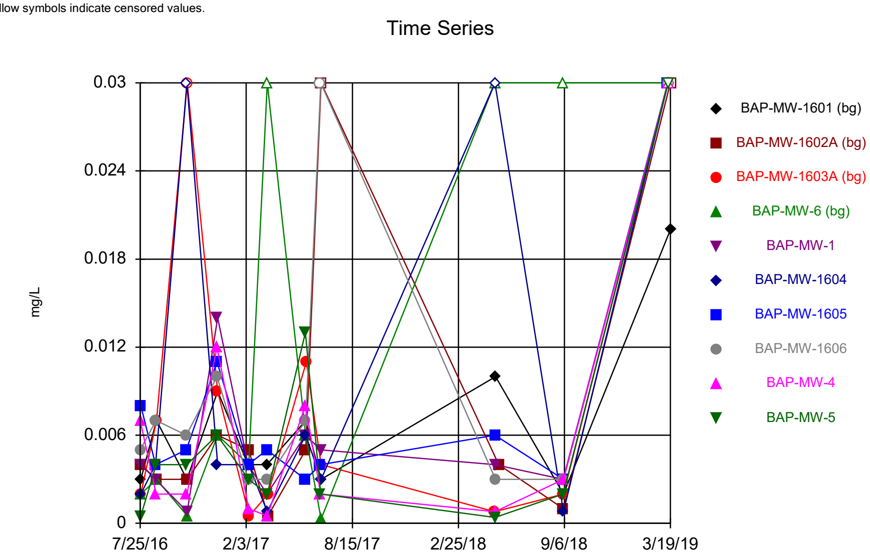
Constituent: Fluoride, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



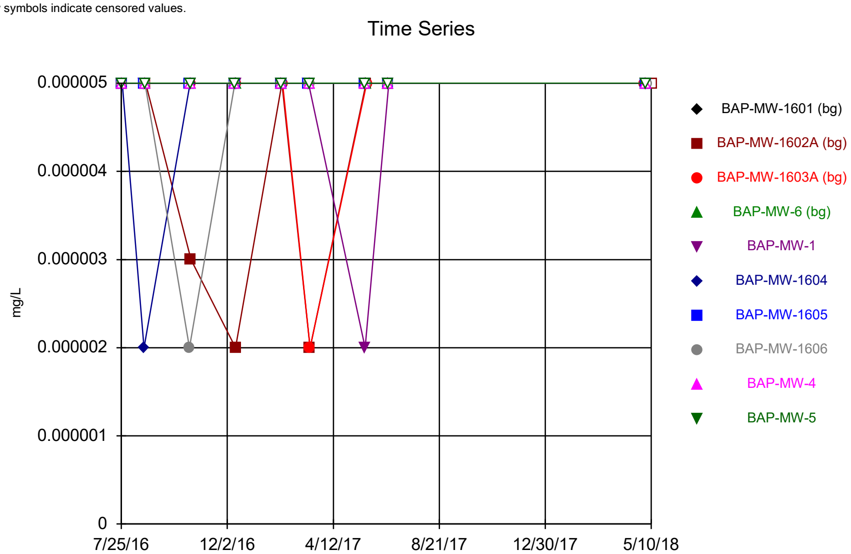
Constituent: Lead, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



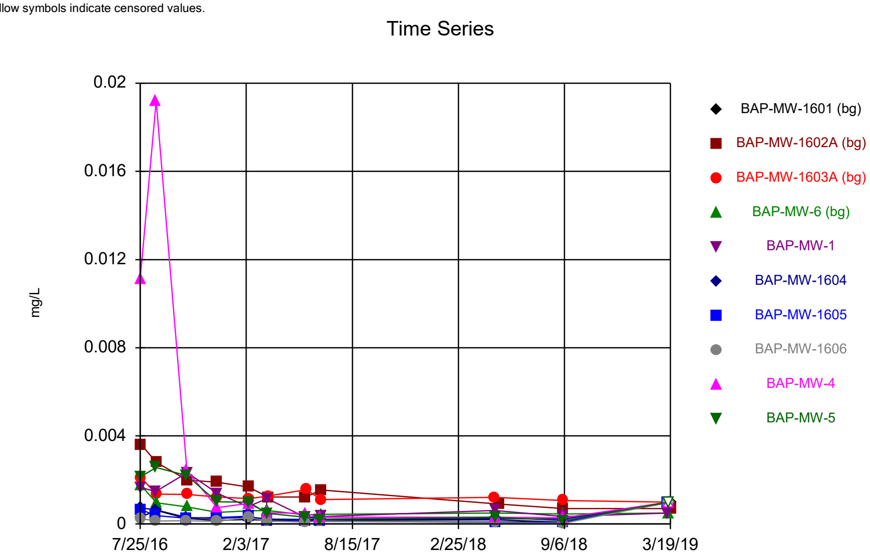
Constituent: Lithium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

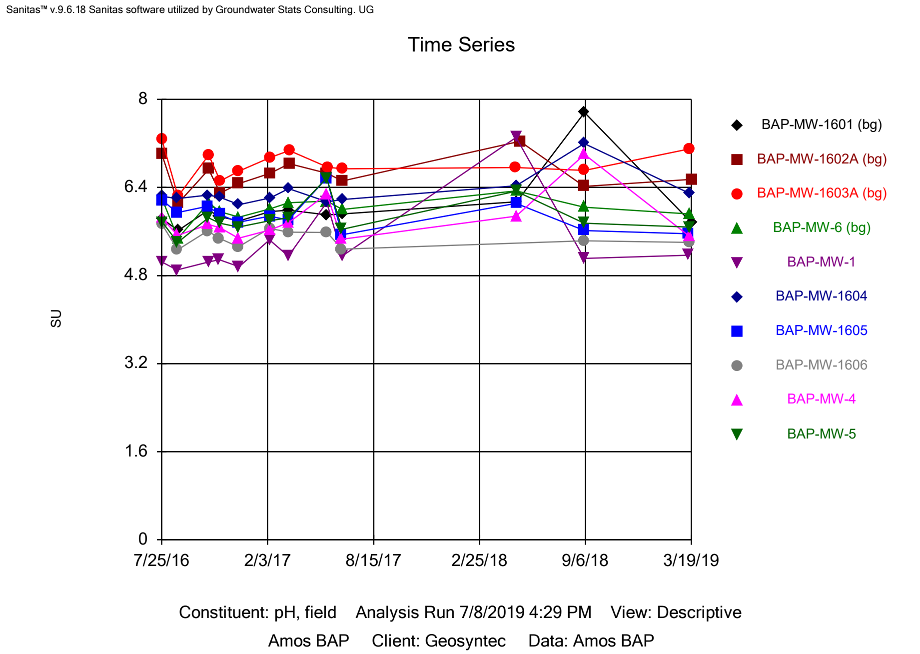


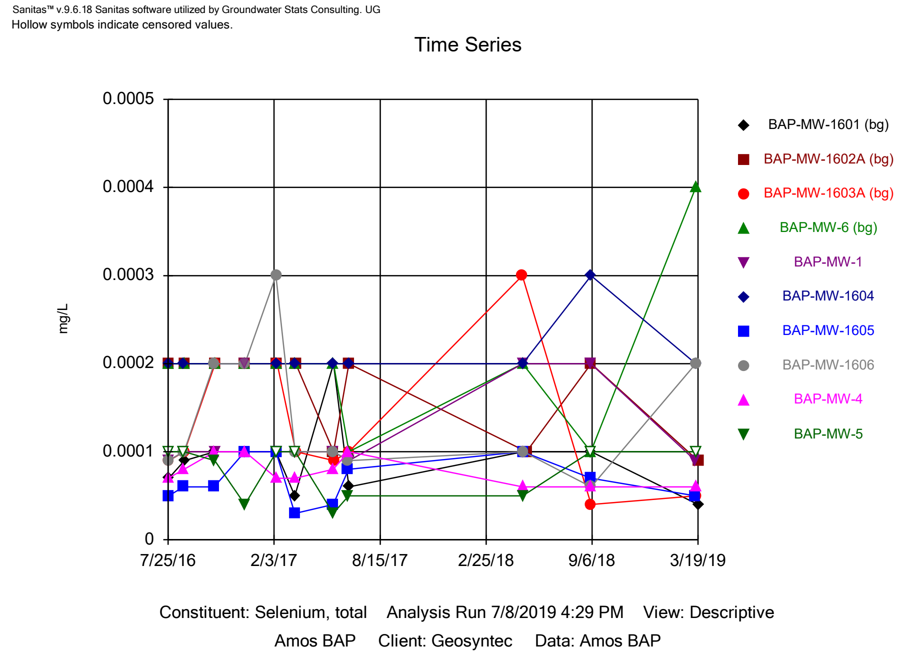
Constituent: Mercury, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

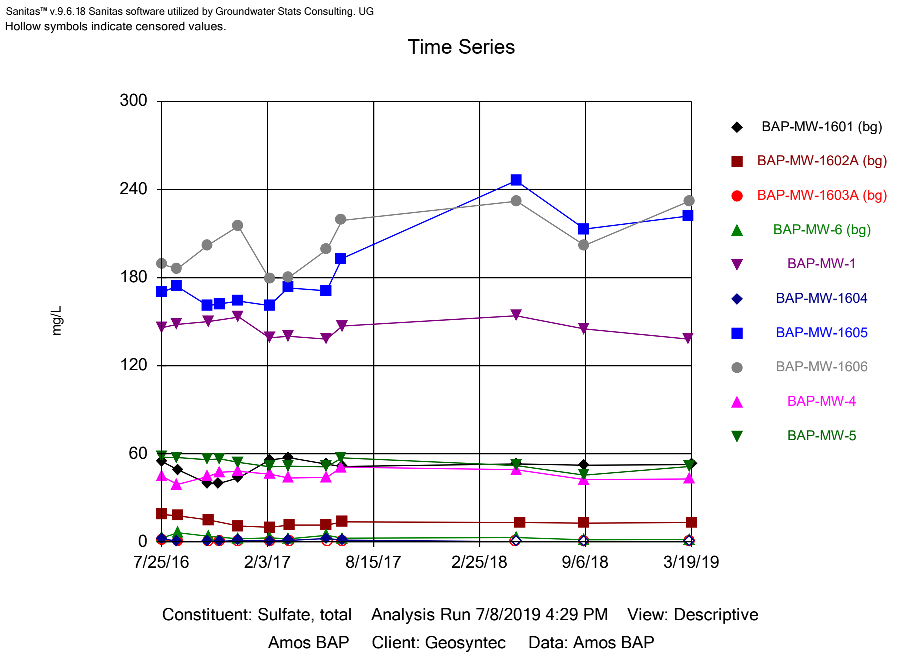
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

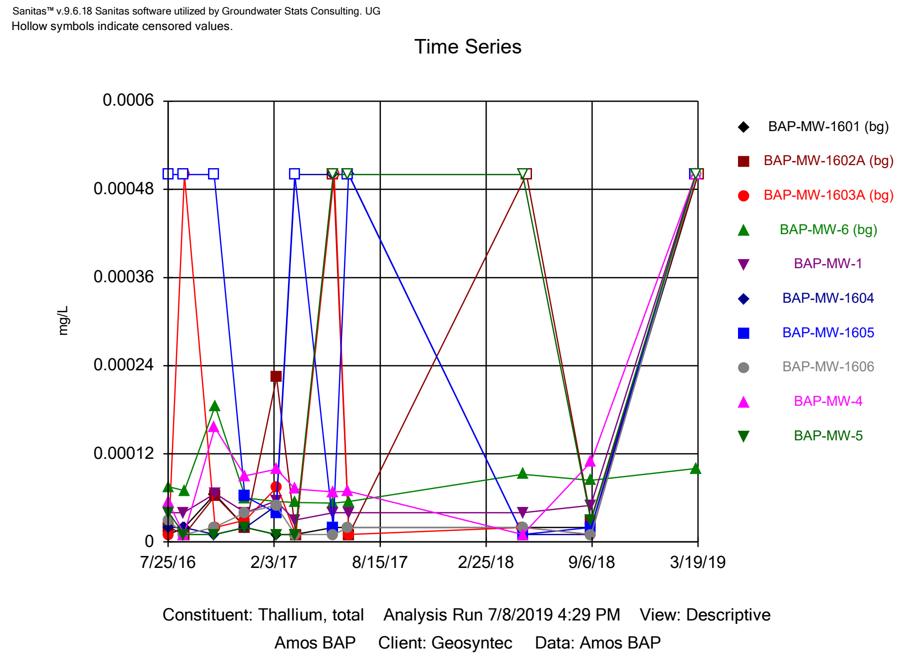


Constituent: Molybdenum, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

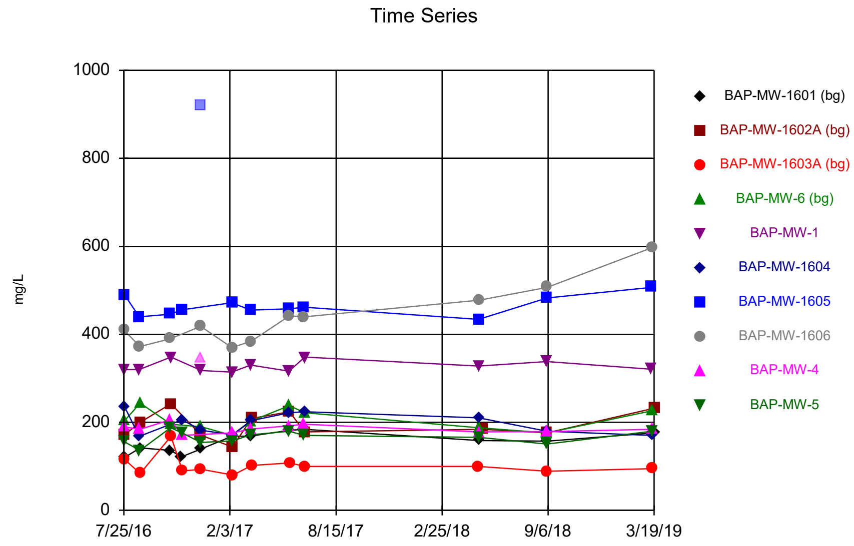

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
SU
8
6.4
4.8
3.2
1.6
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: pH, field Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.0005
0.0004
0.0003
0.0002
0.0001
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Selenium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
300
240
180
120
60
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Sulfate, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.0006
0.00048
0.00036
0.00024
0.00012
0
7/25/16
2/3/17
8/15/17
2/25/18
9/6/18
3/19/19
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-6 (bg)
BAP-MW-1
BAP-MW-1604
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
Constituent: Thallium, total Analysis Run 7/8/2019 4:29 PM View: Descriptive
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 7/8/2019 4:29 PM View: Descriptive

Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE B: OUTLIER SUMMARY

Outlier Summary

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 7/8/2019, 4:01 PM

	BAP-MW-1601 Combined Radium 226 + 228 (pCi/L)	BAP-MW-6 Combined Radium 226 + 228 (pCi/L)	BAP-MW-1 Combined Radium 226 + 228 (pCi/L)	BAP-MW-1 Selenium, total (mg/L)	BAP-MW-1605 Total Dissolved Solids [TDS] (mg/L)	BAP-MW-4 Total Dissolved Solids [TDS] (mg/L)
10/19/2016			1.86 (o)			
12/12/2016					920 (o)	348 (o)
12/13/2016				0.0002 (o)		
2/7/2017	35.021 (o)					
2/8/2017		20.83 (o)				

FIGURE C: INTERWELL PREDICTION LIMITS

Interwell Prediction Limit Summary - Significant Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 6/24/2019, 2:34 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Calcium, total (mg/L)	**BAP-MW-1**	**19.6**	**n/a**	**3/14/2019**	**38.4**	**Yes**	**44**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0009736**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	**BAP-MW-1605**	**19.6**	**n/a**	**3/14/2019**	**45.4**	**Yes**	**44**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0009736**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	**BAP-MW-1606**	**19.6**	**n/a**	**3/15/2019**	**59**	**Yes**	**44**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0009736**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**BAP-MW-1**	**41**	**n/a**	**3/14/2019**	**55.2**	**Yes**	**46**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**BAP-MW-1605**	**41**	**n/a**	**3/14/2019**	**92.5**	**Yes**	**46**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**BAP-MW-1606**	**41**	**n/a**	**3/15/2019**	**157**	**Yes**	**46**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**BAP-MW-1**	**57.4**	**n/a**	**3/14/2019**	**138**	**Yes**	**46**	**n/a**	**n/a**	**21.74**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**BAP-MW-1605**	**57.4**	**n/a**	**3/14/2019**	**222**	**Yes**	**46**	**n/a**	**n/a**	**21.74**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**BAP-MW-1606**	**57.4**	**n/a**	**3/15/2019**	**232**	**Yes**	**46**	**n/a**	**n/a**	**21.74**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1**	**253.3**	**n/a**	**3/14/2019**	**321**	**Yes**	**46**	**162.3**	**47.56**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1605**	**253.3**	**n/a**	**3/14/2019**	**507**	**Yes**	**46**	**162.3**	**47.56**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1606**	**253.3**	**n/a**	**3/15/2019**	**597**	**Yes**	**46**	**162.3**	**47.56**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary - All Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 6/24/2019, 2:34 PM

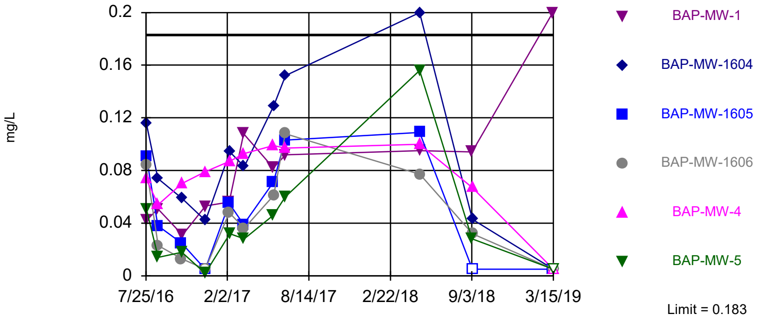
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	BAP-MW-1	0.183	n/a	3/14/2019	0.2	No	44	n/a	n/a	27.27	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Boron, total (mg/L)	BAP-MW-1604	0.183	n/a	3/15/2019	0.005ND	No	44	n/a	n/a	27.27	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Boron, total (mg/L)	BAP-MW-1605	0.183	n/a	3/14/2019	0.005ND	No	44	n/a	n/a	27.27	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Boron, total (mg/L)	BAP-MW-1606	0.183	n/a	3/15/2019	0.005ND	No	44	n/a	n/a	27.27	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Boron, total (mg/L)	BAP-MW-4	0.183	n/a	3/15/2019	0.005ND	No	44	n/a	n/a	27.27	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Boron, total (mg/L)	BAP-MW-5	0.183	n/a	3/15/2019	0.005ND	No	44	n/a	n/a	27.27	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Calcium, total (mg/L)	**BAP-MW-1**	**19.6**	**n/a**	**3/14/2019**	**38.4**	**Yes**	**44**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0009736**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	BAP-MW-1604	19.6	n/a	3/15/2019	13.1	No	44	n/a	n/a	0	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Calcium, total (mg/L)	**BAP-MW-1605**	**19.6**	**n/a**	**3/14/2019**	**45.4**	**Yes**	**44**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0009736**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	**BAP-MW-1606**	**19.6**	**n/a**	**3/15/2019**	**59**	**Yes**	**44**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0009736**	**NP Inter (normality) 1 of 2**
Calcium, total (mg/L)	BAP-MW-4	19.6	n/a	3/15/2019	14.5	No	44	n/a	n/a	0	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Calcium, total (mg/L)	BAP-MW-5	19.6	n/a	3/15/2019	16.2	No	44	n/a	n/a	0	n/a	n/a	0.0009736	NP Inter (normality) 1 of 2
Chloride, total (mg/L)	**BAP-MW-1**	**41**	**n/a**	**3/14/2019**	**55.2**	**Yes**	**46**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	BAP-MW-1604	41	n/a	3/15/2019	16.6	No	46	n/a	n/a	0	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Chloride, total (mg/L)	**BAP-MW-1605**	**41**	**n/a**	**3/14/2019**	**92.5**	**Yes**	**46**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**BAP-MW-1606**	**41**	**n/a**	**3/15/2019**	**157**	**Yes**	**46**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	BAP-MW-4	41	n/a	3/15/2019	13.3	No	46	n/a	n/a	0	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Chloride, total (mg/L)	BAP-MW-5	41	n/a	3/15/2019	18.5	No	46	n/a	n/a	0	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Sulfate, total (mg/L)	**BAP-MW-1**	**57.4**	**n/a**	**3/14/2019**	**138**	**Yes**	**46**	**n/a**	**n/a**	**21.74**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	BAP-MW-1604	57.4	n/a	3/15/2019	0.2ND	No	46	n/a	n/a	21.74	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Sulfate, total (mg/L)	**BAP-MW-1605**	**57.4**	**n/a**	**3/14/2019**	**222**	**Yes**	**46**	**n/a**	**n/a**	**21.74**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**BAP-MW-1606**	**57.4**	**n/a**	**3/15/2019**	**232**	**Yes**	**46**	**n/a**	**n/a**	**21.74**	**n/a**	**n/a**	**0.0008958**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	BAP-MW-4	57.4	n/a	3/15/2019	42.8	No	46	n/a	n/a	21.74	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Sulfate, total (mg/L)	BAP-MW-5	57.4	n/a	3/15/2019	51.3	No	46	n/a	n/a	21.74	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1**	**253.3**	**n/a**	**3/14/2019**	**321**	**Yes**	**46**	**162.3**	**47.56**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1604	253.3	n/a	3/15/2019	170	No	46	162.3	47.56	0	None	No	0.001254	Param Inter 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1605**	**253.3**	**n/a**	**3/14/2019**	**507**	**Yes**	**46**	**162.3**	**47.56**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1606**	**253.3**	**n/a**	**3/15/2019**	**597**	**Yes**	**46**	**162.3**	**47.56**	**0**	**None**	**No**	**0.001254**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-4	253.3	n/a	3/15/2019	184	No	46	162.3	47.56	0	None	No	0.001254	Param Inter 1 of 2
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-5	253.3	n/a	3/15/2019	180	No	46	162.3	47.56	0	None	No	0.001254	Param Inter 1 of 2

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 44 background values. 27.27% NDs. Annual per-constituent alpha = 0.01162. Individual comparison alpha = 0.0009736 (1 of 2). Comparing 6 points to limit.

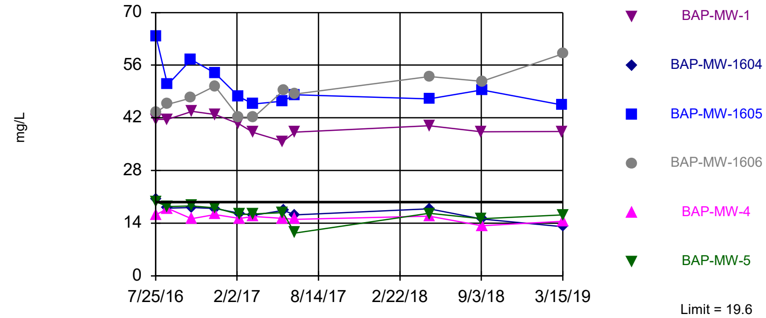
Constituent: Boron, total Analysis Run 6/24/2019 2:31 PM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 44 background values. Annual per-constituent alpha = 0.01162. Individual comparison alpha = 0.0009736 (1 of 2). Comparing 6 points to limit.

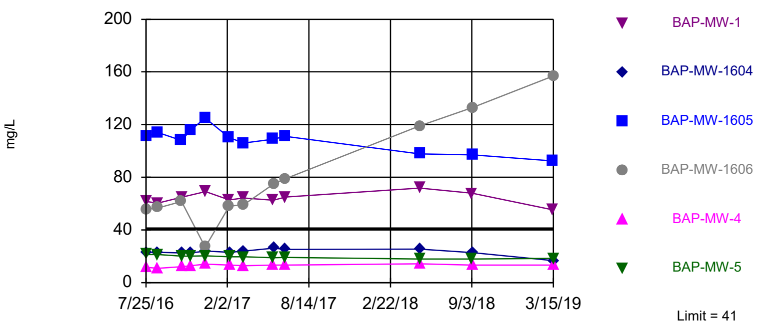
Constituent: Calcium, total Analysis Run 6/24/2019 2:31 PM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 46 background values. Annual per-constituent alpha = 0.0107. Individual comparison alpha = 0.0008958 (1 of 2). Comparing 6 points to limit.

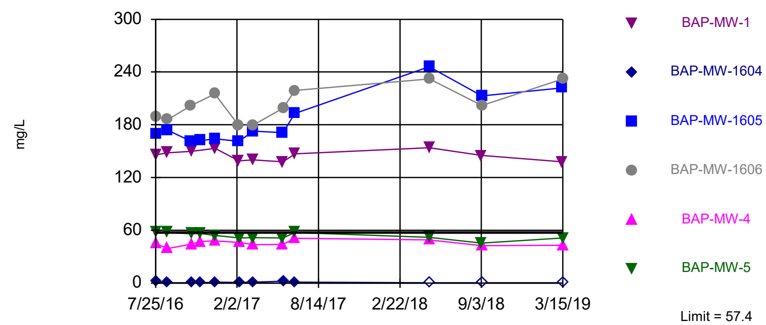
Constituent: Chloride, total Analysis Run 6/24/2019 2:31 PM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 46 background values. 21.74% NDs. Annual per-constituent alpha = 0.0107. Individual comparison alpha = 0.0008958 (1 of 2). Comparing 6 points to limit.

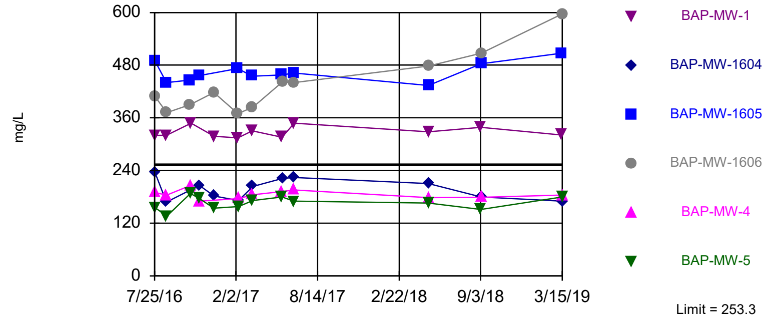
Constituent: Sulfate, total Analysis Run 6/24/2019 2:32 PM View: PL's - Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: BAP-MW-1, BAP-MW-1605, BAP-MW-1606

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=162.3, Std. Dev.=47.56, n=46. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9397, critical = 0.927. Kappa = 1.913 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.001254. Comparing 6 points to limit.

Constituent: Total Dissolved Solids [TDS] Analysis Run 6/24/2019 2:32 PM View: PL's - Interwell

Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE D: INTRAWELL PREDICTION LIMITS

Intrawell Prediction Limit Summary - All Results (No Significant)

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 7/8/2019, 4:20 PM

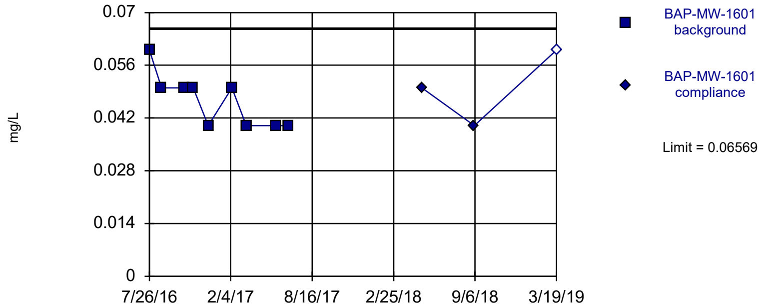
Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride, total (mg/L)	BAP-MW-1	0.06	n/a	3/14/2019	0.03	No	8	n/a	n/a	62.5	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1601	0.06569	n/a	3/19/2019	0.06ND	No	9	0.04667	0.007071	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1602A	0.18	n/a	3/19/2019	0.14	No	8	n/a	n/a	0	n/a	n/a	0.02144	NP (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1603A	0.3428	n/a	3/15/2019	0.27	No	9	0.2511	0.03408	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1604	0.1273	n/a	3/15/2019	0.09	No	9	0.07111	0.02088	0	None	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1605	0.1078	n/a	3/14/2019	0.06ND	No	9	0.04556	0.02315	33.33	Kaplan-Meier	No	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-1606	0.06	n/a	3/15/2019	0.06ND	No	8	n/a	n/a	87.5	n/a	n/a	0.02144	NP (NDs) 1 of 2
Fluoride, total (mg/L)	BAP-MW-4	0.2468	n/a	3/15/2019	0.06	No	9	-2.972	0.5846	11.11	None	ln(x)	0.001254	Param 1 of 2
Fluoride, total (mg/L)	BAP-MW-5	0.2	n/a	3/15/2019	0.05	No	9	n/a	n/a	11.11	n/a	n/a	0.01809	NP (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-6	0.1001	n/a	3/15/2019	0.05	No	8	0.05125	0.01727	0	None	No	0.001254	Param 1 of 2
pH, field (SU)	BAP-MW-1	6.13	4.9	3/14/2019	5.17	No	9	n/a	n/a	0	n/a	n/a	0.03619	NP (normality) 1 of 2
pH, field (SU)	BAP-MW-1601	6.191	5.558	3/19/2019	5.76	No	9	5.874	0.1176	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1602A	7.323	5.853	3/19/2019	6.55	No	9	6.588	0.2732	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1603A	7.64	5.973	3/15/2019	7.1	No	9	6.807	0.3098	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1604	6.431	5.995	3/15/2019	6.3	No	9	6.213	0.08109	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1605	6.74	5.182	3/14/2019	5.56	No	9	5.961	0.2895	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-1606	5.973	5.034	3/15/2019	5.4	No	9	5.503	0.1746	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-4	6.385	5.035	3/15/2019	5.52	No	9	5.71	0.2508	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-5	6.663	4.961	3/15/2019	5.68	No	9	5.812	0.3162	0	None	No	0.0006268	Param 1 of 2
pH, field (SU)	BAP-MW-6	6.568	5.405	3/15/2019	5.92	No	9	5.987	0.2162	0	None	No	0.0006268	Param 1 of 2

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.04667, Std. Dev.=0.007071, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8049, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

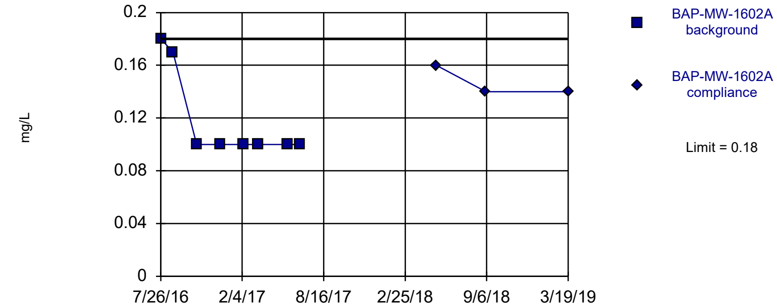
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

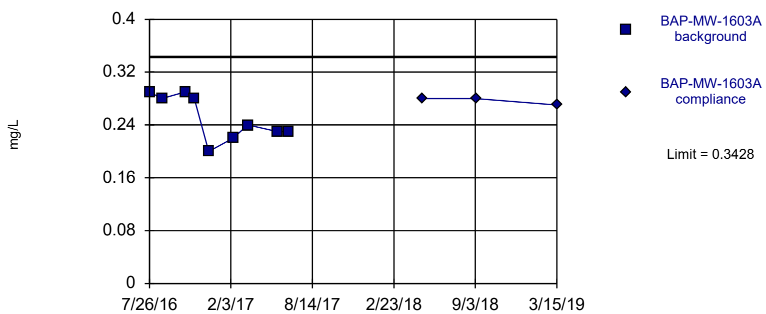
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.2511, Std. Dev.=0.03408, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8781, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

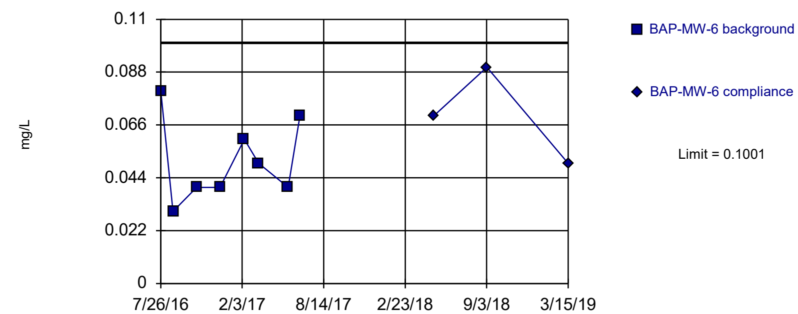
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.05125, Std. Dev.=0.01727, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.919, critical = 0.749. Kappa = 2.831 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

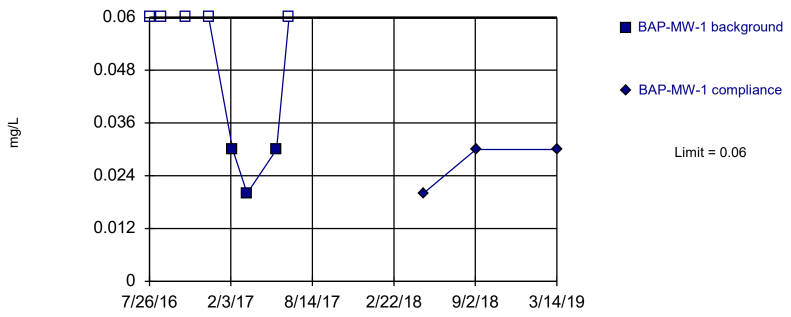
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 62.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

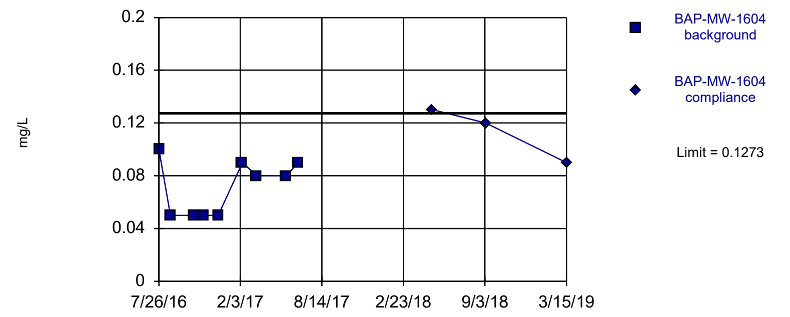
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=0.07111, Std. Dev.=0.02088, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.81, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

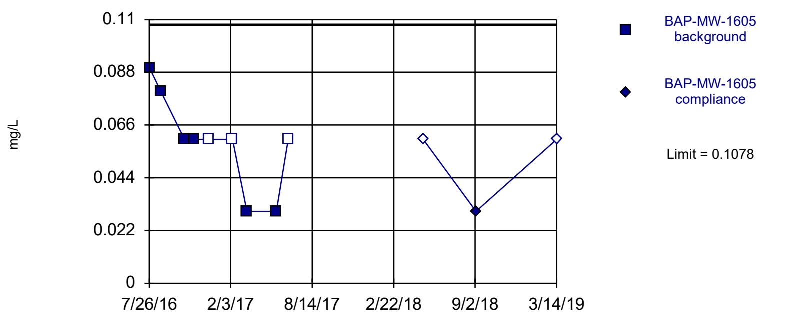
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (after Kaplan-Meier Adjustment): Mean=0.04556, Std. Dev.=0.02315, n=9, 33.33% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8602, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

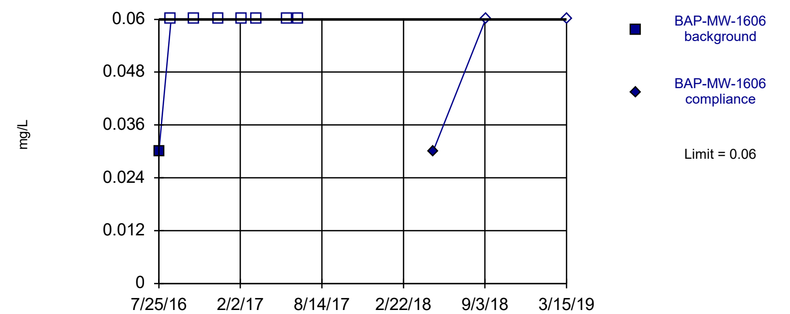
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 8 background values. 87.5% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2).

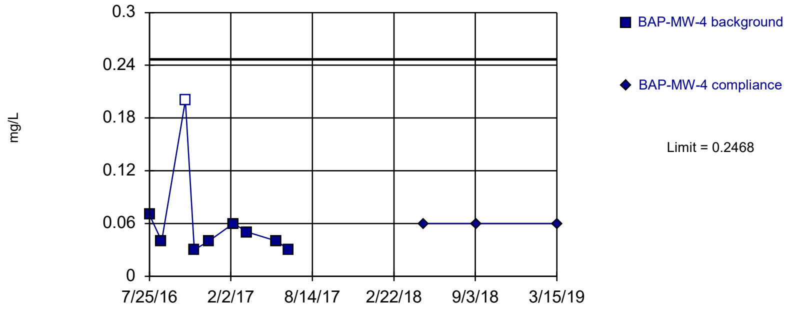
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Parametric



Background Data Summary (based on natural log transformation): Mean=-2.972, Std. Dev.=0.5846, n=9, 11.11% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8153, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

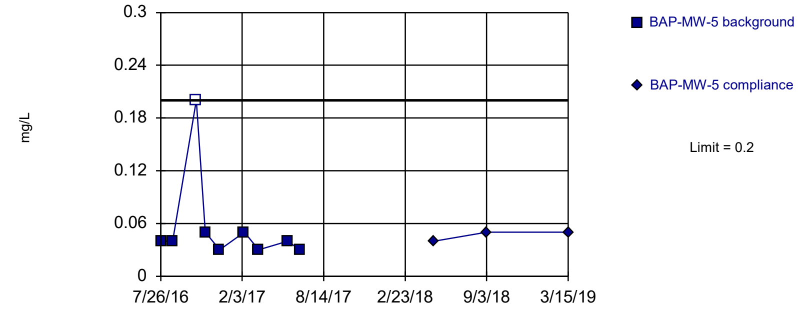
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Within Limit

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 9 background values. 11.11% NDs. Well-constituent pair annual alpha = 0.03586. Individual comparison alpha = 0.01809 (1 of 2).

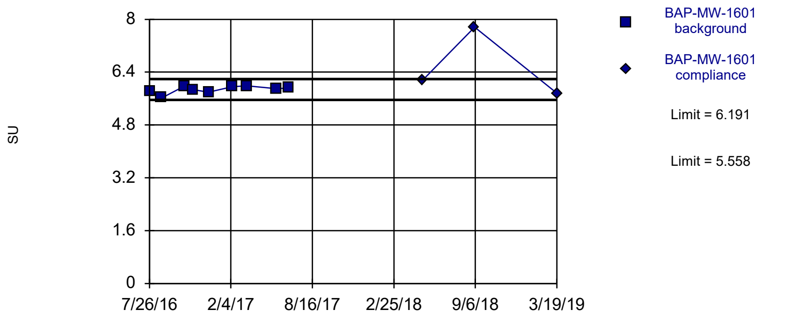
Constituent: Fluoride, total Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.874, Std. Dev.=0.1176, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8865, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

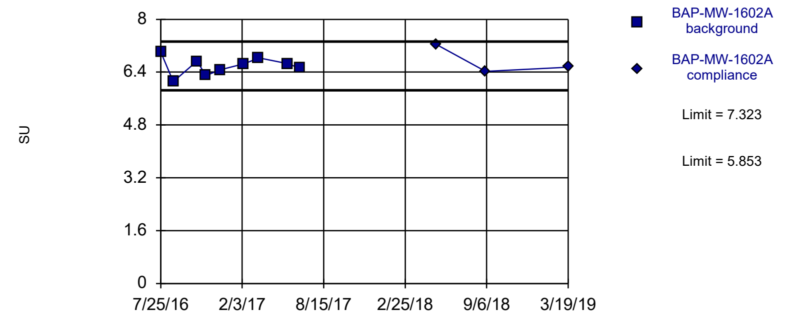
Constituent: pH, field Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=6.588, Std. Dev.=0.2732, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9838, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

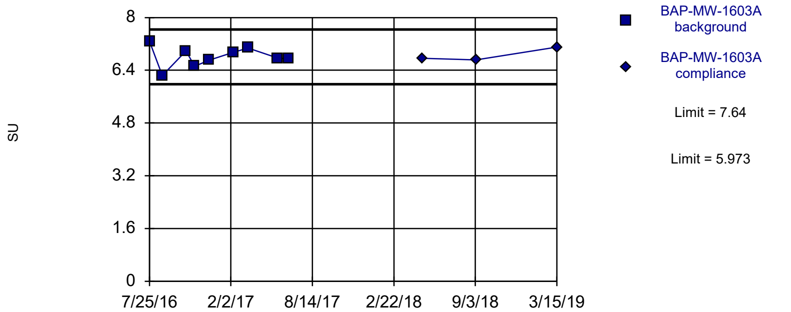
Constituent: pH, field Analysis Run 7/8/2019 4:17 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=6.807, Std. Dev.=0.3098, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9809, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

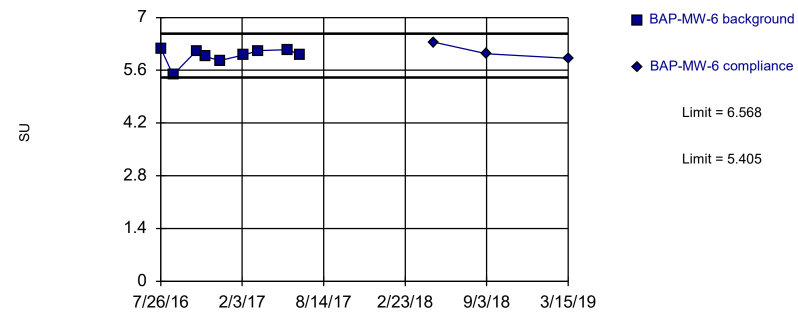
Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.987, Std. Dev.=0.2162, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.807, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

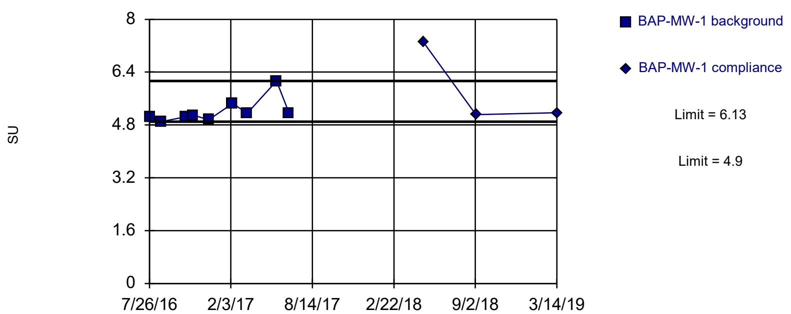
Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Non-parametric



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 9 background values. Well-constituent pair annual alpha = 0.07172. Individual comparison alpha = 0.03619 (1 of 2).

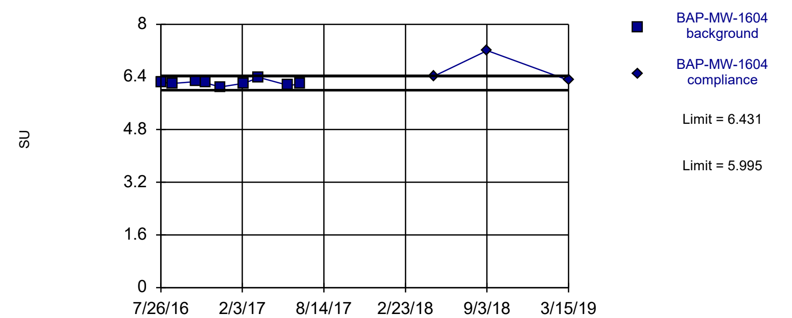
Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=6.213, Std. Dev.=0.08109, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9491, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

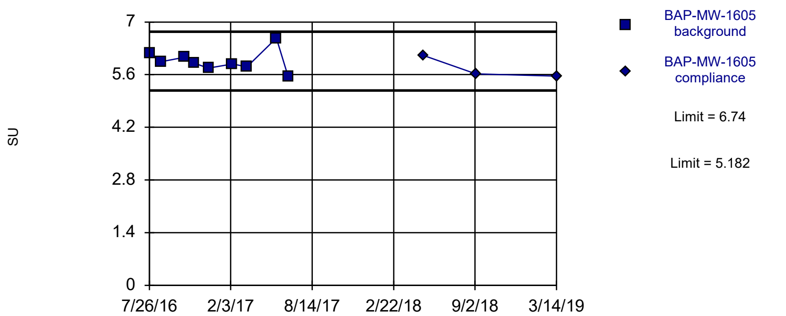
Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.961, Std. Dev.=0.2895, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9339, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell

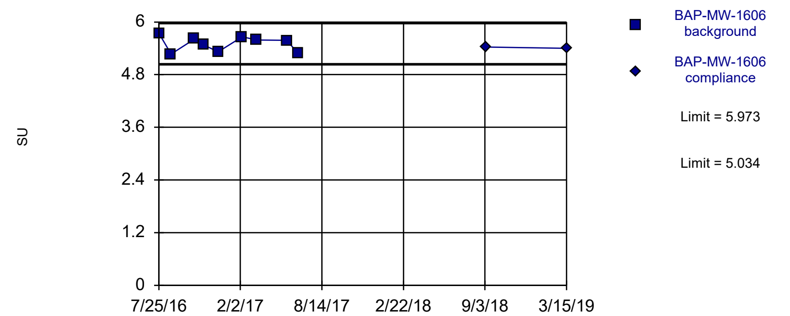
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.503, Std. Dev.=0.1746, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8973, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell

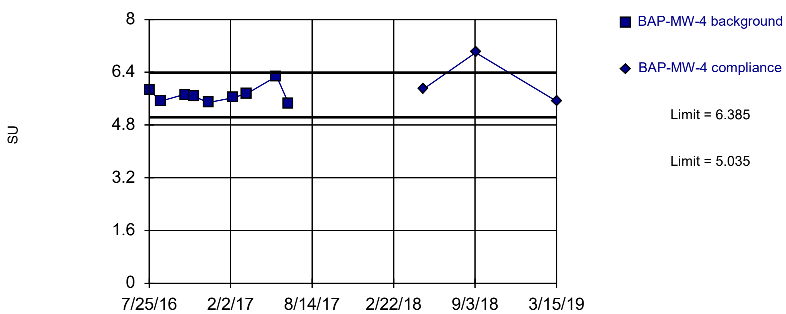
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.71, Std. Dev.=0.2508, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8598, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell

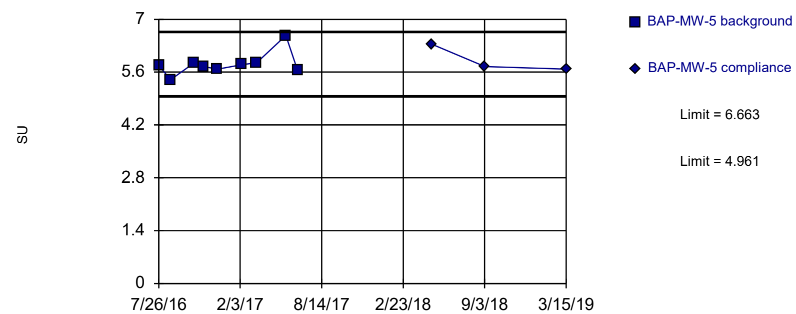
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=5.812, Std. Dev.=0.3162, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7908, critical = 0.764. Kappa = 2.69 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254.

Constituent: pH, field Analysis Run 7/8/2019 4:18 PM View: PL's - Intrawell

Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE E: TREND TESTS

Trend Test Summary Table - Significant Results

Amos BAP Client: Geosyntec Data: Amos BAP Printed 7/8/2019, 4:12 PM

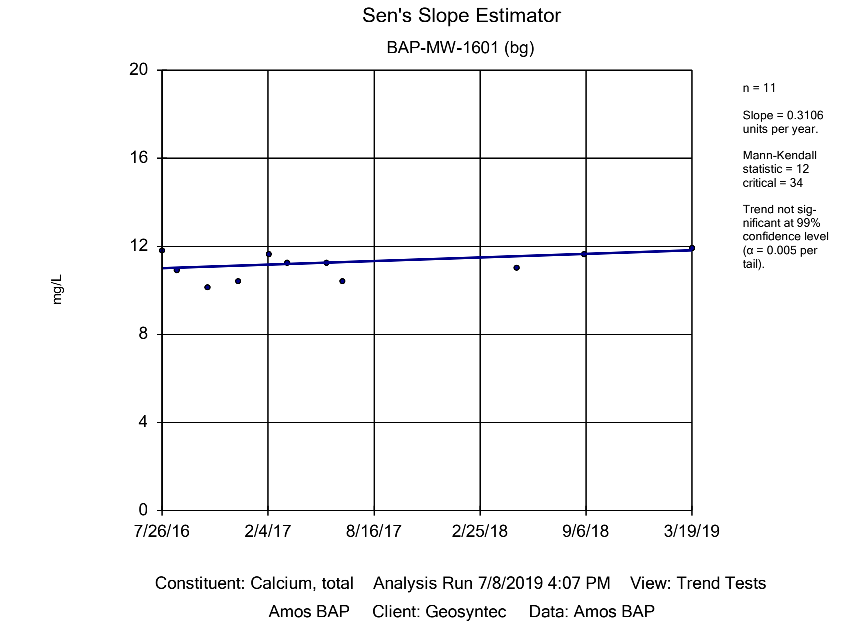
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Chloride, total (mg/L)	**BAP-MW-1601 (bg)**	**1.691**	**42**	**38**	**Yes**	**12**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**BAP-MW-1606**	**39.66**	**45**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1606**	**66.32**	**35**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Test Summary Table - All Results

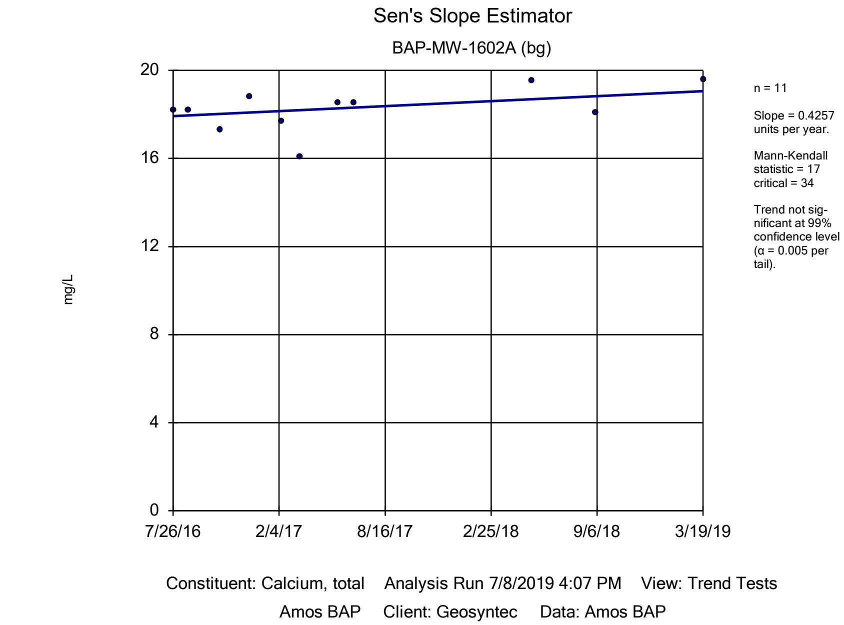
Amos BAP Client: Geosyntec Data: Amos BAP Printed 7/8/2019, 4:12 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Calcium, total (mg/L)	BAP-MW-1601 (bg)	0.3106	12	34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1602A (bg)	0.4257	17	34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1603A (bg)	-0.8588	-25	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-6 (bg)	0	-3	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1	-2.001	-22	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1605	-4.297	-29	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1606	4.813	30	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**BAP-MW-1601 (bg)**	**1.691**	**42**	**38**	**Yes**	**12**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	BAP-MW-1602A (bg)	0.9824	30	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-1603A (bg)	0.002683	0	38	No	12	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-6 (bg)	0.2236	9	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-1	2.421	11	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-1605	-7.725	-35	-38	No	12	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**BAP-MW-1606**	**39.66**	**45**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	BAP-MW-1601 (bg)	1.675	12	38	No	12	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1602A (bg)	-1.157	-11	-34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1603A (bg)	0	-1	-38	No	12	83.33	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-6 (bg)	-0.711	-21	-34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1	-1.474	-10	-34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1605	24.91	35	38	No	12	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1606	14.87	25	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1601 (bg)	22.43	36	38	No	12	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1602A (bg)	6.657	7	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1603A (bg)	-2.598	-7	-38	No	12	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-6 (bg)	-6.626	-7	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1	1.334	7	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1605	17.3	15	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	**BAP-MW-1606**	**66.32**	**35**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**

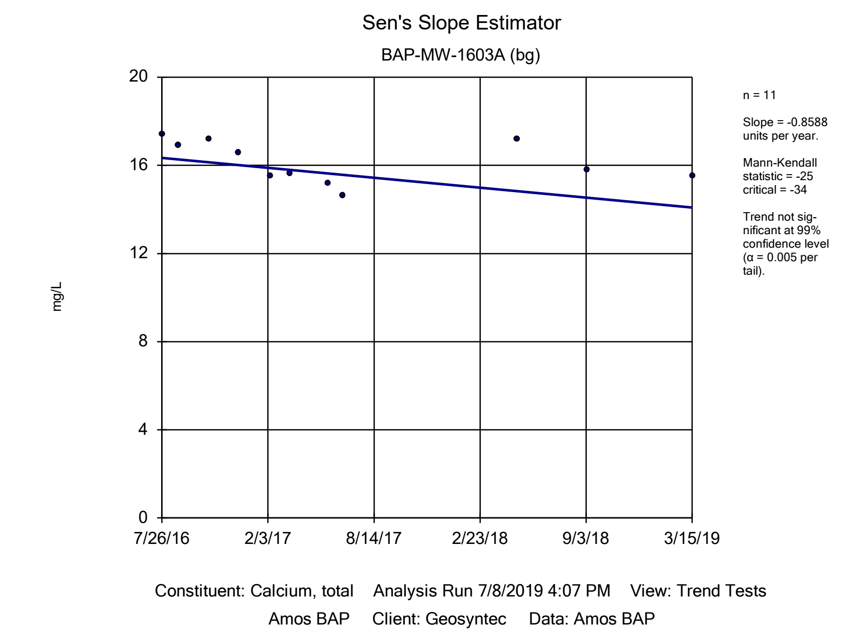
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



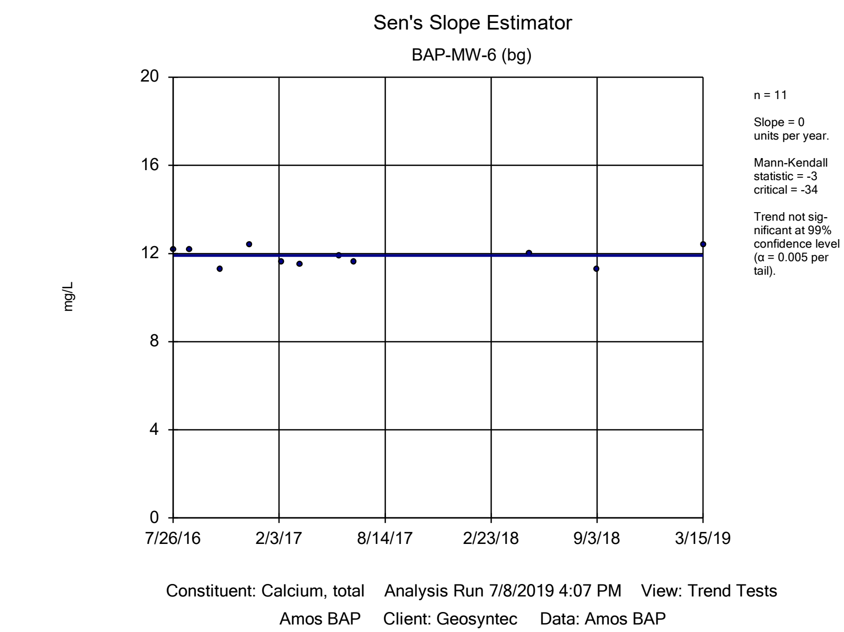
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

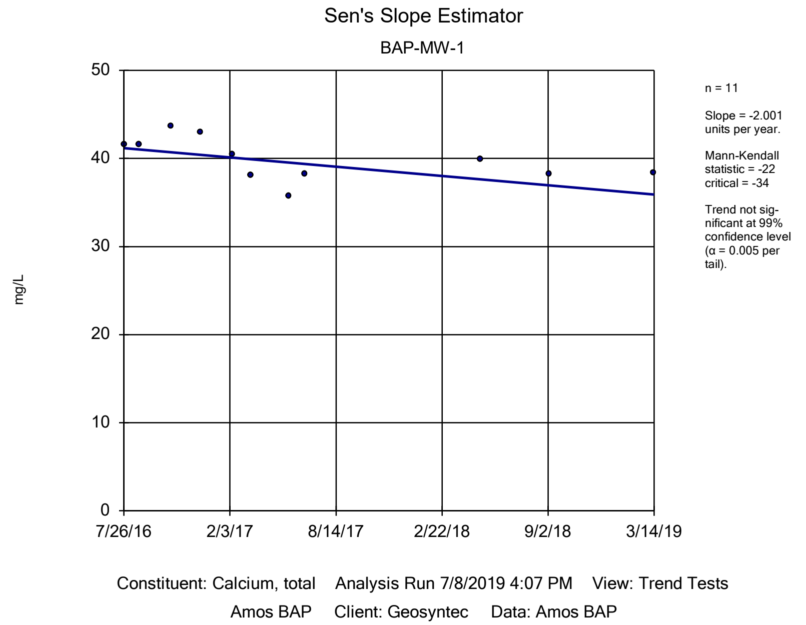


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

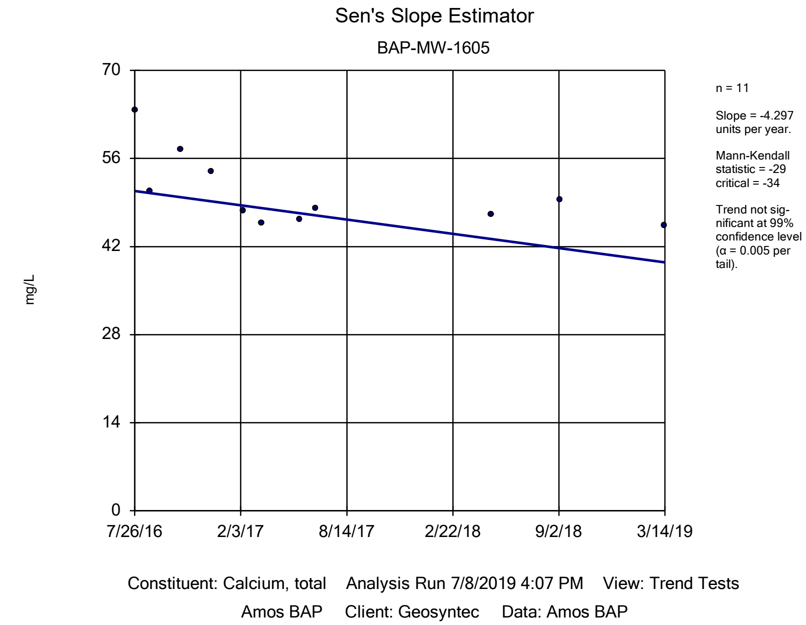


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

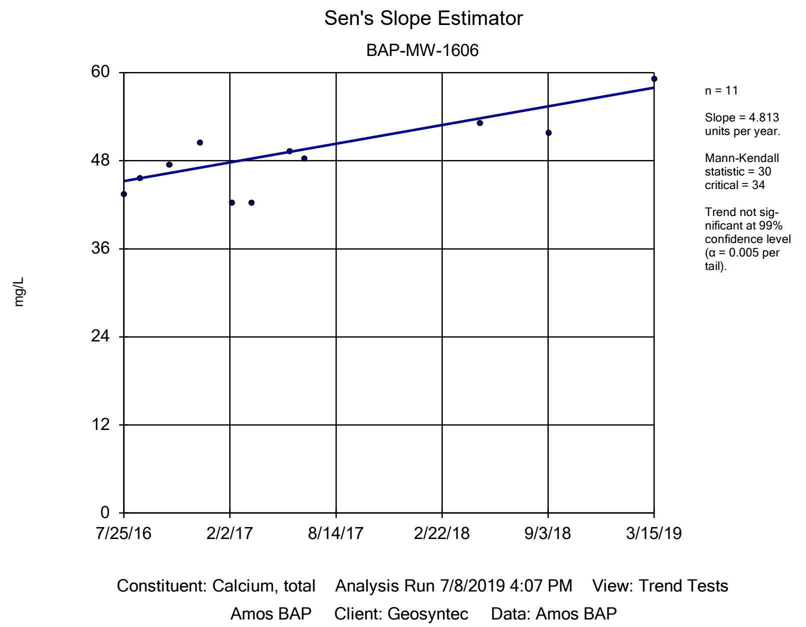




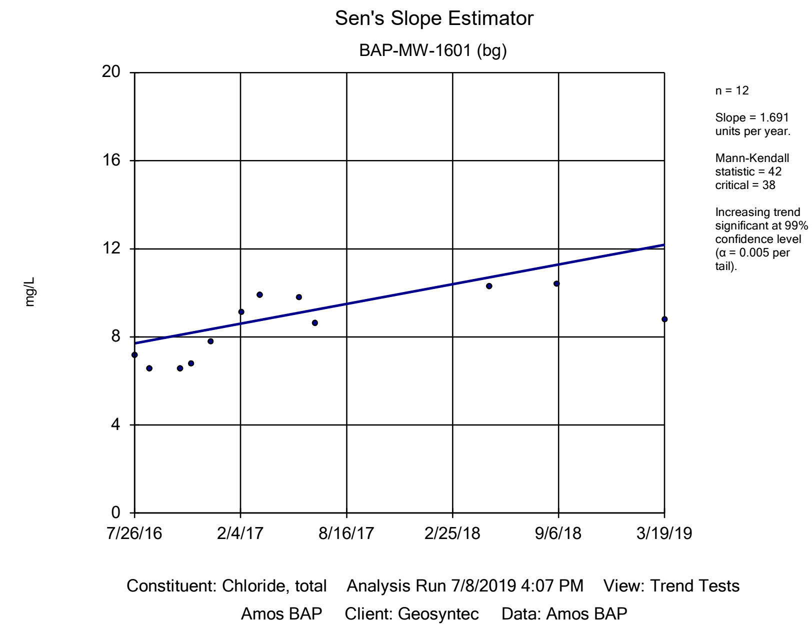
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



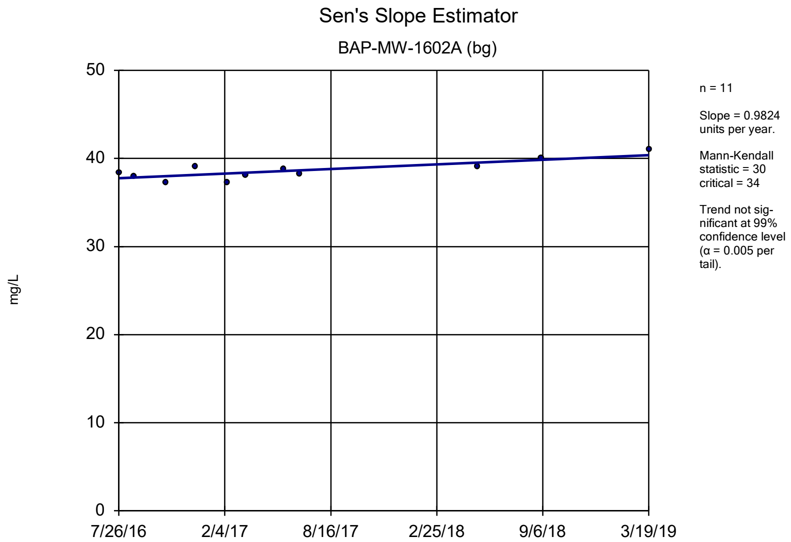
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

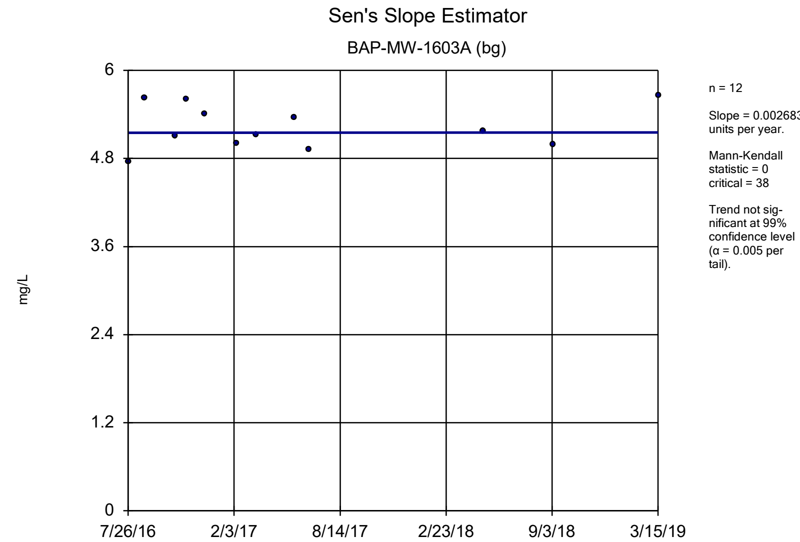


Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



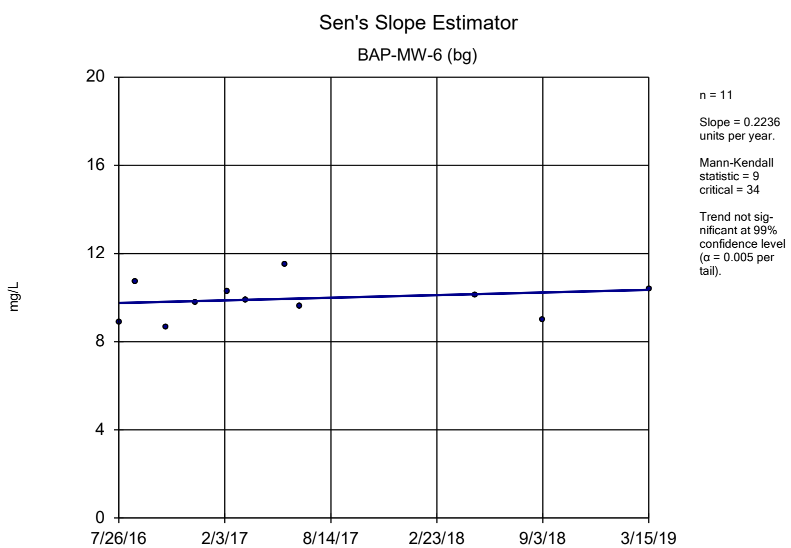
Constituent: Chloride, total Analysis Run 7/8/2019 4:07 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



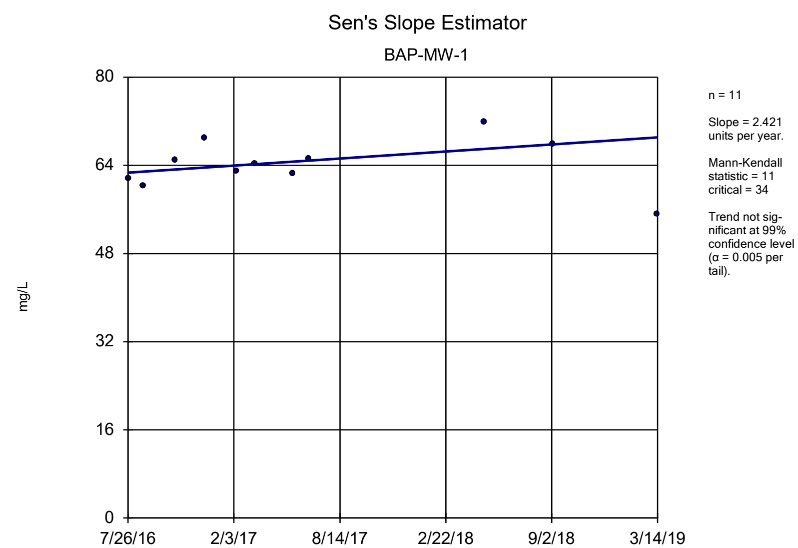
Constituent: Chloride, total Analysis Run 7/8/2019 4:07 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



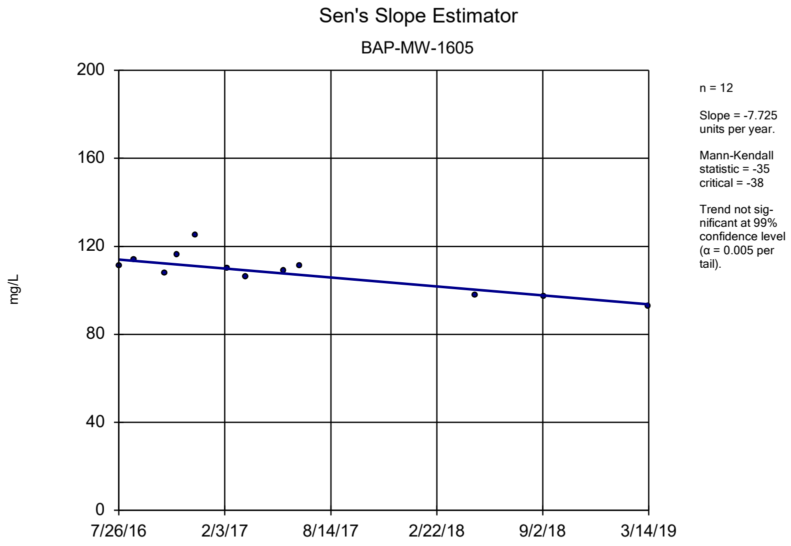
Constituent: Chloride, total Analysis Run 7/8/2019 4:07 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



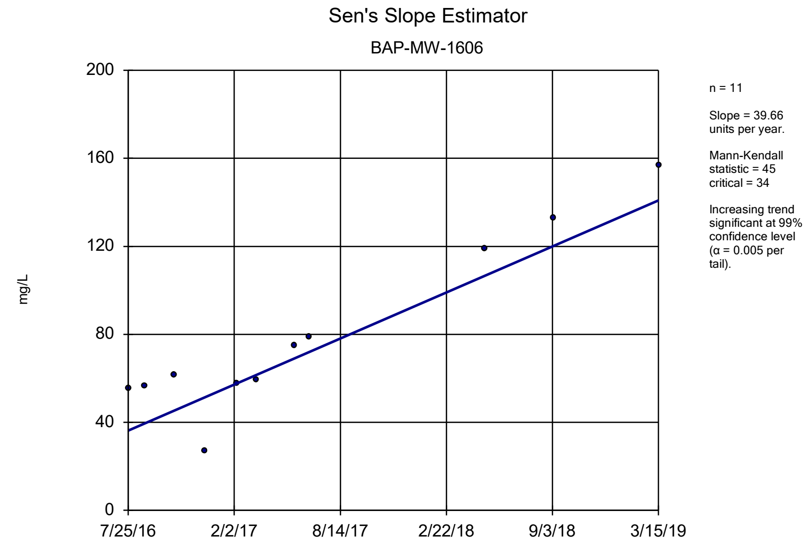
Constituent: Chloride, total Analysis Run 7/8/2019 4:07 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



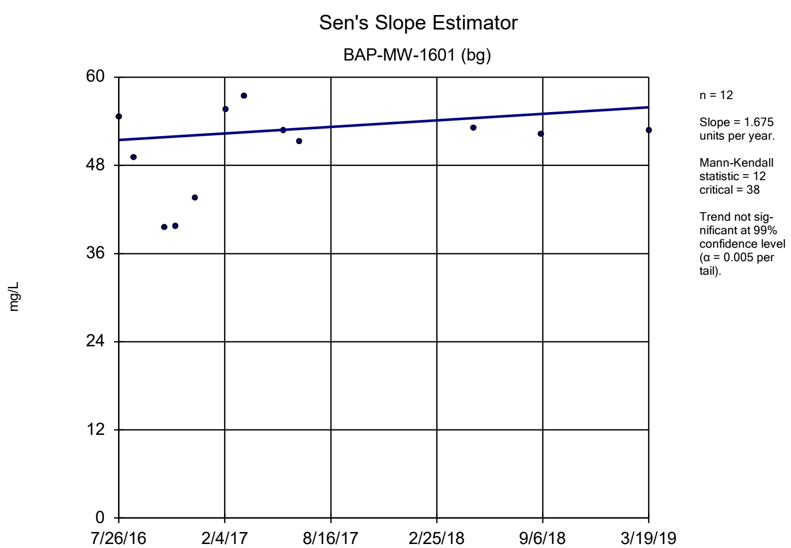
Constituent: Chloride, total Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



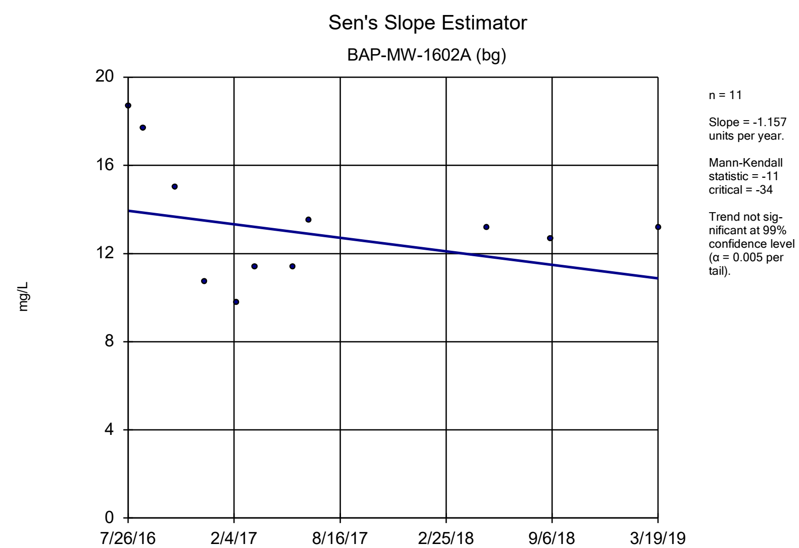
Constituent: Chloride, total Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



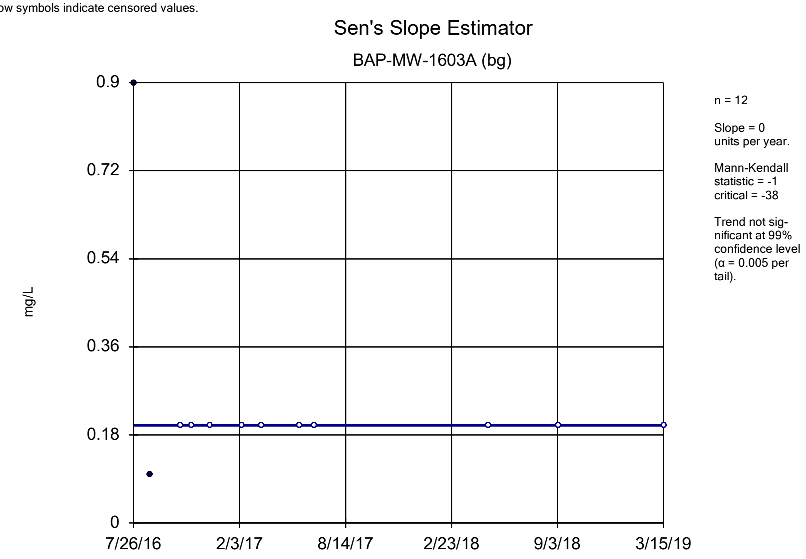
Constituent: Sulfate, total Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



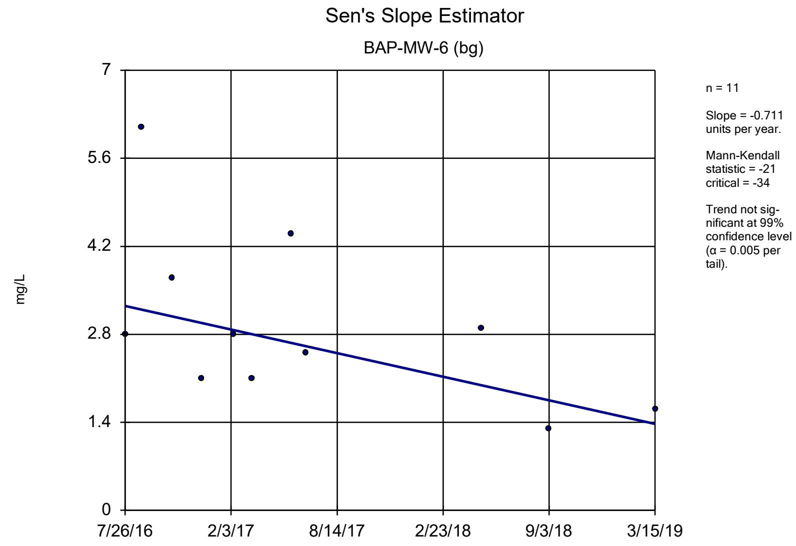
Constituent: Sulfate, total Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Hollow symbols indicate censored values.



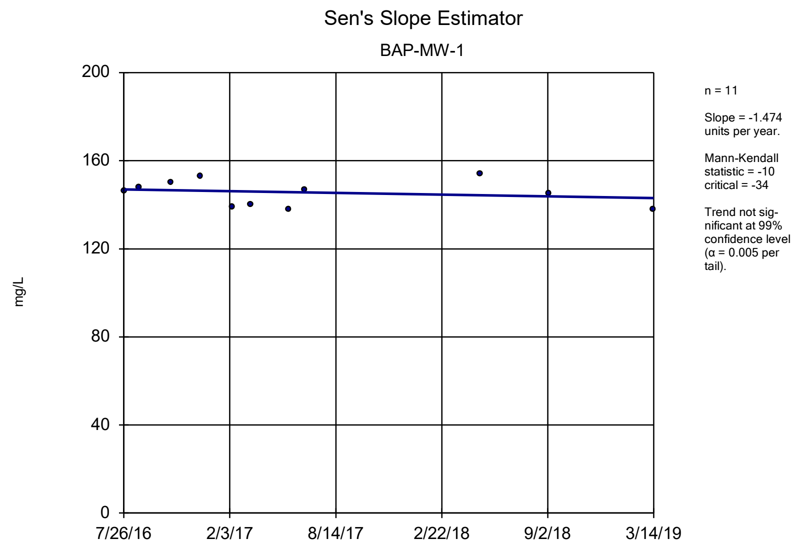
Constituent: Sulfate, total   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



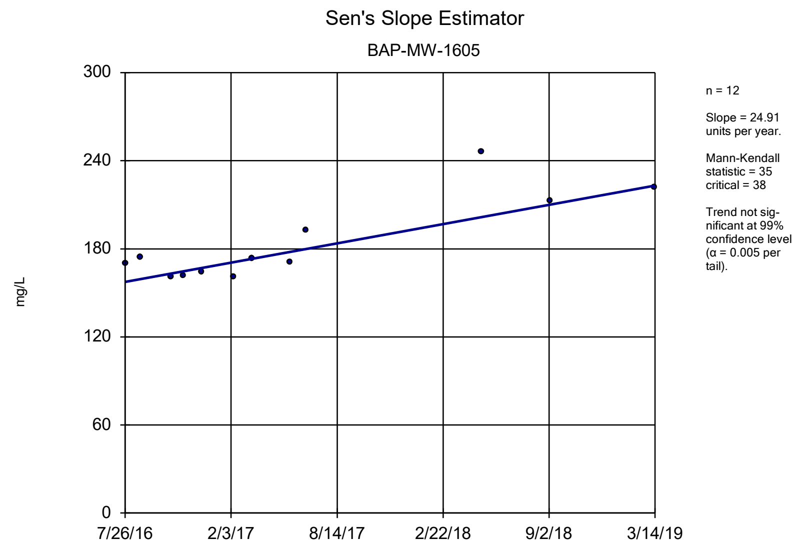
Constituent: Sulfate, total   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

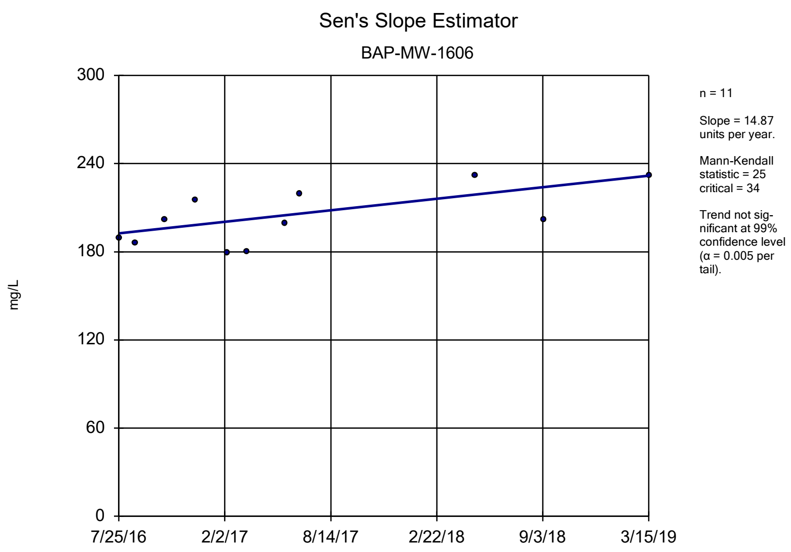


Constituent: Sulfate, total   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP

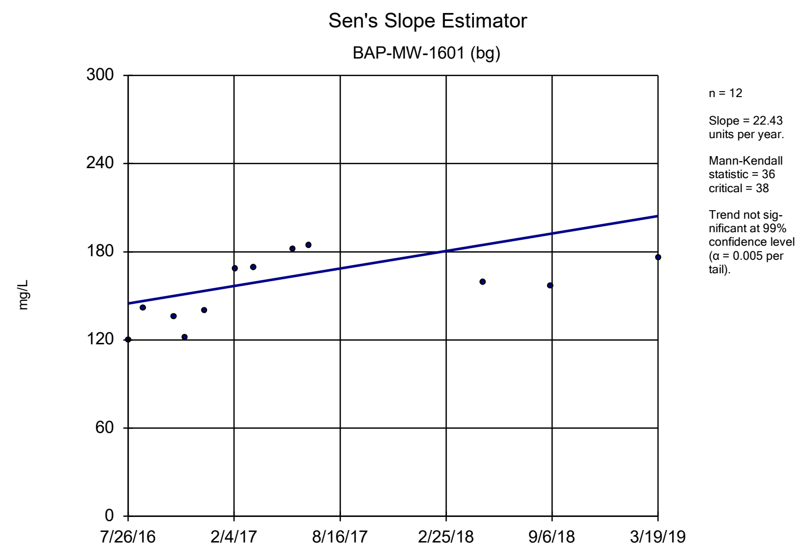
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



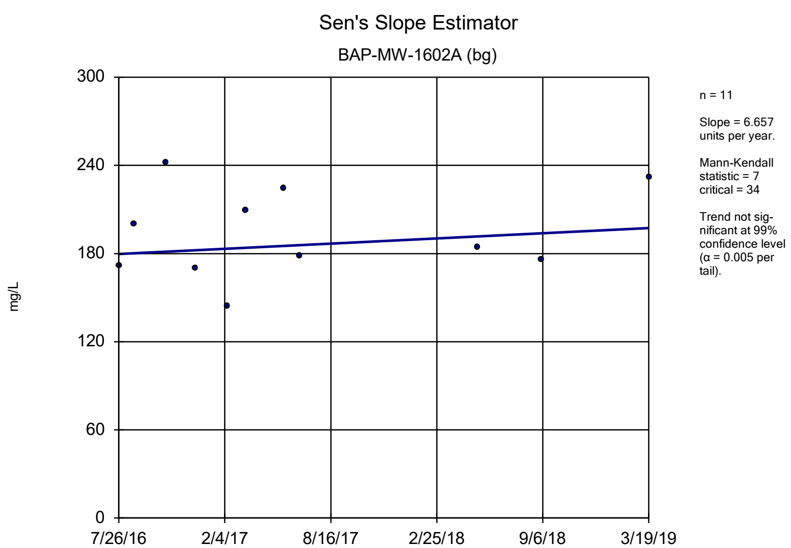
Constituent: Sulfate, total   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP



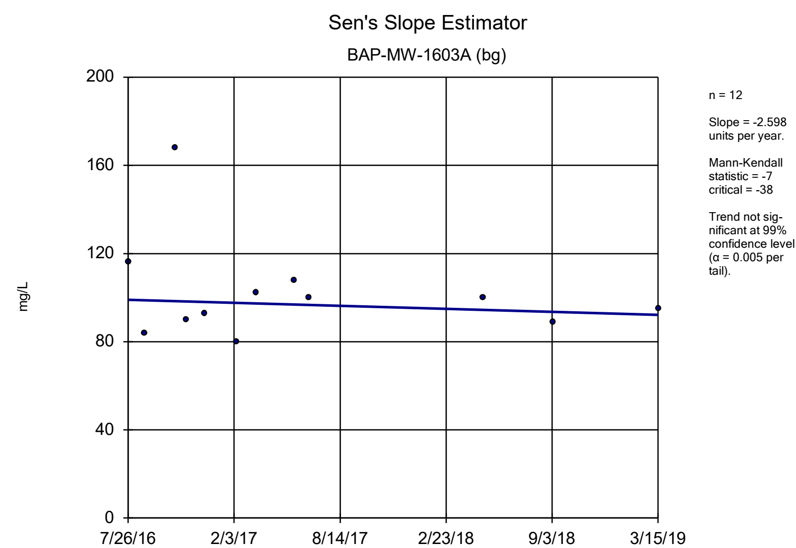
Constituent: Sulfate, total   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP



Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP

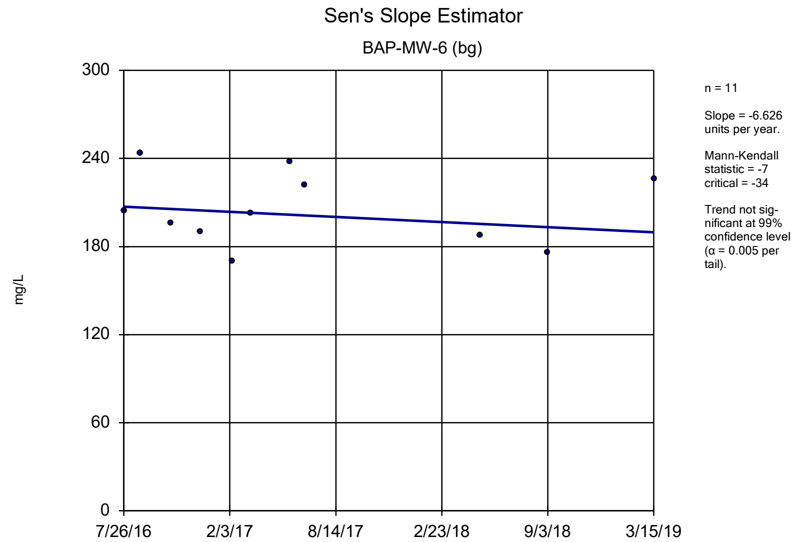


Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP



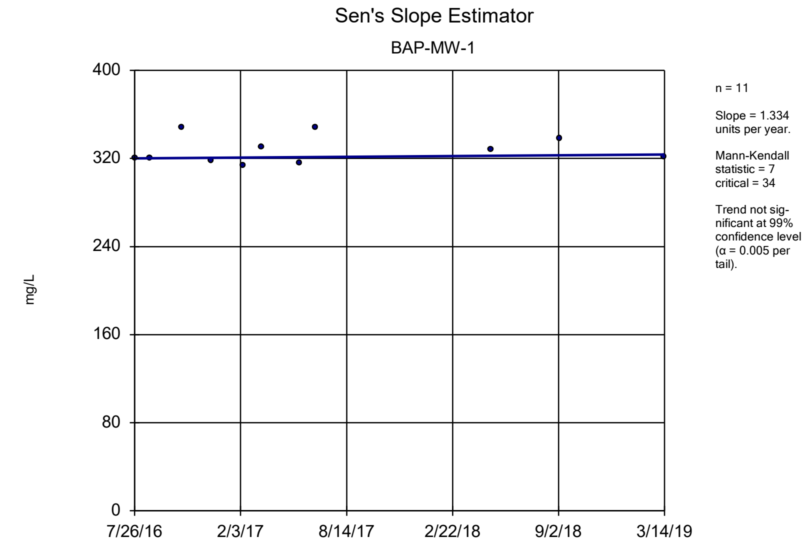
Constituent: Total Dissolved Solids [TDS]   Analysis Run 7/8/2019 4:08 PM   View: Trend Tests
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



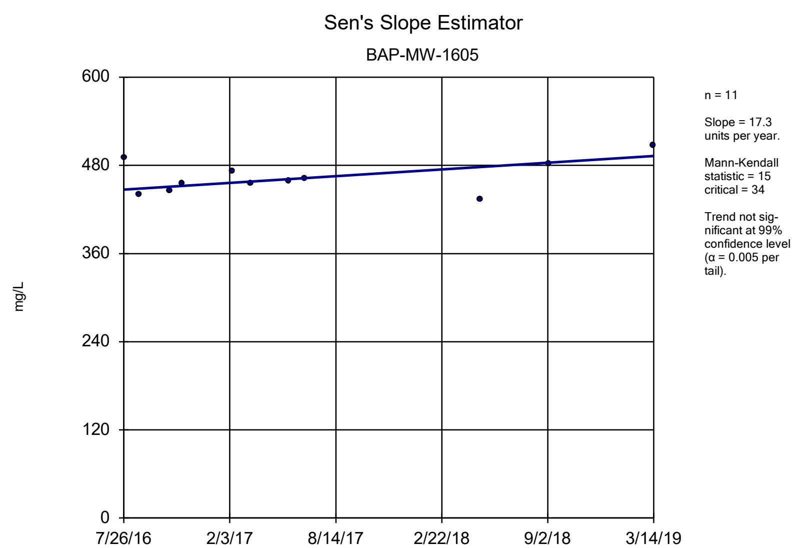
Constituent: Total Dissolved Solids [TDS] Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



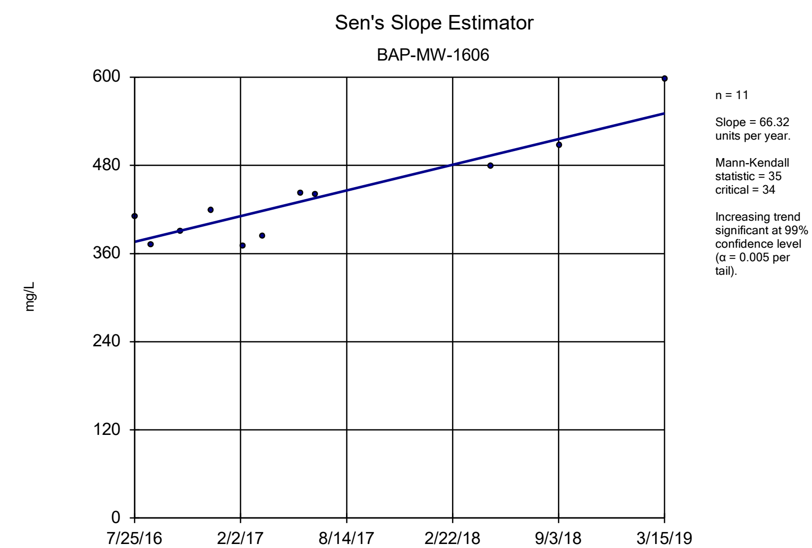
Constituent: Total Dissolved Solids [TDS] Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 7/8/2019 4:08 PM View: Trend Tests
Amos BAP Client: Geosyntec Data: Amos BAP

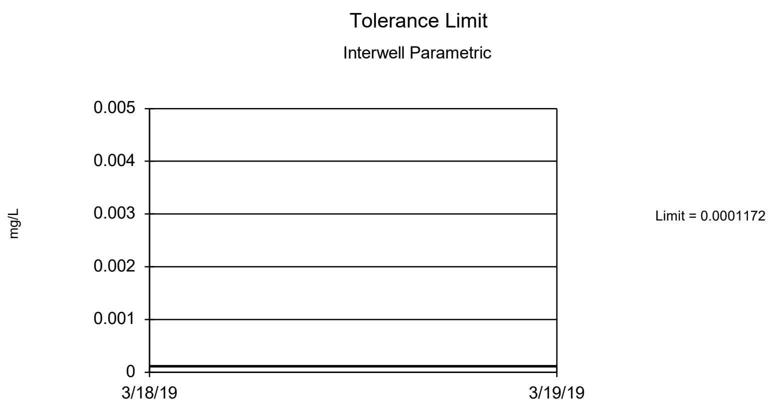
FIGURE F: TOLERANCE LIMITS

Tolerance Limit Summary Table

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 5/28/2019, 11:44 AM

Constituent	Well	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.0001172	44	0.03269	0.007742	11.36	None	x^(1/3)	0.05	Inter
Arsenic, total (mg/L)	n/a	0.0899	44	n/a	n/a	0	n/a	n/a	0.1047	NP Inter(normality)
Barium, total (mg/L)	n/a	0.3029	44	0.1889	0.05429	0	None	No	0.05	Inter
Beryllium, total (mg/L)	n/a	0.0001031	44	0.006345	0.001816	2.273	None	sqrt(x)	0.05	Inter
Cadmium, total (mg/L)	n/a	0.00003	44	n/a	n/a	11.36	n/a	n/a	0.1047	NP Inter(normality)
Chromium, total (mg/L)	n/a	0.002592	44	0.02931	0.01029	0	None	sqrt(x)	0.05	Inter
Cobalt, total (mg/L)	n/a	0.03204	44	-5.822	1.134	0	None	ln(x)	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	n/a	4.73	46	-0.01249	0.7507	0	None	ln(x)	0.05	Inter
Fluoride, total (mg/L)	n/a	0.29	46	n/a	n/a	2.174	n/a	n/a	0.09447	NP Inter(normality)
Lead, total (mg/L)	n/a	0.006355	44	0.09729	0.0419	0	None	x^(1/3)	0.05	Inter
Lithium, total (mg/L)	n/a	0.01321	44	-6.947	1.248	18.18	Kaplan-Meier	ln(x)	0.05	Inter
Mercury, total (mg/L)	n/a	0.000005	36	n/a	n/a	88.89	n/a	n/a	0.1578	NP Inter(NDs)
Molybdenum, total (mg/L)	n/a	0.002868	44	0.02938	0.01152	2.273	None	sqrt(x)	0.05	Inter
Selenium, total (mg/L)	n/a	0.0004	44	n/a	n/a	2.273	n/a	n/a	0.1047	NP Inter(normality)
Thallium, total (mg/L)	n/a	0.0005	44	n/a	n/a	15.91	n/a	n/a	0.1047	NP Inter(normality)

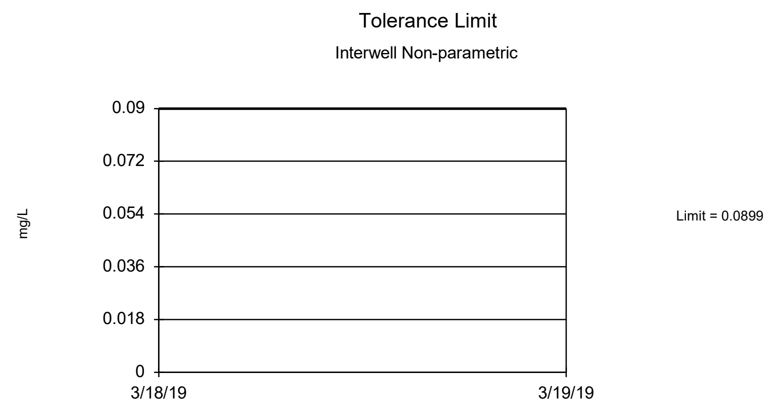
Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG



95% coverage. Background Data Summary (based on cube root transformation): Mean=0.03269, Std. Dev.=0.007742, n=44, 11.36% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9335, critical = 0.924. Report alpha = 0.05.

Constituent: Antimony, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

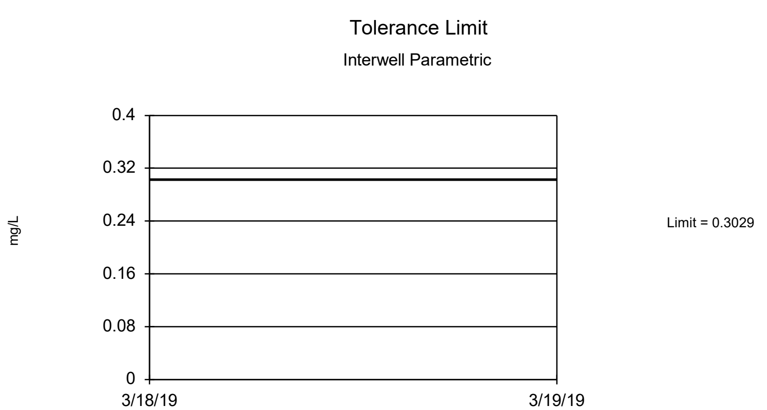
Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 44 background values. 90.04% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1047.

Constituent: Arsenic, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

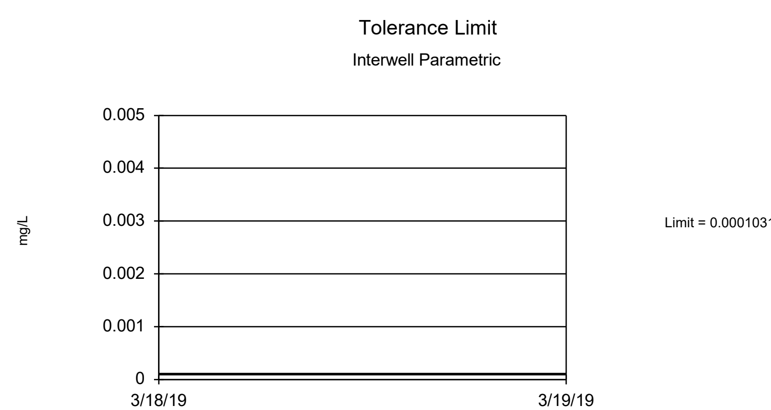
Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG



95% coverage. Background Data Summary: Mean=0.1889, Std. Dev.=0.05429, n=44. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.95, critical = 0.924. Report alpha = 0.05.

Constituent: Barium, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG



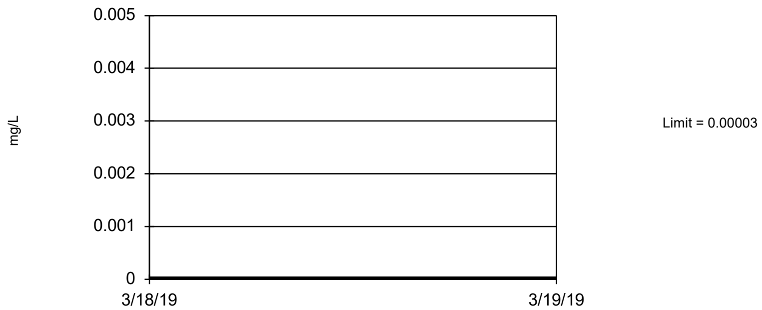
95% coverage. Background Data Summary (based on square root transformation): Mean=0.006345, Std. Dev.=0.001816, n=44, 2.273% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9689, critical = 0.924. Report alpha = 0.05.

Constituent: Beryllium, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



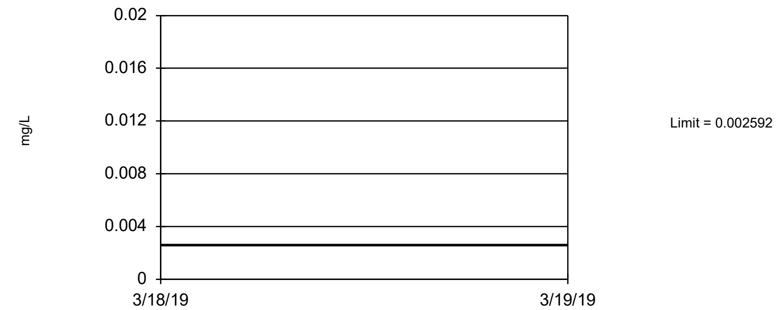
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 44 background values. 11.36% NDs. 90.04% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1047.

Constituent: Cadmium, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary (based on square root transformation): Mean=0.02931, Std. Dev.=0.01029, n=44. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9802, critical = 0.924. Report alpha = 0.05.

Constituent: Chromium, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric

95% coverage. Background Data Summary (based on natural log transformation): Mean=-5.822, Std. Dev.=1.134, n=44. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9247, critical = 0.924. Report alpha = 0.05.

Constituent: Cobalt, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric

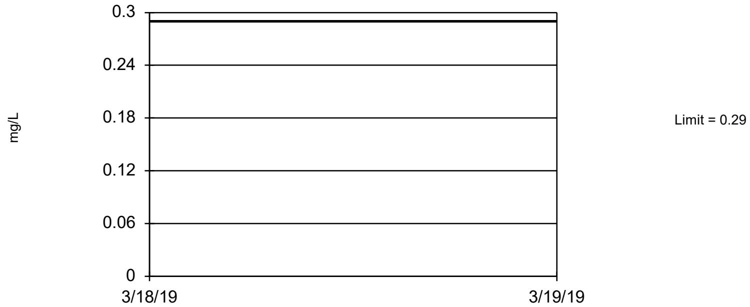
95% coverage. Background Data Summary (based on natural log transformation): Mean=-0.01249, Std. Dev.=0.7507, n=46. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9504, critical = 0.927. Report alpha = 0.05.

Constituent: Combined Radium 226 + 228 Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



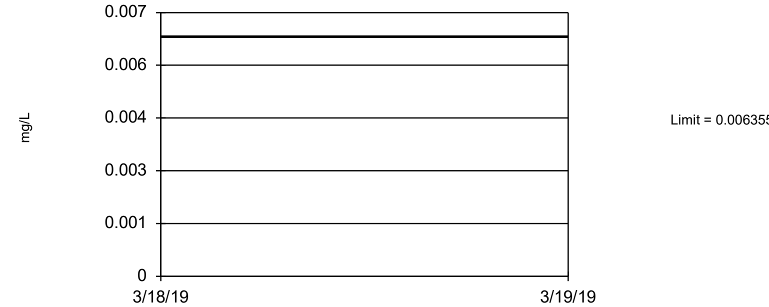
Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 46 background values. 2.174% NDs. 90.43% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.63% coverage at alpha=0.5. Report alpha = 0.09447.

Constituent: Fluoride, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



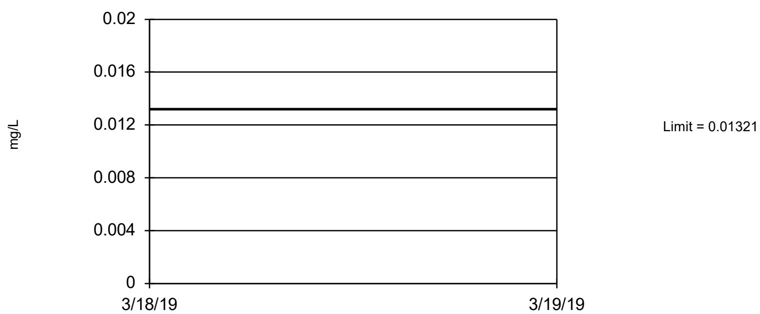
95% coverage. Background Data Summary (based on cube root transformation): Mean=0.09729, Std. Dev.=0.0419, n=44. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9386, critical = 0.924. Report alpha = 0.05.

Constituent: Lead, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-6.947, Std. Dev.=1.248, n=44, 18.18% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.932, critical = 0.924. Report alpha = 0.05.

Constituent: Lithium, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric

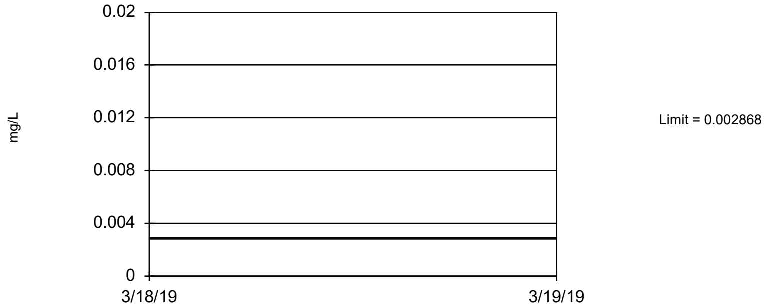
Non-parametric test used in lieu of parametric tolerance limit because censored data exceeded 75%. Limit is highest of 36 background values. 88.89% NDs. 88.09% coverage at alpha=0.01; 91.99% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1578.

Constituent: Mercury, total Analysis Run 5/28/2019 11:42 AM View: UTL's - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Parametric



95% coverage. Background Data Summary (based on square root transformation): Mean=0.02938, Std. Dev.=0.01152, n=44, 2.273% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9725, critical = 0.924. Report alpha = 0.05.

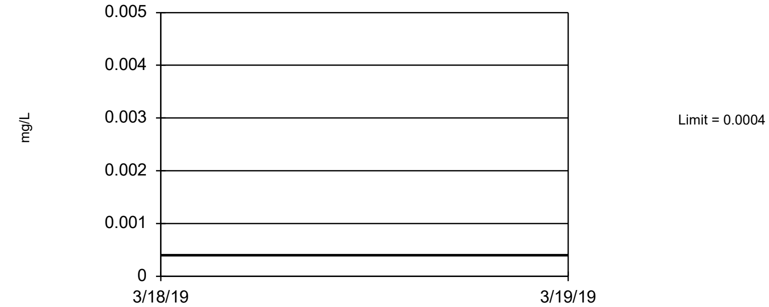
Constituent: Molybdenum, total   Analysis Run 5/28/2019 11:42 AM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 44 background values. 2.273% NDs. 90.04% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1047.

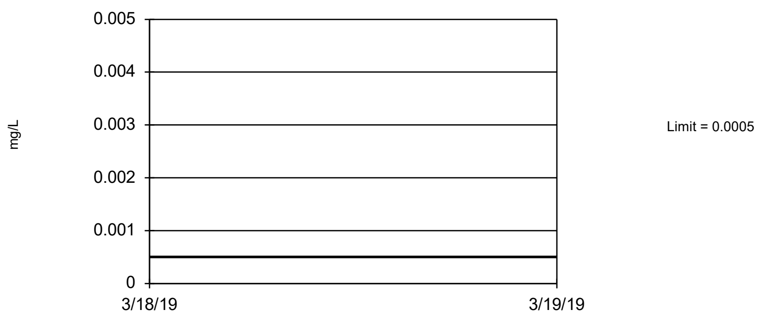
Constituent: Selenium, total   Analysis Run 5/28/2019 11:43 AM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Tolerance Limit

Interwell Non-parametric



Non-parametric test used in lieu of parametric tolerance limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 44 background values. 15.91% NDs. 90.04% coverage at alpha=0.01; 93.55% coverage at alpha=0.05; 98.24% coverage at alpha=0.5. Report alpha = 0.1047.

Constituent: Thallium, total   Analysis Run 5/28/2019 11:43 AM   View: UTL's - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

FIGURE G: GROUNDWATER PROTECTION STANDARDS

AMOS BAP GWPS				
Constituent Name	**MCL**	**Rule-Based**	**Background**	**GWPS**
Antimony, Total (mg/L)	0.006		0.00012	0.006
Arsenic, Total (mg/L)	0.01		0.09	0.09
Barium, Total (mg/L)	2		0.31	2
Beryllium, Total (mg/L)	0.004		0.0001	0.004
Cadmium, Total (mg/L)	0.005		0.00003	0.005
Chromium, Total (mg/L)	0.1		0.0026	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.032	0.032
Combined Radium, Total (pCi/L)	5		4.7	5
Fluoride, Total (mg/L)	4		0.29	4
Lead, Total (mg/L)	0.015		0.0064	0.015
Lithium, Total (mg/L)	n/a	0.04	0.013	0.04
Mercury, Total (mg/L)	0.002		0.000005	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.0029	0.1
Selenium, Total (mg/L)	0.05		0.0004	0.05
Thallium, Total (mg/L)	0.002		0.0005	0.002

Grey cell indicates Background is higher than MCL.

MCL = Maximum Contaminant Level

GWPS - Groundwater Protection Standard

FIGURE H: CONFIDENCE INTERVALS

Confidence Interval Summary Table - All Results (No Significant Results)

Amos BAP Client: Geosyntec Data: Amos BAP Printed 5/28/2019, 11:56 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	BAP-MW-1	0.00005	0.00001	0.006	n/a	No	11	0	No	0.006	NP (normality)
Antimony, total (mg/L)	BAP-MW-1604	0.00004	0.00002	0.006	n/a	No	11	0	No	0.006	NP (normality)
Antimony, total (mg/L)	BAP-MW-1605	0.00003623	0.00001468	0.006	n/a	No	11	9.091	No	0.01	Param.
Antimony, total (mg/L)	BAP-MW-1606	0.00003233	0.00001676	0.006	n/a	No	11	0	No	0.01	Param.
Antimony, total (mg/L)	BAP-MW-4	0.00005	0.00002	0.006	n/a	No	11	18.18	No	0.006	NP (Cohens/xfrm)
Antimony, total (mg/L)	BAP-MW-5	0.00004901	0.00001644	0.006	n/a	No	11	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1	0.0001655	0.0001108	0.09	n/a	No	11	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1604	0.005768	0.004262	0.09	n/a	No	11	0	x^(1/3)	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1605	0.004748	0.003288	0.09	n/a	No	11	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1606	0.00325	0.002537	0.09	n/a	No	11	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-4	0.01092	0.002981	0.09	n/a	No	11	0	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-5	0.003495	0.002638	0.09	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1	0.02952	0.02648	2	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1604	0.144	0.1289	2	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1605	0.08785	0.0706	2	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1606	0.06912	0.05888	2	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-4	0.09546	0.08503	2	n/a	No	11	0	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-5	0.1641	0.1497	2	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1	0.000129	0.00011	0.004	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1604	0.00007	0.000038	0.004	n/a	No	11	0	No	0.006	NP (normality)
Beryllium, total (mg/L)	BAP-MW-1605	0.00007079	0.00004212	0.004	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1606	0.0001251	0.00008397	0.004	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-4	0.00005619	0.00004308	0.004	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-5	0.00006027	0.00003645	0.004	n/a	No	11	0	No	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1	0.002962	0.002227	0.005	n/a	No	11	0	No	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1604	0.00005	0.000005	0.005	n/a	No	11	72.73	No	0.006	NP (normality)
Cadmium, total (mg/L)	BAP-MW-1605	0.00005	0.000005	0.005	n/a	No	11	72.73	No	0.006	NP (normality)
Cadmium, total (mg/L)	BAP-MW-1606	0.00019	0.00012	0.005	n/a	No	11	0	No	0.006	NP (normality)
Cadmium, total (mg/L)	BAP-MW-4	0.0002288	0.00004804	0.005	n/a	No	11	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-5	0.00001	0.000006	0.005	n/a	No	11	9.091	No	0.006	NP (normality)
Chromium, total (mg/L)	BAP-MW-1	0.0005442	0.0001063	0.1	n/a	No	11	0	x^(1/3)	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1604	0.00134	0.0006759	0.1	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1605	0.0004306	0.0001703	0.1	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1606	0.00134	0.0004505	0.1	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-4	0.0005178	0.0001961	0.1	n/a	No	11	0	ln(x)	0.01	Param.
Chromium, total (mg/L)	BAP-MW-5	0.000841	0.000122	0.1	n/a	No	11	0	No	0.006	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1	0.01504	0.01061	0.032	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1604	0.00106	0.000406	0.032	n/a	No	11	0	No	0.006	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1605	0.0245	0.00877	0.032	n/a	No	11	0	No	0.006	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1606	0.0162	0.01351	0.032	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-4	0.03519	0.009206	0.032	n/a	No	11	0	x^(1/3)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-5	0.00121	0.000949	0.032	n/a	No	11	0	No	0.006	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1	0.887	0.136	5	n/a	No	11	0	No	0.006	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1604	1.76	0.5864	5	n/a	No	12	0	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1605	1.656	0.5764	5	n/a	No	12	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1606	1.379	0.3541	5	n/a	No	12	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-4	1.278	0.4914	5	n/a	No	12	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-5	1.308	0.6504	5	n/a	No	12	0	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1	0.06	0.02	4	n/a	No	11	45.45	No	0.006	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1604	0.1033	0.06003	4	n/a	No	12	0	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1605	0.08	0.03	4	n/a	No	12	41.67	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1606	0.06	0.03	4	n/a	No	11	81.82	No	0.006	NP (NDs)
Fluoride, total (mg/L)	BAP-MW-4	0.06058	0.03942	4	n/a	No	12	8.333	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-5	0.05007	0.03493	4	n/a	No	12	8.333	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1	0.000252	0.000062	0.015	n/a	No	11	0	No	0.006	NP (normality)

Confidence Interval Summary Table - All Results (No Significant Results)

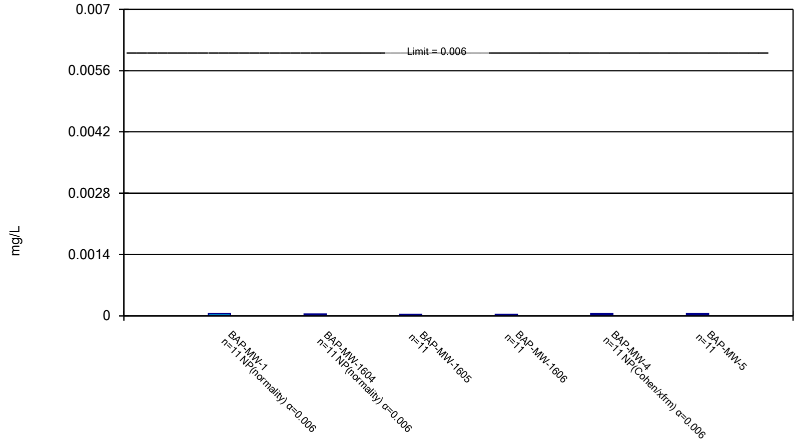
Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 5/28/2019, 11:56 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Lead, total (mg/L)	BAP-MW-1604	0.00108	0.0003767	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1605	0.0001878	0.00005349	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1606	0.001084	0.0003616	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-4	0.0003522	0.0001597	0.015	n/a	No	11	0	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-5	0.0003063	0.00006098	0.015	n/a	No	11	0	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1	0.014	0.0008	0.04	n/a	No	11	9.091	No	0.006	NP (normality)
Lithium, total (mg/L)	BAP-MW-1604	0.15	0.0008	0.04	n/a	No	11	27.27	No	0.006	NP (normality)
Lithium, total (mg/L)	BAP-MW-1605	0.011	0.003	0.04	n/a	No	11	9.091	No	0.006	NP (normality)
Lithium, total (mg/L)	BAP-MW-1606	0.15	0.003	0.04	n/a	No	11	18.18	No	0.006	NP (normality)
Lithium, total (mg/L)	BAP-MW-4	0.01318	0.00093	0.04	n/a	No	11	9.091	ln(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-5	0.0132	0.0009161	0.04	n/a	No	11	9.091	ln(x)	0.01	Param.
Mercury, total (mg/L)	BAP-MW-1	0.000005	0.000002	0.002	n/a	No	9	88.89	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1604	0.000005	0.000002	0.002	n/a	No	9	88.89	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1605	0.000005	0.000005	0.002	n/a	No	9	100	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1606	0.000005	0.000002	0.002	n/a	No	9	88.89	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-4	0.000005	0.000005	0.002	n/a	No	9	100	No	0.002	NP (NDs)
Mercury, total (mg/L)	BAP-MW-5	0.000005	0.000005	0.002	n/a	No	9	100	No	0.002	NP (NDs)
Molybdenum, total (mg/L)	BAP-MW-1	0.001545	0.0004391	0.1	n/a	No	11	0	No	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-1604	0.00074	0.0002	0.1	n/a	No	11	9.091	No	0.006	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-1605	0.0005098	0.000118	0.1	n/a	No	11	9.091	sqrt(x)	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-1606	0.0003029	0.00007582	0.1	n/a	No	11	9.091	ln(x)	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-4	0.0111	0.00028	0.1	n/a	No	11	9.091	No	0.006	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-5	0.001671	0.0003205	0.1	n/a	No	11	9.091	sqrt(x)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-1	0.0002	0.00009	0.05	n/a	No	10	0	No	0.011	NP (normality)
Selenium, total (mg/L)	BAP-MW-1604	0.0002	0.0002	0.05	n/a	No	11	0	No	0.006	NP (normality)
Selenium, total (mg/L)	BAP-MW-1605	0.00008805	0.00004649	0.05	n/a	No	11	0	No	0.01	Param.
Selenium, total (mg/L)	BAP-MW-1606	0.0001921	0.00008255	0.05	n/a	No	11	0	x^(1/3)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-4	0.00009018	0.00006389	0.05	n/a	No	11	0	x^(1/3)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-5	0.0001	0.00003	0.05	n/a	No	11	54.55	No	0.006	NP (normality)
Thallium, total (mg/L)	BAP-MW-1	0.000066	0.00003	0.002	n/a	No	11	9.091	No	0.006	NP (normality)
Thallium, total (mg/L)	BAP-MW-1604	0.0005	0.00001	0.002	n/a	No	11	36.36	No	0.006	NP (normality)
Thallium, total (mg/L)	BAP-MW-1605	0.0005	0.00001	0.002	n/a	No	11	54.55	No	0.006	NP (normality)
Thallium, total (mg/L)	BAP-MW-1606	0.00005	0.00001	0.002	n/a	No	11	9.091	No	0.006	NP (normality)
Thallium, total (mg/L)	BAP-MW-4	0.0001787	0.00002791	0.002	n/a	No	11	9.091	x^(1/3)	0.01	Param.
Thallium, total (mg/L)	BAP-MW-5	0.0005	0.00001	0.002	n/a	No	11	36.36	No	0.006	NP (normality)

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

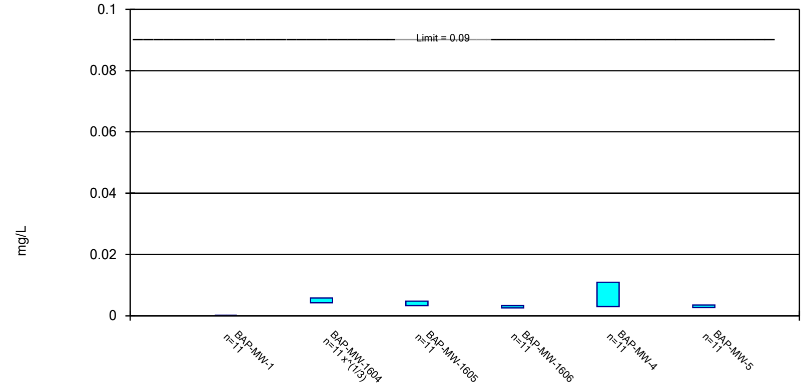


Constituent: Antimony, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

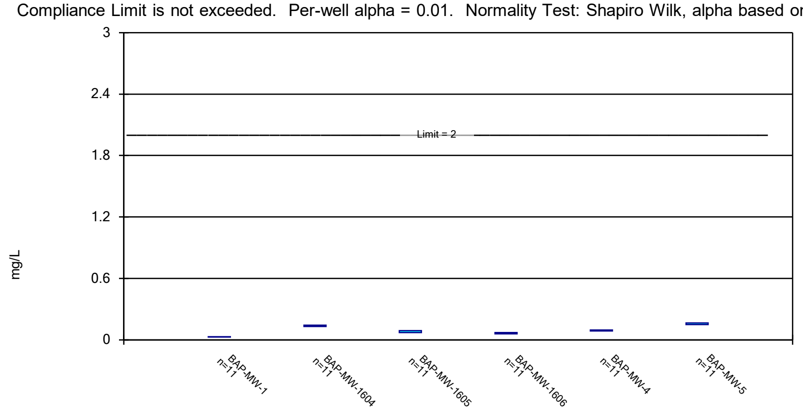


Constituent: Arsenic, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

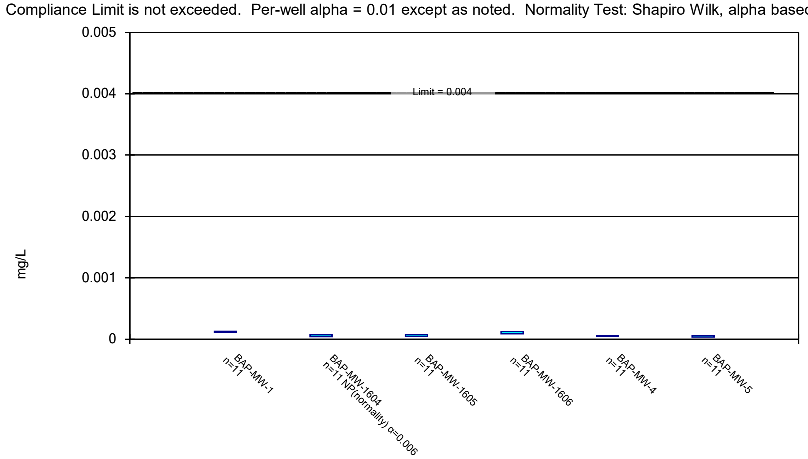


Constituent: Barium, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

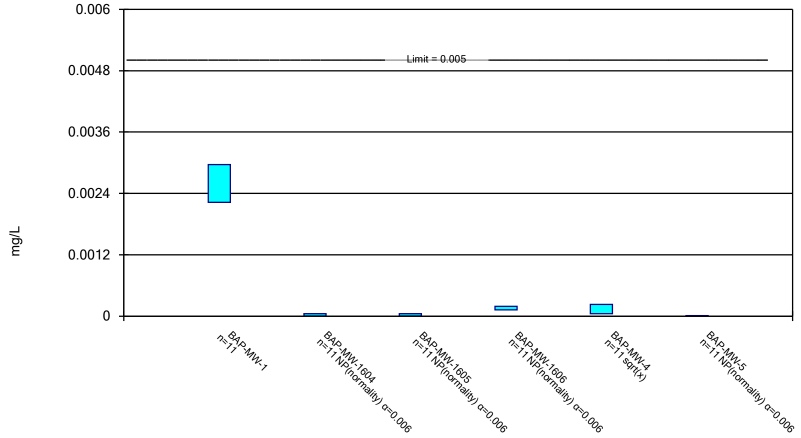


Constituent: Beryllium, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



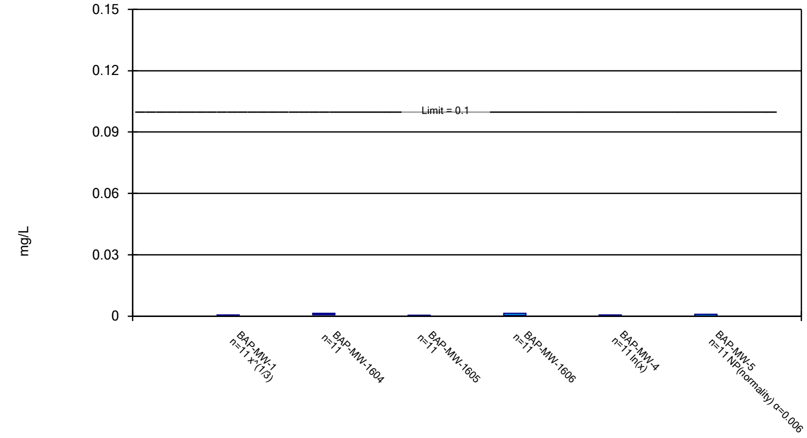
Constituent: Cadmium, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



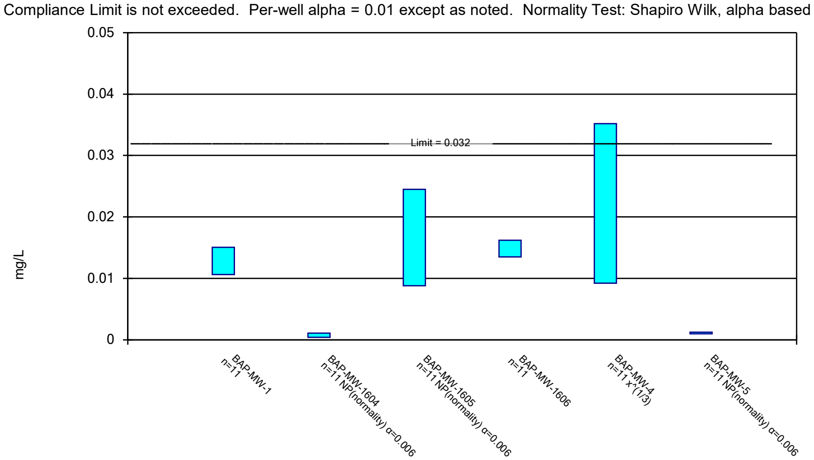
Constituent: Chromium, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



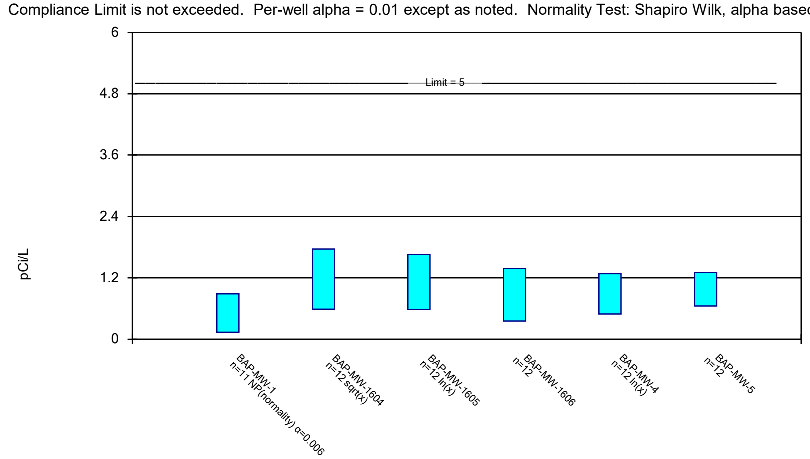
Constituent: Cobalt, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



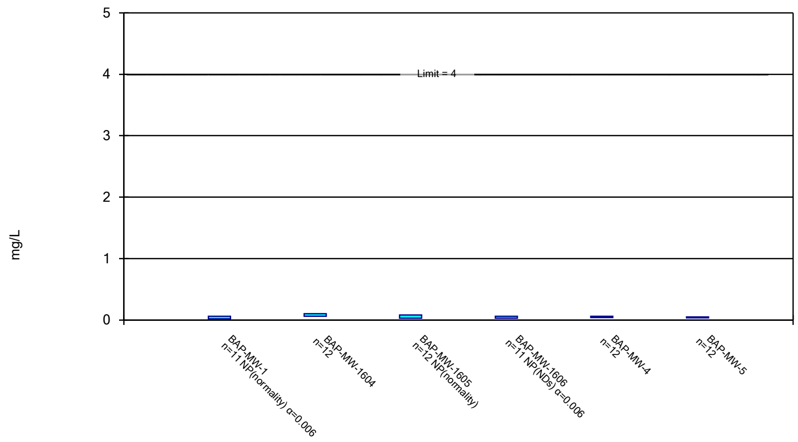
Constituent: Combined Radium 226 + 228 Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals -

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

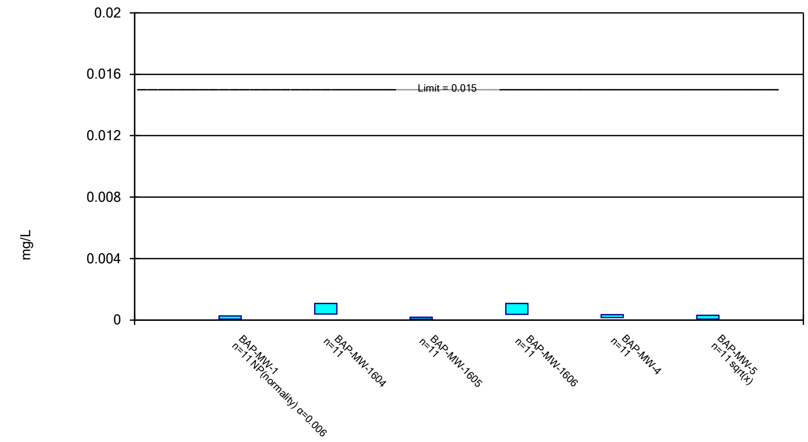


Constituent: Fluoride, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

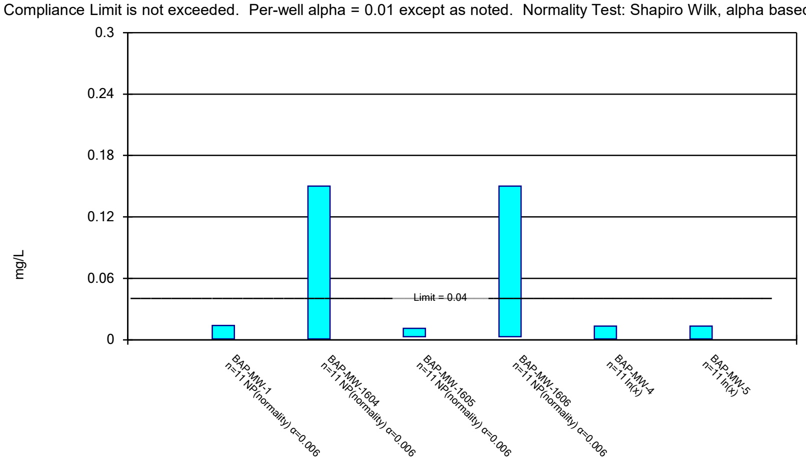


Constituent: Lead, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

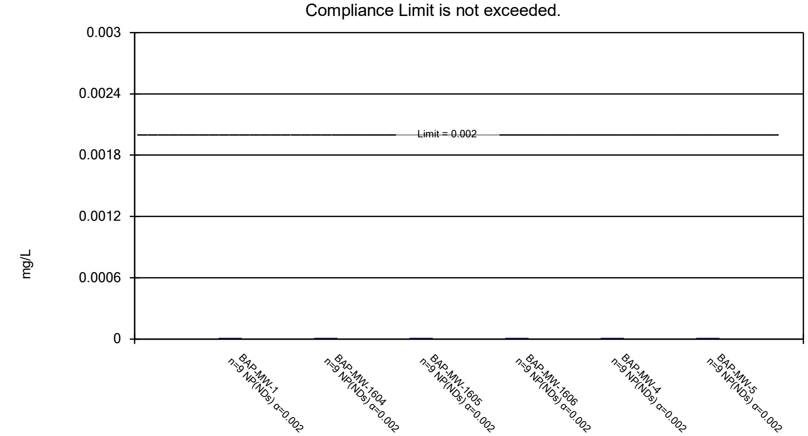


Constituent: Lithium, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

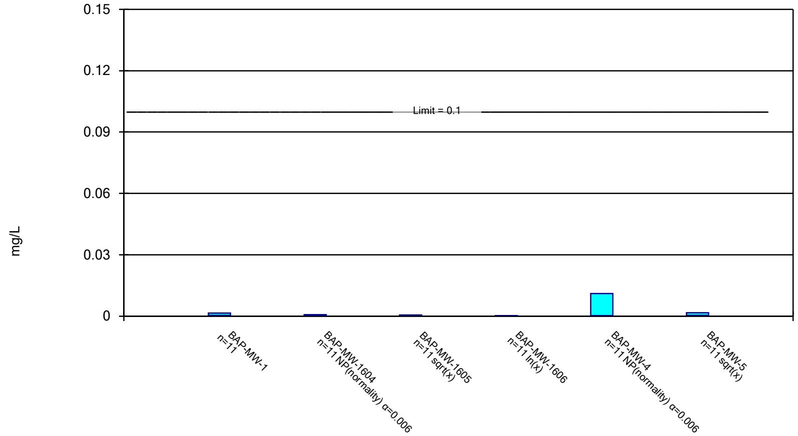


Constituent: Mercury, total Analysis Run 5/28/2019 11:53 AM View: Confidence Intervals - App IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



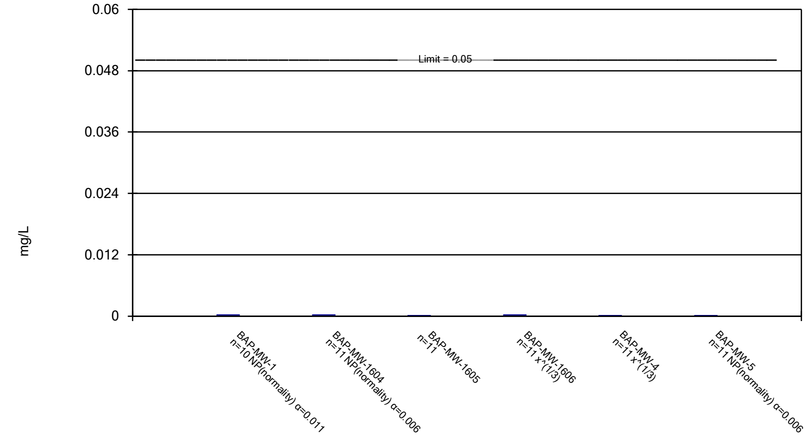
Constituent: Molybdenum, total   Analysis Run 5/28/2019 11:53 AM   View: Confidence Intervals - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



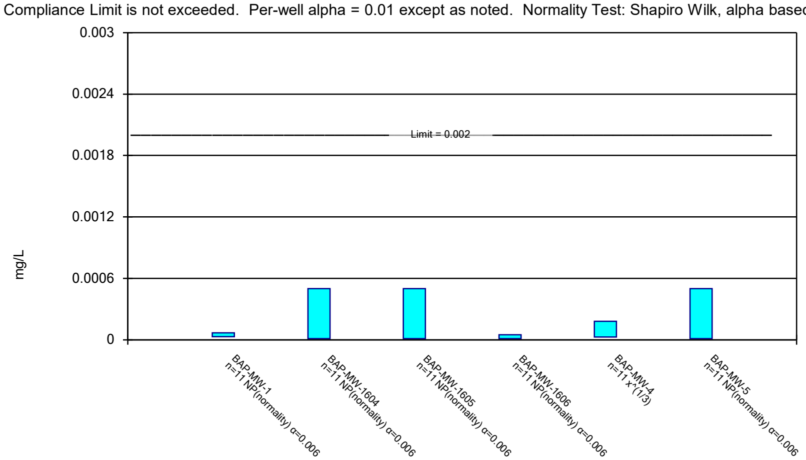
Constituent: Selenium, total   Analysis Run 5/28/2019 11:53 AM   View: Confidence Intervals - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.14 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Thallium, total   Analysis Run 5/28/2019 11:53 AM   View: Confidence Intervals - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Amos Plant
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

December 23, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
SU	Standard Units
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for calcium, chloride, total dissolved solids (TDS), and sulfate at the BAP. An alternative source was not identified following the detection monitoring events, so the BAP has been in assessment monitoring since 2018. During the first 2019 assessment monitoring event, completed in March 2019, no statistically significant levels (SSLs) were identified and the unit remained in assessment monitoring. Two additional assessment monitoring events were conducted at the BAP in June 2019 and July 2019, in accordance with 40 CFR 257.95. The statistical summary of the results of the March 2019 sampling event was completed under a separate cover (Geosyntec, 2019). Only the results of the June and July assessment events are documented in this report.

Prior to conducting the statistical analyses, the groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at concentrations above the GWPS. No SSLs were identified. Prediction limits were recalculated for Appendix III parameters. When compared to the revised prediction limits, concentrations for calcium, chloride, pH, sulfate, and TDS remained above background. Some pH values were also below background. Thus, either the unit will remain in assessment monitoring or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can return to detection monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (June 2019) and 257.95(d)(1) (July 2019). Samples from the June 2019 event were analyzed for all Appendix III and Appendix IV parameters. Samples from the July 2019 event were not analyzed for mercury, as it was not detected at any locations during the June event. A summary of data collected during these assessment monitoring events may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.23 statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in June and July 2019 were screened for potential outliers. Outliers were identified for pH at MW-1, MW-1601, MW-1602A, MW-1603A, MW-1604, and MW-6 in June 2019. The presence of multiple anomalously high pH values during the same event suggests field instrumentation error and these values were removed from the dataset. Outliers were also identified for beryllium at MW-1604 and selenium at MW-6 for the June 2019 event and these values were removed from the dataset.

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for antimony, arsenic, cadmium, combined radium, fluoride, selenium, and thallium due to apparent non-normal distributions and for mercury due to a high non-detect frequency. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Amos BAP.

2.2.3 Establishment of Appendix III Prediction Limits

Upper prediction limits (UPL) were previously established for all Appendix III parameters following the background monitoring period (Geosyntec, 2018). Intrawell tests were used to evaluate potential SSIs for fluoride and pH, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS. While interwell prediction limits have been updated periodically during the assessment monitoring period as sufficient data became available, this represents the first update to the background dataset for parameters evaluated using intrawell tests.

Mann-Whitney (Wilcoxon rank-sum) tests were performed to determine whether the newer data are affected by a release from the BAP. Because the interwell Appendix III limits and the Appendix IV GWPSs are based on data from upgradient wells which we would not expect to have been impacted by a release, these tests were used for intrawell Appendix III tests only. Mann-Whitney tests were used to compare the medians of historical data (July 2016 - October 2017) to the new compliance samples (November 2017 – March 2019) for fluoride and pH. Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Appendix B. No statistically significant differences were found between the two groups for fluoride or pH.

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., “J-flagged” data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

UPLs were updated using all the historical data through March 2019 to represent background values. LPLs were also updated for pH. The updated prediction limits are summarized in Table 3. Intrawell tests continued to be used to evaluate potential SSIs for fluoride and pH, whereas interwell tests continued to be used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS. The UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result did not exceed the UPL, a second sample was not collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.2.4 Evaluation of Potential Appendix III SSIs

The CCR rule allows CCR units to move from assessment monitoring to detection monitoring if all Appendix III and Appendix IV parameters were at or below background levels for two consecutive sampling events [40 CFR 257.95(e)]. Since no Appendix IV SSLs were identified, Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Data collected during the June 2019 and July 2019 assessment monitoring events from each compliance well were compared to the prediction limits to evaluate results above background values. The results from this event and the prediction limits are summarized in Table 4. While the pH measurements exceeded the intrawell UPL of 7.3 SU at MW-1 (10.2 SU) and the intrawell UPL of 7.2 SU at MW-1604 (8.7 SU) for the June 2019 event, both of these values were removed as outliers. The following exceedances of the upper prediction limits (UPLs) were noted:

- Calcium concentrations exceeded the interwell UPL of 19.6 mg/L at MW-1 (35.9 mg/L and 36.8 mg/L), MW-1605 (45.5 mg/L and 46.5 mg/L), and MW-1606 (56.6 mg/L and 52.8 mg/L).

- Chloride concentrations exceeded the interwell UPL of 41.0 mg/L at MW-1 (64.4 mg/L and 57.4 mg/L), MW-1605 (91.8 mg/L and 91.6 mg/L), and MW-1606 (177 mg/L and 186 mg/L).

- Sulfate concentrations exceeded the interwell UPL of 57.4 mg/L at MW-1 (141 mg/L and 143 mg/L), MW 1605 (226 mg/L for both events), and MW-1606 (204 mg/L and 191 mg/L).

- The pH values were below the intrawell LPL of 6.1 SU at MW-1604 (5.9 SU) and below the intrawell LPL of 5.5 SU at MW-4 (5.4 SU).

- TDS concentrations exceeded the interwell UPL of 260 mg/L at MW-1 (330 mg/L and 362 mg/L), MW-1605 (530 mg/L and 517 mg/L), and MW-1606 (571 mg/L and 597 mg/L).

Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Amos BAP during assessment monitoring. As a result, the Amos BAP CCR unit will remain in assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified potential outliers for pH, beryllium, and selenium in the June 2019 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPS. No SSLs were identified.

Revised prediction limits were calculated for Appendix III parameters. Interwell tests continued to be used to evaluate potential SSIs for boron, calcium, chloride, sulfate, and TDS, and intrawell tests continued to be used to evaluate potential SSIs for fluoride and pH. Prediction limits were recalculated using a one-of-two retesting procedure. The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Calcium, chloride, sulfate, and TDS results exceeded background levels; pH values were detected below the background levels.

Based on this evaluation, either the Amos BAP CCR unit will remain in assessment monitoring or an ASD will be conducted to evaluate if the unit can return to detection monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Amos Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – Bottom Ash Pond, John E. Amos Plant, Winfield, West Virginia. January 15, 2018.

Geosyntec, 2019. Statistical Analysis Summary – Bottom Ash Pond, Amos Plant, Winfield, West Virginia. July 10, 2019.

TABLES

Table 1 - Groundwater Data Summary
Amos - Bottom Ash Pond

Component	Unit	BAP-MW-1		BAP-MW-1601		BAP-MW-1602A		BAP-MW-1603A		BAP-MW-1604	
		6/10/2019	7/22/2019	6/12/2019	7/24/2019	6/11/2019	7/23/2019	6/11/2019	7/24/2019	6/10/2019	7/24/2019
Antimony	µg/L	0.0200 J	0.100 U	0.100 U	0.100 U	0.200 U	0.100 U	0.100 U	0.100 U	0.0500 J	0.100 U
Arsenic	µg/L	0.110	0.0900 J	6.02	6.63	20.6	21.7	90.3	85.8	4.88	4.76
Barium	µg/L	27.5	26.4	118	130	229	213	255	249	142	170
Beryllium	µg/L	0.125	0.136	0.0400 J	0.0200 J	0.200 U	0.100 U	0.100 U	0.0400 J	0.142	0.0600 J
Boron	mg/L	0.0800 J	0.0500 J	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.0900 J	0.132
Cadmium	µg/L	2.14	2.47	0.0200 J	0.0100 J	0.100 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U
Calcium	mg/L	35.9	36.8	11.0	10.3	18.8	16.7	15.5	14.4	16.5	18.7
Chloride	mg/L	64.4	57.4	10.0	10.3	41.9	39.4	5.70	5.73	24.4	27.0
Chromium	µg/L	0.200 J	0.0600 J	0.200 J	0.200 J	0.300 J	0.297	0.280	0.650	0.360	1.33
Cobalt	µg/L	12.8	13.5	2.75	3.01	0.523	0.545	0.288	0.517	0.306	0.415
Combined Radium	pCi/L	0.998	0.825	0.533	1.01	1.14	0.888	0.356	0.439	0.831	0.943
Fluoride	mg/L	0.0300 J	0.0200 J	0.0500 J	0.0500 J	0.160	0.130	0.310	0.280	0.110	0.0700
Lead	µg/L	0.0800 J	0.0800 J	0.154	0.200 J	0.677	1.08	0.163	0.580	0.148	0.294
Lithium	mg/L	0.0300 U	0.00257	0.0300 U	0.00141	0.0300 U	0.000908	0.0300 U	0.000870	0.0300 U	0.000485
Mercury	µg/L	0.00500 U	--	0.00500 U	--	0.00500 U	--	0.00500 U	--	0.00500 U	--
Molybdenum	µg/L	2.00 U	2.00 U	2.00 U	2.00 U	4.00 U	0.700 J	1.00 J	1.00 J	2.00 U	0.400 J
Selenium	µg/L	0.100 J	0.200 J	0.0800 J	0.0600 J	0.400 U	0.0600 J	0.0400 J	0.0700 J	0.100 J	0.100 J
Total Dissolved Solids	mg/L	330	362	185	154	217	201	95.0	102	60.0	242
Sulfate	mg/L	141	143	48.8	44.6	13.8	10.3	0.400 U	0.400 U	0.400 U	0.400 U
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	1.00 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
pH	SU	10.2	4.90	6.70	5.88	9.51	6.29	8.82	6.77	8.65	5.92

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not analyzed

Table 1 - Groundwater Data Summary
Amos - Bottom Ash Pond

Component	Unit	BAP-MW-1605		BAP-MW-1606		BAP-MW-4		BAP-MW-5		BAP-MW-6	
		6/11/2019	7/24/2019	6/11/2019	7/24/2019	6/10/2019	7/23/2019	6/10/2019	7/23/2019	6/10/2019	7/24/2019
Antimony	µg/L	0.100 U	0.100 U	0.100 U	0.0300 J	0.100 U	0.0300 J	0.100 U	0.100	0.0300 J	0.100 U
Arsenic	µg/L	3.01	2.82	2.44	3.44	2.50	2.48	2.85	6.74	34.3	34.2
Barium	µg/L	93.2	108	64.1	72.9	90.5	84.6	155	158	161	164
Beryllium	µg/L	0.0700 J	0.0900 J	0.0800 J	0.140	0.0600 J	0.0700 J	0.0400 J	0.121	0.100 U	0.0300 J
Boron	mg/L	0.0600 J	0.0600 J	0.0400 J	0.0400 J	0.0600 J	0.0600 J	0.0400 J	0.100 U	0.100 U	0.0400 J
Cadmium	µg/L	0.0100 J	0.0500 U	0.180	0.210	0.0700	0.0500	0.0500 U	0.0500 U	0.0500 U	0.0500 U
Calcium	mg/L	45.5	46.5	56.6	52.8	14.4	14.8	15.7	14.9	11.8	12.1
Chloride	mg/L	91.8	91.6	177	186	13.0	13.4	16.9	15.3	9.68	9.71
Chromium	µg/L	0.200 J	0.306	0.200 J	1.14	0.274	0.236	0.100 J	0.291	0.309	0.418
Cobalt	µg/L	9.09	8.57	16.5	16.2	10.5	7.24	1.13	1.12	9.72	8.97
Combined Radium	pCi/L	1.06	0.739	0.443	0.743	0.787	0.486	0.890	0.811	0.688	0.657
Fluoride	mg/L	0.0200 J	0.0200 J	0.0200 J	0.0200 J	0.0600	0.0400 J	0.0500 J	0.0400 J	0.0800	0.0500 J
Lead	µg/L	0.0600 J	0.200 J	0.181	1.11	0.406	0.430	0.0400 J	0.762	0.104	0.200 J
Lithium	mg/L	0.0300 U	0.00255	0.0300 U	0.00340	0.0300 U	0.00162	0.0300 U	0.00153	0.0300 U	0.00114
Mercury	µg/L	0.00500 U	--	0.00500 U	--	0.00500 U	--	0.00500 U	--	0.00500 U	--
Molybdenum	µg/L	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	2.00 U	0.500 J	0.400 J
Selenium	µg/L	0.0600 J	0.0800 J	0.0600 J	0.200 J	0.0800 J	0.100 J	0.200 U	0.0800 J	0.100 J	0.100 J
Total Dissolved Solids	mg/L	530	517	571	597	172	186	178	162	205	199
Sulfate	mg/L	226	226	204	191	43.3	44.5	48.4	45.2	2.20	2.20
Thallium	µg/L	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U
pH	SU	5.74	5.42	6.67	5.43	6.81	5.43	5.87	5.58	9.32	5.89

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
-: Not analyzed

Table 2: Groundwater Protection Standards
Amos Plant - Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.0002
Arsenic, Total (mg/L)	0.01		0.09
Barium, Total (mg/L)	2		0.3
Beryllium, Total (mg/L)	0.004		0.0001
Cadmium, Total (mg/L)	0.005		0.00005
Chromium, Total (mg/L)	0.1		0.0022
Cobalt, Total (mg/L)	n/a	0.006	0.018
Combined Radium, Total (pCi/L)	5		7.9
Fluoride, Total (mg/L)	4		0.31
Lead, Total (mg/L)	n/a	0.015	0.0087
Lithium, Total (mg/L)	n/a	0.04	0.011
Mercury, Total (mg/L)	0.002		0.000005
Molybdenum, Total (mg/L)	n/a	0.1	0.0026
Selenium, Total (mg/L)	0.05		0.0003
Thallium, Total (mg/L)	0.002		0.0005

Notes:
Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.
MCL = Maximum Contaminant Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

Table 3: Revised Prediction Limits
Amos Plant - Bottom Ash Pond

Parameter	Unit	Description	MW-1	MW-4	MW-5	MW-1604	MW-1605	MW-1606
Boron	mg/L	Interwell Background Value (UPL)	0.183					
Calcium	mg/L	Interwell Background Value (UPL)	19.6					
Chloride	mg/L	Interwell Background Value (UPL)	41.0					
Fluoride	mg/L	Intrawell Background Value (UPL)	0.0300	0.0822	0.0500	0.146	0.0900	0.0300
pH	SU	Intrawell Background Value (UPL)	7.3	7.0	6.5	7.2	6.6	5.9
		Intrawell Background Value (LPL)	4.9	5.5	5.2	6.1	5.2	5.1
Sulfate	mg/L	Interwell Background Value (UPL)	57.4					
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	260					

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

Table 4: Appendix III Data Summary
Amos Plant - Bottom Ash Pond

Parameter	Unit	Description	MW-1		MW-4		MW-5		MW-1604		MW-1605		MW-1606	
			6/10/2019	7/22/2019	6/10/2019	7/23/2019	6/10/2019	7/23/2019	6/10/2019	7/24/2019	6/11/2019	7/24/2019	6/11/2019	7/24/2019
Boron	mg/L	Interwell Background Value (UPL)	0.183											
		Detection Monitoring Result	0.0800	0.0500	0.0600	0.0600	0.0400	0.0400	0.0900	0.132	0.0600	0.0600	0.0400	0.0400
Calcium	mg/L	Interwell Background Value (UPL)	19.6											
		Detection Monitoring Result	**35.9**	**36.8**	14.4	14.8	15.7	14.9	16.5	18.7	**45.5**	**46.5**	**56.6**	**52.8**
Chloride	mg/L	Interwell Background Value (UPL)	41.0											
		Detection Monitoring Result	**64.4**	**57.4**	13.0	13.4	16.9	15.3	24.4	27.0	**91.8**	**91.6**	**177**	**186**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.0300		0.0822		0.0500		0.146		0.0900		0.0300	
		Detection Monitoring Result	0.0300	0.0200	0.0600	0.0400	0.0500	0.0400	0.110	0.0700	0.0200	0.0200	0.0200	0.0200
pH	SU	Intrawell Background Value (UPL)	7.3		7.0		6.5		7.2		6.6		5.9	
		Intrawell Background Value (LPL)	4.9		5.5		5.2		6.1		5.2		5.1	
		Detection Monitoring Result	**10.2***	4.9	6.8	**5.4**	5.9	5.6	**8.7***	**5.9**	5.7	5.4	6.7	5.4
Sulfate	mg/L	Interwell Background Value (UPL)	57.4											
		Detection Monitoring Result	**141**	**143**	43.3	44.5	48.4	45.2	0.0600	0.0600	**226**	**226**	**204**	**191**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	260											
		Detection Monitoring Result	**330**	**362**	172	186	178	162	60.0	242	**530**	**517**	**571**	**597**

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
Asterisks indicate the value was removed from the dataset as an outlier.

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Amos Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663

License Number

WEST VIRGINIA

Licensing State

12.23.19

Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

December 9, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Amos Bottom Ash Pond
Background Update – 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the background update of groundwater data for 2019 at American Electric Power Company's Amos Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** BAP-MW-1601, BAP-MW-1602A, BAP-MW-1603A, and BAP-MW-6; and
- **Downgradient wells:** BAP-MW-1, BAP-MW-1604, BAP-MW-1605, BAP-MW-1606, BAP-MW-4, and BAP-MW-5.

Data were sent electronically, and the statistical analysis was conducted according to the Statistical Analysis Plan and screening evaluation prepared by GSC and approved by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC.

The CCR program consists of the following constituents:

- o **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS;
- o **Appendix IV** (Assessment Monitoring) **–** antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series and box plots for Appendix III and IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figures A and B, respectively). Values in background, which have previously been flagged as outliers, may be seen in a lighter font and disconnected symbol on the graphs. Additionally, a summary of flagged values follows this letter (Figure C).

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for fluoride and pH; and
2) Interwell prediction limits combined with a 1-of-2 resample plan for boron, calcium, chloride, sulfate, and TDS.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

History of Initial Background Screening Conducted in December 2017

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Tukey's outlier test noted a few outliers as may be seen on the Outlier Summary Table and accompanying graphs. Any values flagged as outliers are plotted in a lighter font on the time series graph. The test identified an outlier for arsenic in well BAP-MW-1604; and pH in well BAP-MW-5; however, these concentrations were similar to concentrations in neighboring wells and were not flagged as outliers. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed a couple statistically significant increasing trends and several statistically significant decreasing trends were included in the previous screening. All trends were relatively low in magnitude when compared to average concentrations and data, therefore, required no adjustment at this time.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified variation for all Appendix III parameters except for boron. Therefore, boron is eligible for interwell prediction limits, and all other parameters were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits will initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility. When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the above parameters were found to be within their respective background limit for fluoride and pH; while confidence intervals were above their respective background limits in at least one well for calcium, chloride, sulfate, and TDS. Therefore, intrawell methods are recommended for fluoride and pH, and interwell methods are initially recommended for boron, calcium, chloride, sulfate and TDS. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through June 2017 at each well were used to establish intrawell background limits for the parameters identified above based on a 1-of-2 resample plan that will be used for future comparisons. Interwell prediction limits, combined with a 1-of-2 resample plan, were constructed from upgradient wells for parameters eligible for interwell testing. Downgradient measurements will be compared to these background limits during each subsequent semi-annual sampling event.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes. In the interwell case, newer data will be included in background during each sample event after careful screening for new outliers. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary.

Background Update – Appendix III Parameters – November 2019

Prior to updating background data, samples were re-evaluated for all wells for intrawell parameters and all upgradient wells for interwell parameters using Tukey's outlier test and visual screening with the July 2019 samples. Note that the reporting limit during the March 2019 event for boron in wells BAP-MW-1603A, BAP-MW-1604, BAP-MW-1605, BAP-MW-1606, BAP-MW-4, BAP-MW-5, and BAP-MW-6 was 1.0 mg/L compared to a historical reporting limit of 0.005 mg/L and, therefore, these values were flagged as outliers to avoid setting a statistical limit that would not be conservative from a regulatory perspective.

As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. An updated summary of Tukey's test results and flagged outliers follows this letter.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through June 2017 to the new compliance samples at each well through March 2019 to evaluate whether the groups are statistically different at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). No statistically significant differences were found between the two groups for the well/constituent pairs.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report.

Intrawell prediction limits using all historical data through March 2019, combined with a 1-of-2 resample plan, were constructed for fluoride and pH (Figure E).

For parameters tested using interwell analyses, the Sen's Slope/Mann-Kendall trend test was used on upgradient wells to determine whether concentrations are statistically increasing, decreasing or stable (Figure F). No statistically significant increasing or decreasing trends were noted with the exception of increasing trends for chloride in upgradient wells BAP-MW-1601 and BAP-MW-1602A. The magnitude of these trends, however, is low relative to the average concentrations in these wells. Therefore, no adjustments were required at this time. A summary of these results is included with the trend tests.

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells through March 2019 for boron, calcium, chloride, and TDS (Figure G). Interwell prediction limits pool upgradient well data to establish a background limit for an individual constituent. A summary table of the updated limits may be found following this letter in the Prediction Limit Summary Tables.

Evaluation of Appendix IV Parameters – November 2019

Interwell Tolerance limits were used to calculate background limits from all available pooled upgradient well data for Appendix IV parameters to determine the Alternate Contaminant Level (ACL) for each constituent (Figure H). Background data are screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Any flagged values may be seen on the Outlier Summary following this letter.

Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure I).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of the MCL, CCR-Rule specified levels, or background as discussed above (Figure J). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No exceedances were noted for any of the well/constituent pairs. A summary of the confidence interval results follows this letter.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Amos Bottom Ash Pond. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

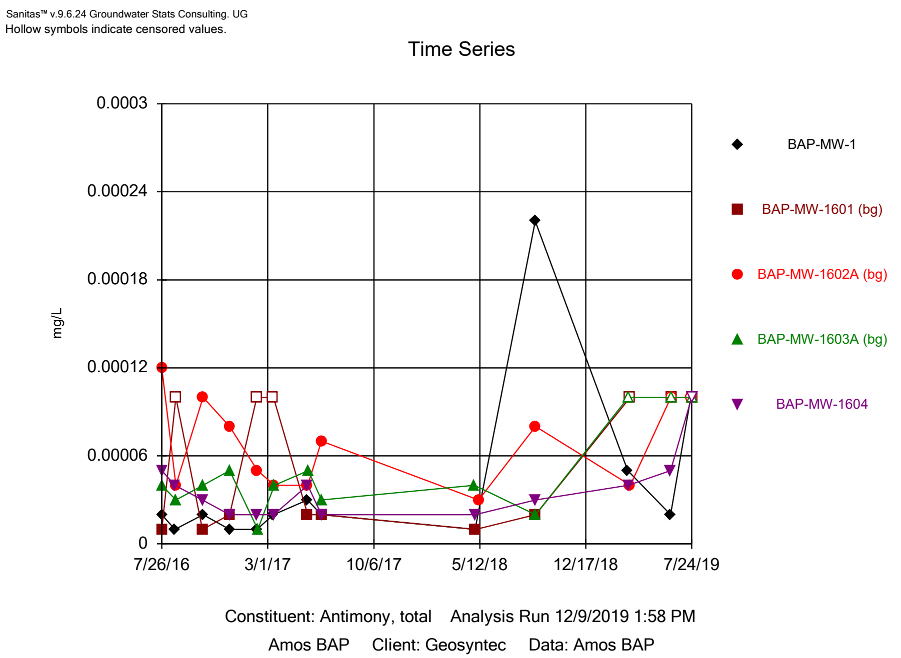
ACollins

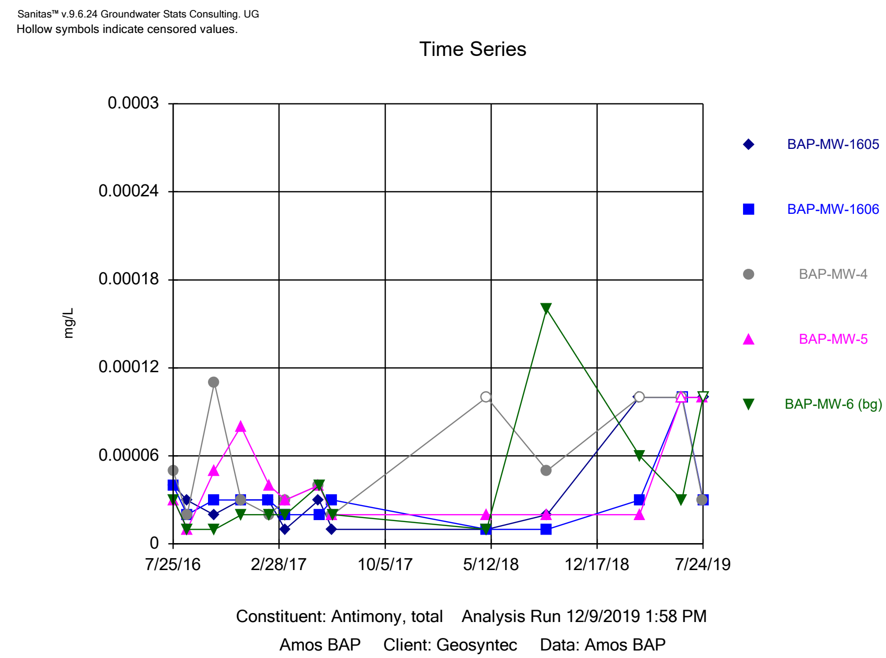
Andrew T. Collins
Groundwater Analyst

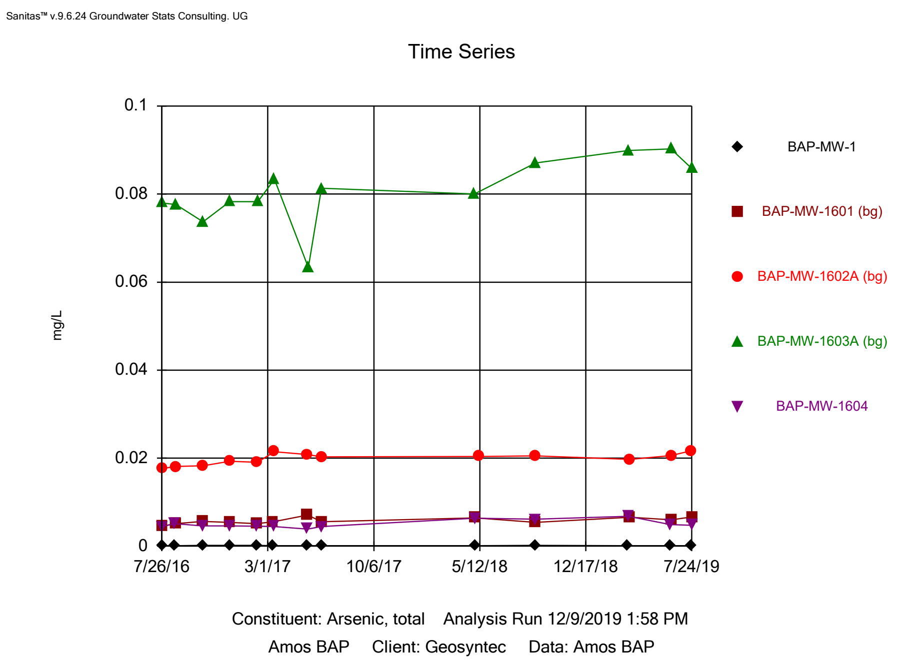
Kristina Rayner

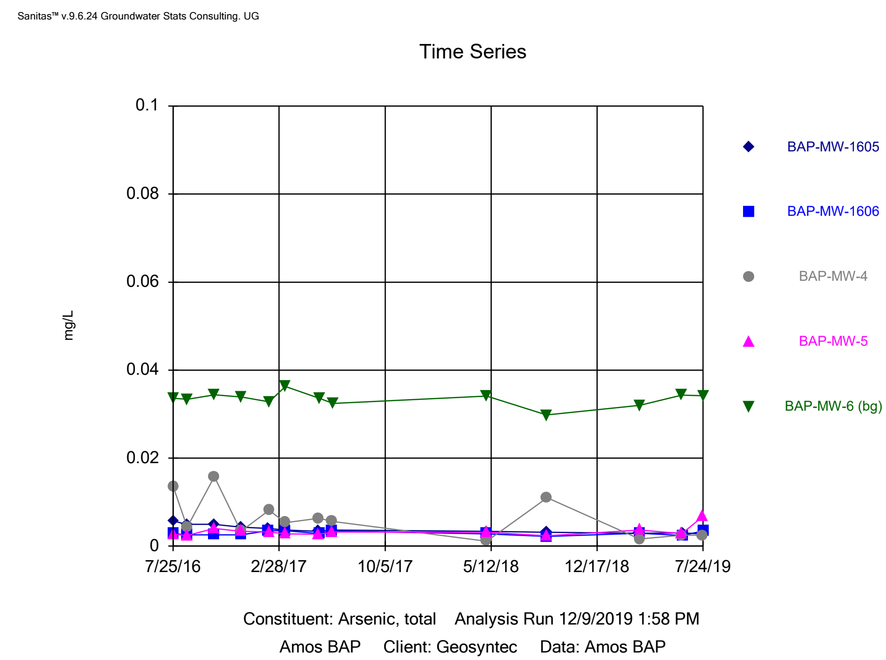
Kristina L. Rayner
Groundwater Statistician

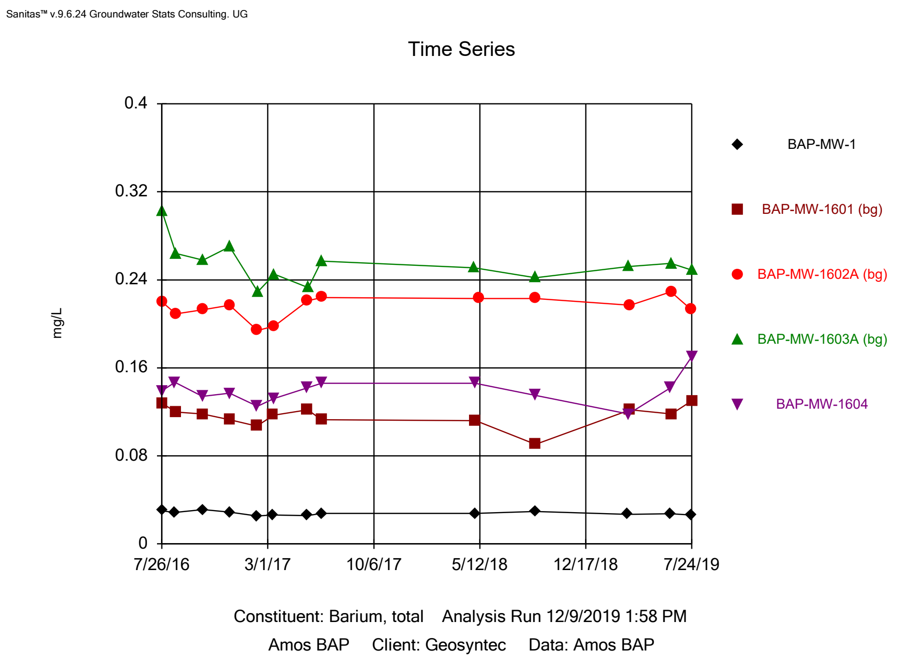
FIGURE A: TIME SERIES

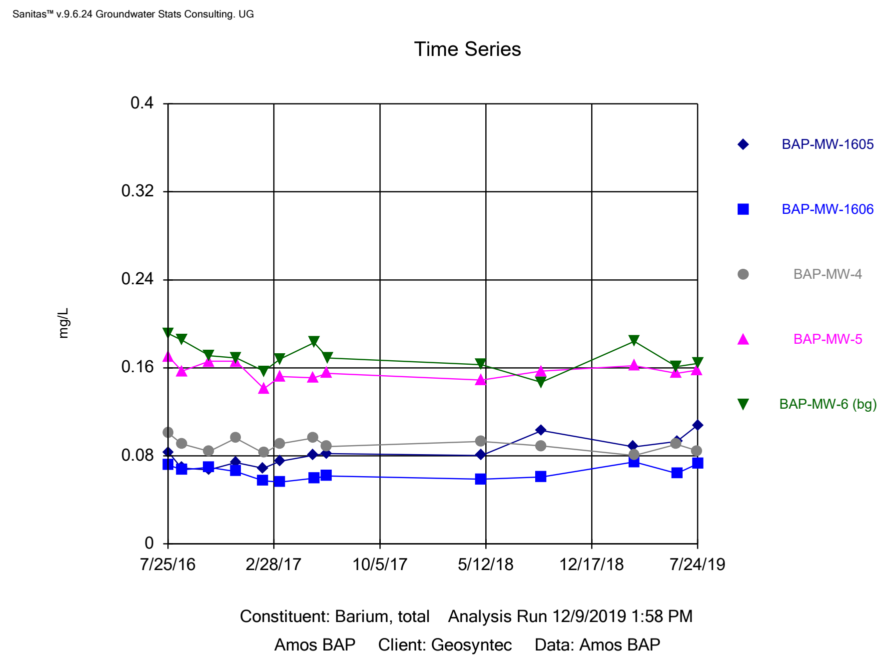

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0003
0.00024
0.00018
0.00012
0.00006
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Antimony, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP

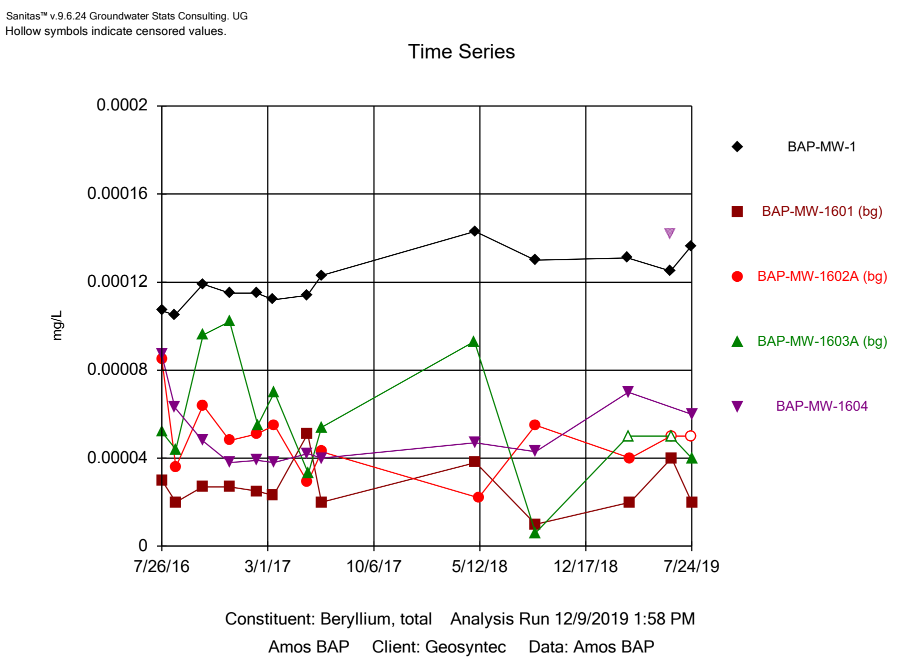

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0003
0.00024
0.00018
0.00012
0.00006
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Antimony, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP

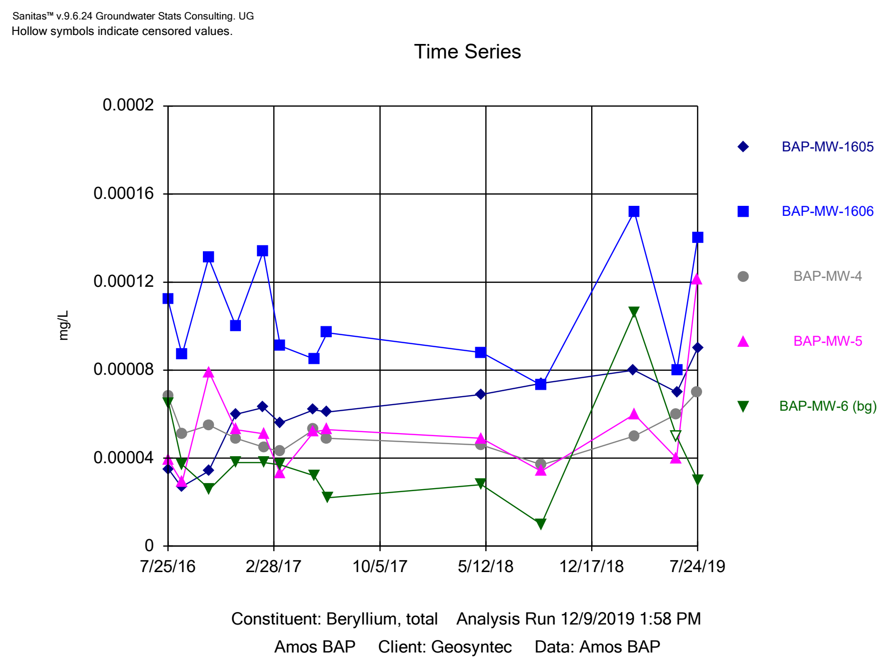

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.1
0.08
0.06
0.04
0.02
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Arsenic, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP

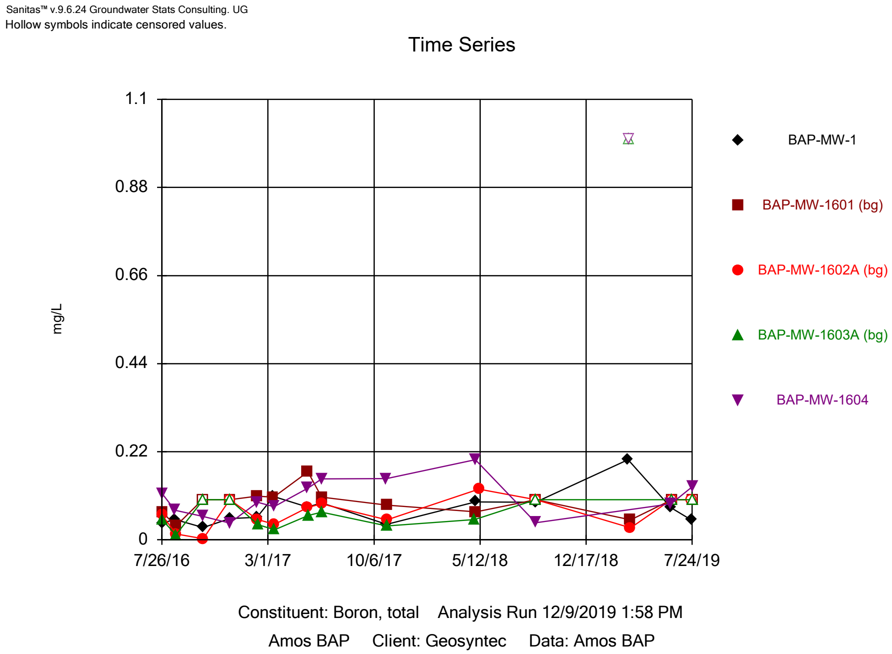

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.1
0.08
0.06
0.04
0.02
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Arsenic, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.4
0.32
0.24
0.16
0.08
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Barium, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP

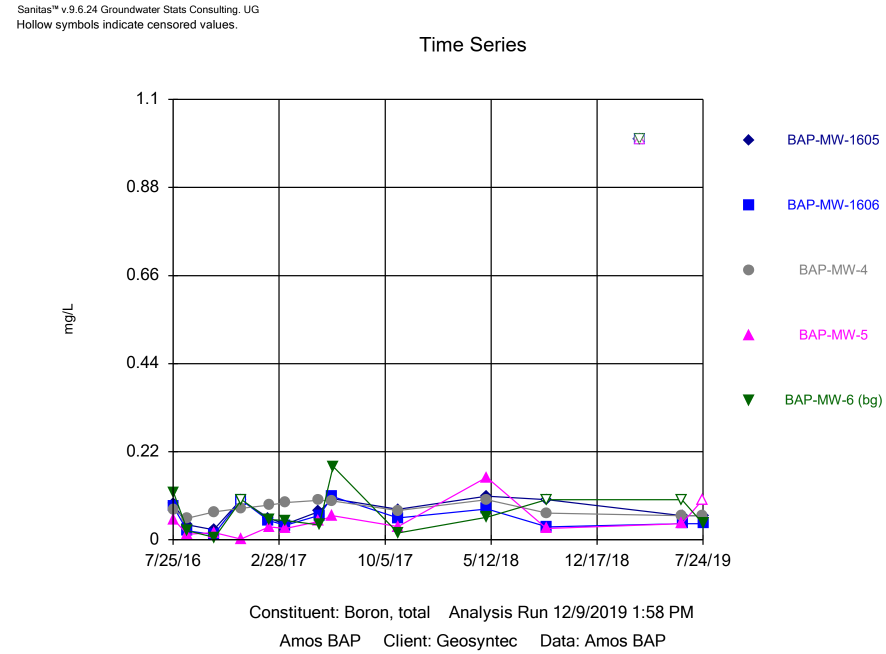

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.4
0.32
0.24
0.16
0.08
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Barium, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0002
0.00016
0.00012
0.00008
0.00004
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Beryllium, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP

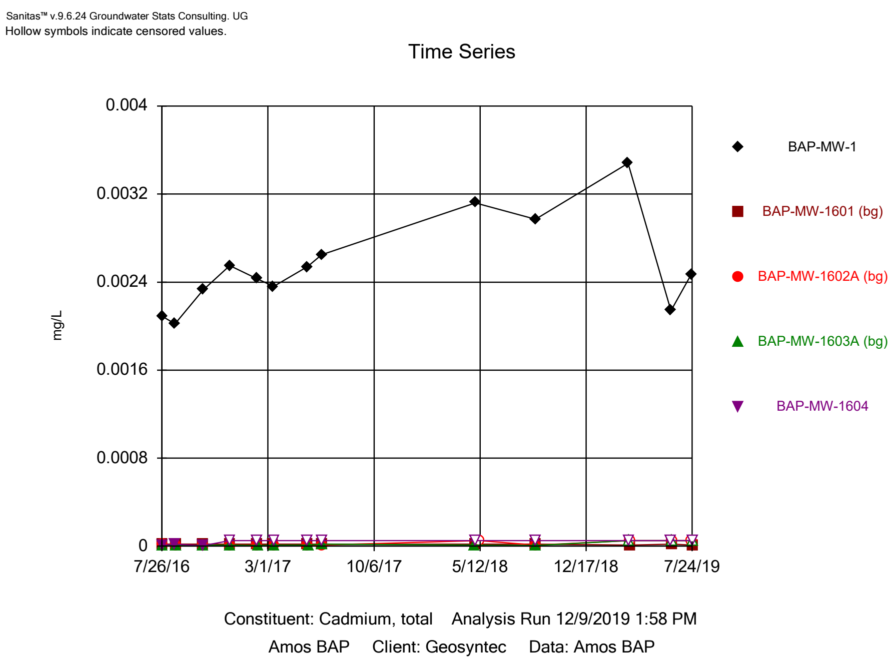

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0002
0.00016
0.00012
0.00008
0.00004
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Beryllium, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP



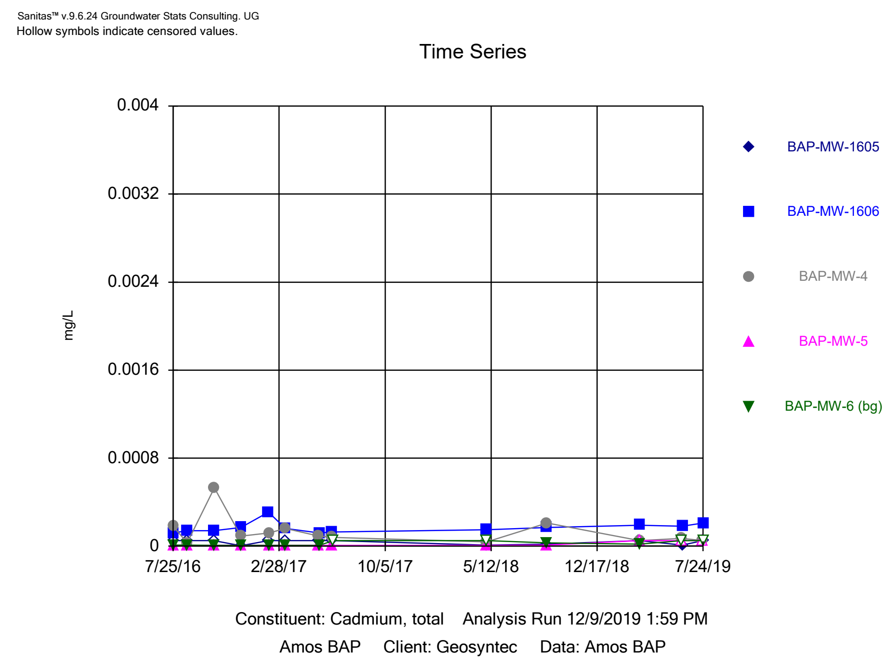
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
1.1
0.88
0.66
0.44
0.22
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Boron, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP



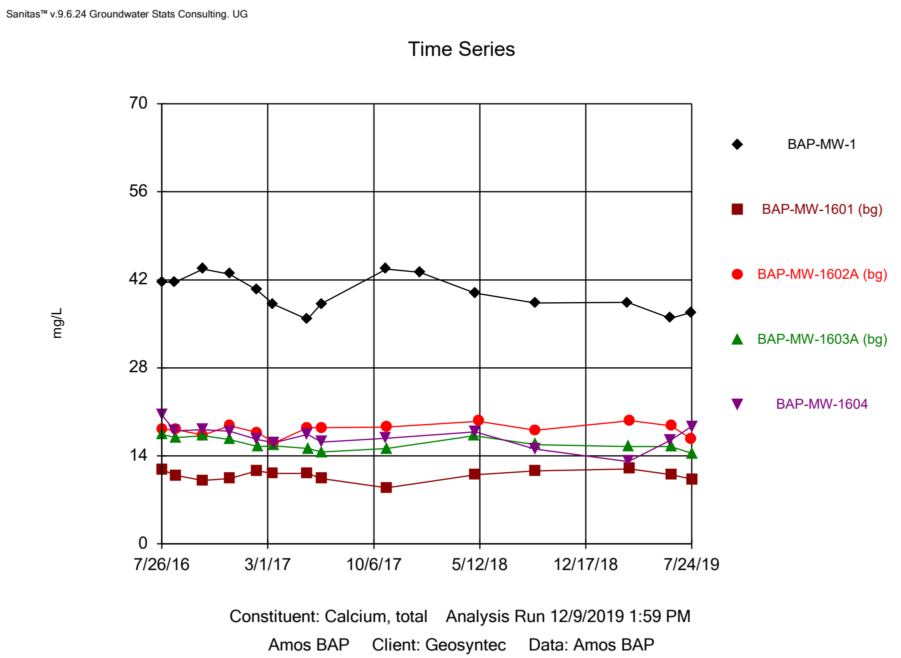
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
1.1
0.88
0.66
0.44
0.22
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Boron, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP



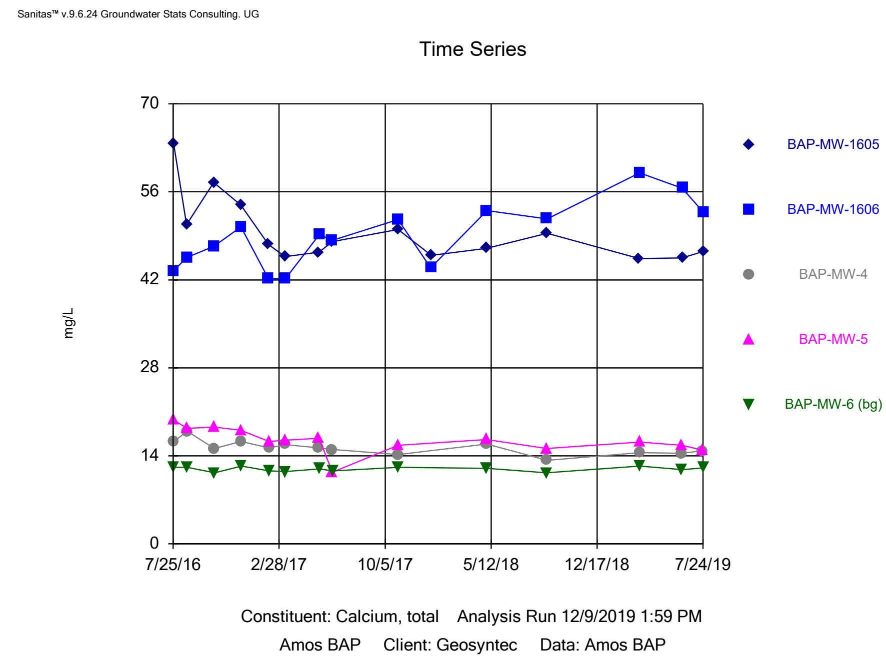
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.004
0.0032
0.0024
0.0016
0.0008
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Cadmium, total Analysis Run 12/9/2019 1:58 PM
Amos BAP Client: Geosyntec Data: Amos BAP



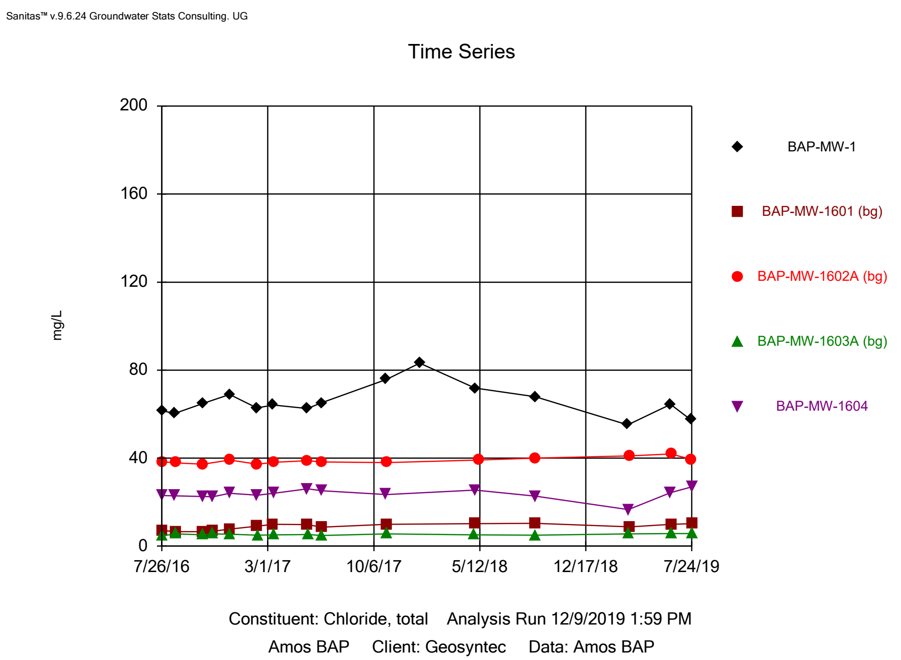
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.004
0.0032
0.0024
0.0016
0.0008
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Cadmium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



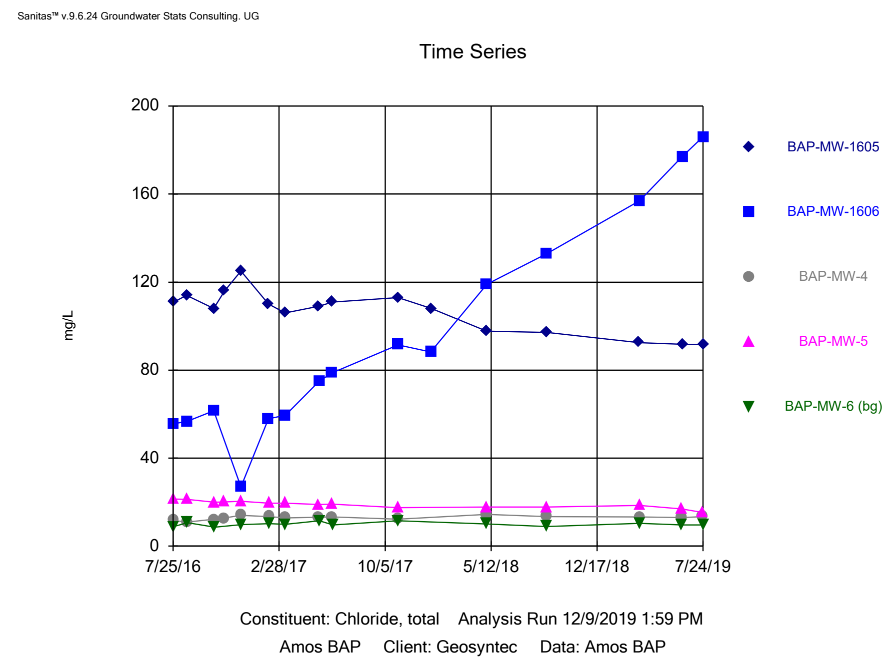
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
mg/L
70
56
42
28
14
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Calcium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



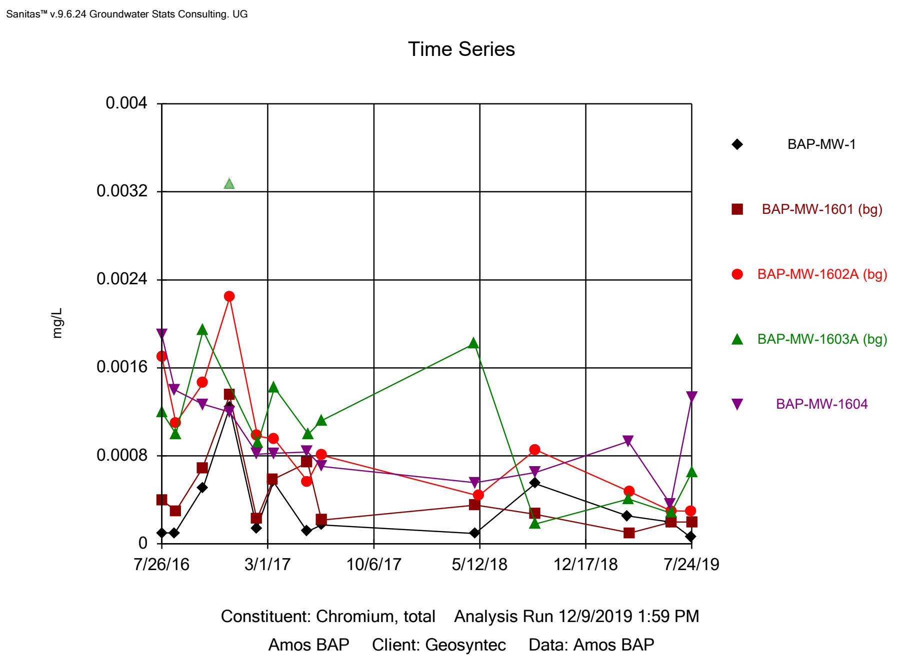
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
mg/L
70
56
42
28
14
0
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Calcium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



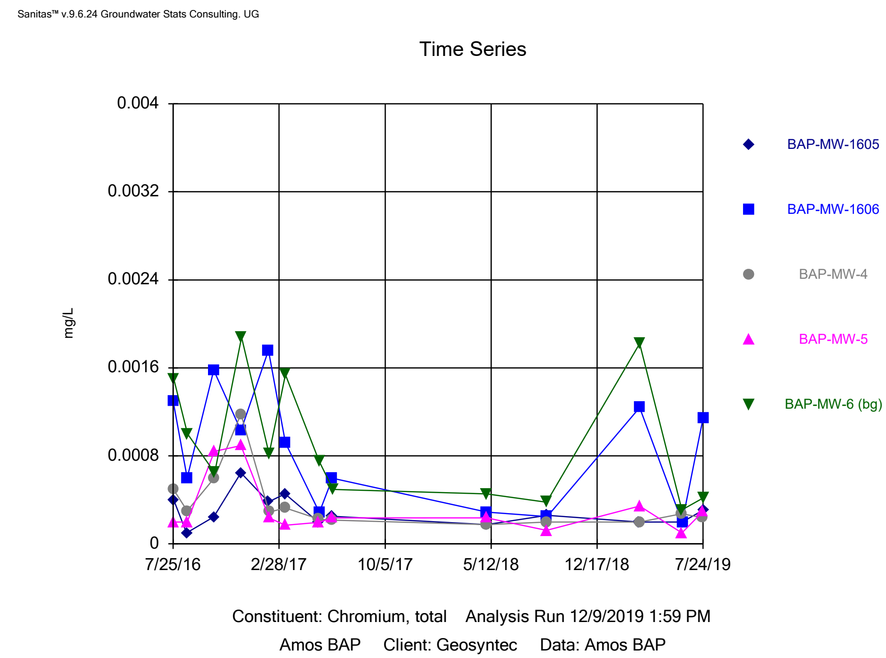
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Chloride, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



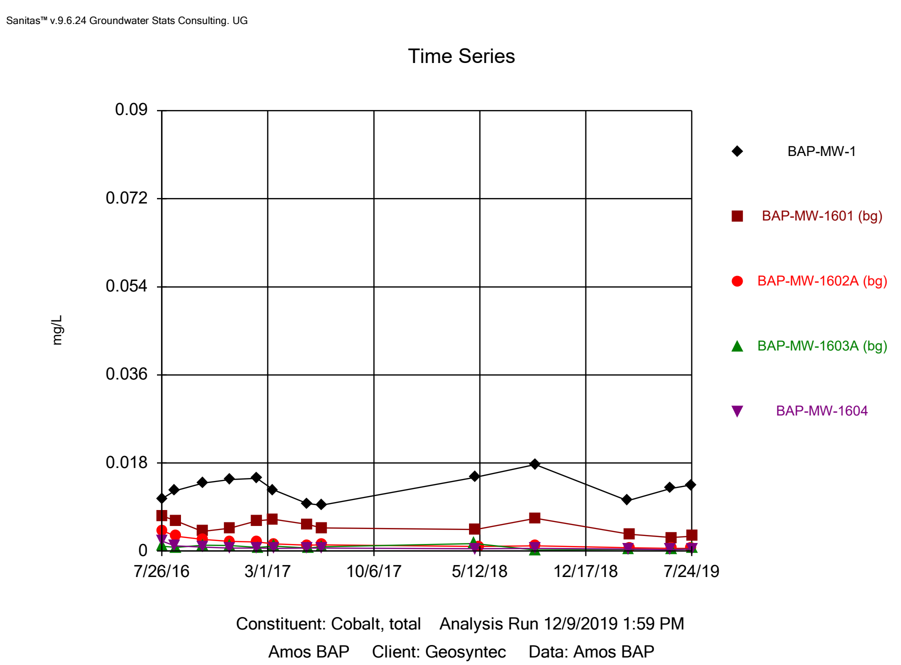
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Chloride, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



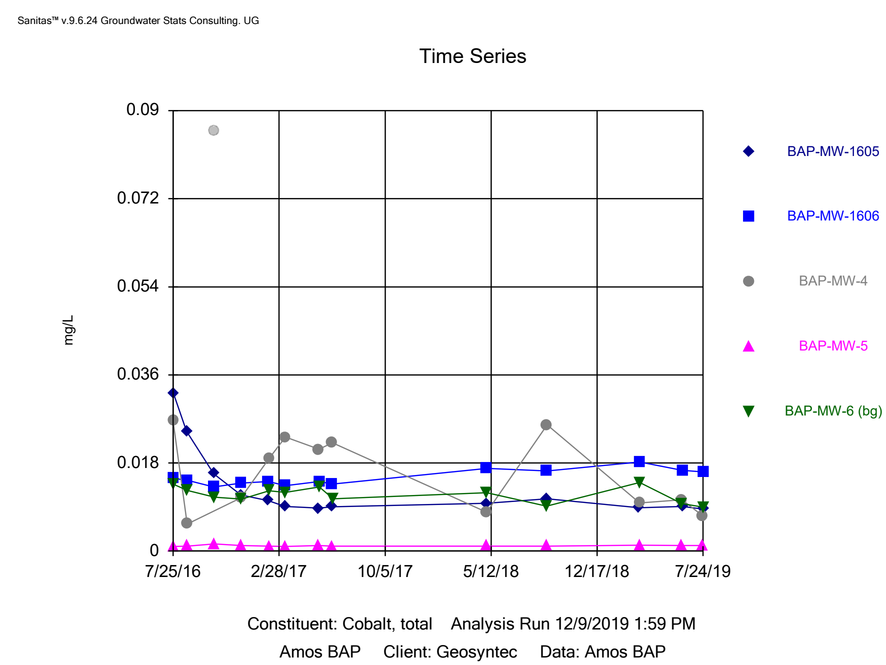
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.004
0.0032
0.0024
0.0016
0.0008
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Chromium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



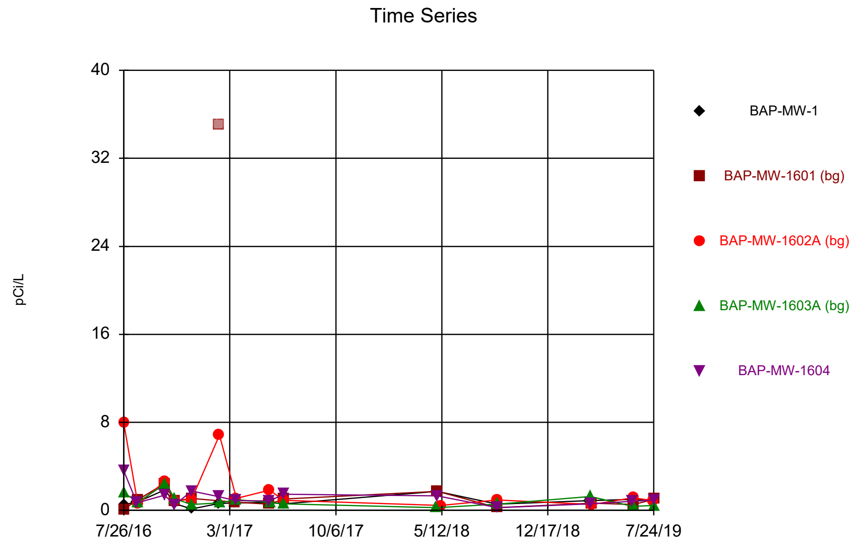
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.004
0.0032
0.0024
0.0016
0.0008
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Chromium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Cobalt, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

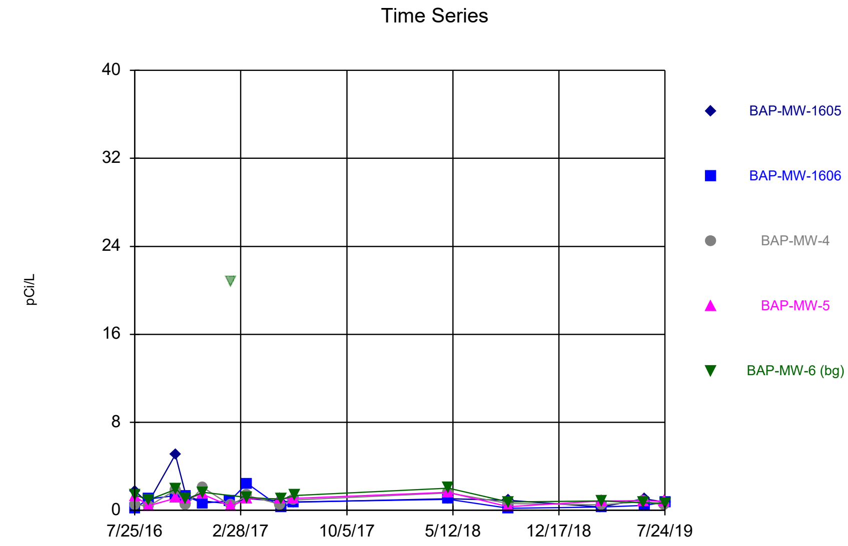


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Cobalt, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



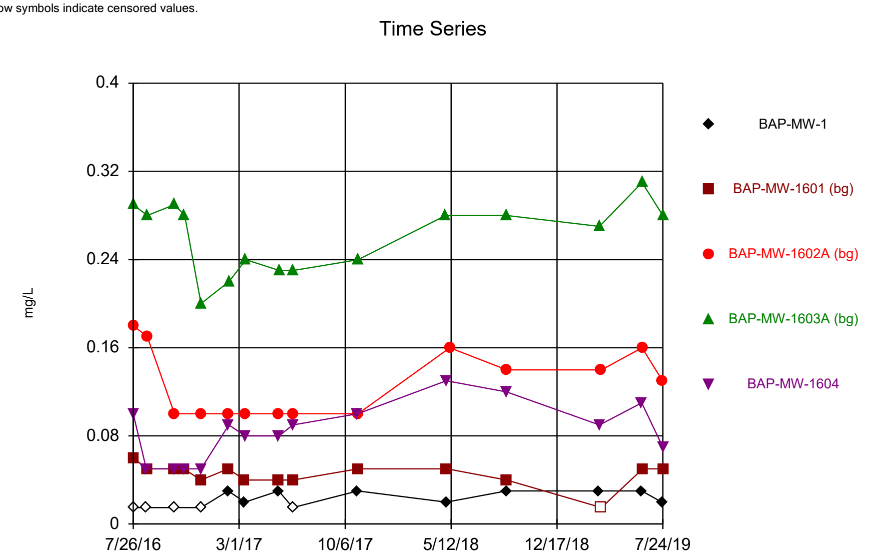
Constituent: Combined Radium 226 + 228 Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



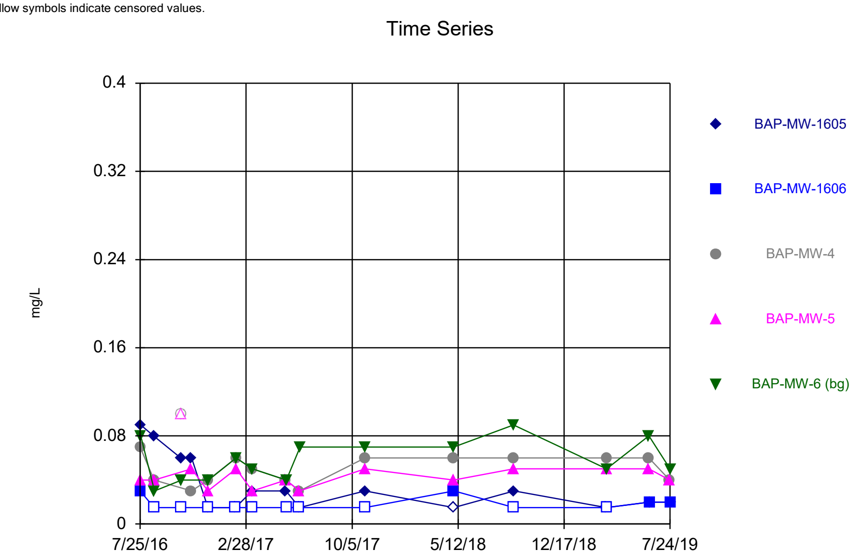
Constituent: Combined Radium 226 + 228 Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

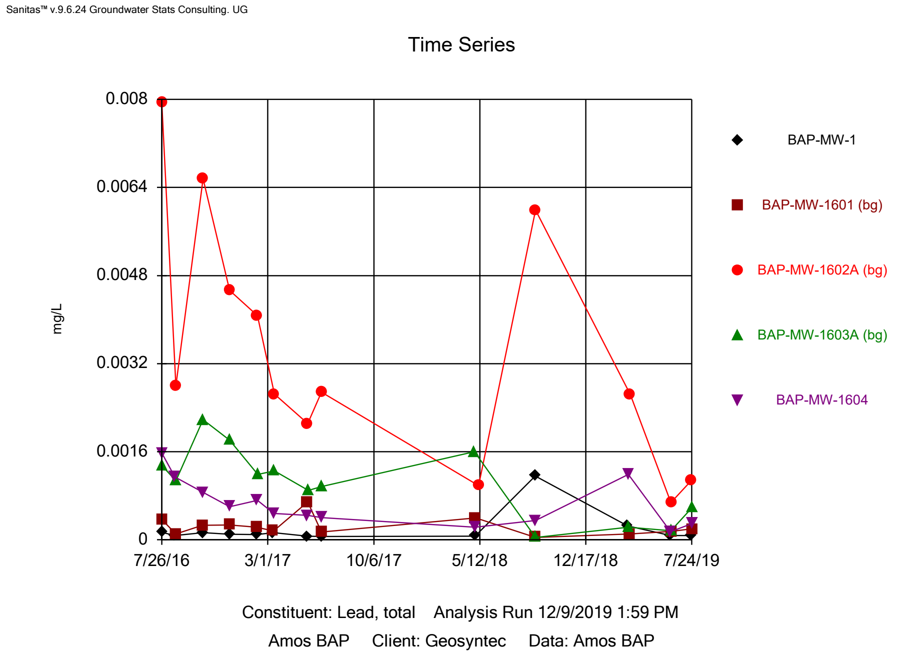


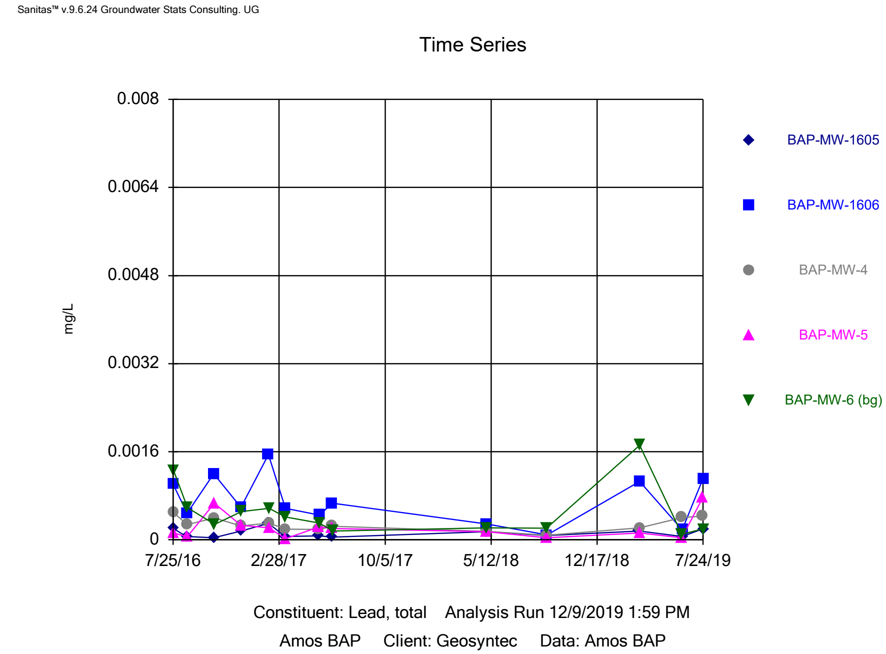
Constituent: Fluoride, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

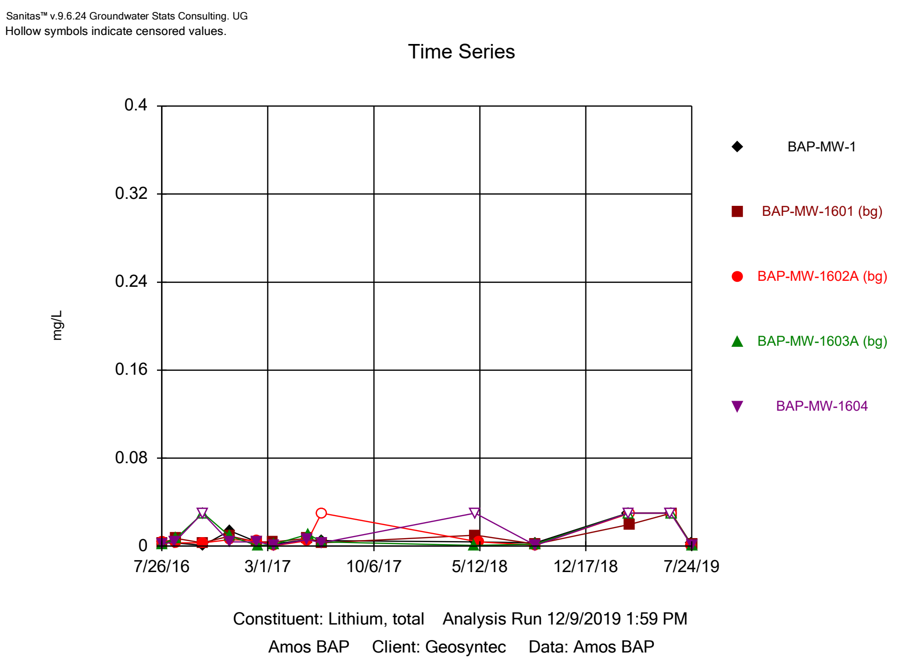
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

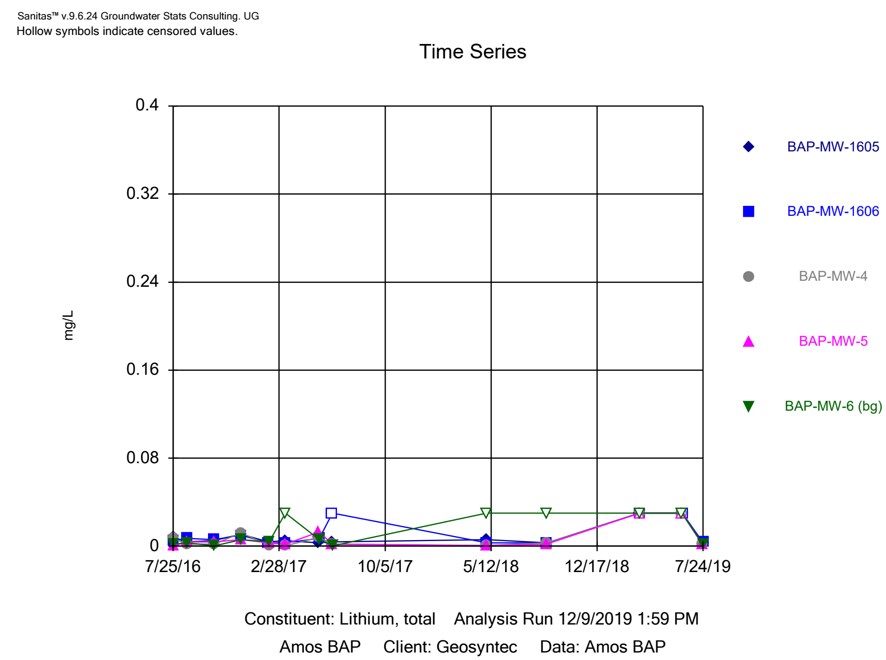


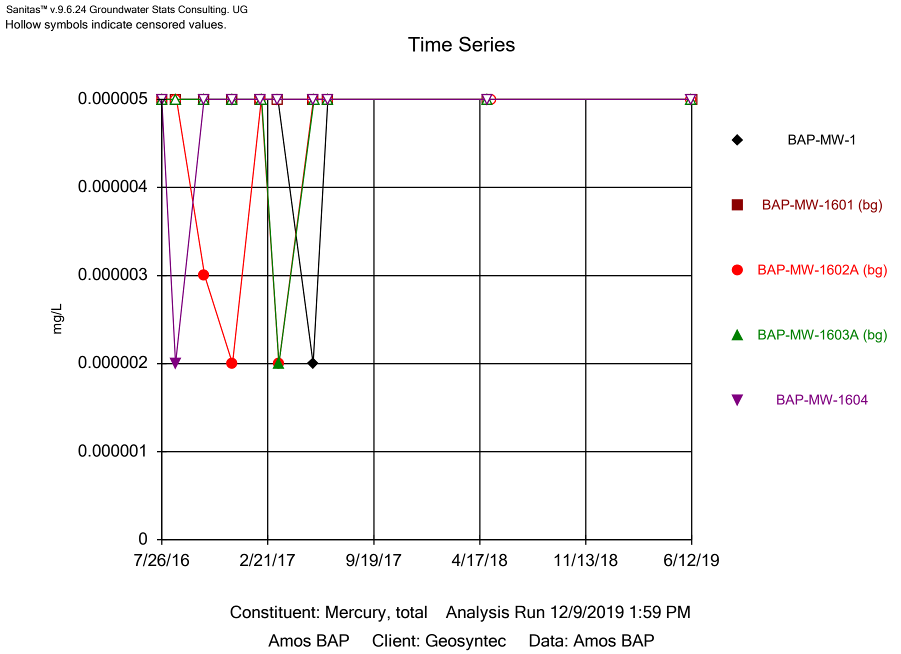
Constituent: Fluoride, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.008
0.0064
0.0048
0.0032
0.0016
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Lead, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

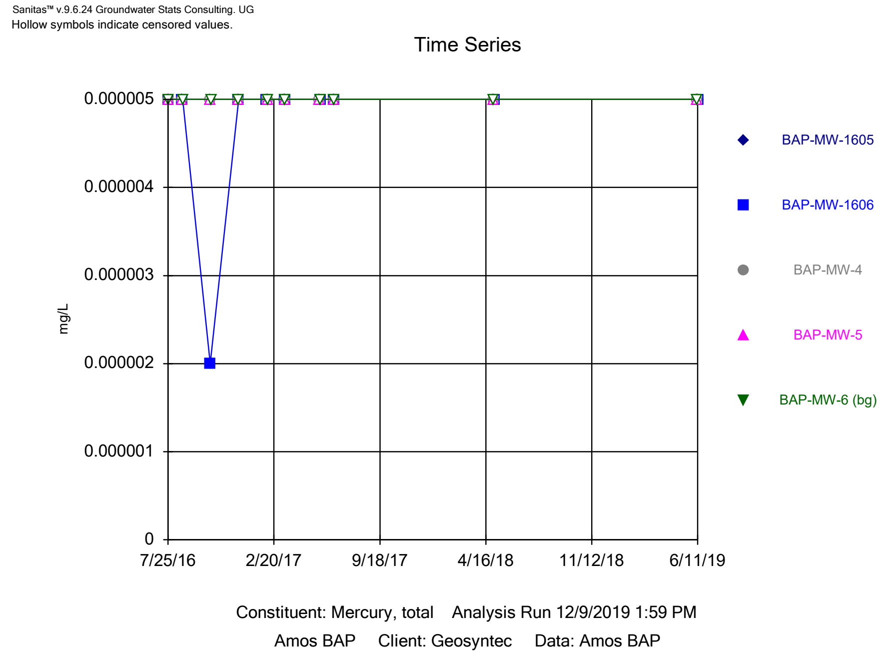

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
0.008
0.0064
0.0048
0.0032
0.0016
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Lead, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.4
0.32
0.24
0.16
0.08
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Lithium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

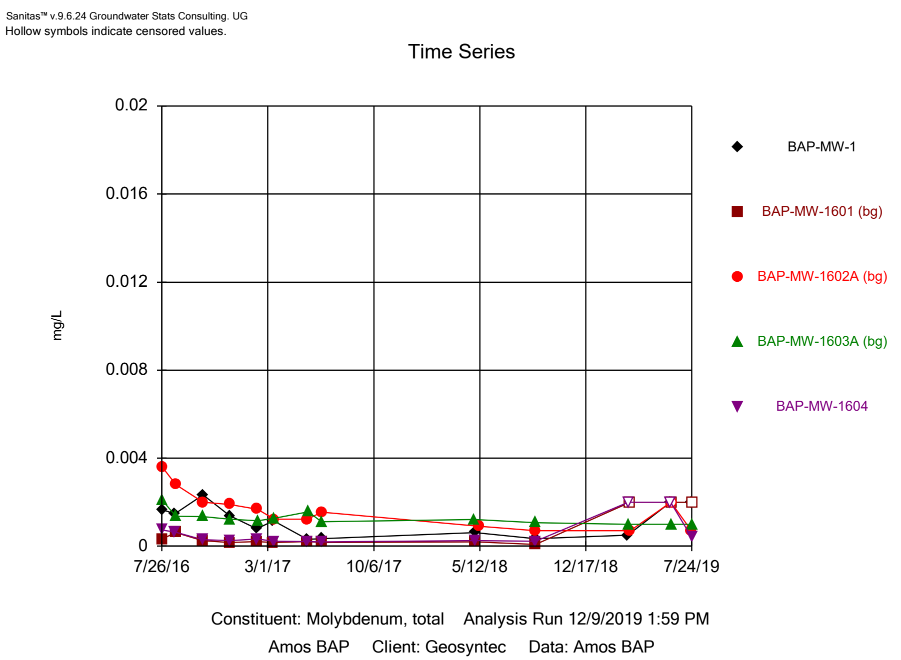

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.4
0.32
0.24
0.16
0.08
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Lithium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



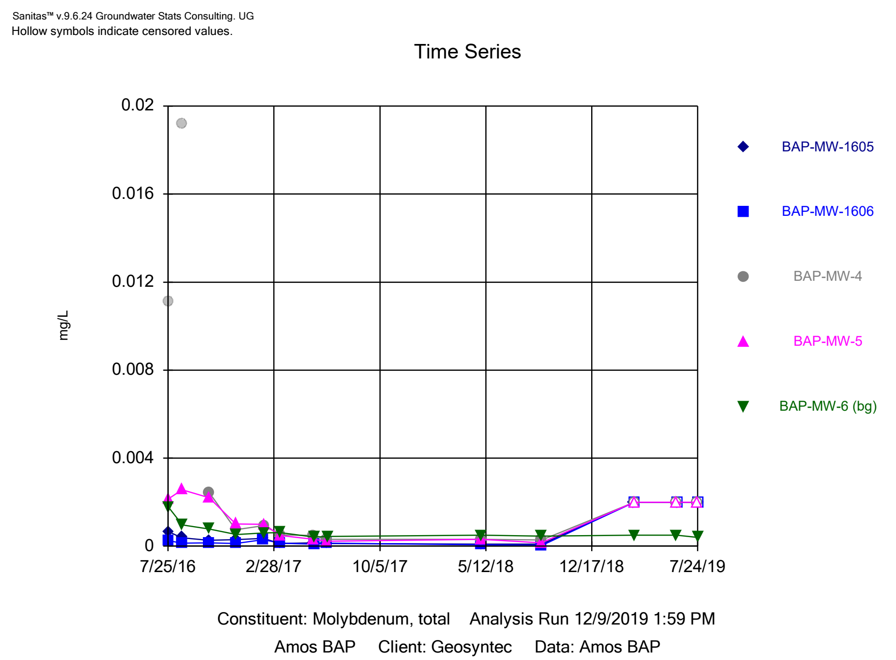
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.000005
0.000004
0.000003
0.000002
0.000001
0
mg/L
7/26/16
2/21/17
9/19/17
4/17/18
11/13/18
6/12/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Mercury, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



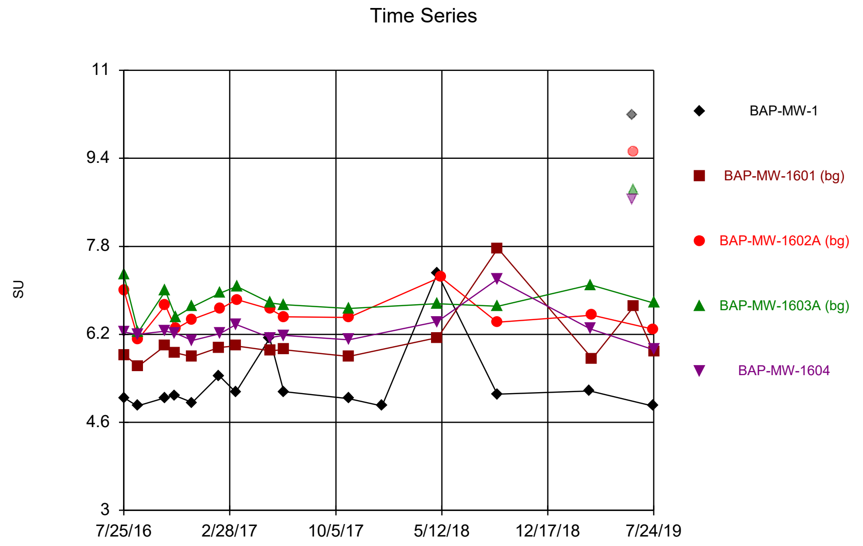
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.000005
0.000004
0.000003
0.000002
0.000001
0
mg/L
7/25/16
2/20/17
9/18/17
4/16/18
11/12/18
6/11/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Mercury, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.02
0.016
0.012
0.008
0.004
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Molybdenum, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



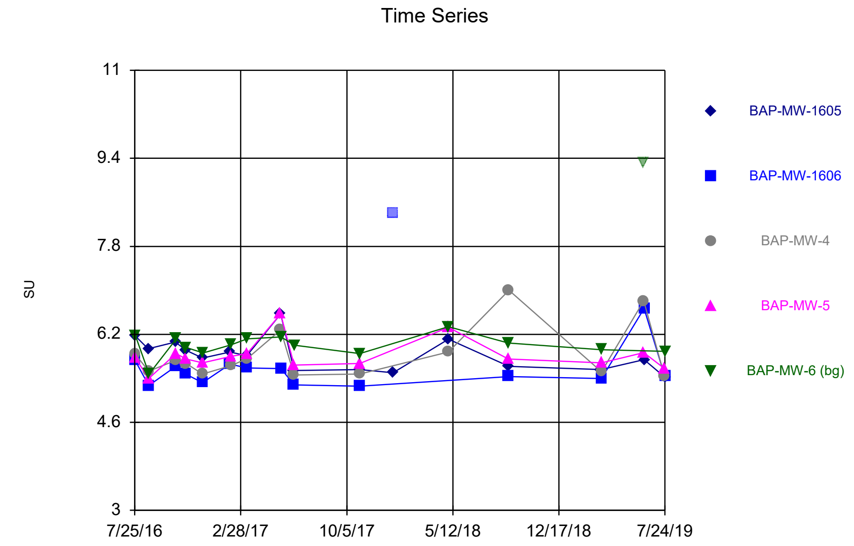
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.02
0.016
0.012
0.008
0.004
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Molybdenum, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: pH, field Analysis Run 12/9/2019 1:59 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

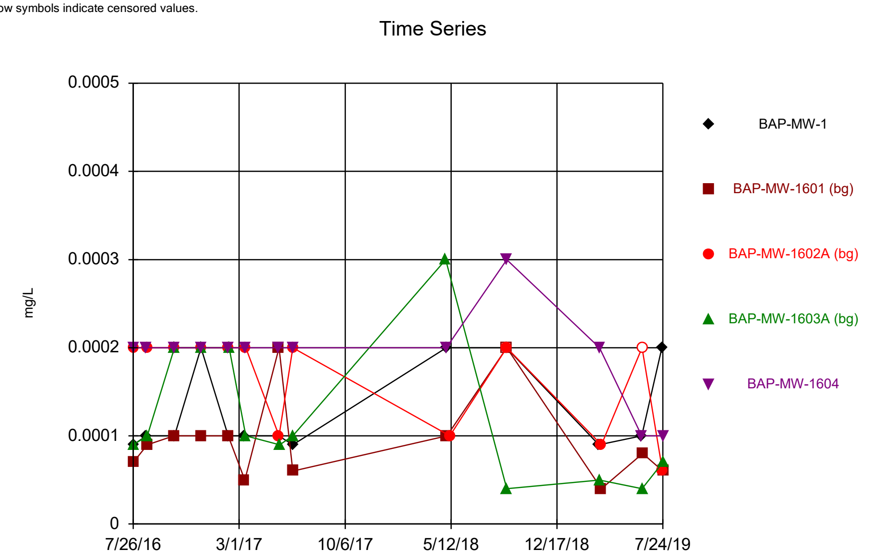


Constituent: pH, field Analysis Run 12/9/2019 1:59 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

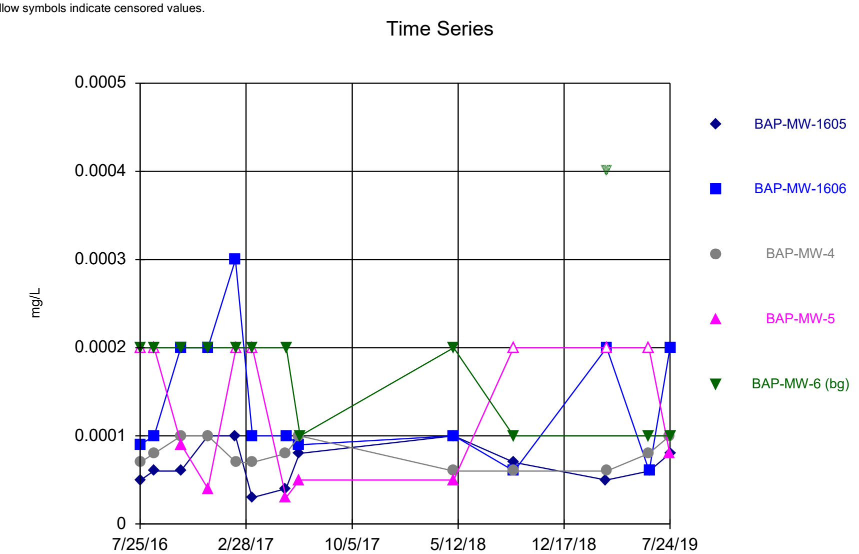


Constituent: Selenium, total Analysis Run 12/9/2019 1:59 PM

Amos BAP Client: Geosyntec Data: Amos BAP

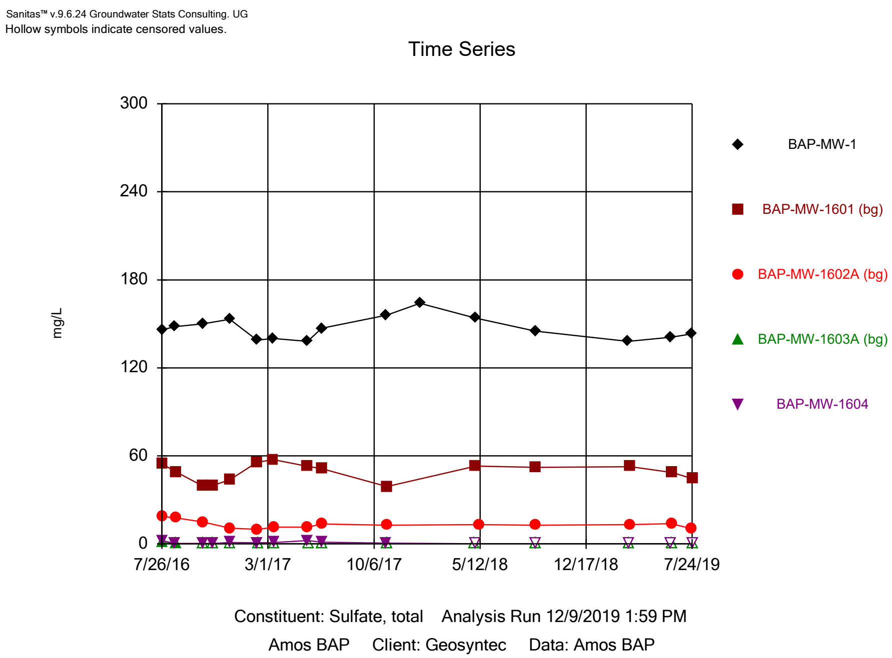
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

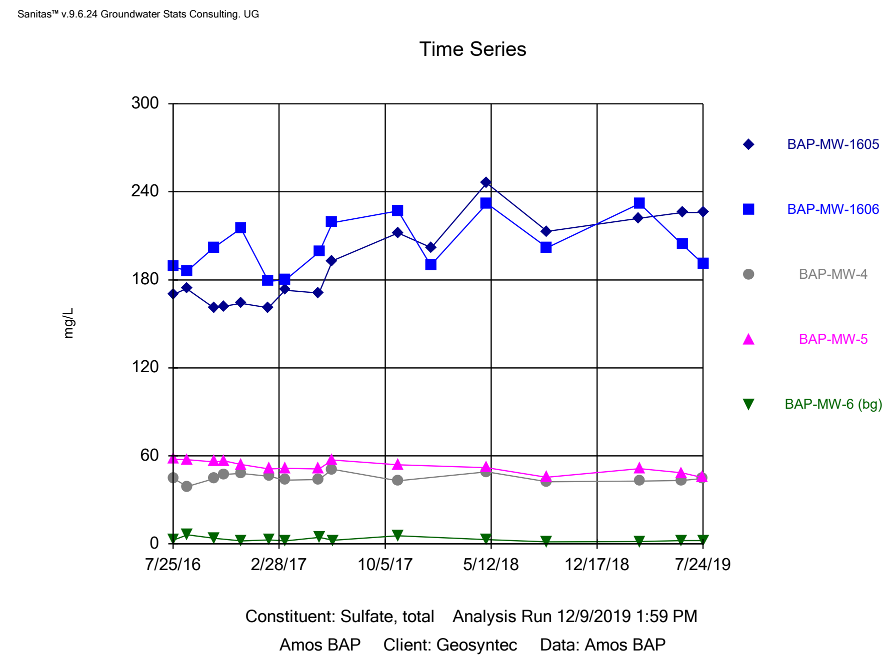
Hollow symbols indicate censored values.

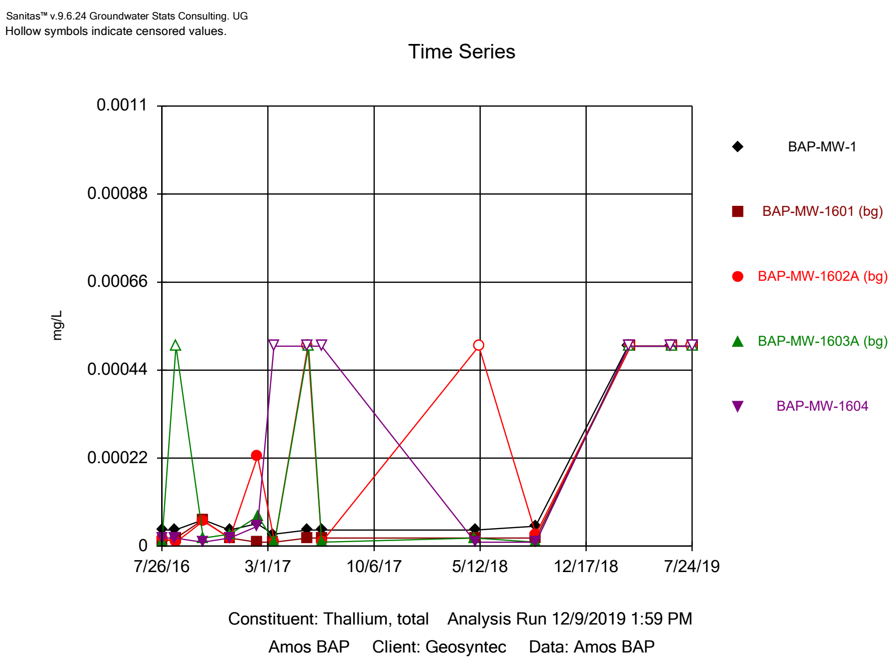


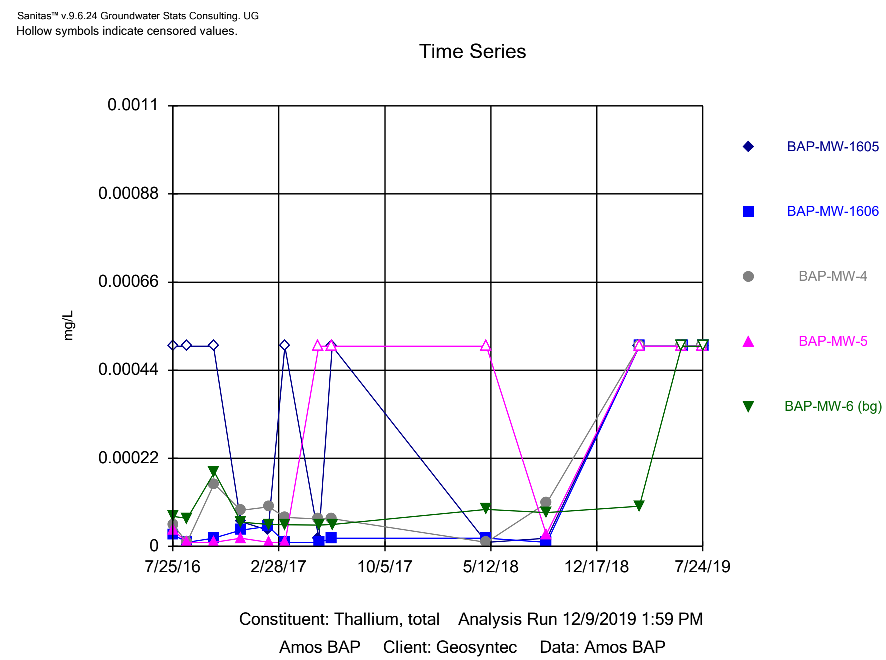
Constituent: Selenium, total Analysis Run 12/9/2019 1:59 PM

Amos BAP Client: Geosyntec Data: Amos BAP

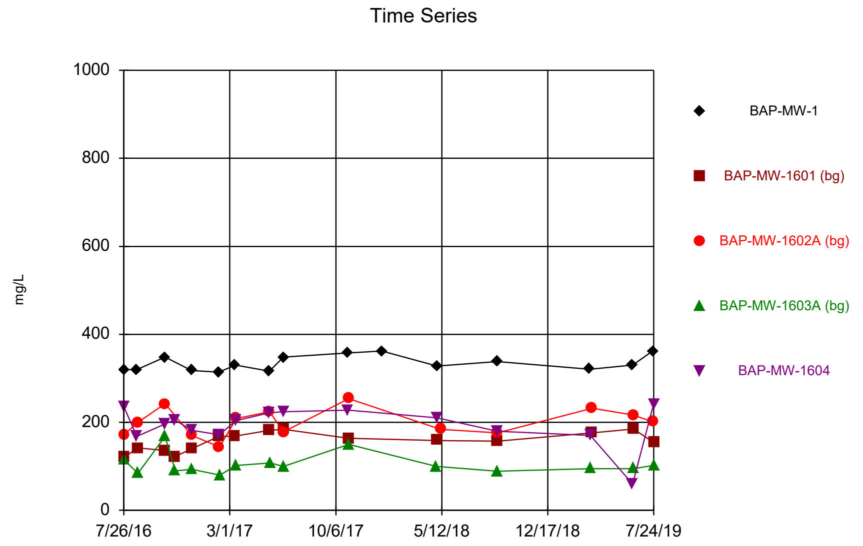

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
300
240
180
120
60
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Sulfate, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Time Series
300
240
180
120
60
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Sulfate, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0011
0.00088
0.00066
0.00044
0.00022
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Thallium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

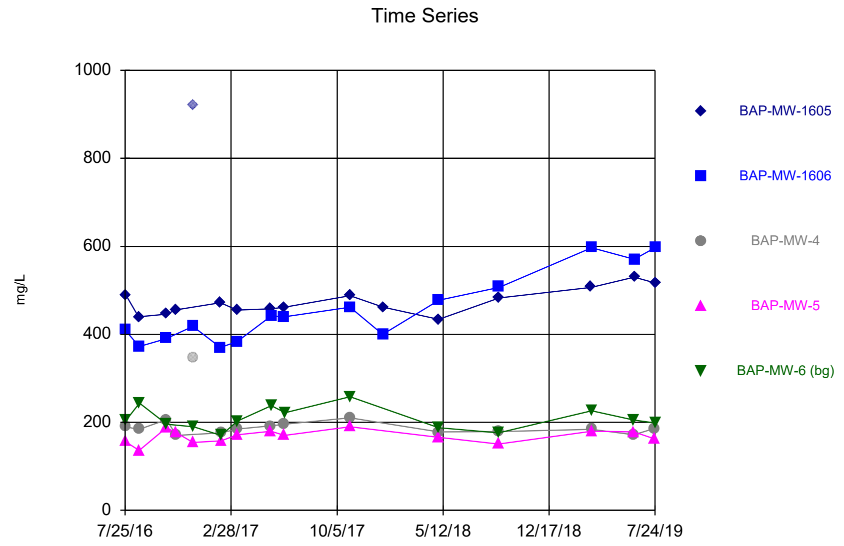

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
0.0011
0.00088
0.00066
0.00044
0.00022
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Thallium, total Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

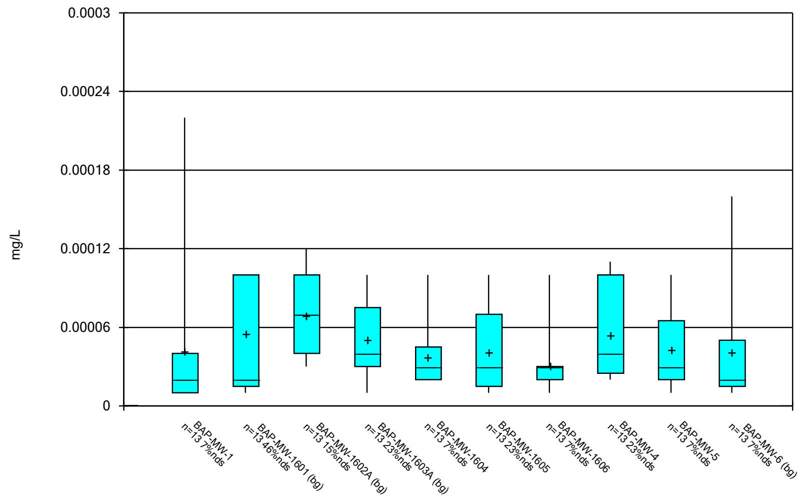


Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 1:59 PM
Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE B: BOX PLOTS

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

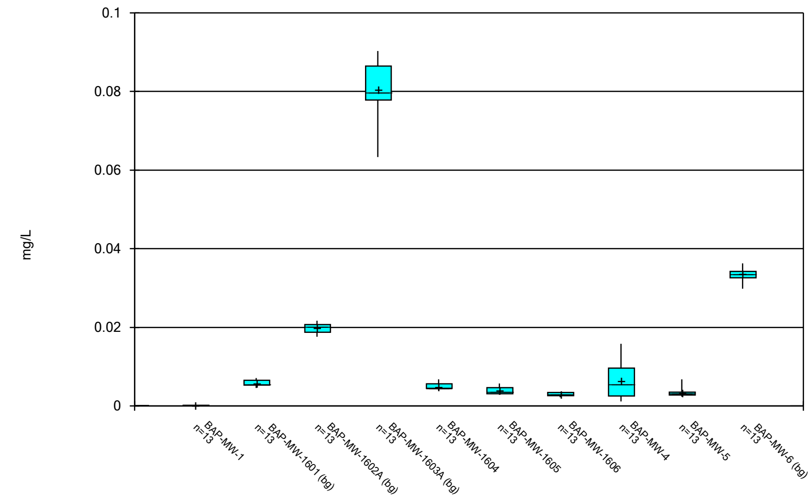


Constituent: Antimony, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

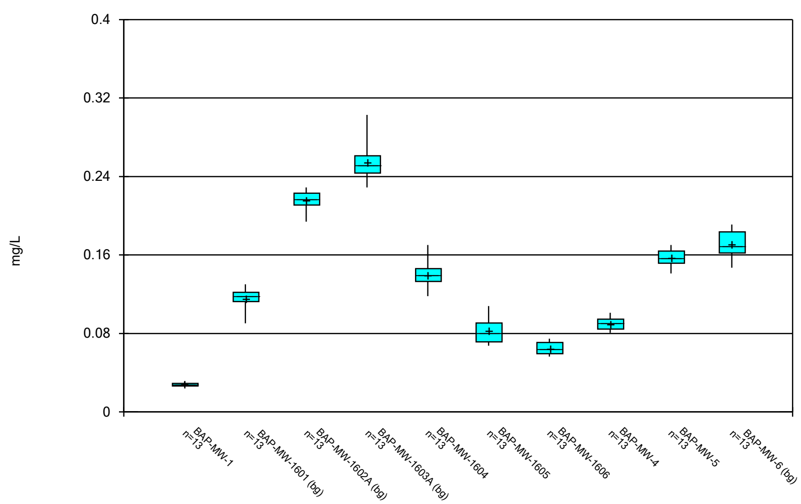


Constituent: Arsenic, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

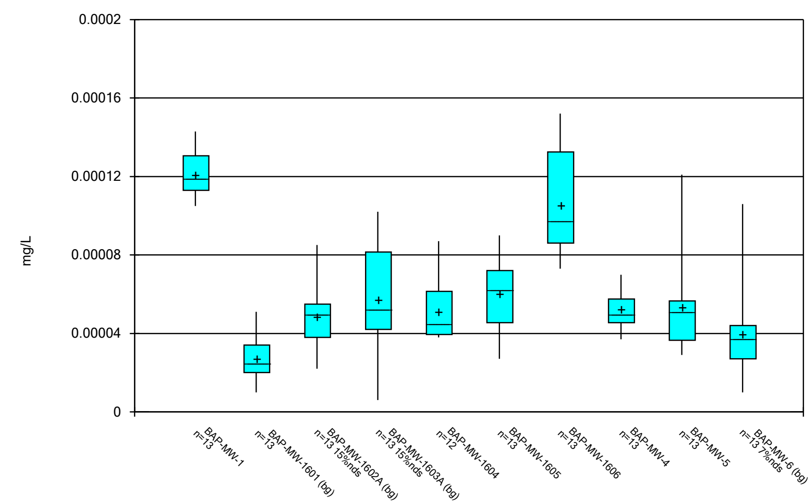


Constituent: Barium, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

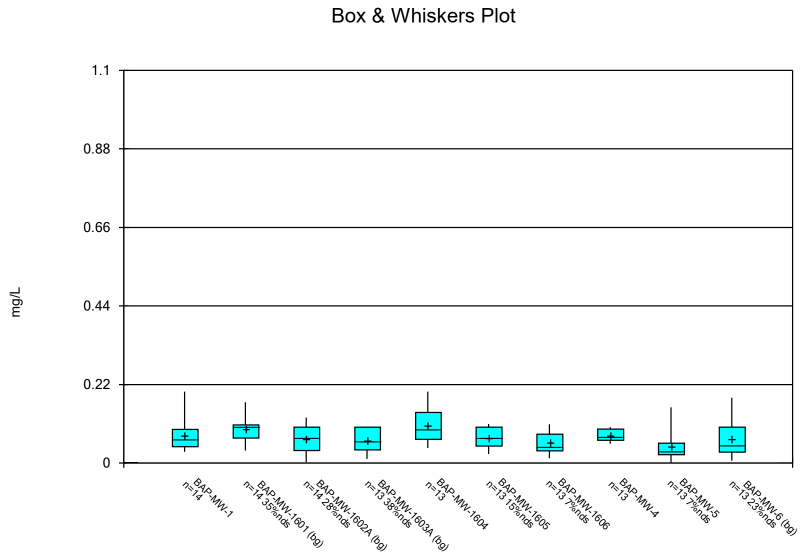
Box & Whiskers Plot



Constituent: Beryllium, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

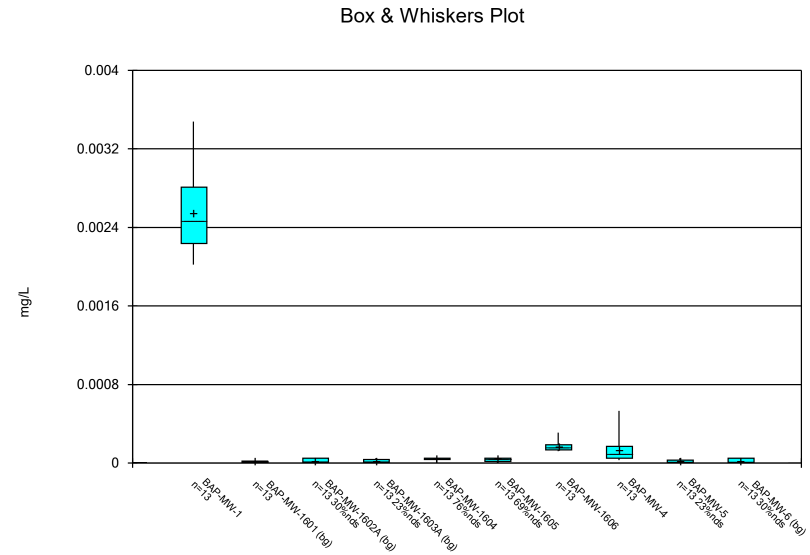
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Boron, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

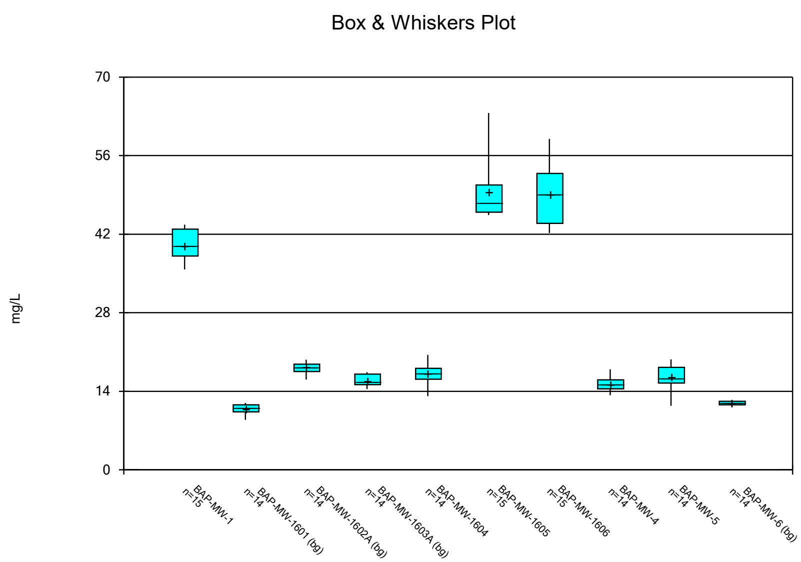
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Cadmium, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

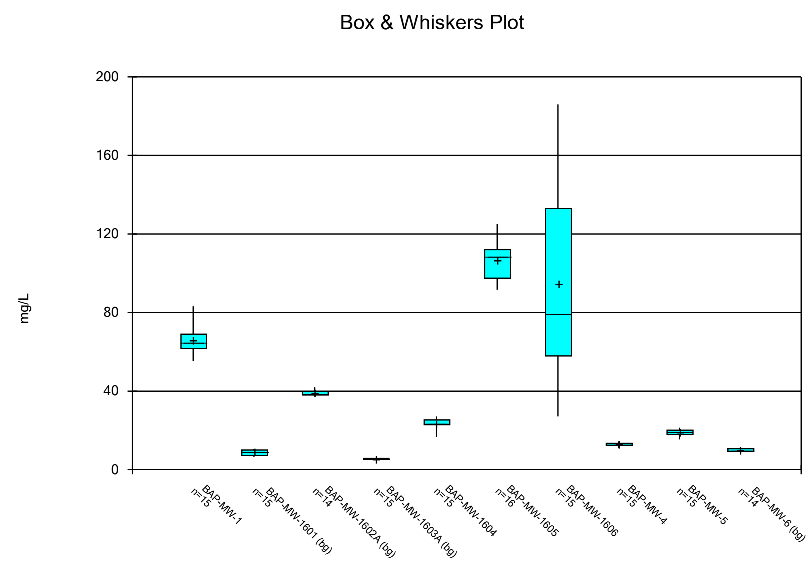
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Calcium, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

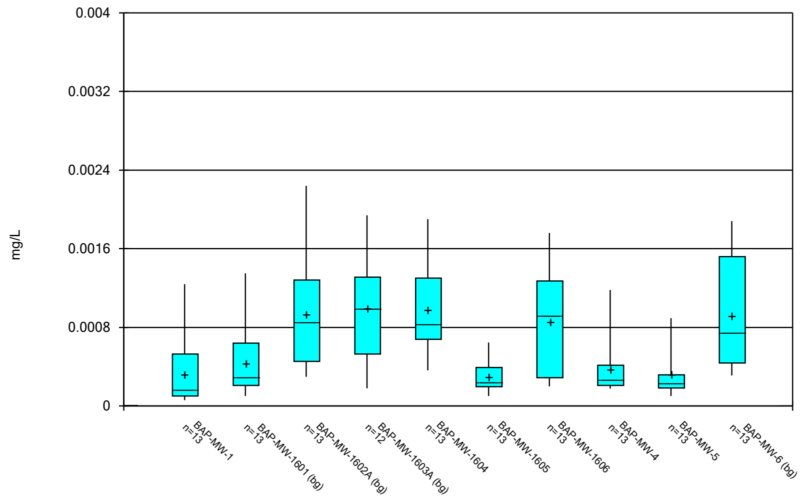


Constituent: Chloride, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

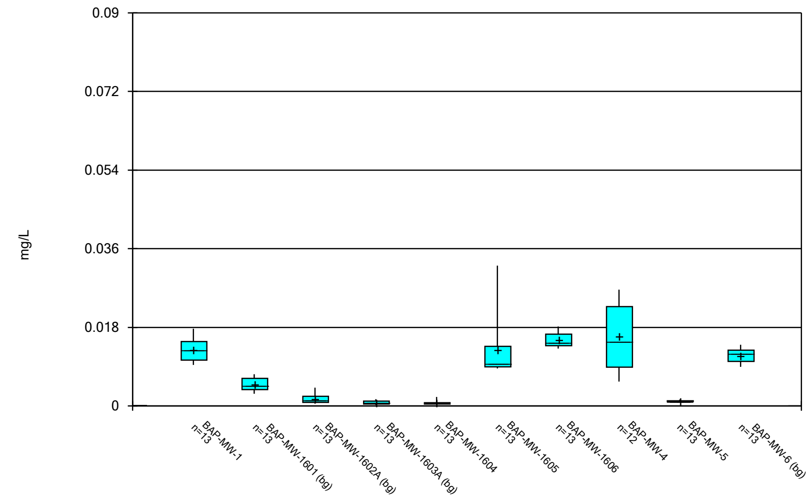


Constituent: Chromium, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

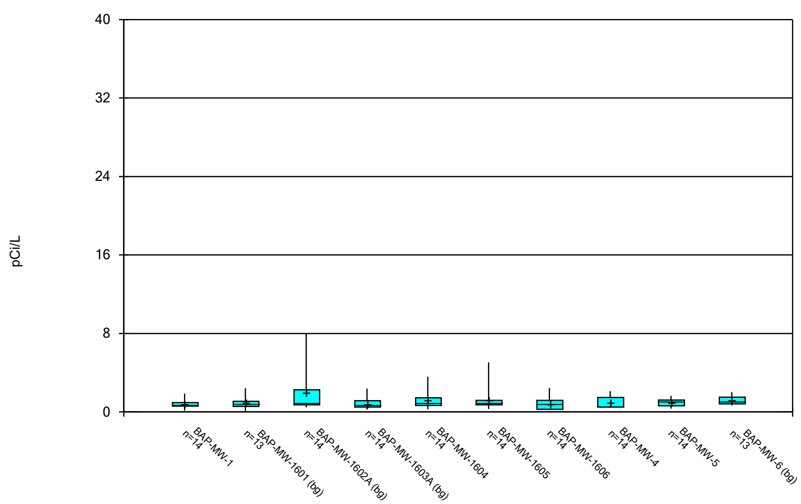


Constituent: Cobalt, total Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

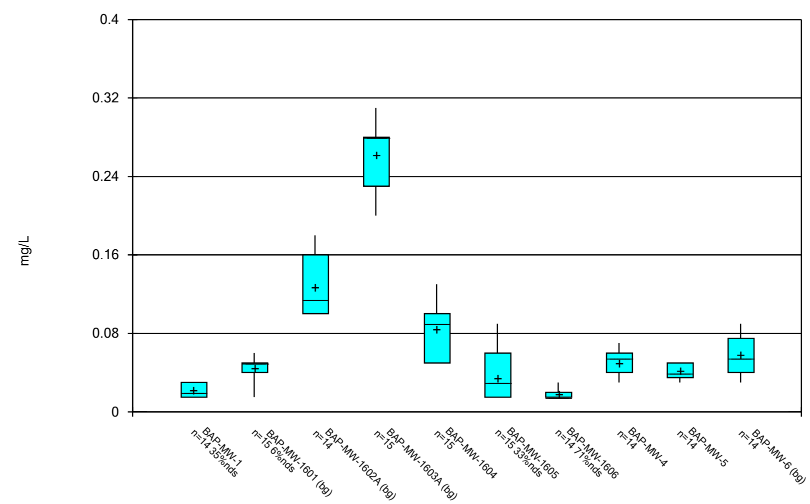


Constituent: Combined Radium 226 + 228 Analysis Run 12/9/2019 2:00 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

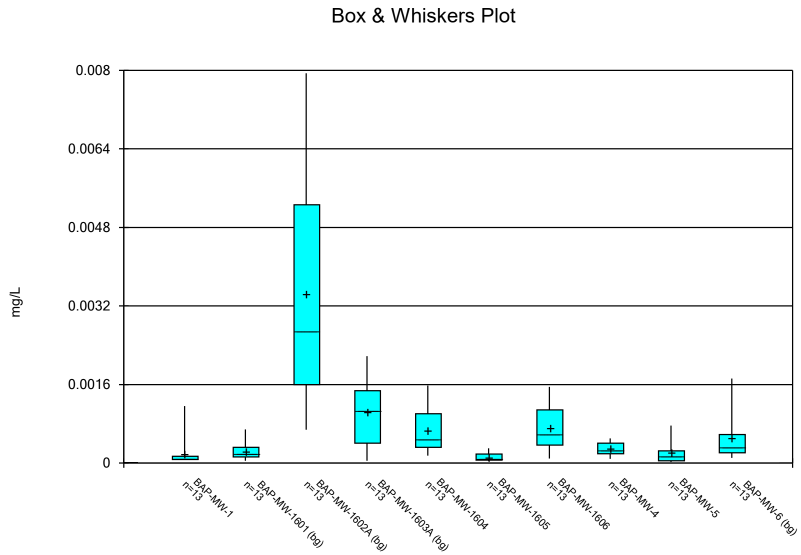
Box & Whiskers Plot



Constituent: Fluoride, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

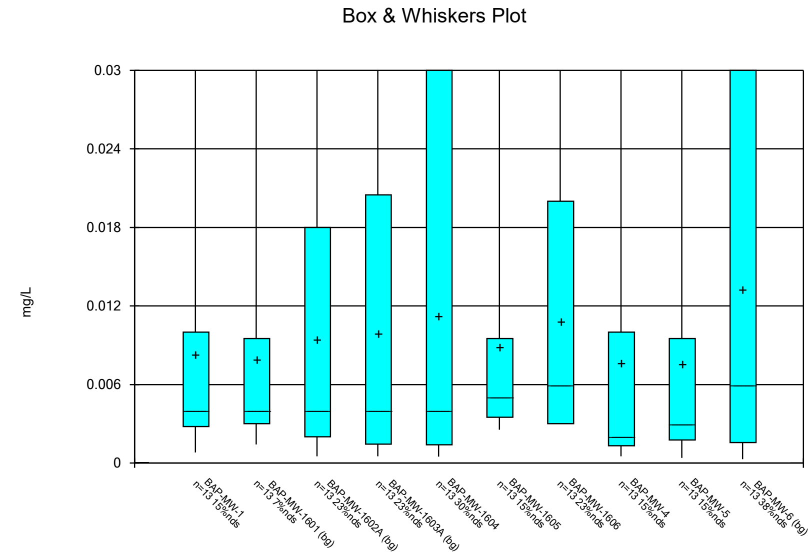
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Lead, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

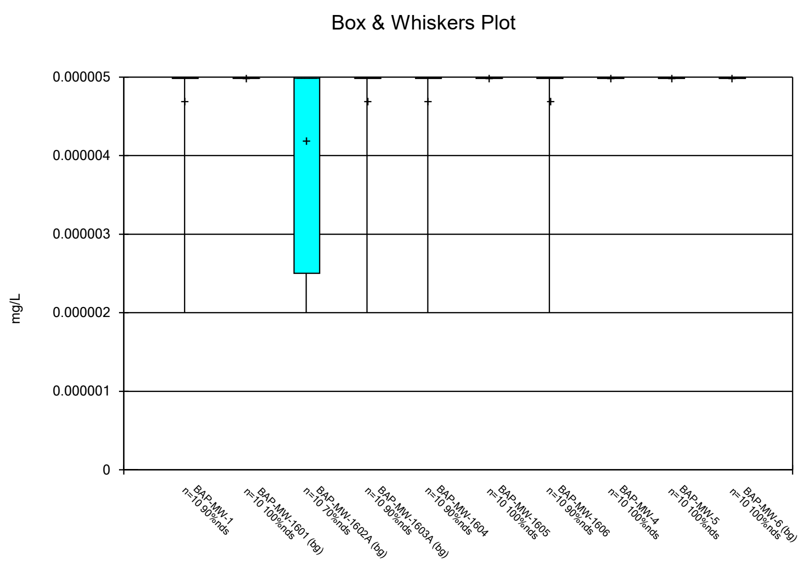
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Lithium, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

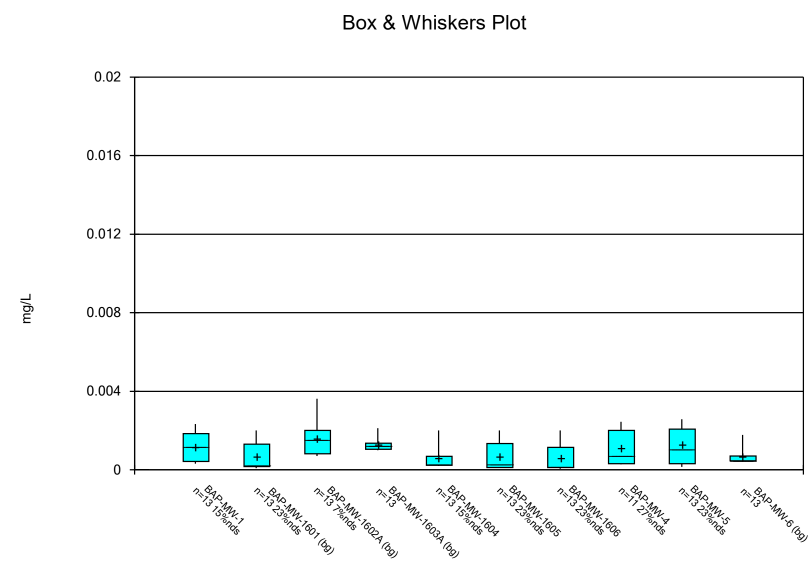
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Mercury, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

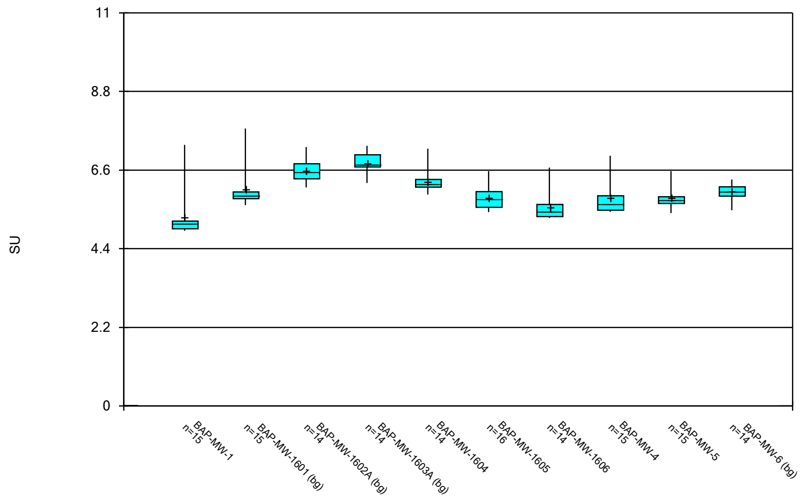


Constituent: Molybdenum, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

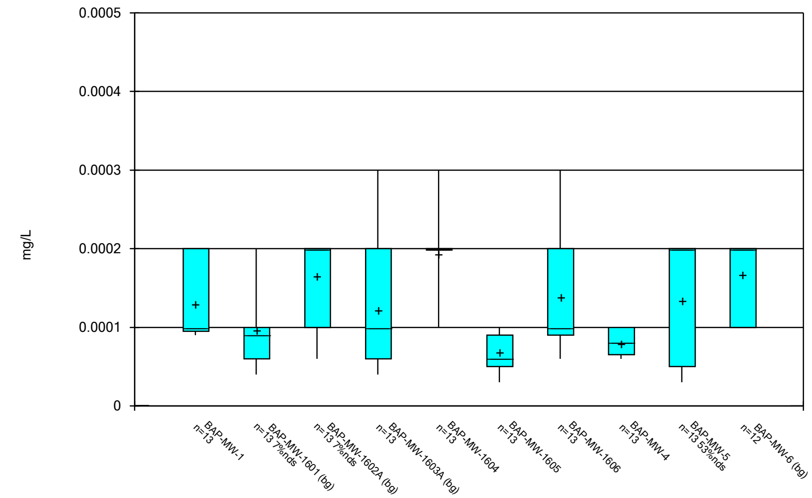


Constituent: pH, field Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

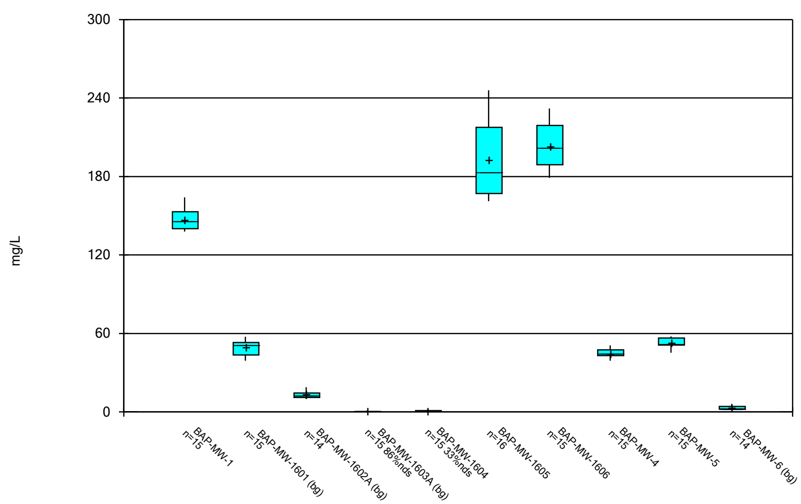


Constituent: Selenium, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot

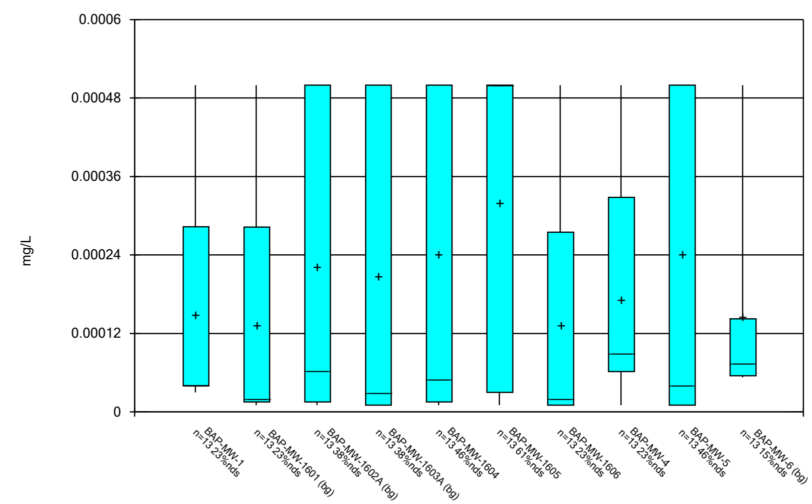


Constituent: Sulfate, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

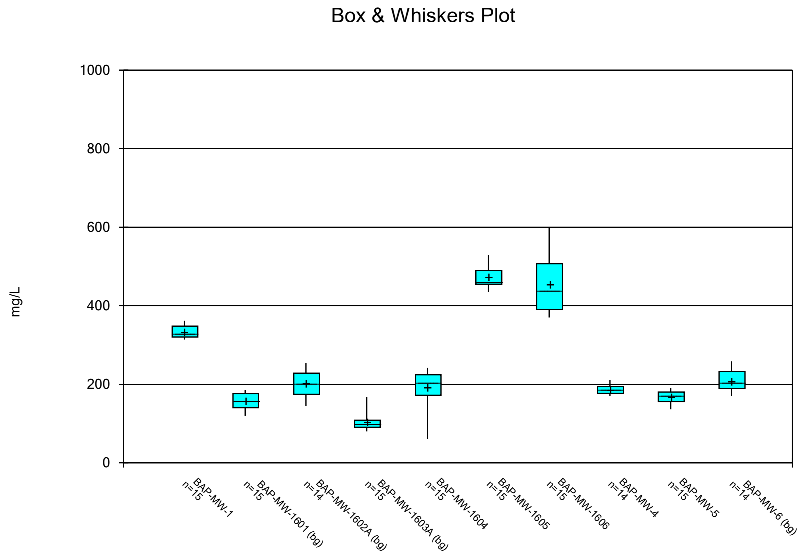
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Thallium, total Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 2:01 PM

Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE C: OUTLIER SUMMARY

Outlier Summary

Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/9/2019, 2:02 PM

	BAP-MW-1604 Beryllium, total (mg/L)	BAP-MW-1603A Boron, total (mg/L)	BAP-MW-1604 Boron, total (mg/L)	BAP-MW-1605 Boron, total (mg/L)	BAP-MW-1606 Boron, total (mg/L)	BAP-MW-4 Boron, total (mg/L)	BAP-MW-5 Boron, total (mg/L)	BAP-MW-6 Boron, total (mg/L)	BAP-MW-1603A Chromium, total (mg/L)	BAP-MW-4 Cobalt, total (mg/L)
7/25/2016										
8/23/2016										
10/18/2016										0.0859 (o)
12/12/2016										
12/13/2016									0.00327 (o)	
2/7/2017										
2/8/2017										
1/8/2018										
3/14/2019				<1 (o)						
3/15/2019		<0.1 (o)	<1 (o)		<1 (o)	<1 (o)	<0.1 (o)	<0.1 (o)		
6/10/2019	0.000142 (o)									
6/11/2019										

	BAP-MW-1601 Combined Radium 226 + 228 (pCi/L)	BAP-MW-6 Combined Radium 226 + 228 (pCi/L)	BAP-MW-4 Fluoride, total (mg/L)	BAP-MW-5 Fluoride, total (mg/L)	BAP-MW-4 Molybdenum, total (mg/L)	BAP-MW-1 pH, field (SU)	BAP-MW-1602A pH, field (SU)	BAP-MW-1603A pH, field (SU)	BAP-MW-1604 pH, field (SU)	BAP-MW-1606 pH, field (SU)
7/25/2016					0.0111 (o)					
8/23/2016					0.0192 (o)					
10/18/2016			<0.03 (o)	<0.03 (o)						
12/12/2016										
12/13/2016										
2/7/2017	35.021 (o)									
2/8/2017		20.83 (o)								
1/8/2018										8.4 (o)
3/14/2019										
3/15/2019										
6/10/2019						10.19 (o)			8.65 (o)	
6/11/2019							9.51 (o)	8.82 (o)		

Outlier Summary

Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/9/2019, 2:02 PM

	BAP-MW-6 pH, field (SU)	BAP-MW-6 Selenium, total (mg/L)	BAP-MW-1605 Total Dissolved Solids [TDS] (mg/L)	BAP-MW-4 Total Dissolved Solids [TDS] (mg/L)
7/25/2016				
8/23/2016				
10/18/2016				
12/12/2016			920 (o)	348 (o)
12/13/2016				
2/7/2017				
2/8/2017				
1/8/2018				
3/14/2019				
3/15/2019		0.0004 (o)		
6/10/2019	9.32 (o)			
6/11/2019				

Upgradient Outlier Analysis - Significant Results

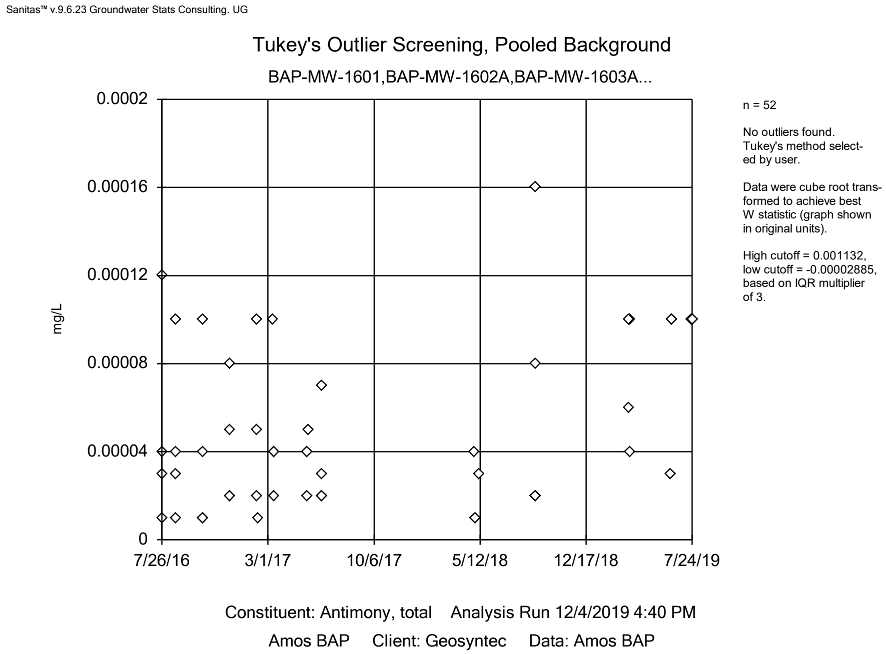
Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 12/4/2019, 4:42 PM

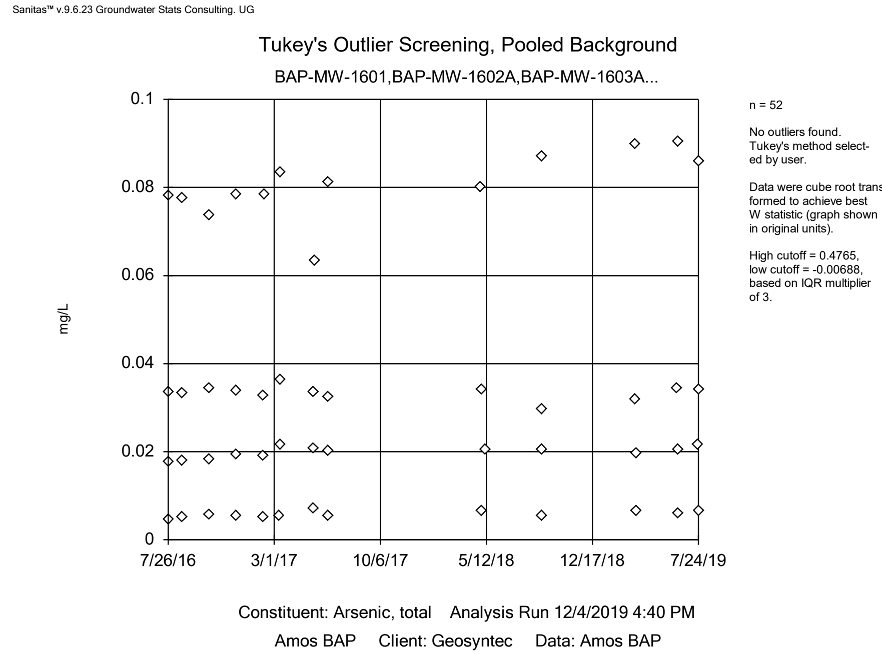
Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Combined Radium 226 + 228 (pCi/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**35.02,20.83**	**NP**	**NaN**	**56**	**2.197**	**5.34**	**ln(x)**	**ShapiroFrancia**

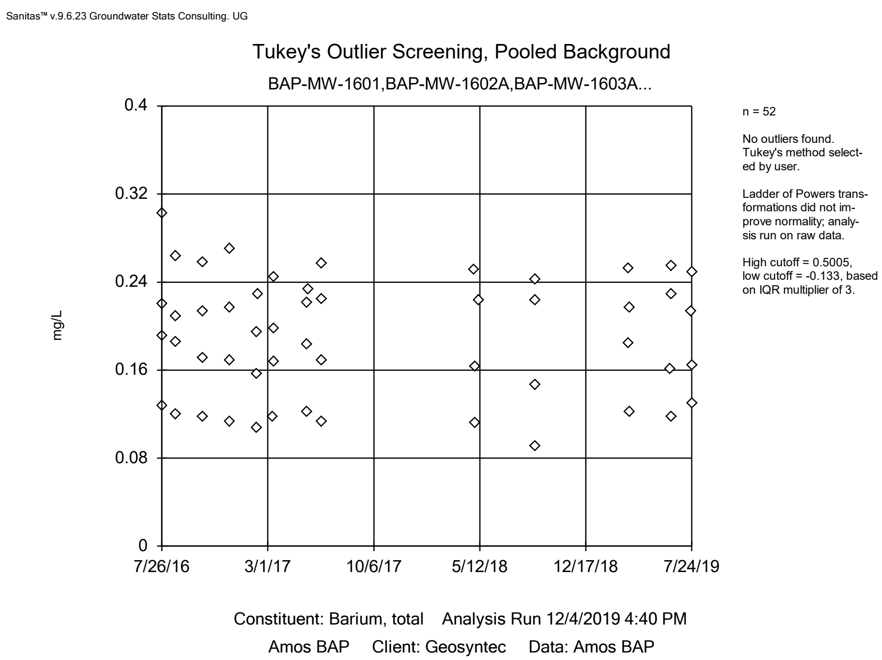
Upgradient Outlier Analysis - All Results

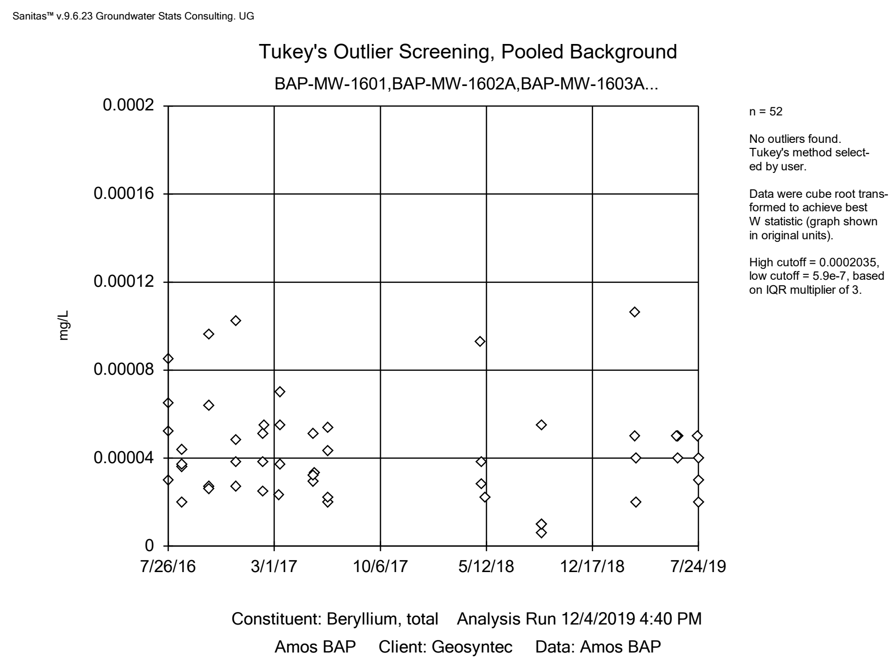
Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 12/4/2019, 4:42 PM

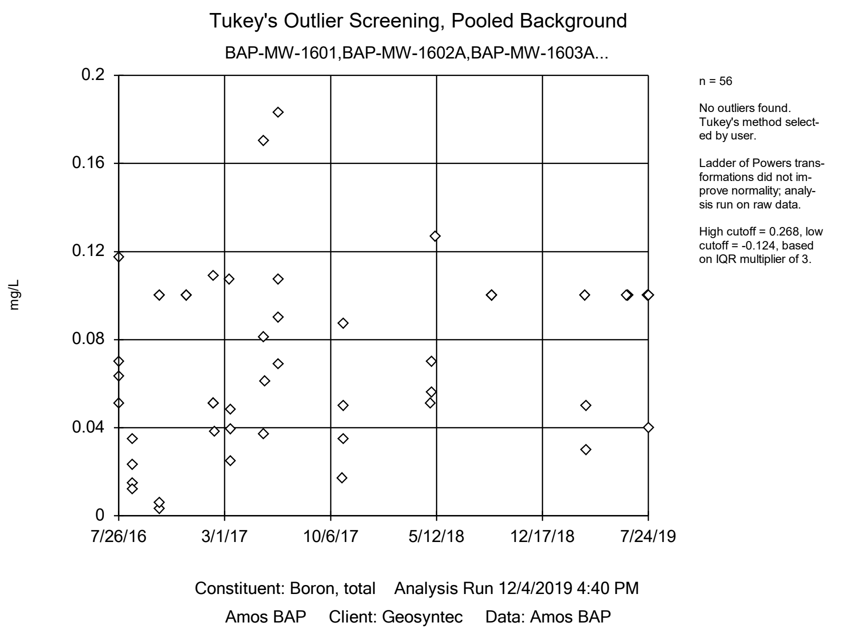
Constituent	Well	Outlier	Value(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.00005346	0.00003793	x^(1/3)	ShapiroFrancia
Arsenic, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.0349	0.02862	x^(1/3)	ShapiroFrancia
Barium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.1891	0.05365	normal	ShapiroFrancia
Beryllium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.00004313	0.00002279	x^(1/3)	ShapiroFrancia
Boron, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	56	0.07454	0.03869	normal	ShapiroFrancia
Cadmium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.00002083	0.00001622	ln(x)	ShapiroFrancia
Calcium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	56	14.21	3.096	ln(x)	ShapiroFrancia
Chloride, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	58	15.45	13.5	ln(x)	ShapiroFrancia
Chromium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.0008655	0.0006459	ln(x)	ShapiroFrancia
Cobalt, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.004737	0.00442	ln(x)	ShapiroFrancia
Combined Radium 226 + 228 (pCi/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**35.02,20.83**	**NP**	**NaN**	**56**	**2.197**	**5.34**	**ln(x)**	**ShapiroFrancia**
Fluoride, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	58	0.1241	0.0907	ln(x)	ShapiroFrancia
Lead, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.001302	0.00173	ln(x)	ShapiroFrancia
Lithium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.01015	0.01147	ln(x)	ShapiroFrancia
Mercury, total (mg/L)	BAP-MW-1601,BAP-M...	n/a	n/a	NP	NaN	40	0.000004725	8.5e-7	unknown	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.0009669	0.0006889	x^(1/3)	ShapiroFrancia
Selenium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.0001419	0.00007433	ln(x)	ShapiroFrancia
Sulfate, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	58	16.67	20.09	ln(x)	ShapiroFrancia
Thallium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	52	0.0001763	0.0002119	ln(x)	ShapiroFrancia
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	NP	NaN	58	166.4	48.65	normal	ShapiroFrancia

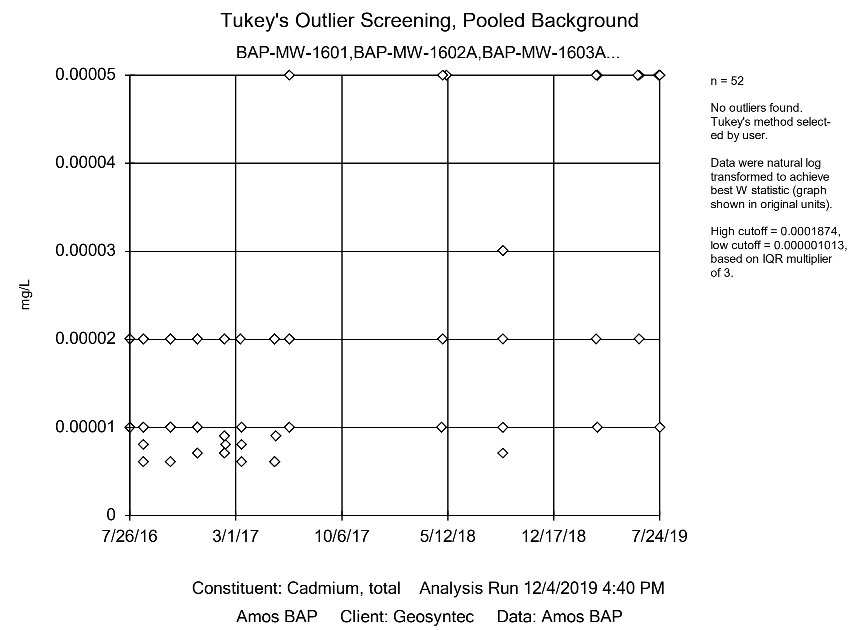

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.0002
0.00016
0.00012
0.00008
0.00004
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.001132, low cutoff = -0.00002885, based on IQR multiplier of 3.
Constituent: Antimony, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP

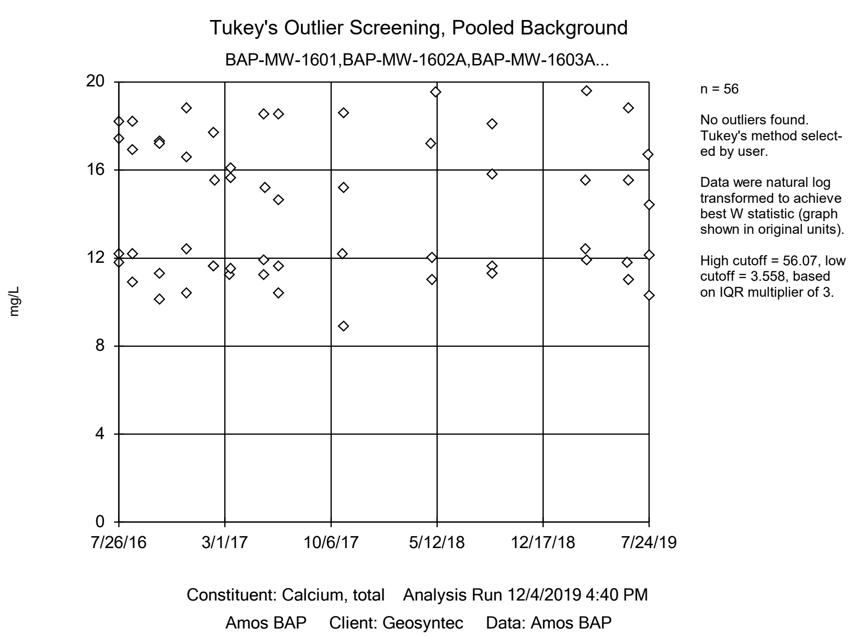

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.1
0.08
0.06
0.04
0.02
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.4765, low cutoff = -0.00688, based on IQR multiplier of 3.
Constituent: Arsenic, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP

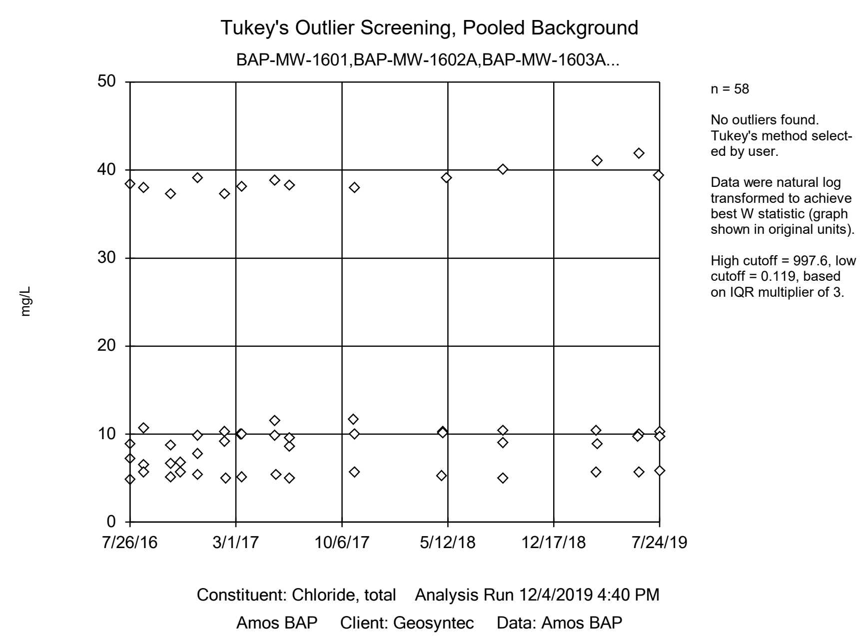

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.4
0.32
0.24
0.16
0.08
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.5005, low cutoff = -0.133, based on IQR multiplier of 3.
Constituent: Barium, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.0002
0.00016
0.00012
0.00008
0.00004
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0002035, low cutoff = 5.9e-7, based on IQR multiplier of 3.
Constituent: Beryllium, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.2
0.16
0.12
0.08
0.04
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 56
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.268, low cutoff = -0.124, based on IQR multiplier of 3.
Constituent: Boron, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP

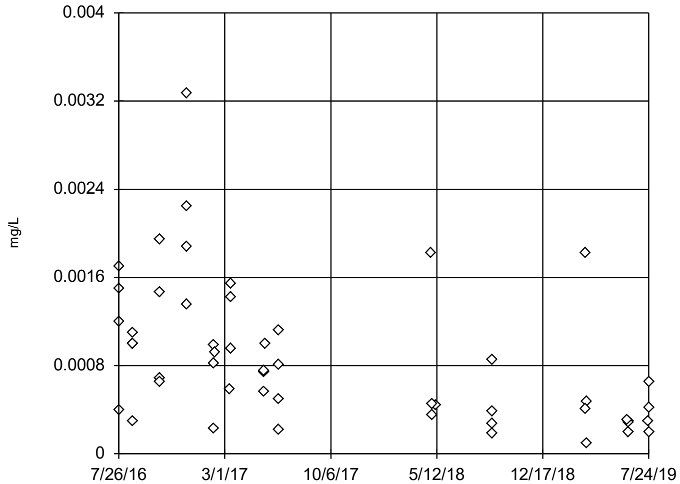

Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.00005
0.00004
0.00003
0.00002
0.00001
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0001874, low cutoff = 0.000001013, based on IQR multiplier of 3.
Constituent: Cadmium, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
20
16
12
8
4
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 56
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 56.07, low cutoff = 3.558, based on IQR multiplier of 3.
Constituent: Calcium, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
50
40
30
20
10
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 58
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 997.6, low cutoff = 0.119, based on IQR multiplier of 3.
Constituent: Chloride, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 52

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

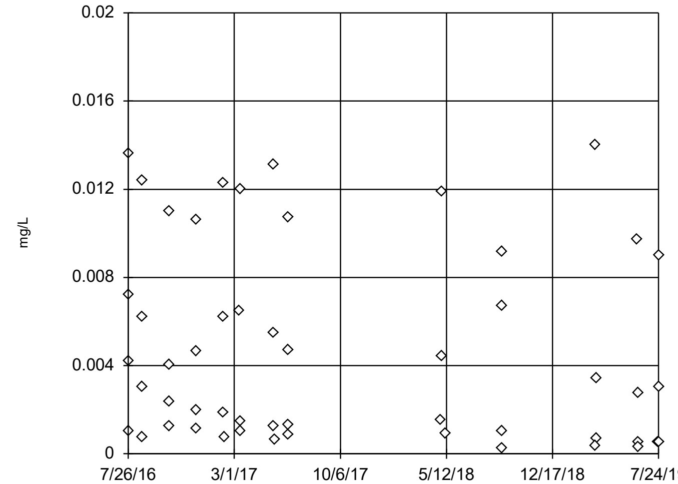
High cutoff = 0.03677, low cutoff = 0.00001155, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/4/2019 4:40 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 52

No outliers found.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

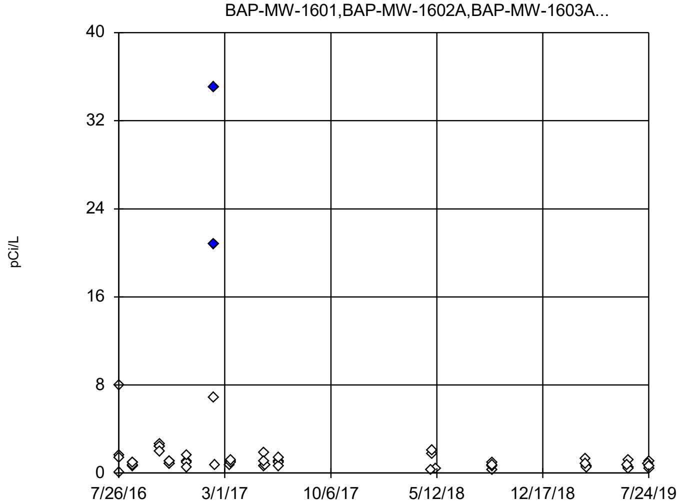
High cutoff = 3.86, low cutoff = 0.00000215, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 12/4/2019 4:40 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 56

Outliers are drawn as solid.
Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

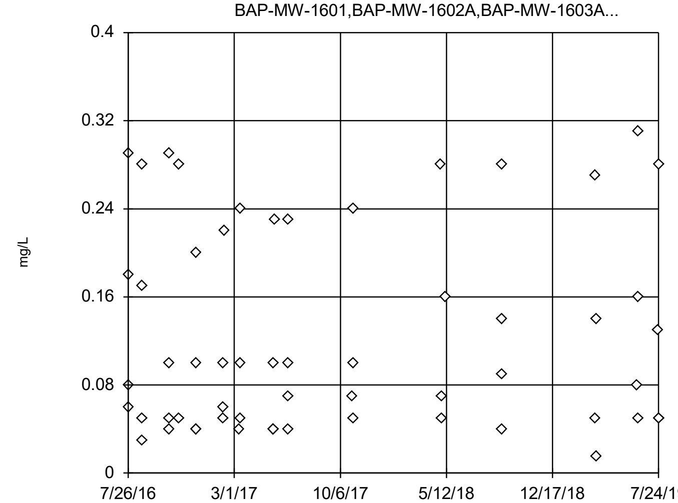
High cutoff = 11.87, low cutoff = 0.07589, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 12/4/2019 4:40 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 58

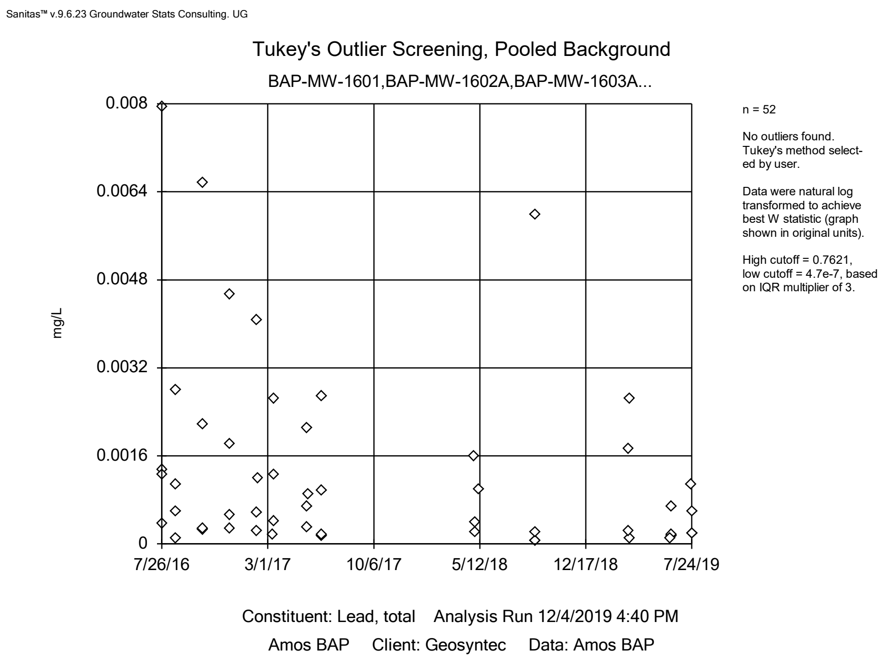
No outliers found.
Tukey's method selected by user.

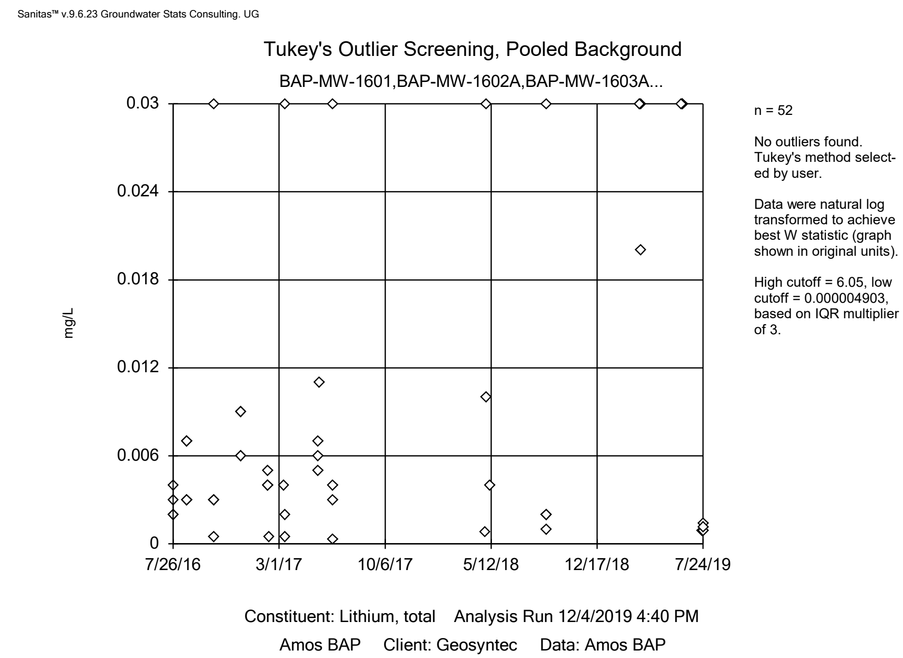
Data were natural log transformed to achieve best W statistic (graph shown in original units).

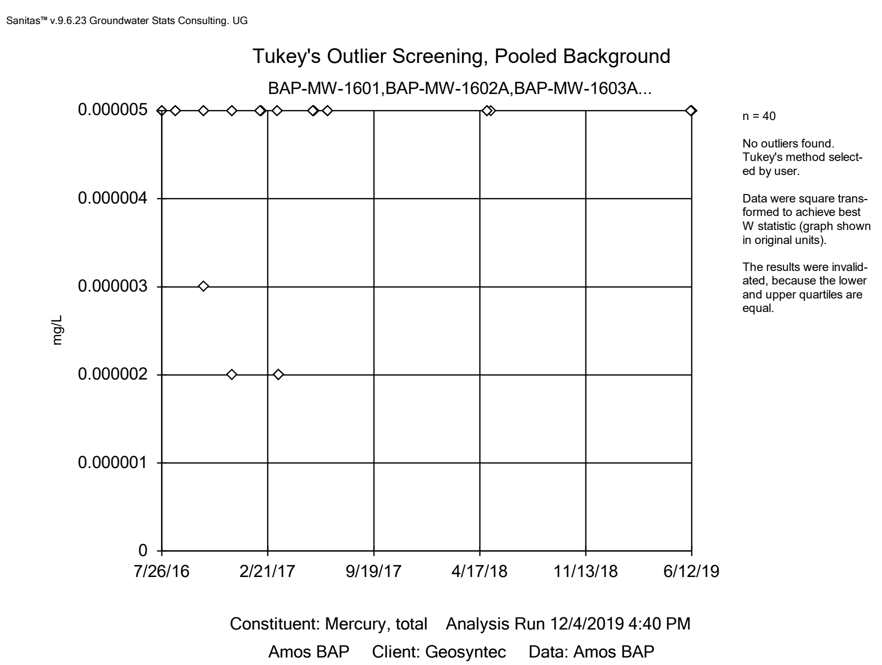
High cutoff = 15.49, low cutoff = 0.0006772, based on IQR multiplier of 3.

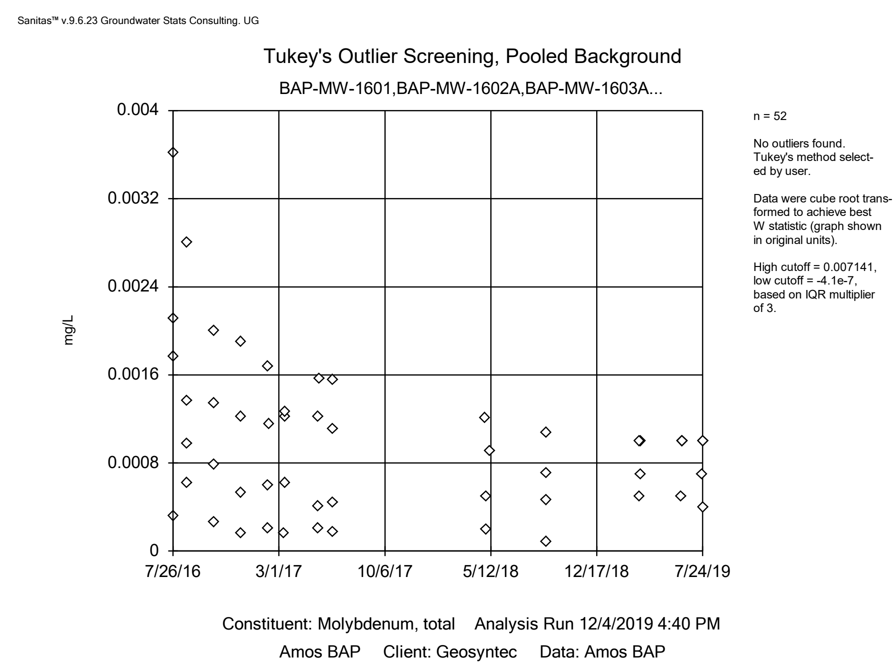
Constituent: Fluoride, total Analysis Run 12/4/2019 4:40 PM

Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.008
0.0064
0.0048
0.0032
0.0016
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.7621, low cutoff = 4.7e-7, based on IQR multiplier of 3.
Constituent: Lead, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.03
0.024
0.018
0.012
0.006
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 6.05, low cutoff = 0.000004903, based on IQR multiplier of 3.
Constituent: Lithium, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP

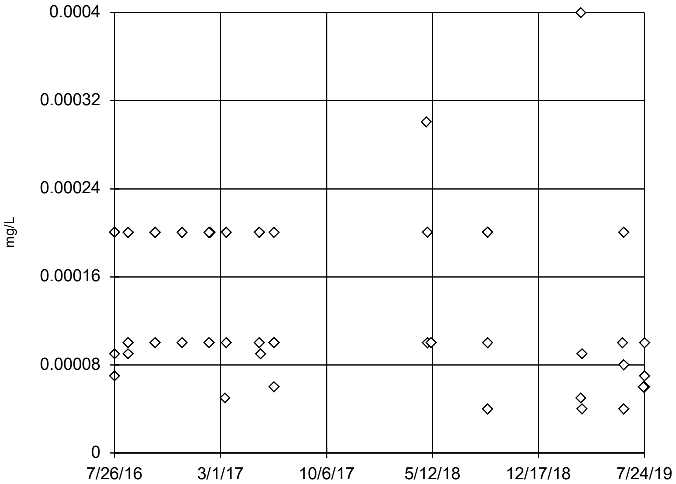

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.000005
0.000004
0.000003
0.000002
0.000001
0
7/26/16
2/21/17
9/19/17
4/17/18
11/13/18
6/12/19
n = 40
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening, Pooled Background
BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...
mg/L
0.004
0.0032
0.0024
0.0016
0.0008
0
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 52
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.007141, low cutoff = -4.1e-7, based on IQR multiplier of 3.
Constituent: Molybdenum, total Analysis Run 12/4/2019 4:40 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 52

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.002195, low cutoff = 0.000008201, based on IQR multiplier of 3.

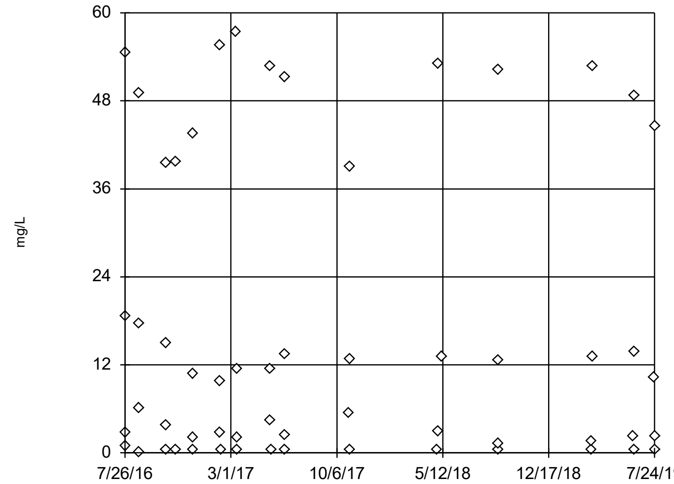
Constituent: Selenium, total   Analysis Run 12/4/2019 4:40 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 58

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.1e7, low cutoff = 0.000002127, based on IQR multiplier of 3.

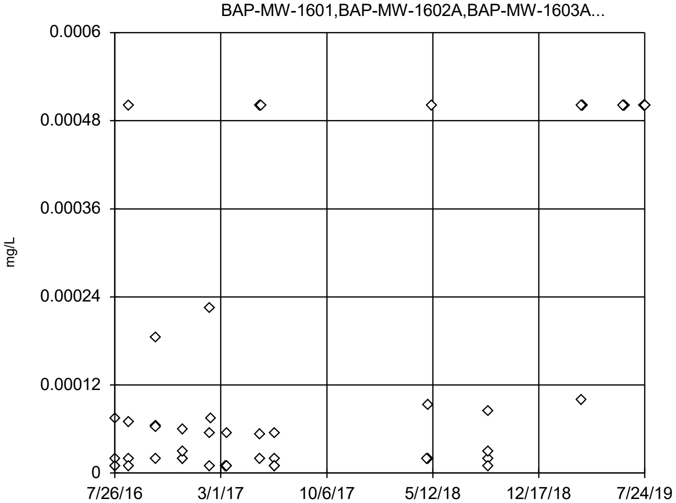
Constituent: Sulfate, total   Analysis Run 12/4/2019 4:40 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 52

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 7.813, low cutoff = 1.3e-9, based on IQR multiplier of 3.

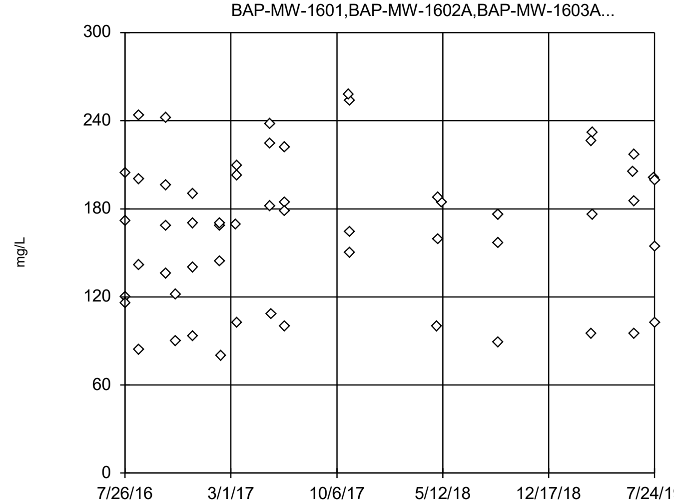
Constituent: Thallium, total   Analysis Run 12/4/2019 4:40 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 58

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 445, low cutoff = -122, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS]   Analysis Run 12/4/2019 4:40 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Outlier Analysis - Significant Results

Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/4/2019, 4:38 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Combined Radium 226 + 228 (pCi/L)	**BAP-MW-1605**	**Yes**	**5.063**	**10/17/2016**	**NP**	**NaN**	**14**	**1.208**	**1.158**	**ln(x)**	**ShapiroWilk**
Lead, total (mg/L)	**BAP-MW-1**	**Yes**	**0.00116**	**9/4/2018**	**NP**	**NaN**	**13**	**0.0001877**	**0.0002965**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1**	**Yes**	**7.31,10.19**	**5/3/2018,6/10/2019**	**NP**	**NaN**	**16**	**5.596**	**1.371**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1601 (bg)**	**Yes**	**7.76,6.7**	**9/5/2018,6/12/2019**	**NP**	**NaN**	**15**	**6.061**	**0.5289**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1602A (bg)**	**Yes**	**9.51**	**6/11/2019**	**NP**	**NaN**	**15**	**6.787**	**0.8057**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1603A (bg)**	**Yes**	**8.82**	**6/11/2019**	**NP**	**NaN**	**15**	**6.939**	**0.5779**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1604**	**Yes**	**7.2,8.65**	**9/4/2018,6/10/2019**	**NP**	**NaN**	**15**	**6.435**	**0.6752**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1606**	**Yes**	**8.4**	**1/8/2018**	**NP**	**NaN**	**15**	**5.741**	**0.8118**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-5**	**Yes**	**6.57**	**5/22/2017**	**NP**	**NaN**	**15**	**5.813**	**0.2887**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-6 (bg)**	**Yes**	**9.32**	**6/10/2019**	**NP**	**NaN**	**15**	**6.216**	**0.8806**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 12/4/2019, 4:38 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.00003769	0.00005644	ln(x)	ShapiroWilk
Antimony, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.00003308	0.00001251	normal	ShapiroWilk
Antimony, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.00002923	0.00001498	normal	ShapiroWilk
Antimony, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.00002692	0.00001109	normal	ShapiroWilk
Antimony, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.00004231	0.00002386	ln(x)	ShapiroWilk
Antimony, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.00003923	0.00002597	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.0001323	0.00003345	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.004995	0.0008646	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.003848	0.0009016	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.002901	0.0004412	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.006262	0.004658	ln(x)	ShapiroWilk
Arsenic, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.003332	0.001128	ln(x)	ShapiroWilk
Barium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.02784	0.001727	ln(x)	ShapiroWilk
Barium, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.1395	0.01248	ln(x)	ShapiroWilk
Barium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.08252	0.01276	ln(x)	ShapiroWilk
Barium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.06469	0.006131	ln(x)	ShapiroWilk
Barium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.08983	0.00593	ln(x)	ShapiroWilk
Barium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.1568	0.007883	x^2	ShapiroWilk
Beryllium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.0001212	0.00001143	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.00005823	0.00002924	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.00006008	0.00001848	x^2	ShapiroWilk
Beryllium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0001054	0.00002573	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.000052	0.000009434	ln(x)	ShapiroWilk
Beryllium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.00005331	0.00002427	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.00255	0.0004225	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.00004092	0.00001757	sqrt(x)	ShapiroWilk
Cadmium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.000038	0.000019	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0001685	0.00005047	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.0001308	0.0001323	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.00001708	0.00001882	ln(x)	ShapiroWilk
Chromium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.0003153	0.0003324	ln(x)	ShapiroWilk
Chromium, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.0009828	0.0004185	x^(1/3)	ShapiroWilk
Chromium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.0002932	0.0001453	ln(x)	ShapiroWilk
Chromium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0008608	0.0005306	normal	ShapiroWilk
Chromium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.0003634	0.0002748	ln(x)	ShapiroWilk
Chromium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.0003128	0.0002541	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.01287	0.002431	sqrt(x)	ShapiroWilk
Cobalt, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.0007052	0.0004492	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.01293	0.00725	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.01508	0.001582	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.02118	0.02084	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.001086	0.000135	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	14	0.8191	0.4609	x^(1/3)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	14	1.165	0.808	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	**BAP-MW-1605**	**Yes**	**5.063**	**10/17/2016**	**NP**	**NaN**	**14**	**1.208**	**1.158**	**ln(x)**	**ShapiroWilk**
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	14	0.8276	0.6118	x^(1/3)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	14	0.9033	0.5816	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	14	0.9609	0.3888	normal	ShapiroWilk
Fluoride, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	14	0.02786	0.004258	x^6	ShapiroWilk
Fluoride, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	15	0.084	0.02613	normal	ShapiroWilk
Fluoride, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	15	0.04	0.02171	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	BAP-MW-1606	n/a	n/a	n/a	NP	NaN	14	0.02857	0.003631	unknown	ShapiroWilk
Fluoride, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	15	0.04867	0.01356	normal	ShapiroWilk
Fluoride, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	15	0.04133	0.008338	normal	ShapiroWilk
Lead, total (mg/L)	**BAP-MW-1**	**Yes**	**0.00116**	**9/4/2018**	**NP**	**NaN**	**13**	**0.0001877**	**0.0002965**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results

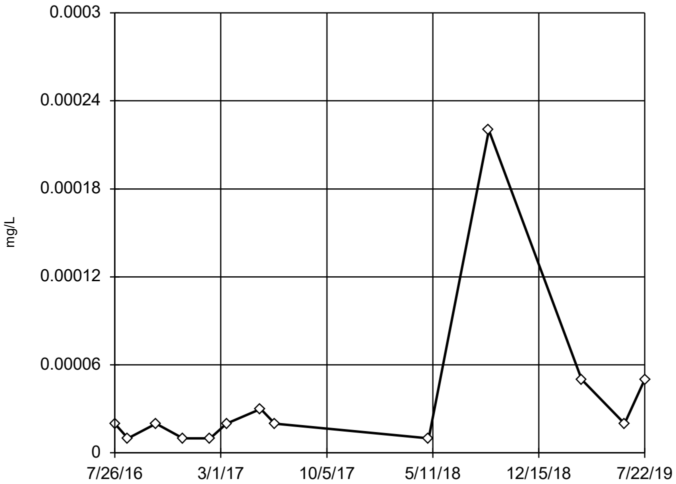
Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/4/2019, 4:38 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Lead, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.0006503	0.0004308	ln(x)	ShapiroWilk
Lead, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.0001221	0.000079	ln(x)	ShapiroWilk
Lead, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0007109	0.0004398	sqrt(x)	ShapiroWilk
Lead, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.0002808	0.0001218	sqrt(x)	ShapiroWilk
Lead, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.0002232	0.000233	ln(x)	ShapiroWilk
Lithium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.008336	0.01013	ln(x)	ShapiroWilk
Lithium, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.01116	0.01316	ln(x)	ShapiroWilk
Lithium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.008888	0.009646	ln(x)	ShapiroWilk
Lithium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0108	0.01114	ln(x)	ShapiroWilk
Lithium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.007686	0.01047	ln(x)	ShapiroWilk
Lithium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.007572	0.01047	ln(x)	ShapiroWilk
Mercury, total (mg/L)	BAP-MW-1	n/a	n/a	n/a	NP	NaN	10	0.0000047	9.5e-7	unknown	ShapiroWilk
Mercury, total (mg/L)	BAP-MW-1604	n/a	n/a	n/a	NP	NaN	10	0.0000047	9.5e-7	unknown	ShapiroWilk
Mercury, total (mg/L)	BAP-MW-1605	n/a	n/a	n/a	NP	NaN	10	0.000005	0	unknown	ShapiroWilk
Mercury, total (mg/L)	BAP-MW-1606	n/a	n/a	n/a	NP	NaN	10	0.0000047	9.5e-7	unknown	ShapiroWilk
Mercury, total (mg/L)	BAP-MW-4	n/a	n/a	n/a	NP	NaN	10	0.000005	0	unknown	ShapiroWilk
Mercury, total (mg/L)	BAP-MW-5	n/a	n/a	n/a	NP	NaN	10	0.000005	0	unknown	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.001147	0.0007142	sqrt(x)	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.0005962	0.0006452	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.0006592	0.0007801	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0005723	0.0008167	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.003255	0.005584	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.001262	0.0009074	x^(1/3)	ShapiroWilk
pH, field (SU)	**BAP-MW-1**	**Yes**	**7.31,10.19**	**5/3/2018,6/10/2019**	**NP**	**NaN**	**16**	**5.596**	**1.371**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1601 (bg)**	**Yes**	**7.76,6.7**	**9/5/2018,6/12/2019**	**NP**	**NaN**	**15**	**6.061**	**0.5289**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1602A (bg)**	**Yes**	**9.51**	**6/11/2019**	**NP**	**NaN**	**15**	**6.787**	**0.8057**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1603A (bg)**	**Yes**	**8.82**	**6/11/2019**	**NP**	**NaN**	**15**	**6.939**	**0.5779**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-1604**	**Yes**	**7.2,8.65**	**9/4/2018,6/10/2019**	**NP**	**NaN**	**15**	**6.435**	**0.6752**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	BAP-MW-1605	No	n/a	n/a	NP	NaN	16	5.823	0.3031	ln(x)	ShapiroWilk
pH, field (SU)	**BAP-MW-1606**	**Yes**	**8.4**	**1/8/2018**	**NP**	**NaN**	**15**	**5.741**	**0.8118**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	BAP-MW-4	No	n/a	n/a	NP	NaN	15	5.834	0.4887	ln(x)	ShapiroWilk
pH, field (SU)	**BAP-MW-5**	**Yes**	**6.57**	**5/22/2017**	**NP**	**NaN**	**15**	**5.813**	**0.2887**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**BAP-MW-6 (bg)**	**Yes**	**9.32**	**6/10/2019**	**NP**	**NaN**	**15**	**6.216**	**0.8806**	**ln(x)**	**ShapiroWilk**
Selenium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.0001285	0.00004981	ln(x)	ShapiroWilk
Selenium, total (mg/L)	BAP-MW-1604	n/a	n/a	n/a	NP	NaN	13	0.0001923	0.00004935	unknown	ShapiroWilk
Selenium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.00006769	0.00002315	x^(1/3)	ShapiroWilk
Selenium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0001385	0.00007313	ln(x)	ShapiroWilk
Selenium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.00007923	0.00001605	ln(x)	ShapiroWilk
Selenium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.00008	0.00002708	normal	ShapiroWilk
Thallium, total (mg/L)	BAP-MW-1	No	n/a	n/a	NP	NaN	13	0.0001494	0.0002001	ln(x)	ShapiroWilk
Thallium, total (mg/L)	BAP-MW-1604	No	n/a	n/a	NP	NaN	13	0.0002415	0.0002493	ln(x)	ShapiroWilk
Thallium, total (mg/L)	BAP-MW-1605	No	n/a	n/a	NP	NaN	13	0.0003194	0.0002381	ln(x)	ShapiroWilk
Thallium, total (mg/L)	BAP-MW-1606	No	n/a	n/a	NP	NaN	13	0.0001323	0.00021	ln(x)	ShapiroWilk
Thallium, total (mg/L)	BAP-MW-4	No	n/a	n/a	NP	NaN	13	0.0001722	0.0001908	ln(x)	ShapiroWilk
Thallium, total (mg/L)	BAP-MW-5	No	n/a	n/a	NP	NaN	13	0.0002408	0.0002499	ln(x)	ShapiroWilk

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

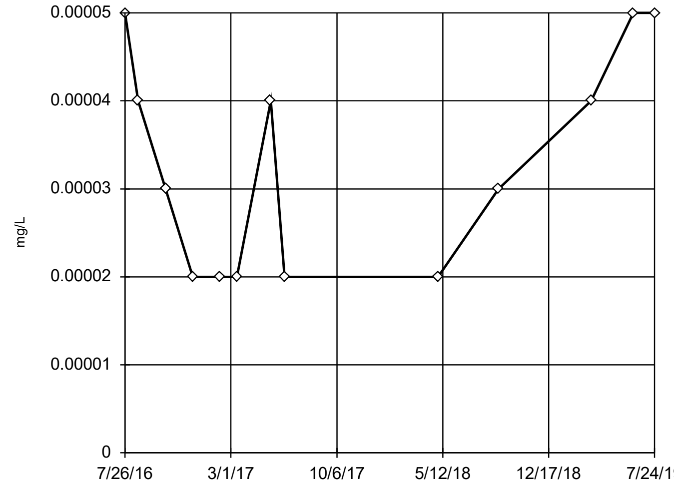
High cutoff = 0.00225, low cutoff = 1.7e-7, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 12/4/2019 4:35 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1604



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

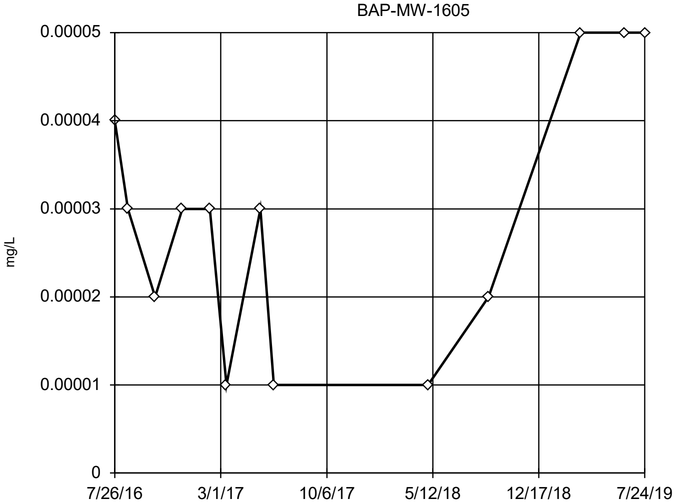
High cutoff = 0.00012, low cutoff = -0.000055, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 12/4/2019 4:35 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1605



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

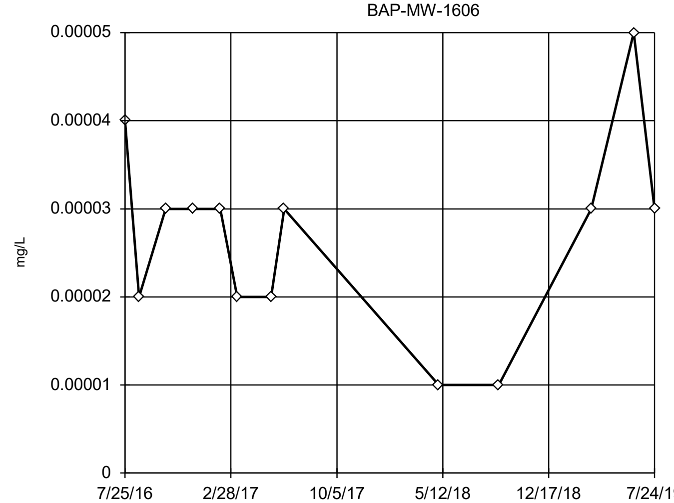
High cutoff = 0.000135, low cutoff = -0.000075, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 12/4/2019 4:35 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1606



n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

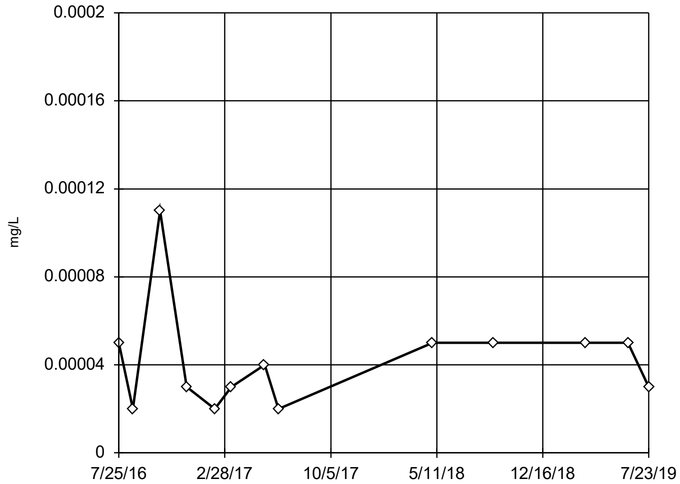
High cutoff = 0.00006, low cutoff = -0.00001, based on IQR multiplier of 3.

Constituent: Antimony, total Analysis Run 12/4/2019 4:35 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-4



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0004253, low cutoff = 0.00000288, based on IQR multiplier of 3.

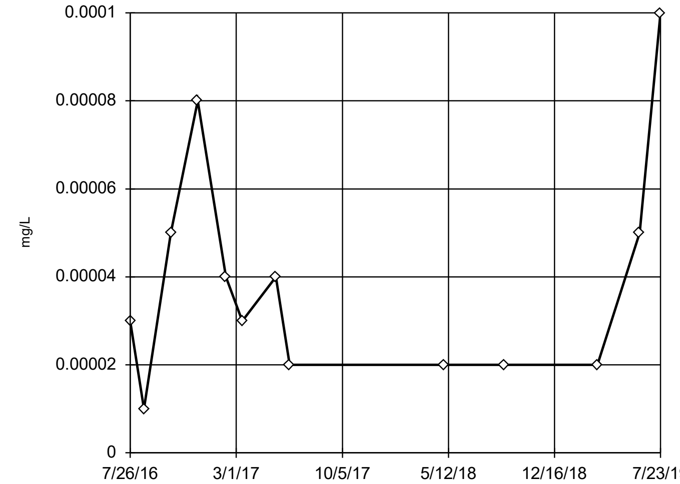
Constituent: Antimony, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-5



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0007812, low cutoff = 0.00000128, based on IQR multiplier of 3.

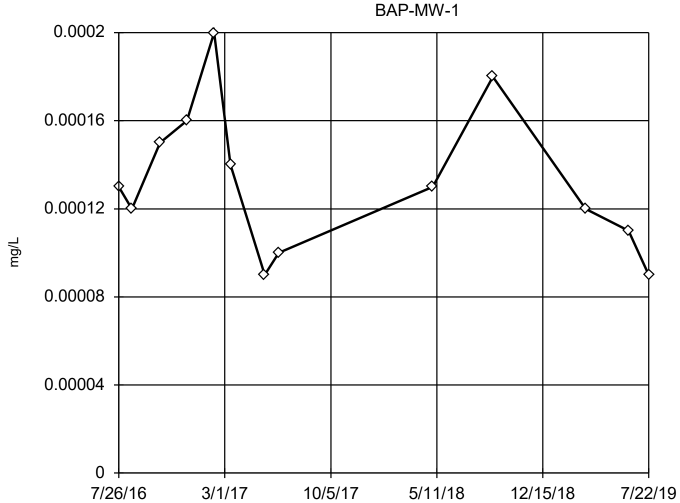
Constituent: Antimony, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0004993, low cutoff = 0.00003254, based on IQR multiplier of 3.

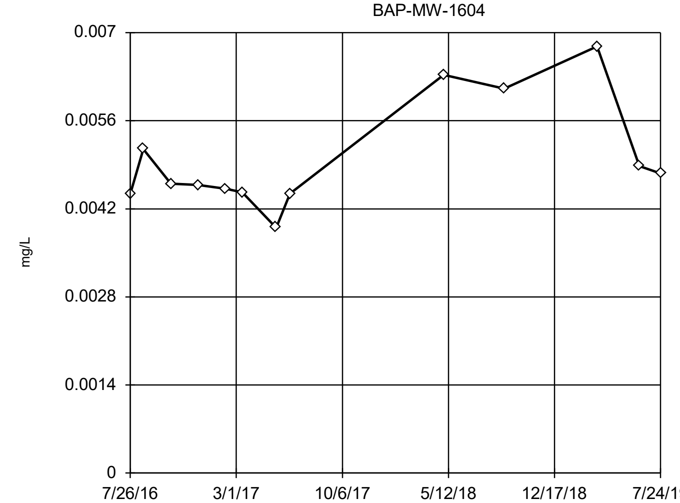
Constituent: Arsenic, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1604



n = 13

No outliers found. Tukey's method selected by user.

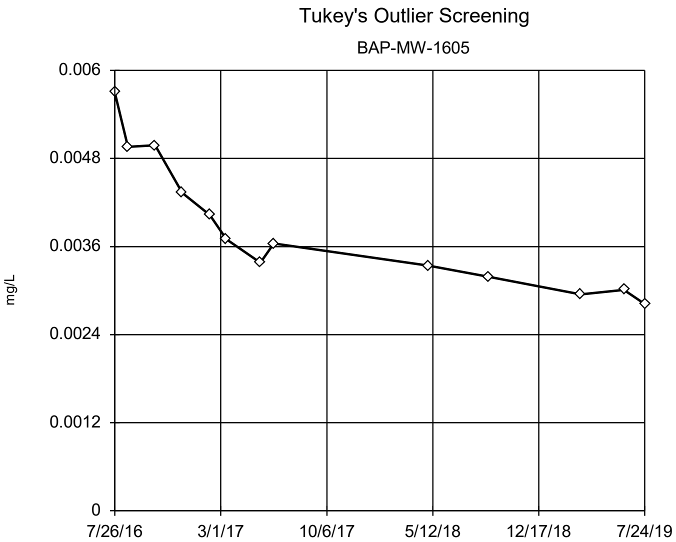
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01124, low cutoff = 0.002222, based on IQR multiplier of 3.

Constituent: Arsenic, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

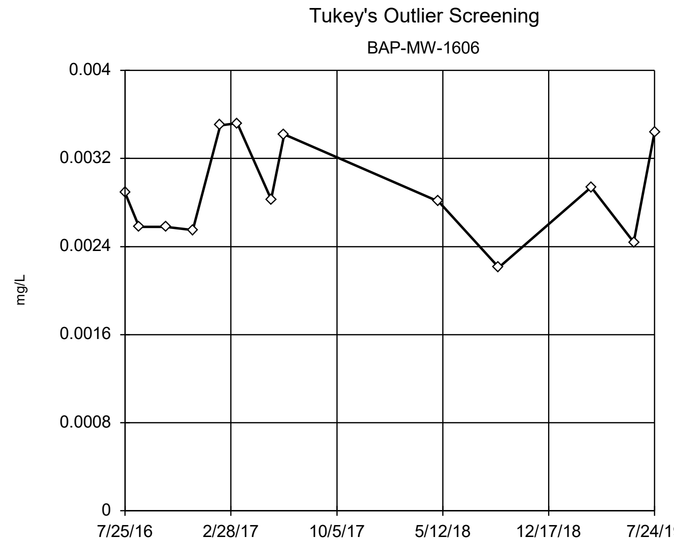
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0155, low cutoff = 0.0009263, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

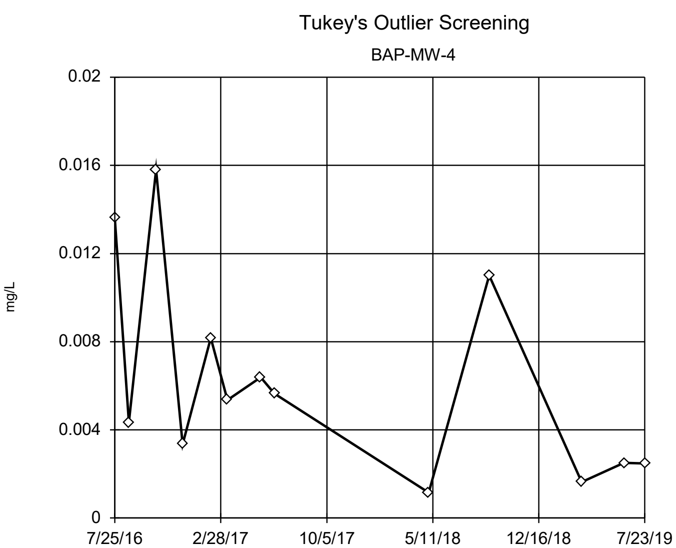
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.008202, low cutoff = 0.001073, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

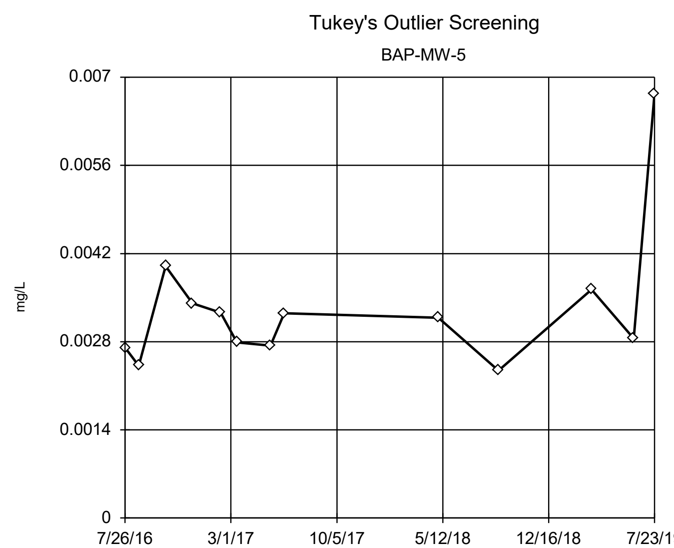
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.5232, low cutoff = 0.00004512, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

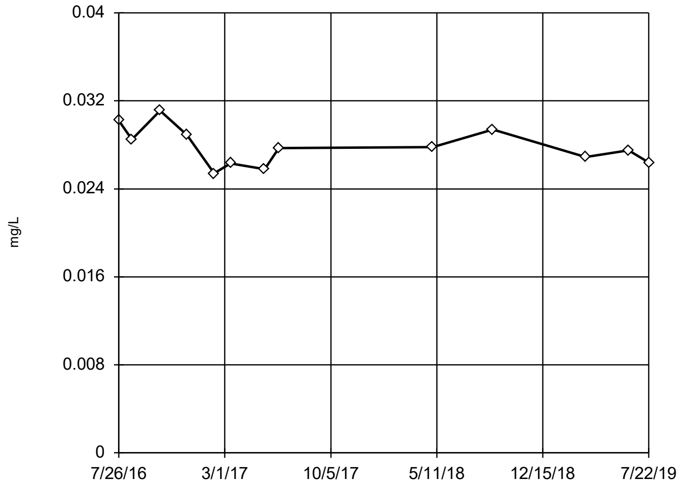
High cutoff = 0.007573, low cutoff = 0.001266, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.03946, low cutoff = 0.01946, based on IQR multiplier of 3.

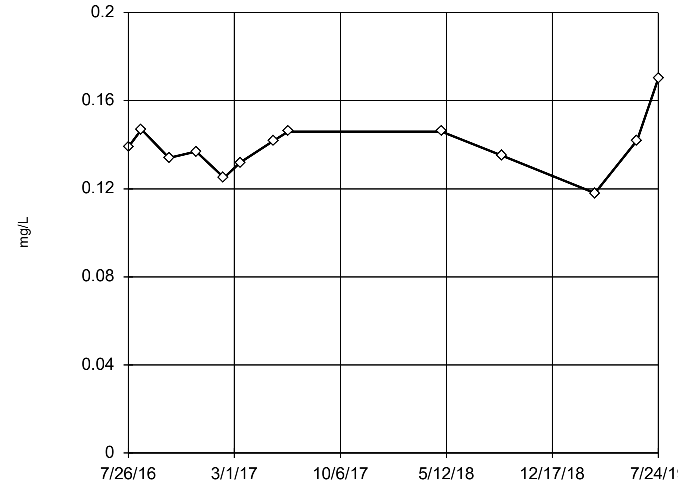
Constituent: Barium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1604



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1931, low cutoff = 0.1005, based on IQR multiplier of 3.

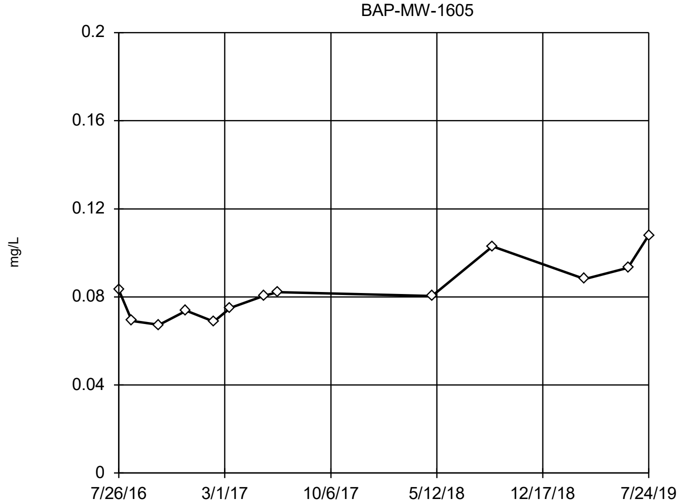
Constituent: Barium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1605



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1851, low cutoff = 0.03495, based on IQR multiplier of 3.

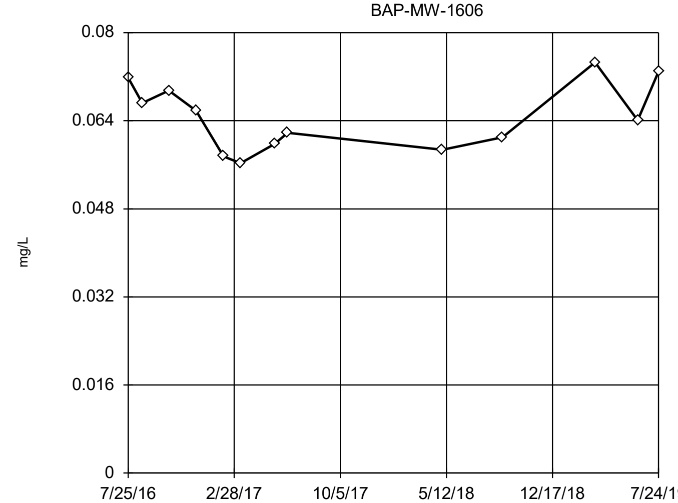
Constituent: Barium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1606



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

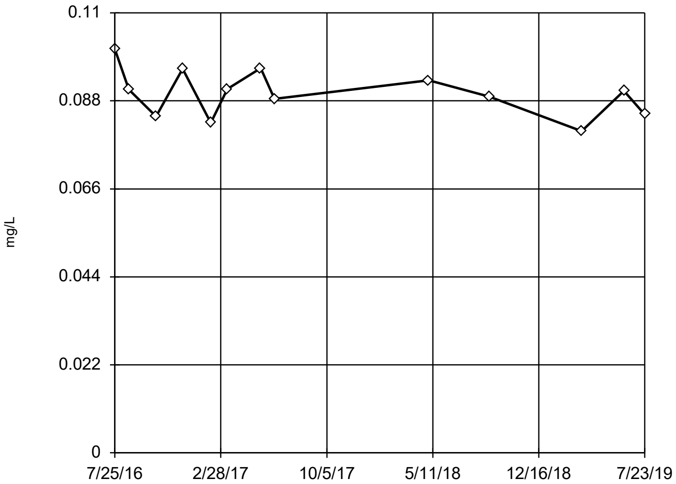
High cutoff = 0.1197, low cutoff = 0.03496, based on IQR multiplier of 3.

Constituent: Barium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Tukey's Outlier Screening

BAP-MW-4



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1331, low cutoff = 0.05991, based on IQR multiplier of 3.

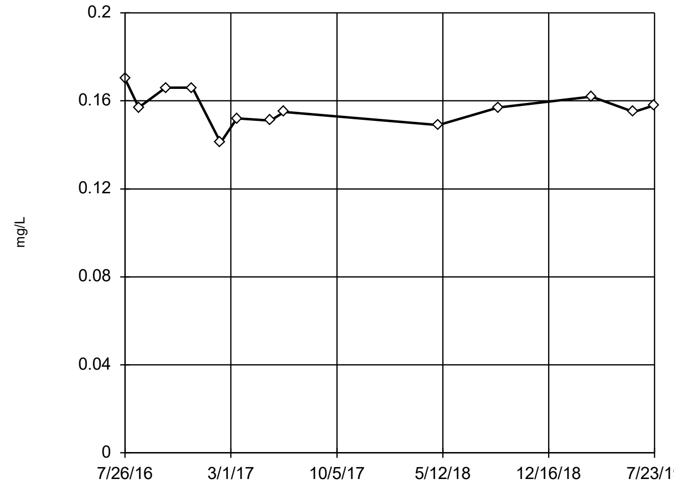
Constituent: Barium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-5



n = 13

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1968, low cutoff = 0.1054, based on IQR multiplier of 3.

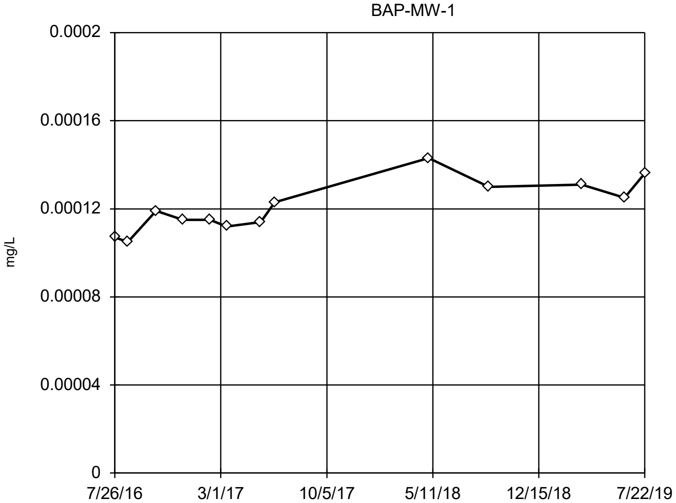
Constituent: Barium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.000201, low cutoff = 0.00007335, based on IQR multiplier of 3.

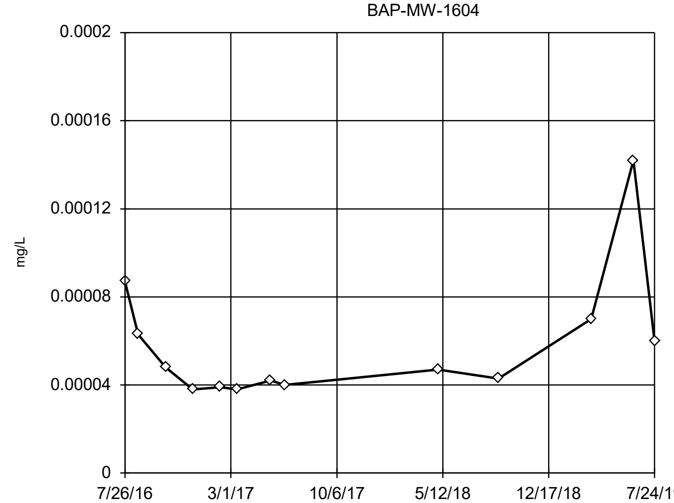
Constituent: Beryllium, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1604



n = 13

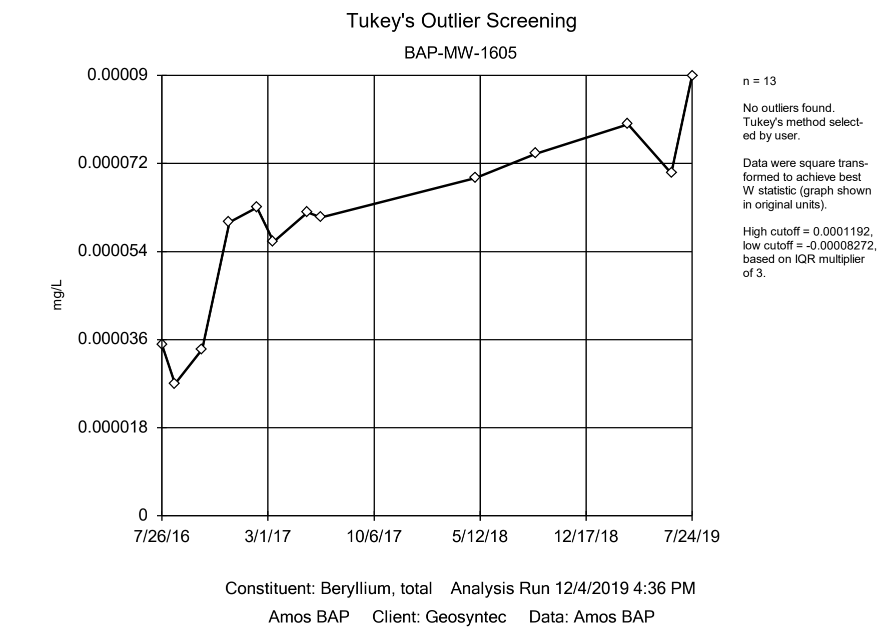
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

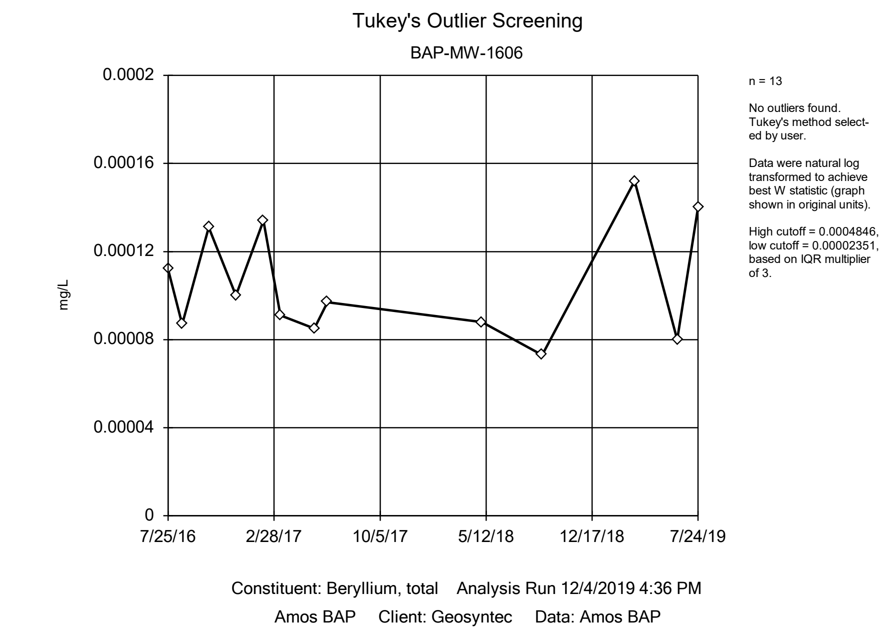
High cutoff = 0.0003156, low cutoff = 0.00000831, based on IQR multiplier of 3.

Constituent: Beryllium, total   Analysis Run 12/4/2019 4:36 PM

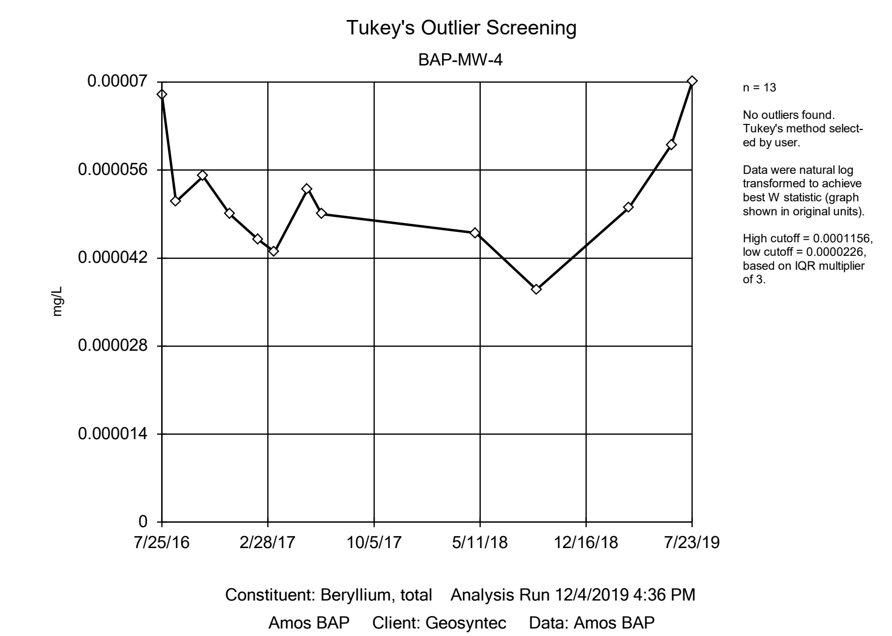
Amos BAP   Client: Geosyntec   Data: Amos BAP



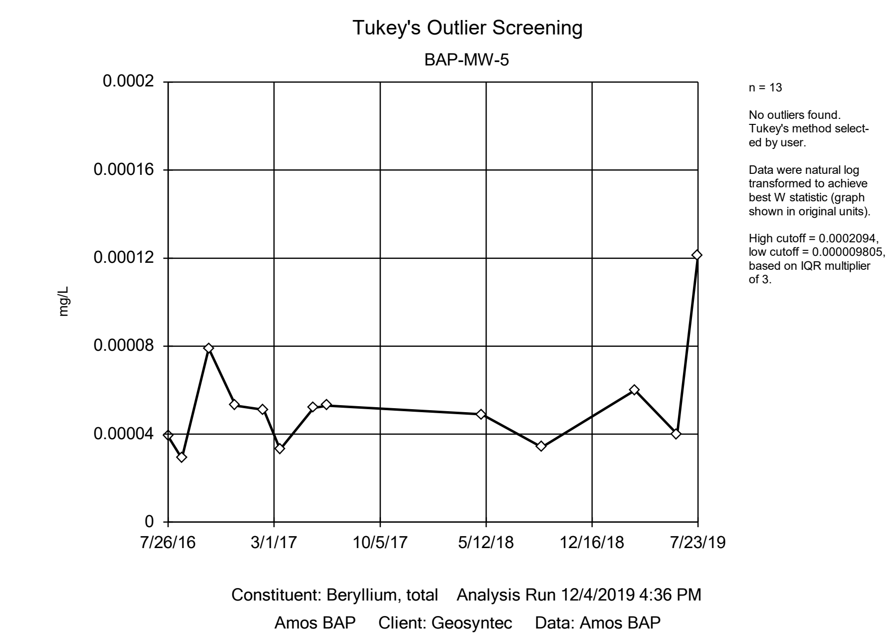
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

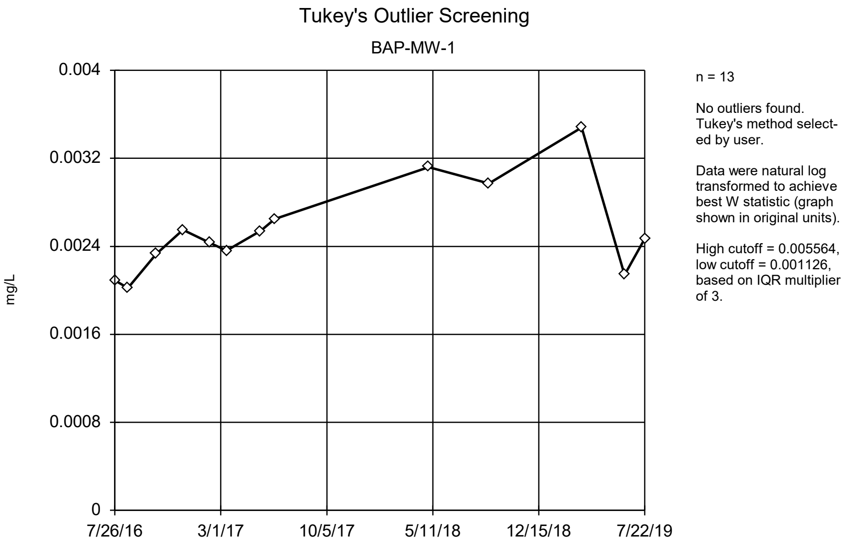


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

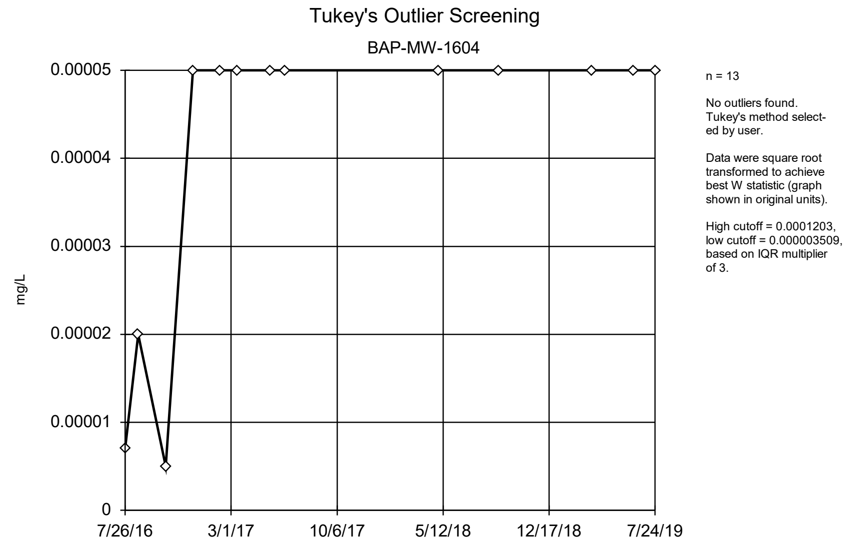


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

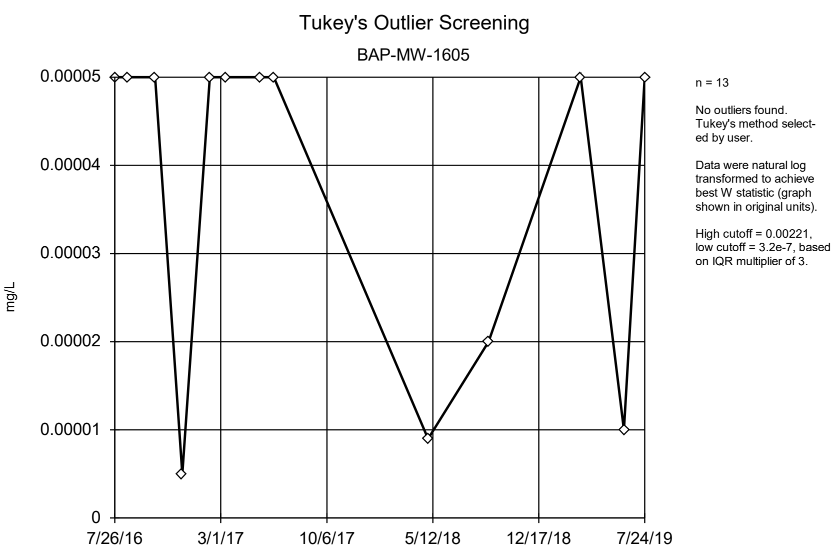




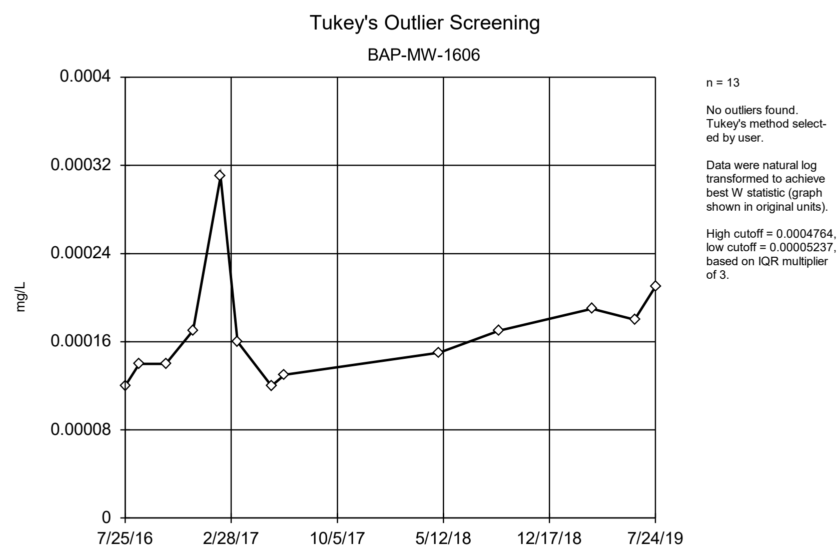
Constituent: Cadmium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: Cadmium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

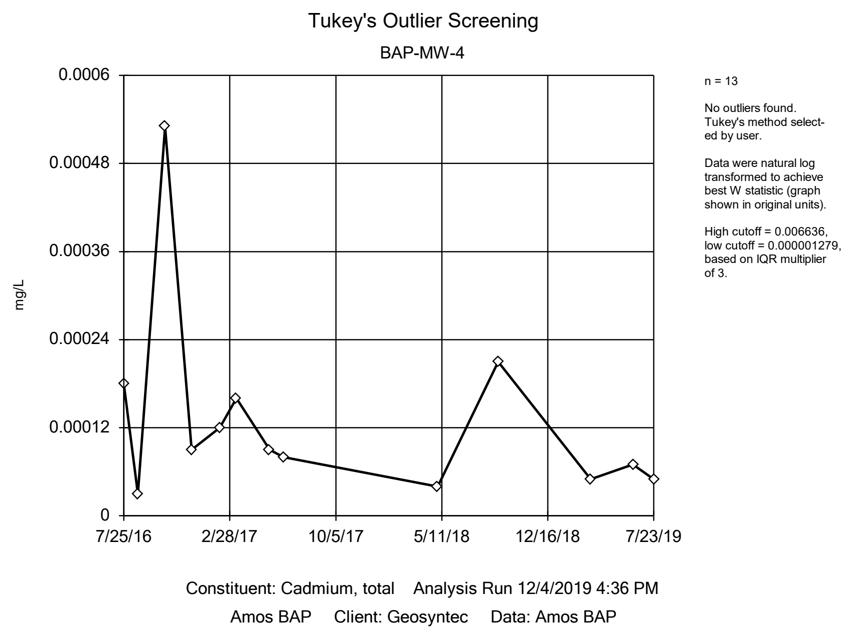


Constituent: Cadmium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

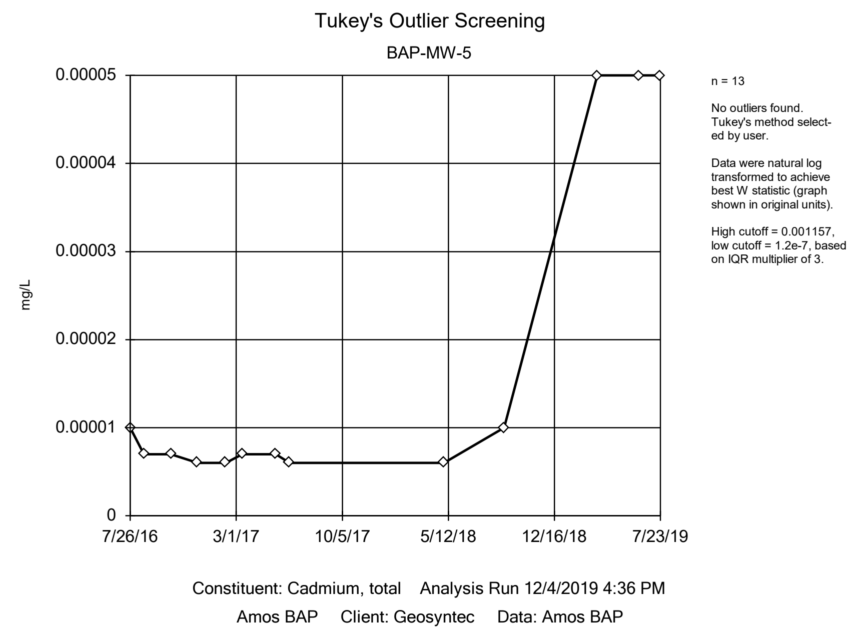


Constituent: Cadmium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

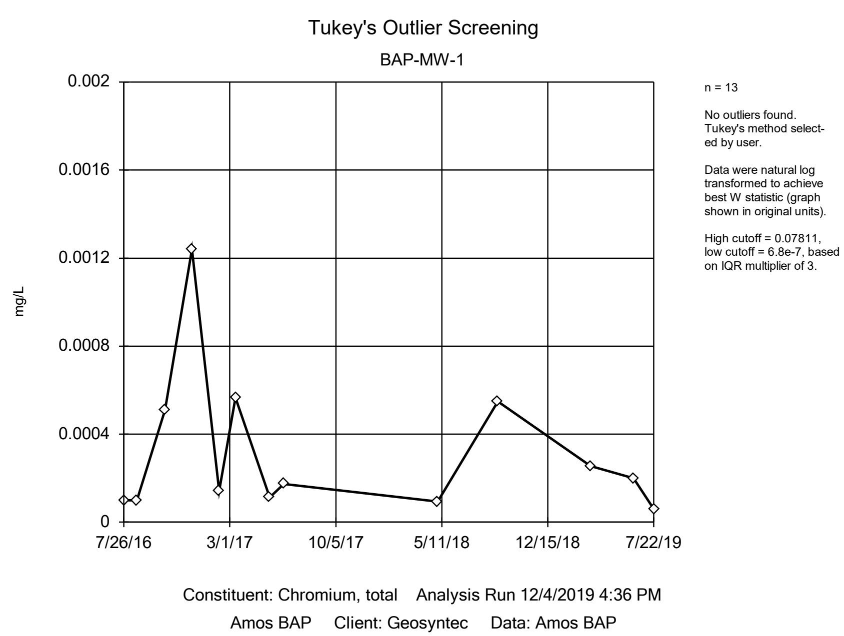
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



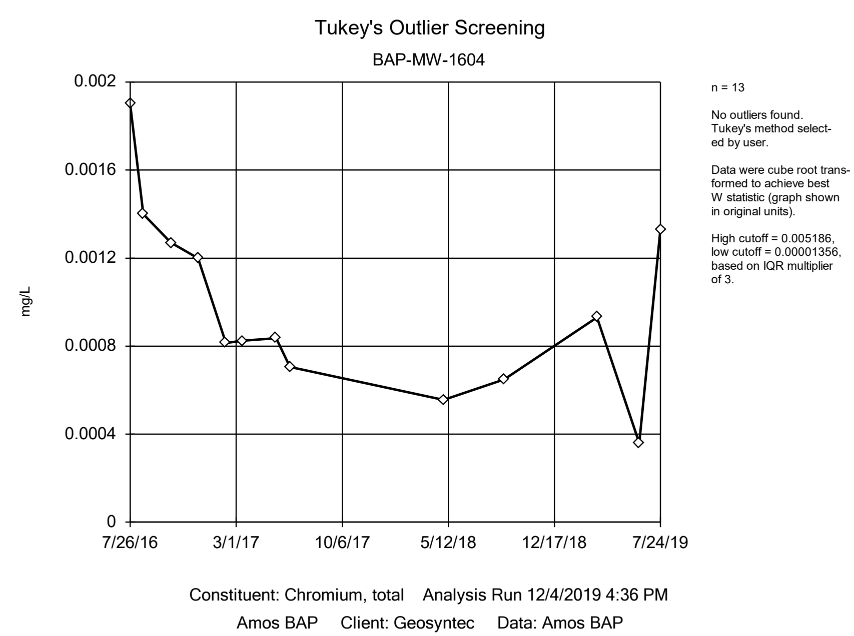
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

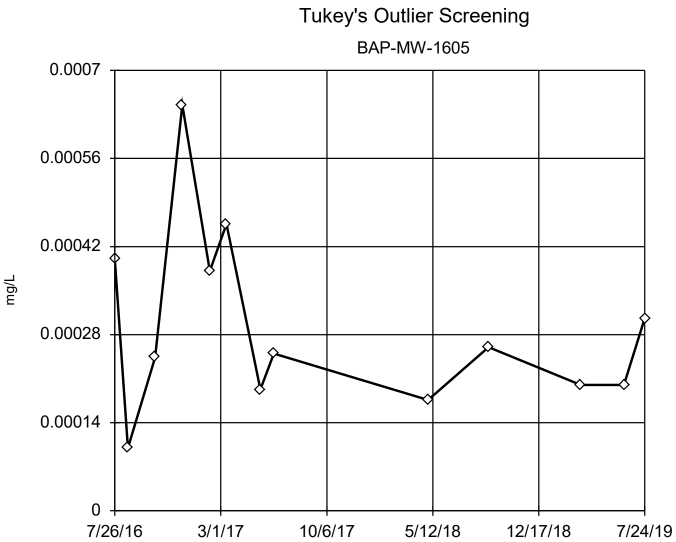


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG





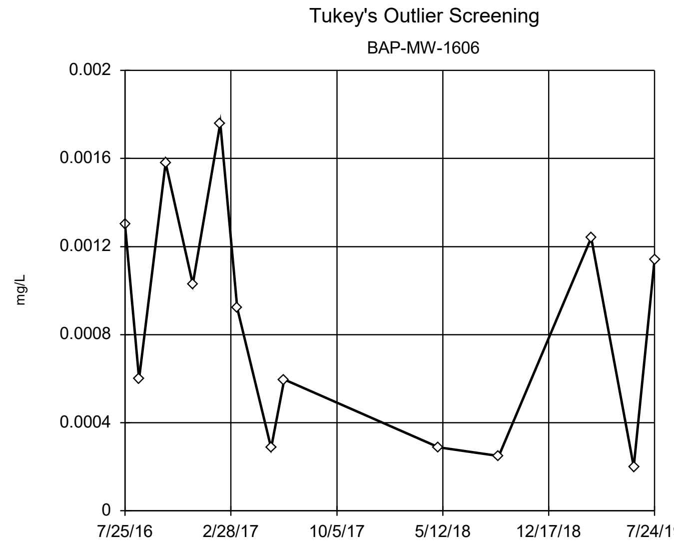
n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.003063, low cutoff = 0.00002504, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



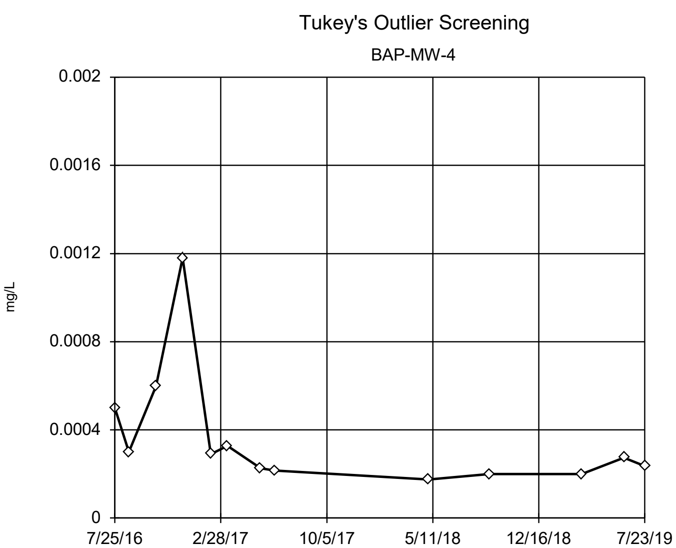
n = 13

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.004218, low cutoff = -0.00266, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



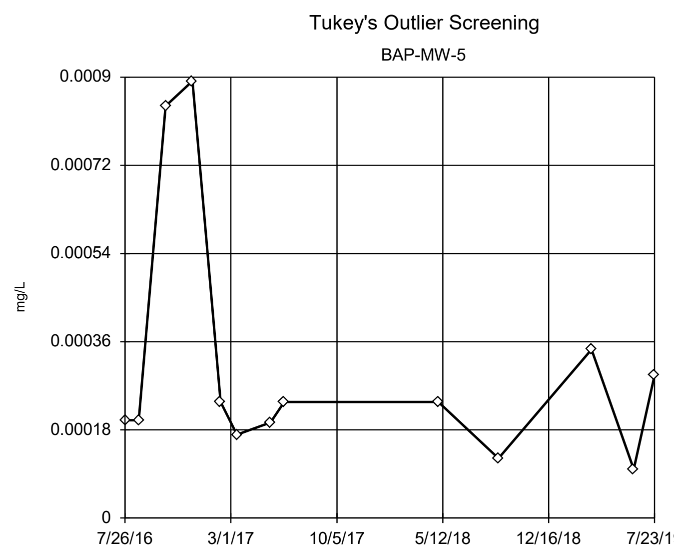
n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.002977, low cutoff = 0.00002823, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



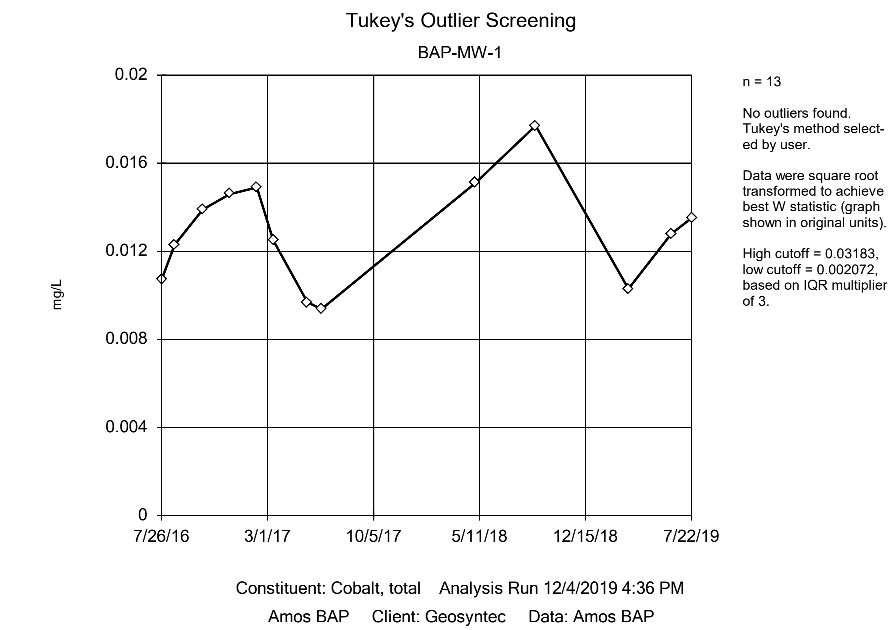
n = 13

No outliers found. Tukey's method selected by user.

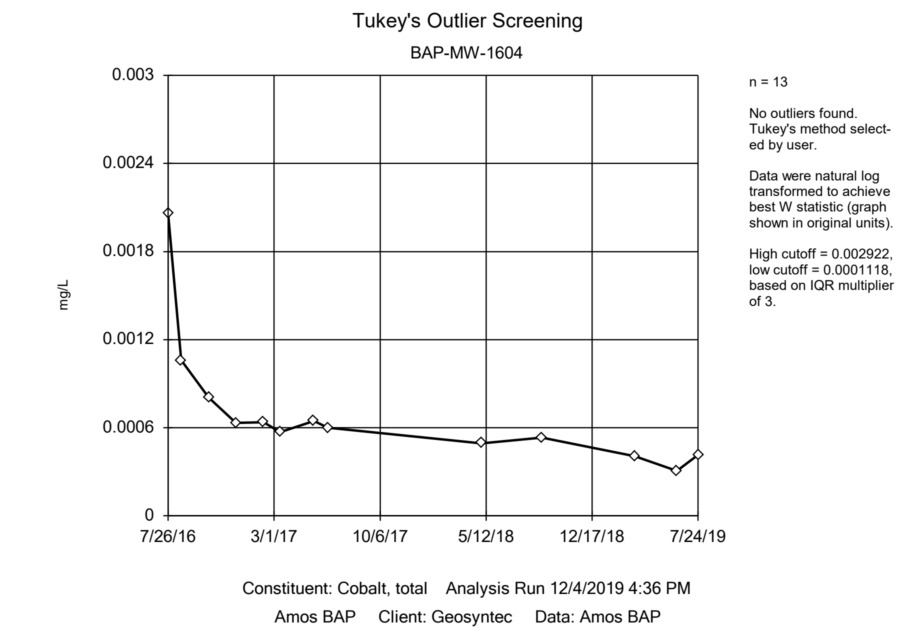
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.00166, low cutoff = 0.0000347, based on IQR multiplier of 3.

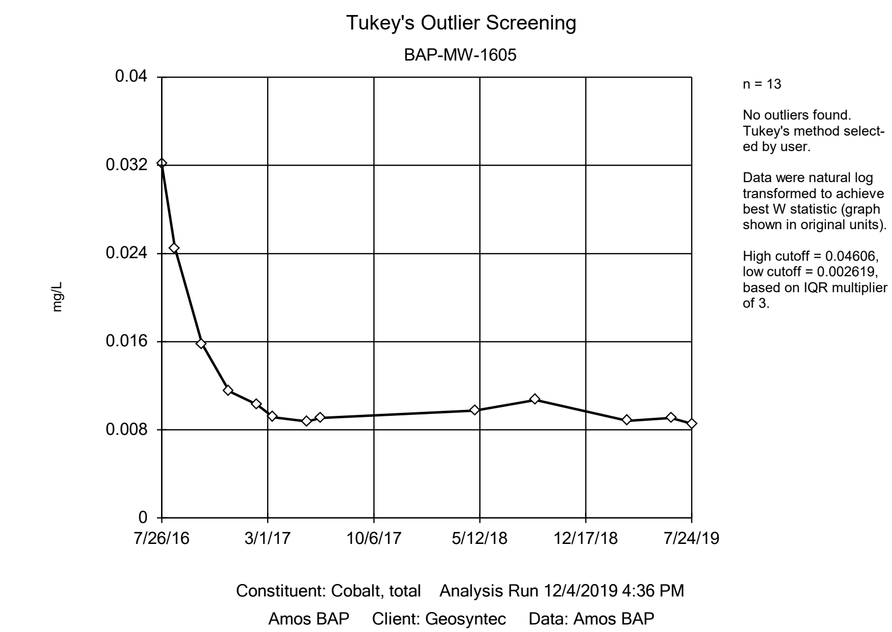
Constituent: Chromium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



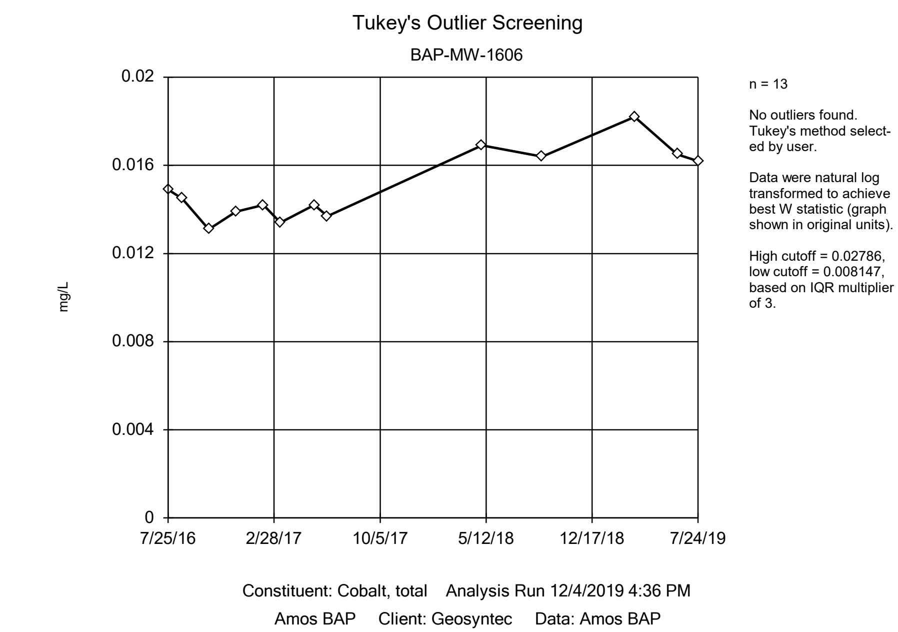
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

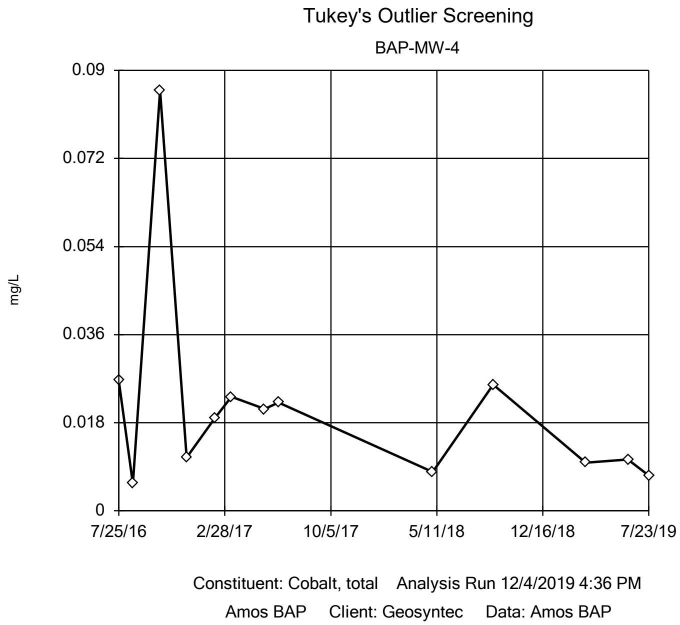


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG





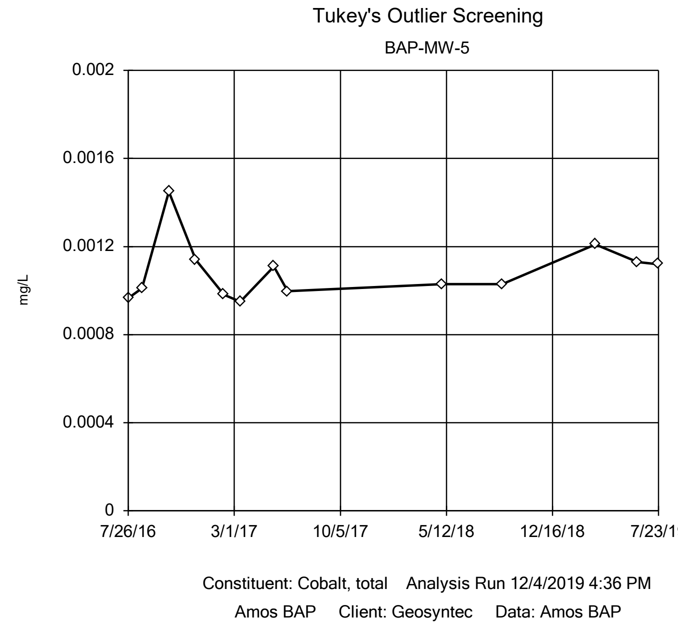
n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.5267, low cutoff = 0.0004106, based on IQR multiplier of 3.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



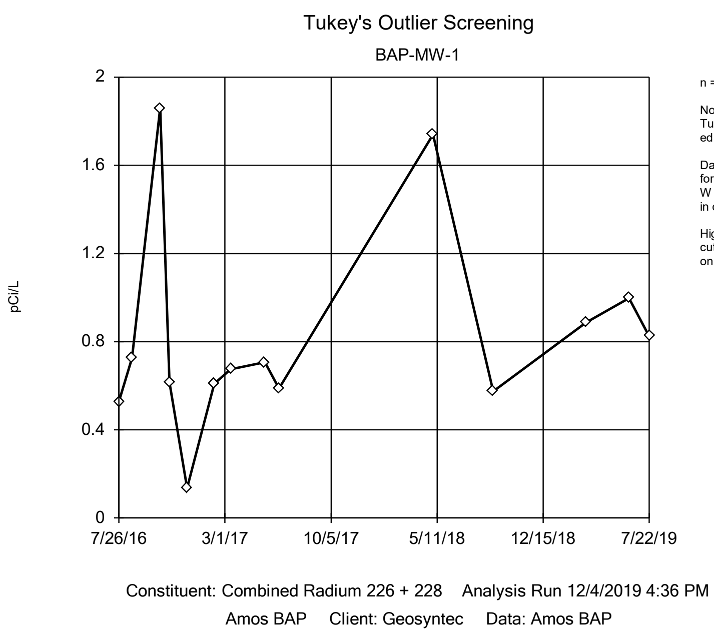
n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.001716, low cutoff = 0.0006543, based on IQR multiplier of 3.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



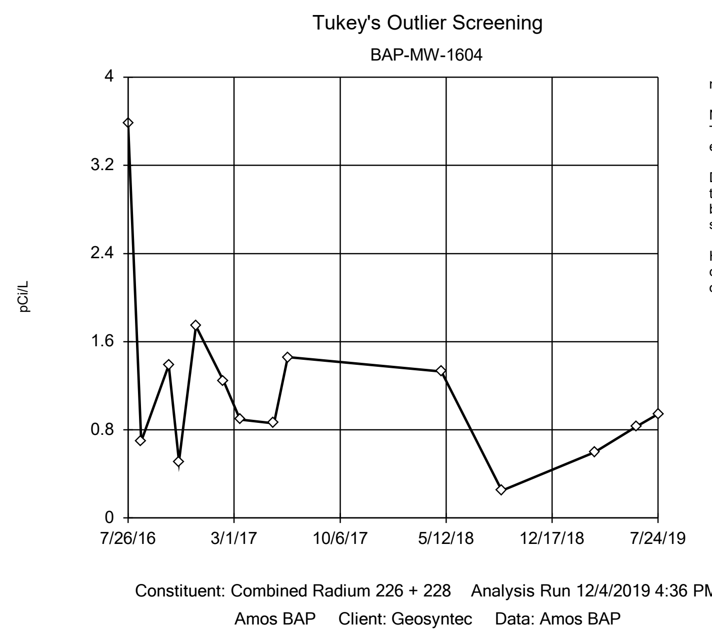
n = 14

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.845, low cutoff = 0.06279, based on IQR multiplier of 3.

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

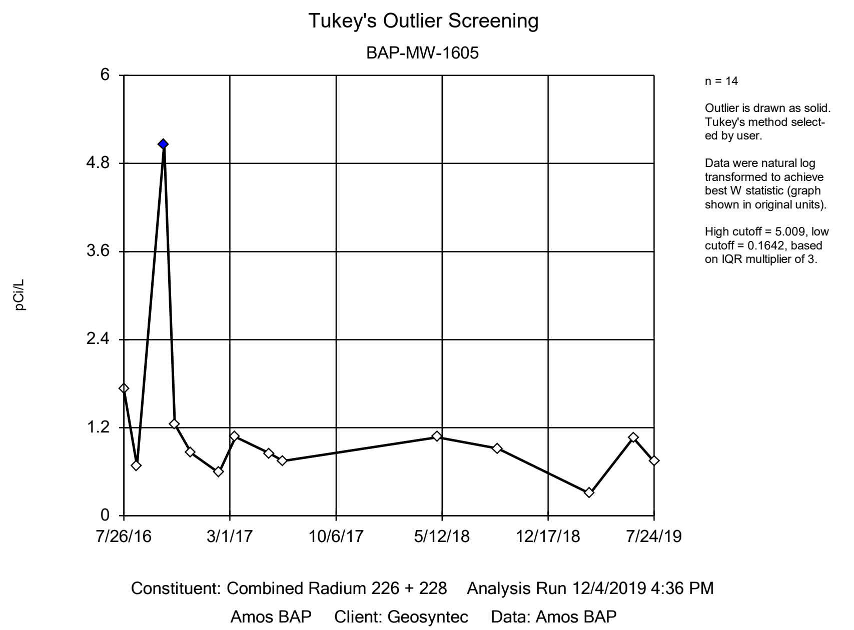


n = 14

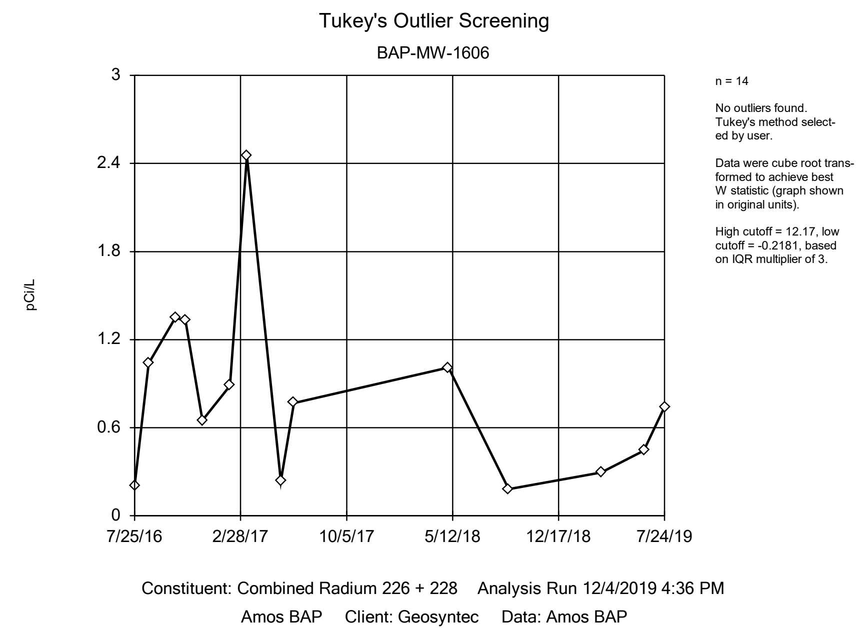
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

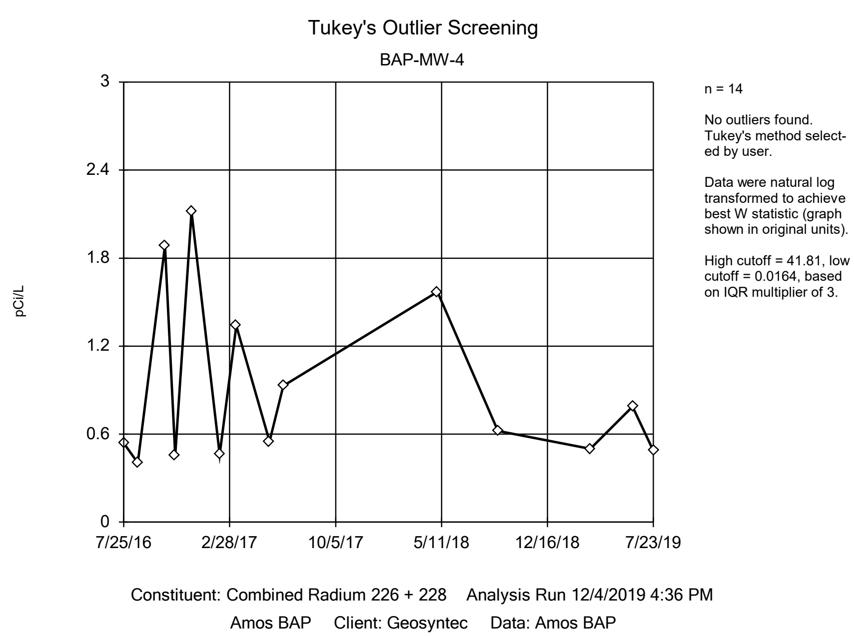
High cutoff = 15.36, low cutoff = 0.0596, based on IQR multiplier of 3.



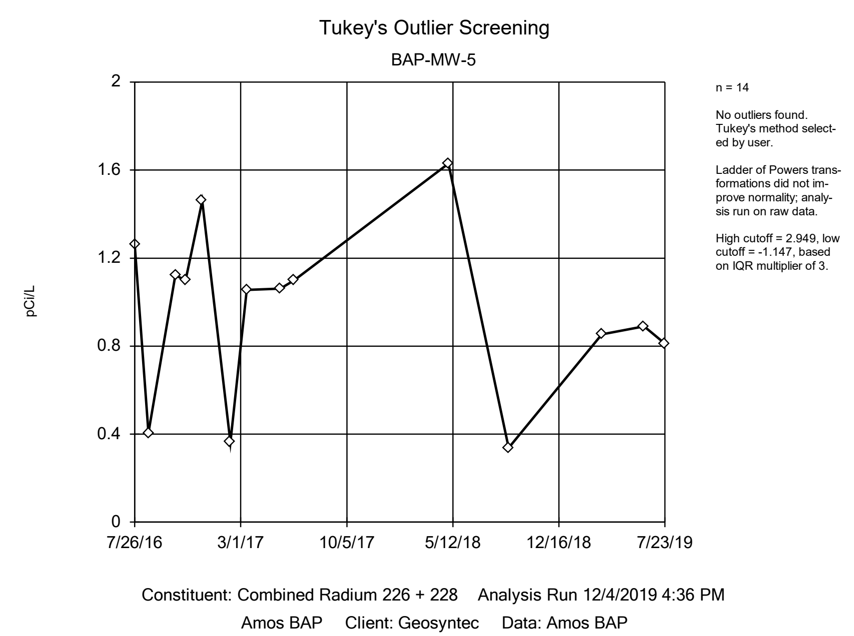
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

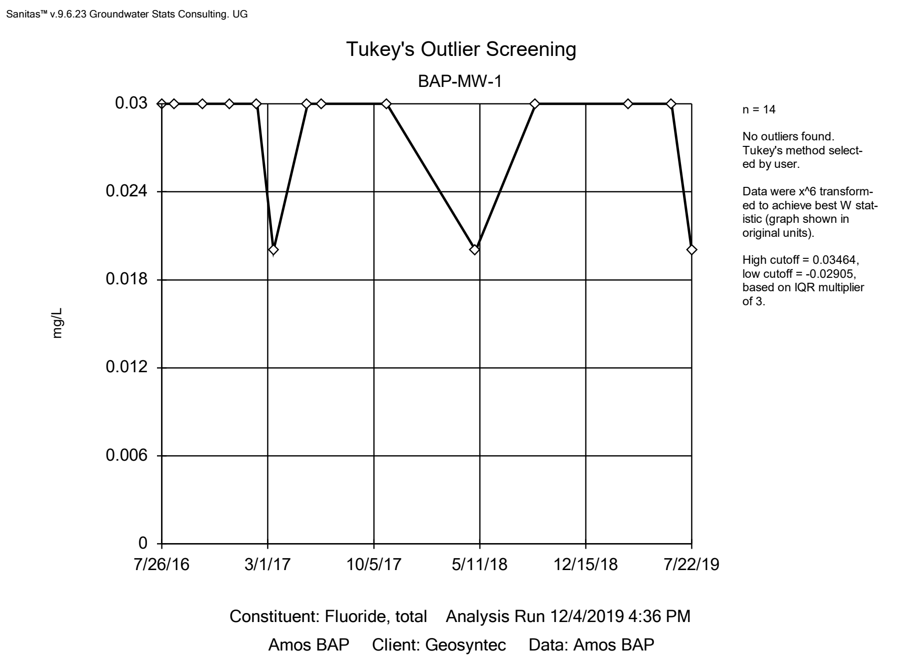


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

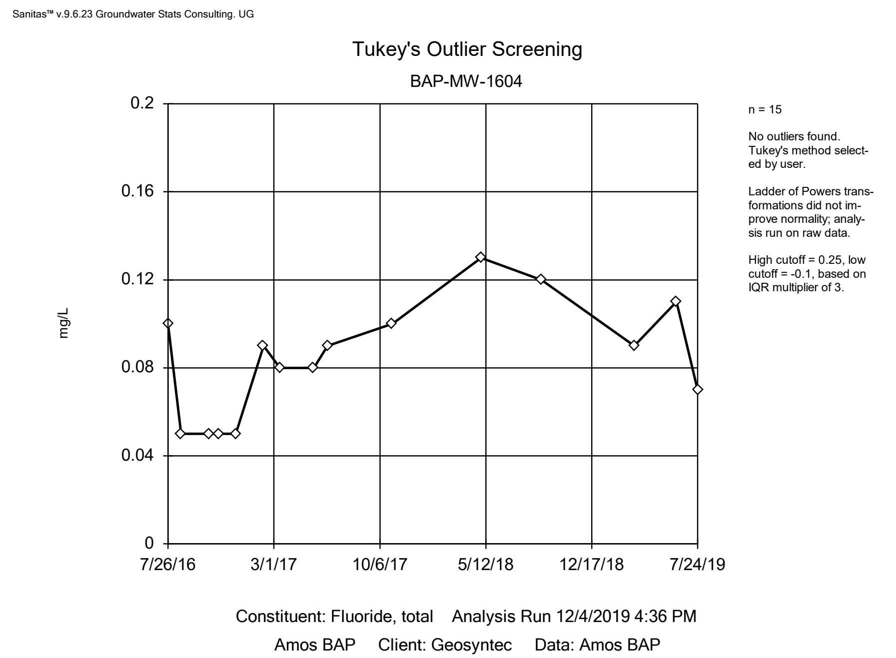


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

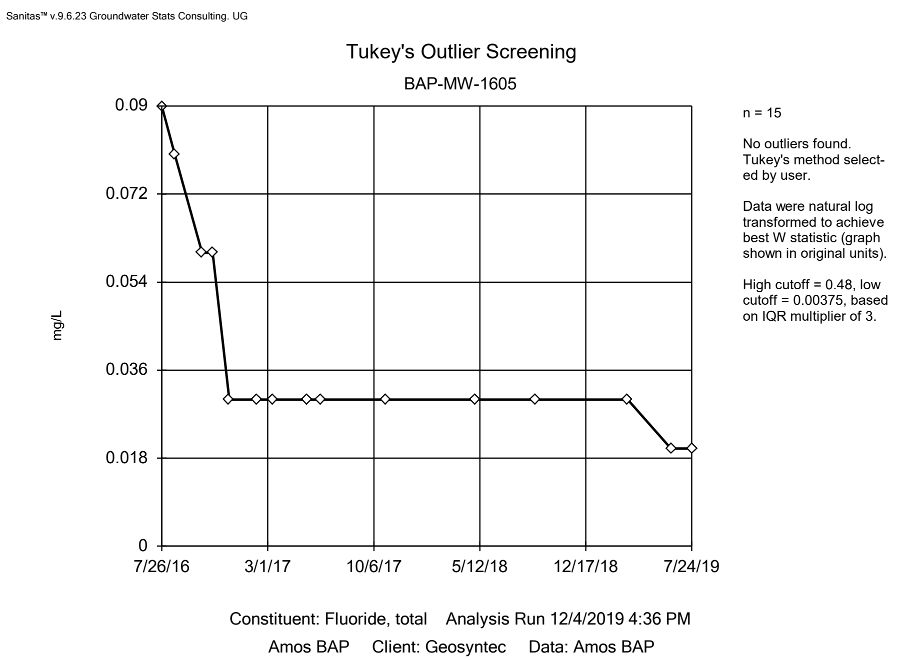




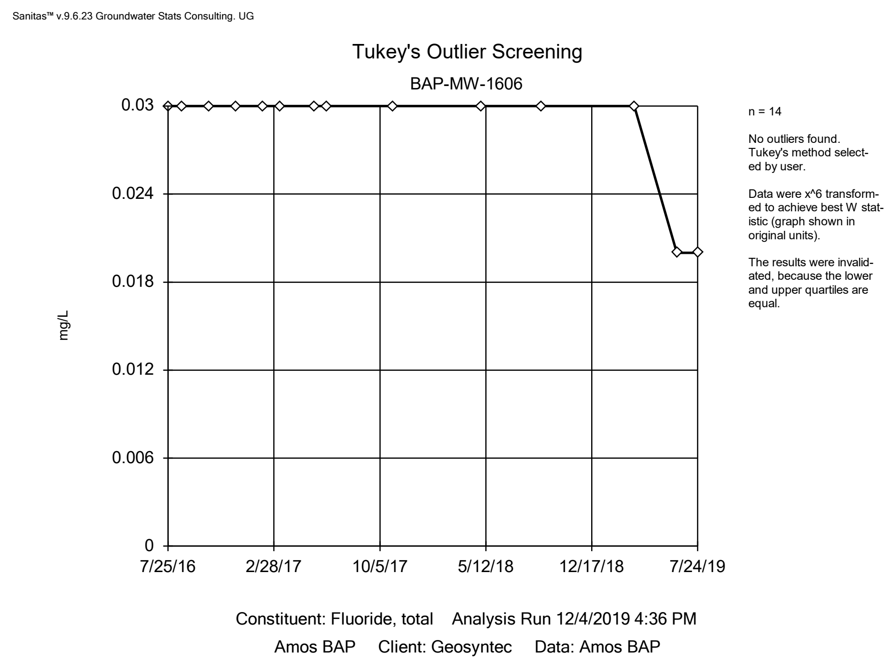
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1
0.03
0.024
0.018
0.012
0.006
0
mg/L
7/26/16
3/1/17
10/5/17
5/11/18
12/15/18
7/22/19
n = 14
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.03464, low cutoff = -0.02905, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



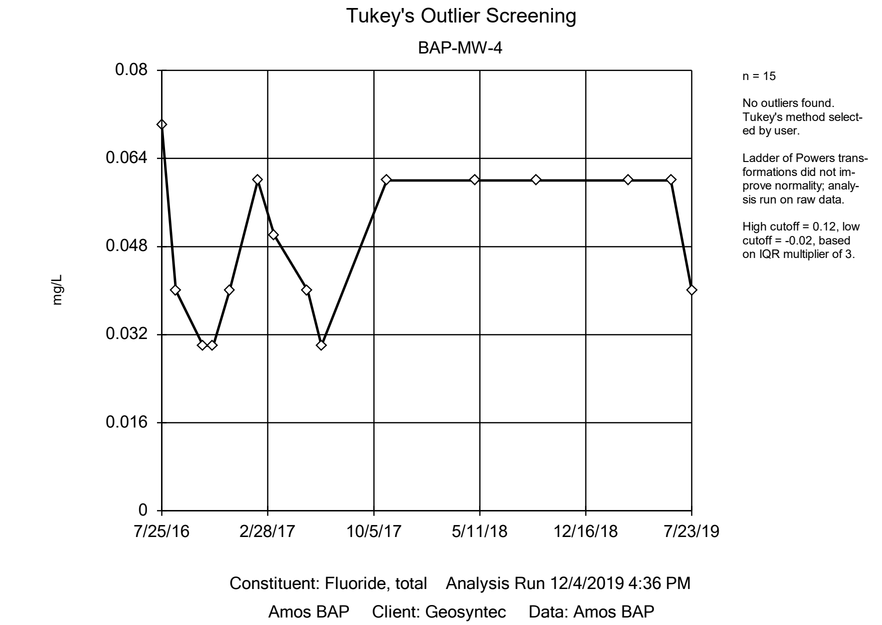
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1604
0.2
0.16
0.12
0.08
0.04
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 15
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.25, low cutoff = -0.1, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

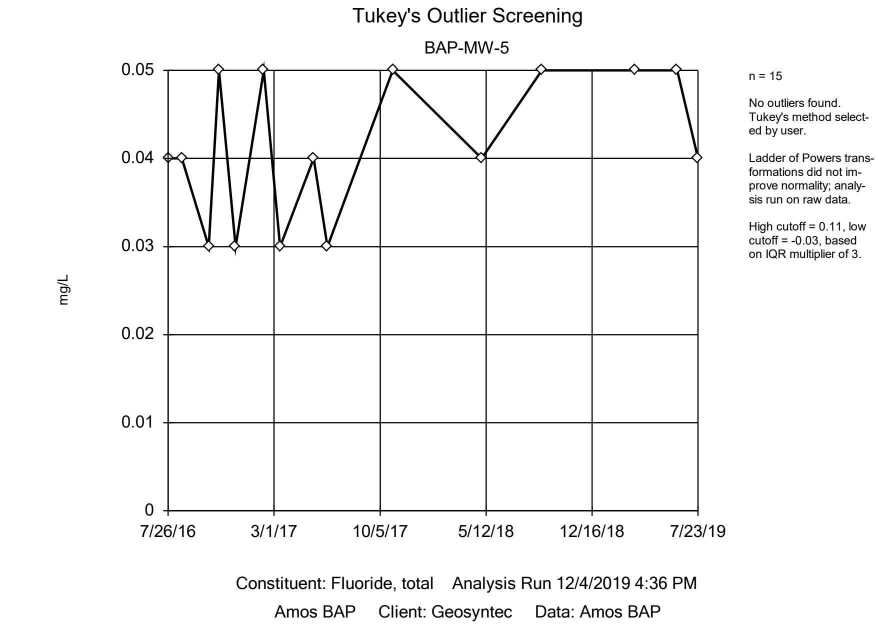


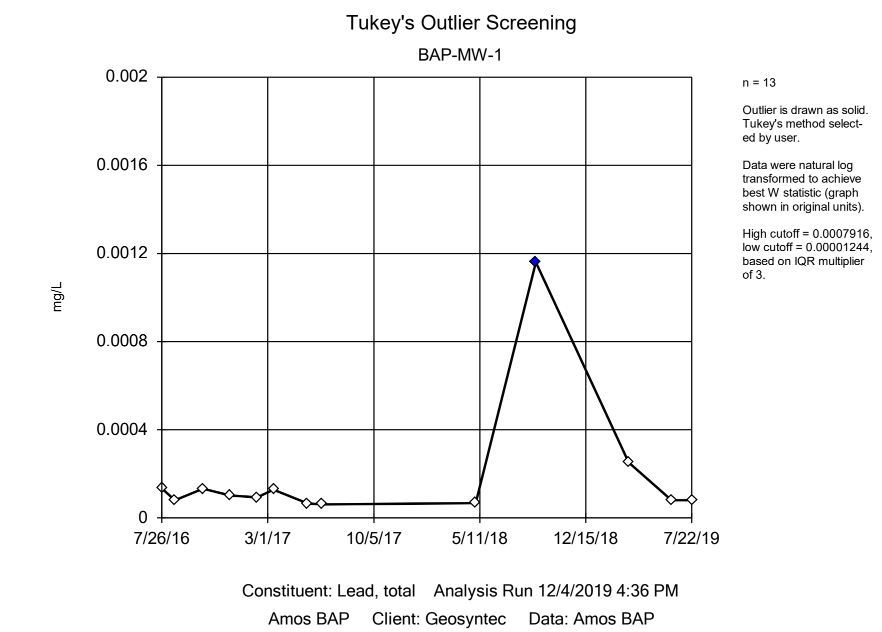
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1605
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 15
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.48, low cutoff = 0.00375, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

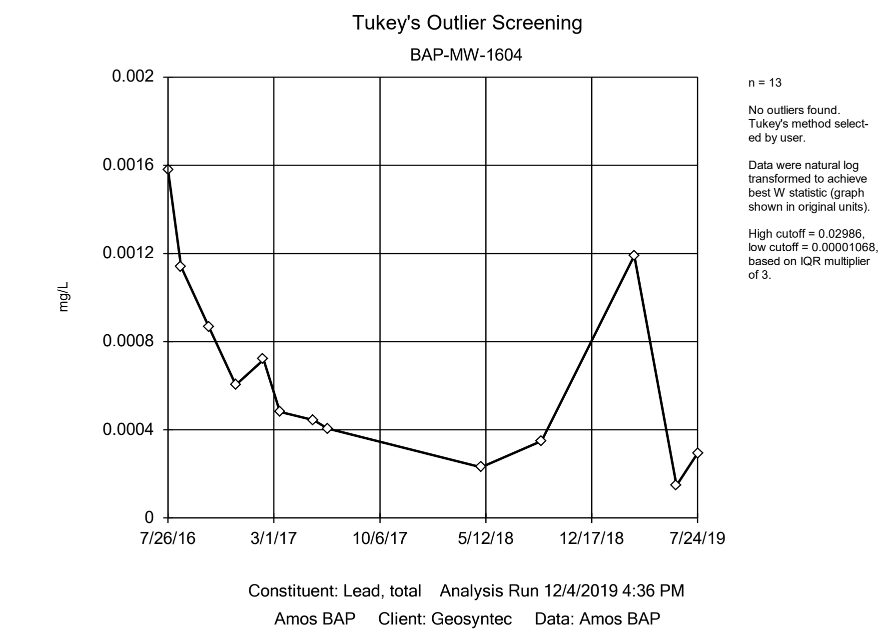


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1606
0.03
0.024
0.018
0.012
0.006
0
mg/L
7/25/16
2/28/17
10/5/17
5/12/18
12/17/18
7/24/19
n = 14
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Fluoride, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

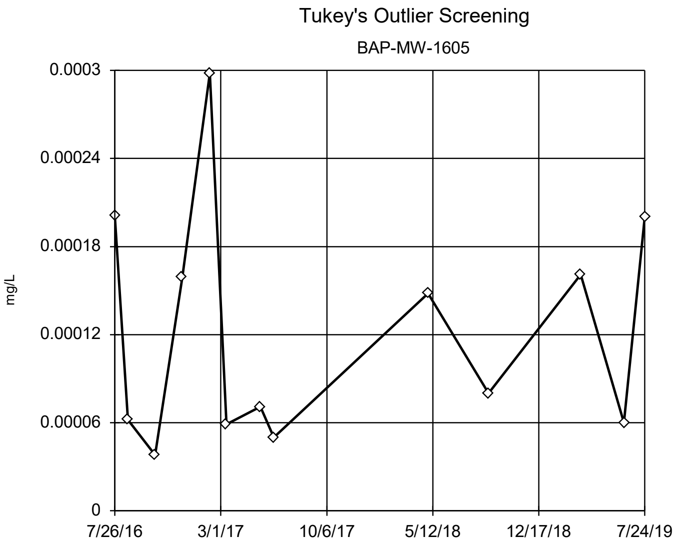

Tukey's Outlier Screening
BAP-MW-4
0.08
0.064
0.048
0.032
0.016
0
mg/L
7/25/16
2/28/17
10/5/17
5/11/18
12/16/18
7/23/19
n = 15
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.12, low cutoff = -0.02, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Tukey's Outlier Screening
BAP-MW-5
0.05
0.04
0.03
0.02
0.01
0
mg/L
7/26/16
3/1/17
10/5/17
5/12/18
12/16/18
7/23/19
n = 15
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.11, low cutoff = -0.03, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Tukey's Outlier Screening
BAP-MW-1
0.002
0.0016
0.0012
0.0008
0.0004
0
mg/L
7/26/16
3/1/17
10/5/17
5/11/18
12/15/18
7/22/19
n = 13
Outlier is drawn as solid. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0007916, low cutoff = 0.00001244, based on IQR multiplier of 3.
Constituent: Lead, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP


Tukey's Outlier Screening
BAP-MW-1604
0.002
0.0016
0.0012
0.0008
0.0004
0
mg/L
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.02986, low cutoff = 0.00001068, based on IQR multiplier of 3.
Constituent: Lead, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

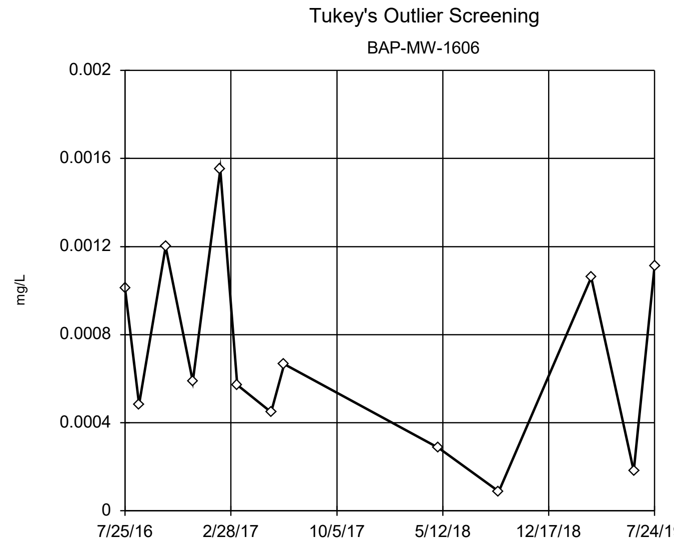
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.004923, low cutoff = 0.000002169, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

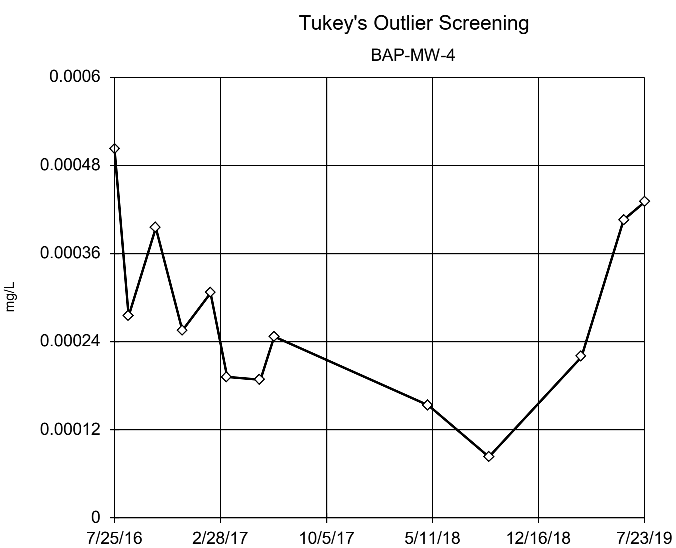
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.00557, low cutoff = -0.0005133, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

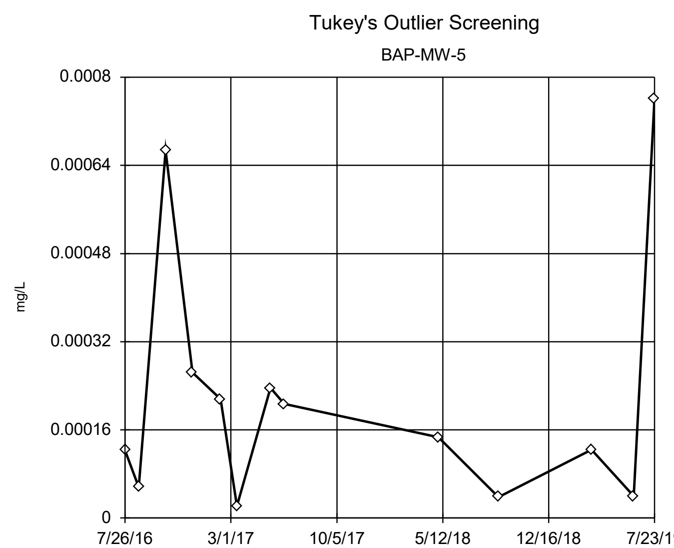
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.001497, low cutoff = -0.00002402, based on IQR multiplier of 3.

Constituent: Lead, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 13

No outliers found. Tukey's method selected by user.

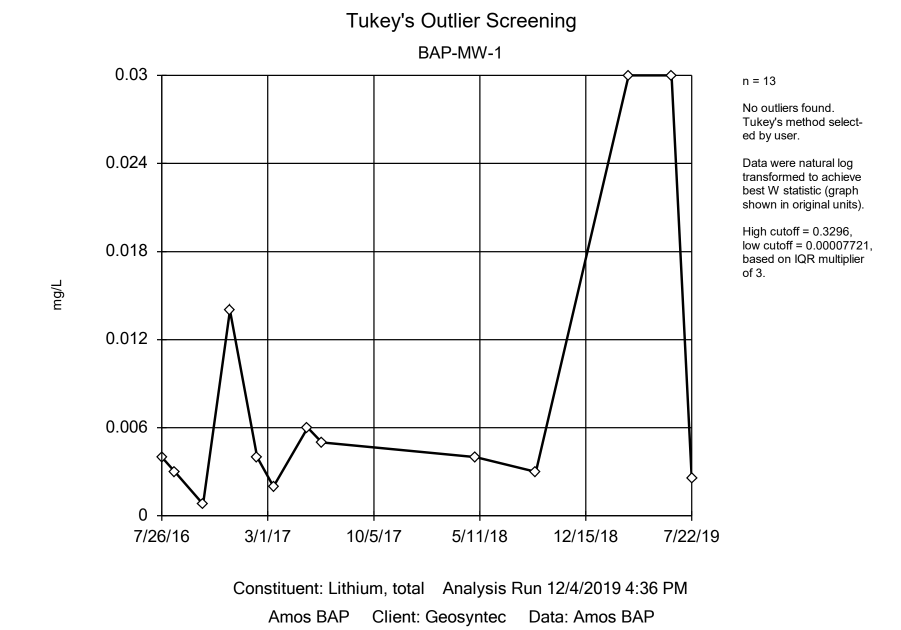
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.03662, low cutoff = 3.2e-7, based on IQR multiplier of 3.

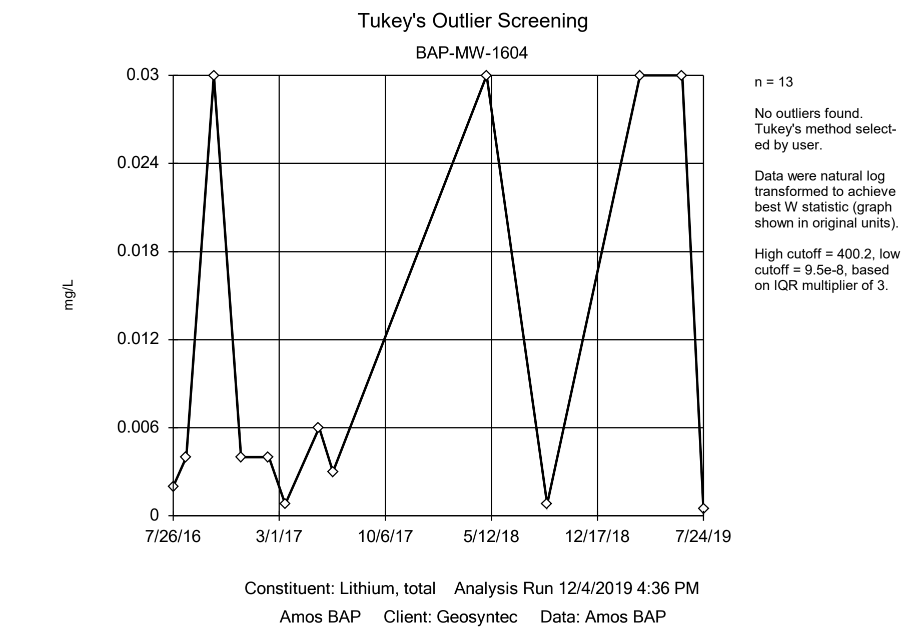
Constituent: Lead, total   Analysis Run 12/4/2019 4:36 PM

Amos BAP   Client: Geosyntec   Data: Amos BAP

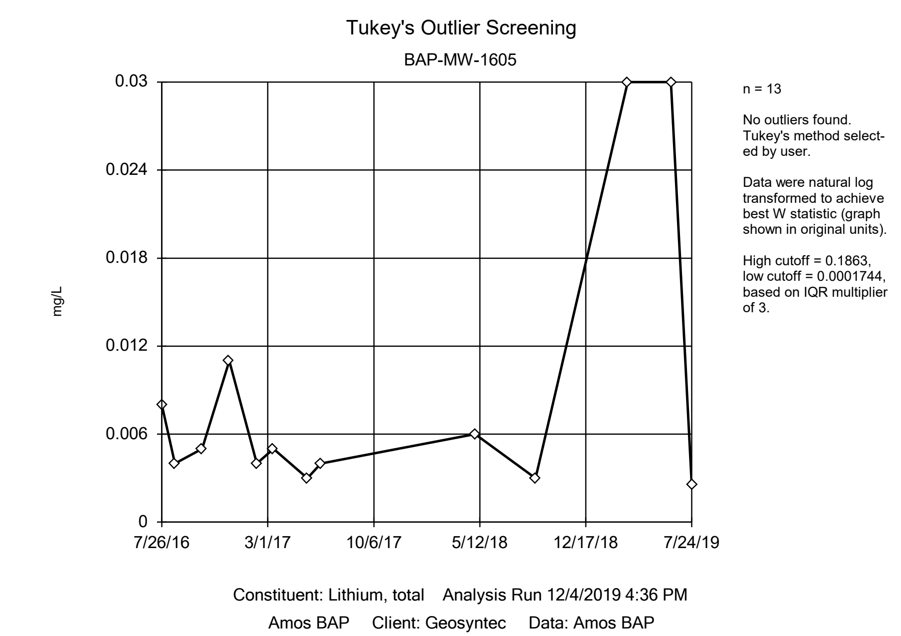
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



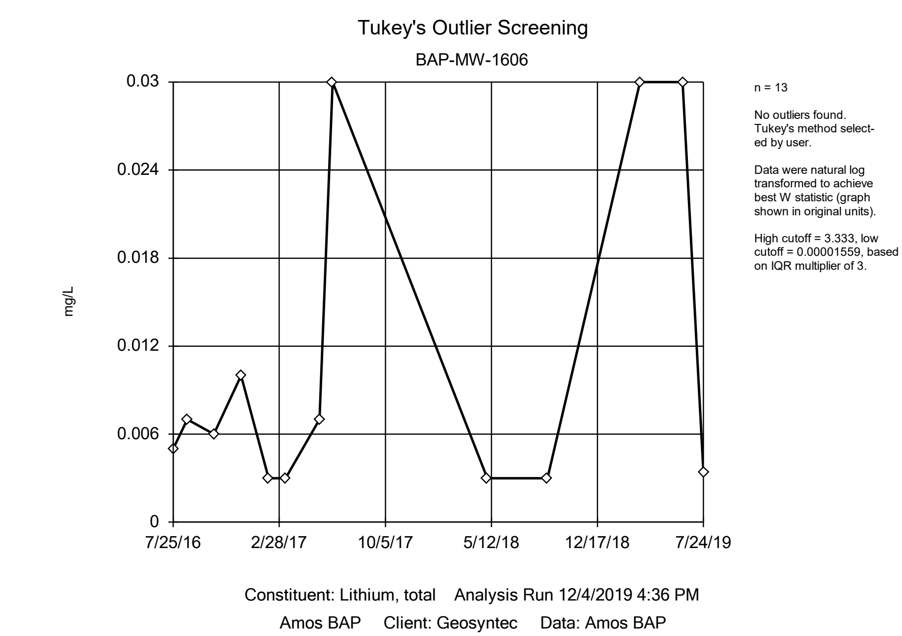
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

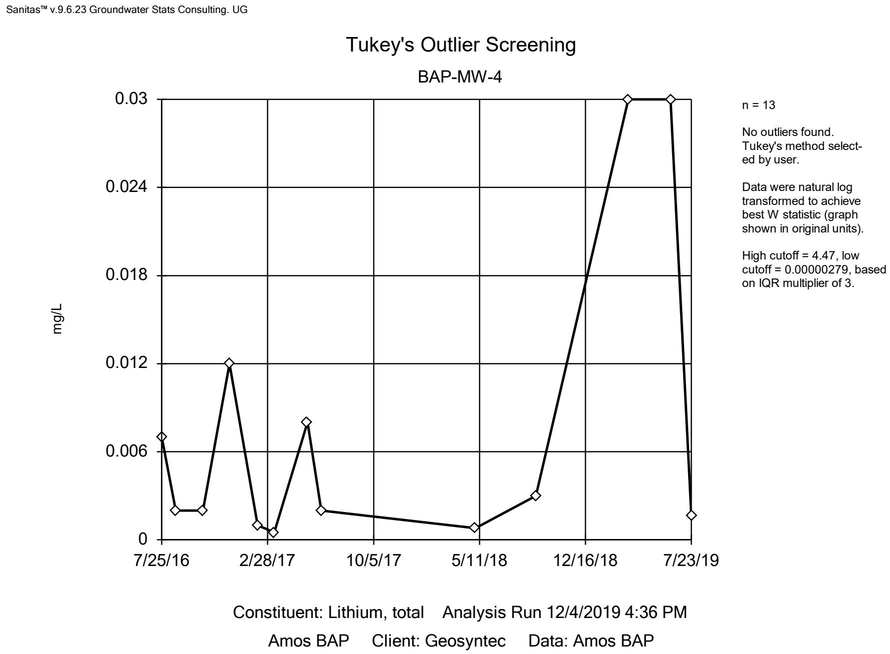


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

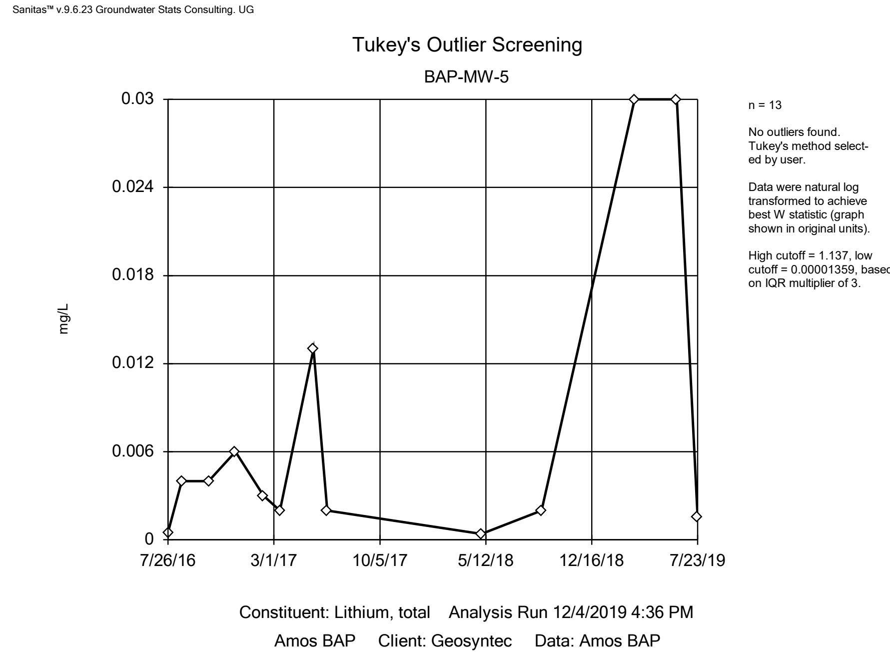


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

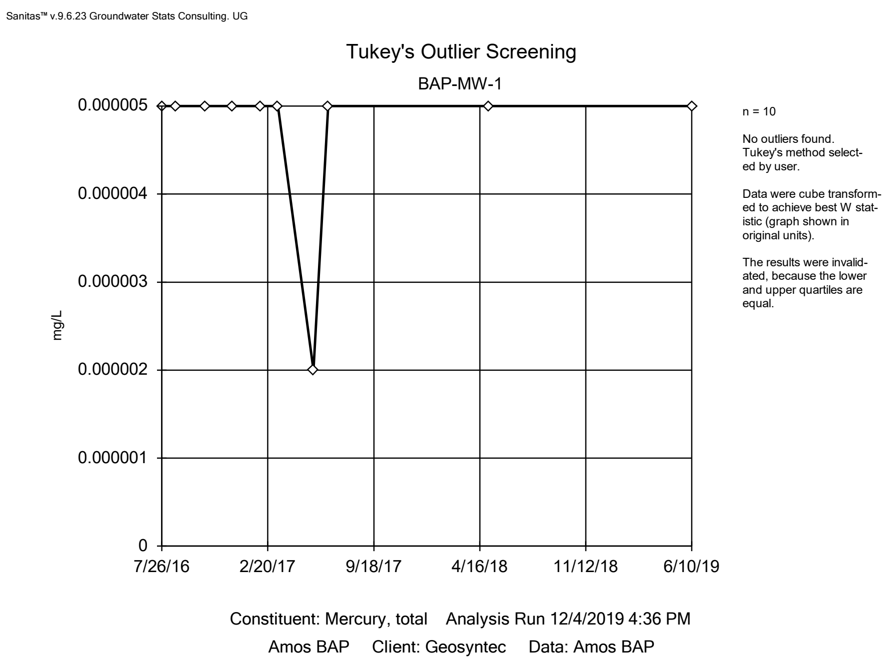




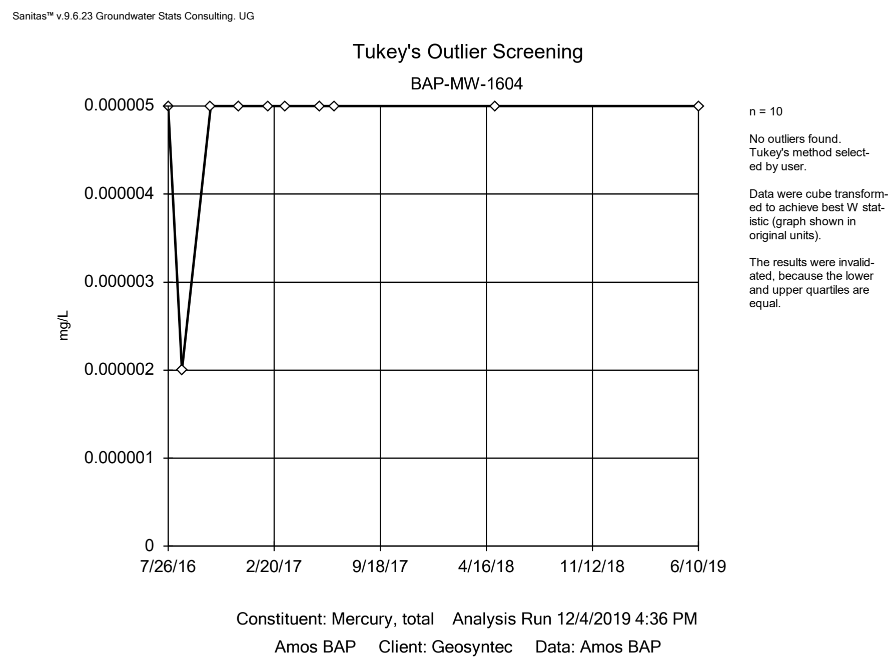
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-4
mg/L
0.03
0.024
0.018
0.012
0.006
0
7/25/16
2/28/17
10/5/17
5/11/18
12/16/18
7/23/19
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 4.47, low cutoff = 0.00000279, based on IQR multiplier of 3.
Constituent: Lithium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-5
mg/L
0.03
0.024
0.018
0.012
0.006
0
7/26/16
3/1/17
10/5/17
5/12/18
12/16/18
7/23/19
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 1.137, low cutoff = 0.00001359, based on IQR multiplier of 3.
Constituent: Lithium, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

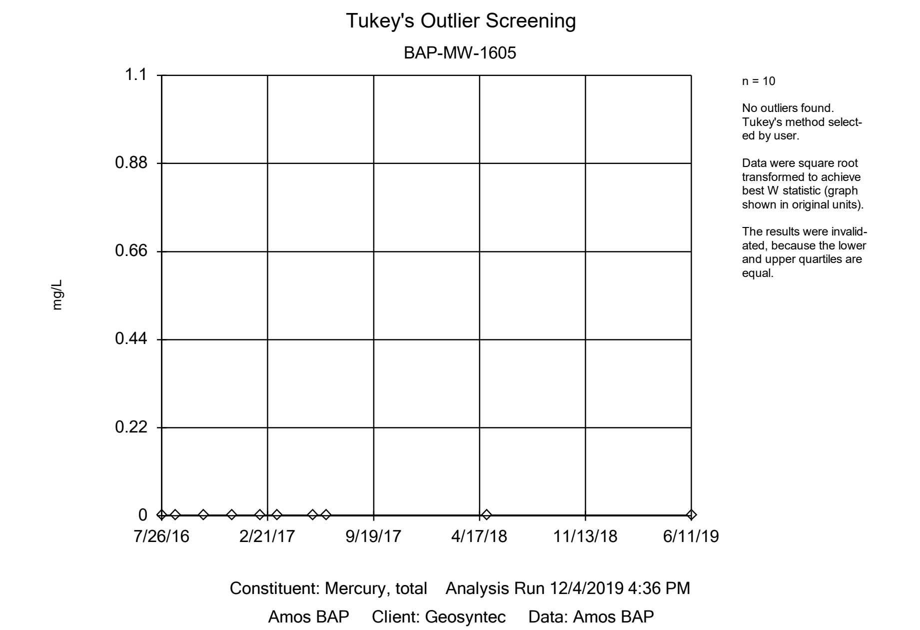


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1
mg/L
0.000005
0.000004
0.000003
0.000002
0.000001
0
7/26/16
2/20/17
9/18/17
4/16/18
11/12/18
6/10/19
n = 10
No outliers found. Tukey's method selected by user.
Data were cube transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

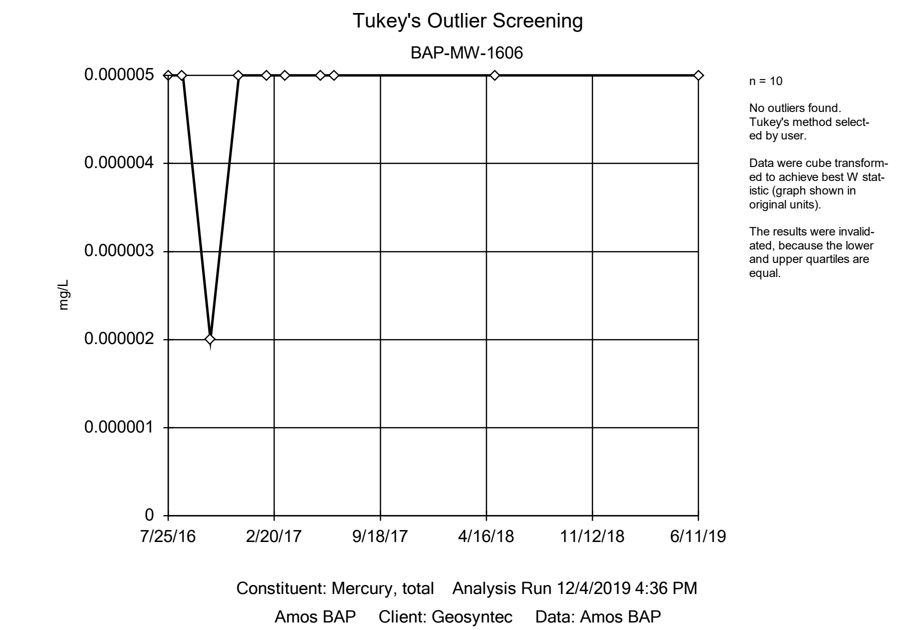


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1604
mg/L
0.000005
0.000004
0.000003
0.000002
0.000001
0
7/26/16
2/20/17
9/18/17
4/16/18
11/12/18
6/10/19
n = 10
No outliers found. Tukey's method selected by user.
Data were cube transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP

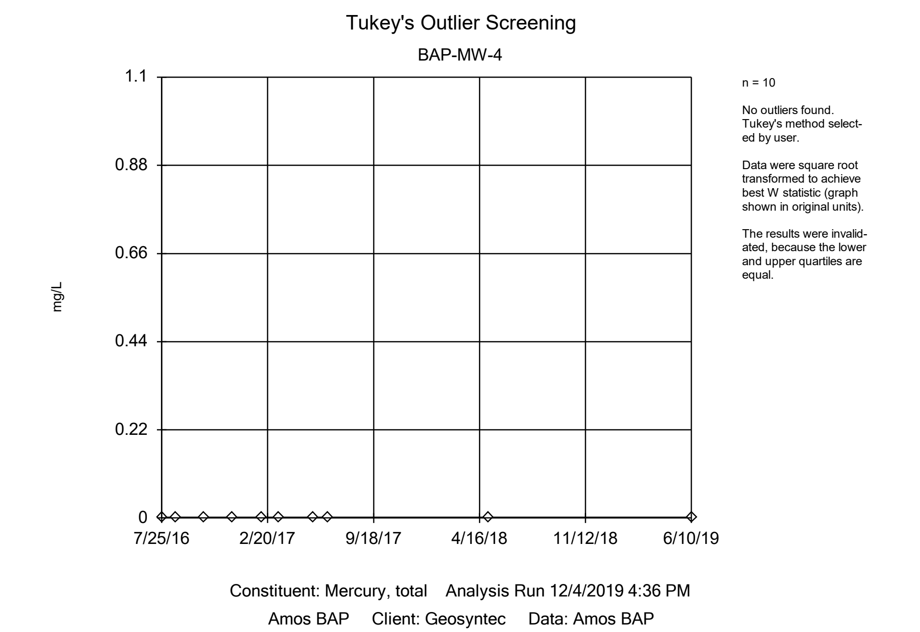
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



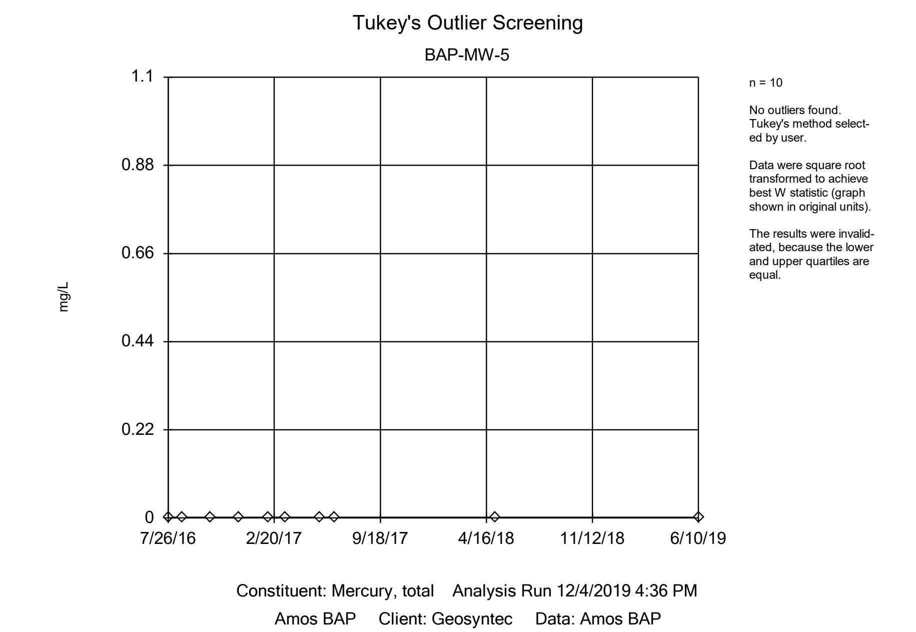
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



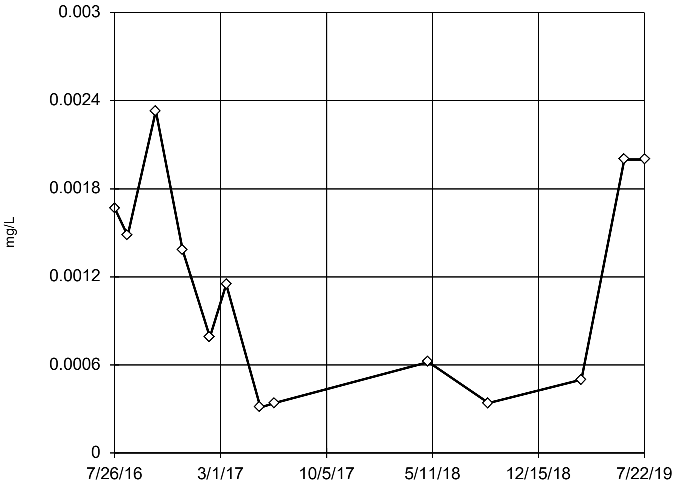
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1



n = 13

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01209, low cutoff = -0.002188, based on IQR multiplier of 3.

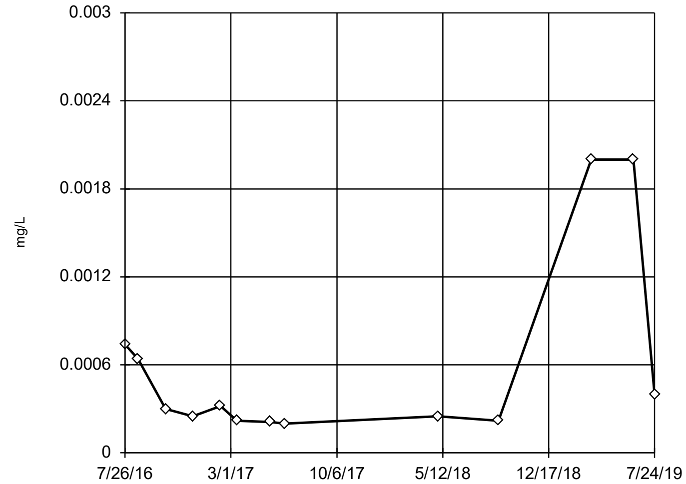
Constituent: Molybdenum, total Analysis Run 12/4/2019 4:36 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1604



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.02106, low cutoff = 0.000007187, based on IQR multiplier of 3.

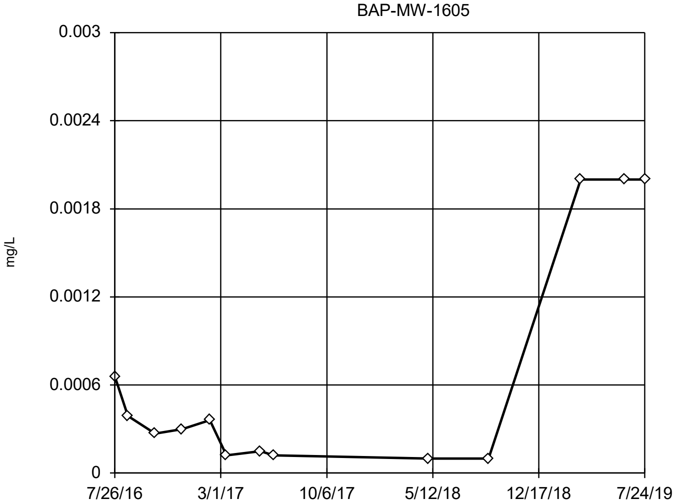
Constituent: Molybdenum, total Analysis Run 12/4/2019 4:36 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1605



n = 13

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.008, low cutoff = 1.4e-7, based on IQR multiplier of 3.

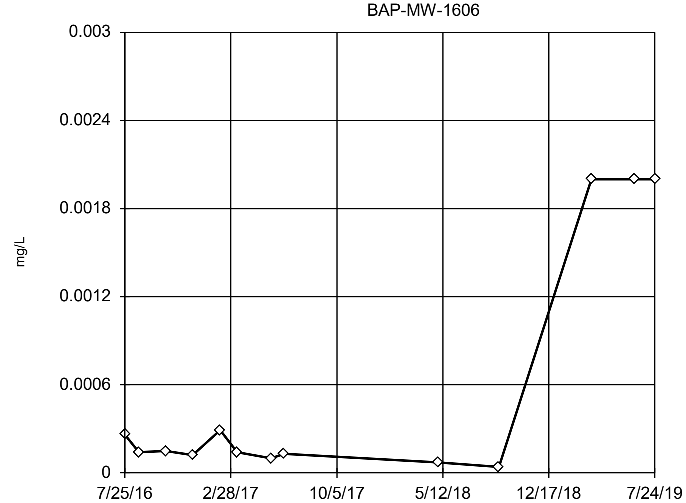
Constituent: Molybdenum, total Analysis Run 12/4/2019 4:36 PM

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

BAP-MW-1606



n = 13

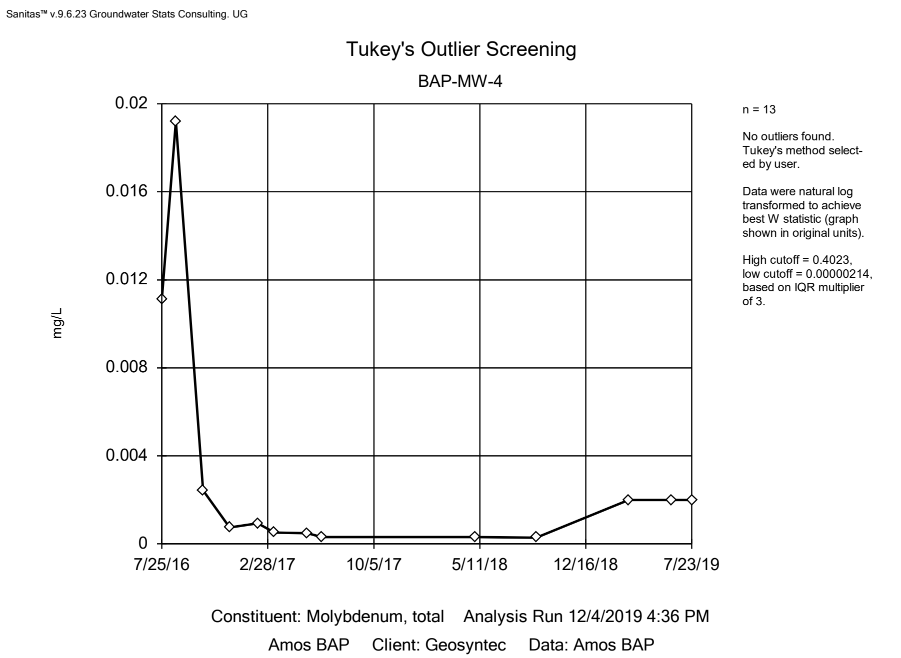
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

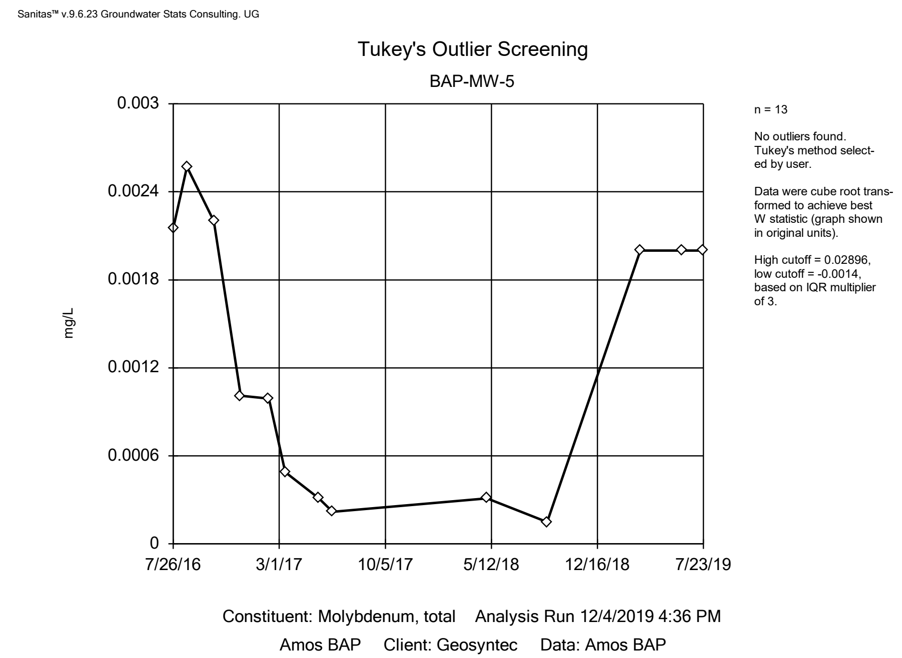
High cutoff = 0.2559, low cutoff = 3.3e-7, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 12/4/2019 4:36 PM

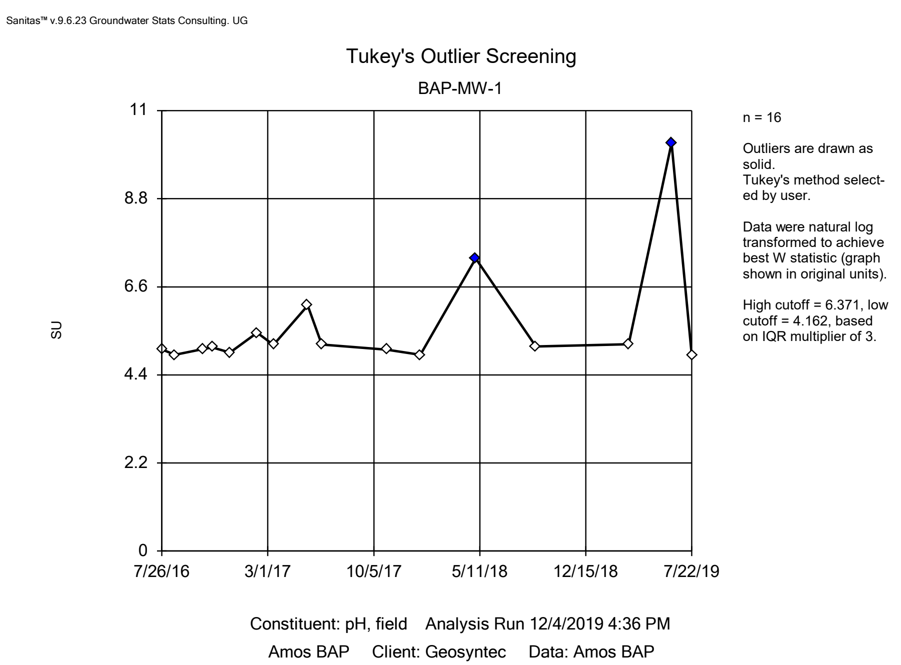
Amos BAP Client: Geosyntec Data: Amos BAP



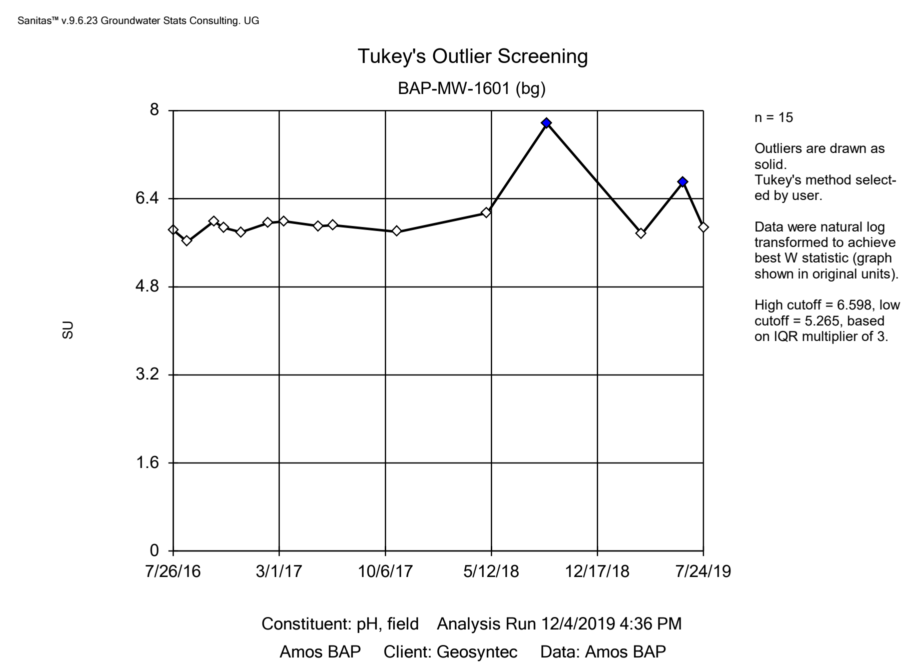
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-4
0.02
0.016
0.012
0.008
0.004
0
mg/L
7/25/16
2/28/17
10/5/17
5/11/18
12/16/18
7/23/19
n = 13
No outliers found.
Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.4023, low cutoff = 0.00000214, based on IQR multiplier of 3.
Constituent: Molybdenum, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



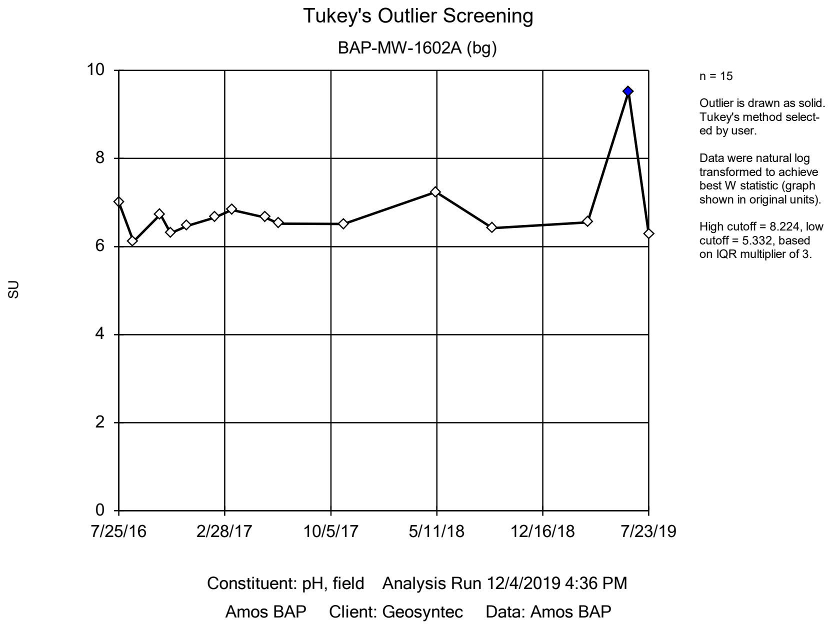
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-5
0.003
0.0024
0.0018
0.0012
0.0006
0
mg/L
7/26/16
3/1/17
10/5/17
5/12/18
12/16/18
7/23/19
n = 13
No outliers found.
Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.02896, low cutoff = -0.0014, based on IQR multiplier of 3.
Constituent: Molybdenum, total Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



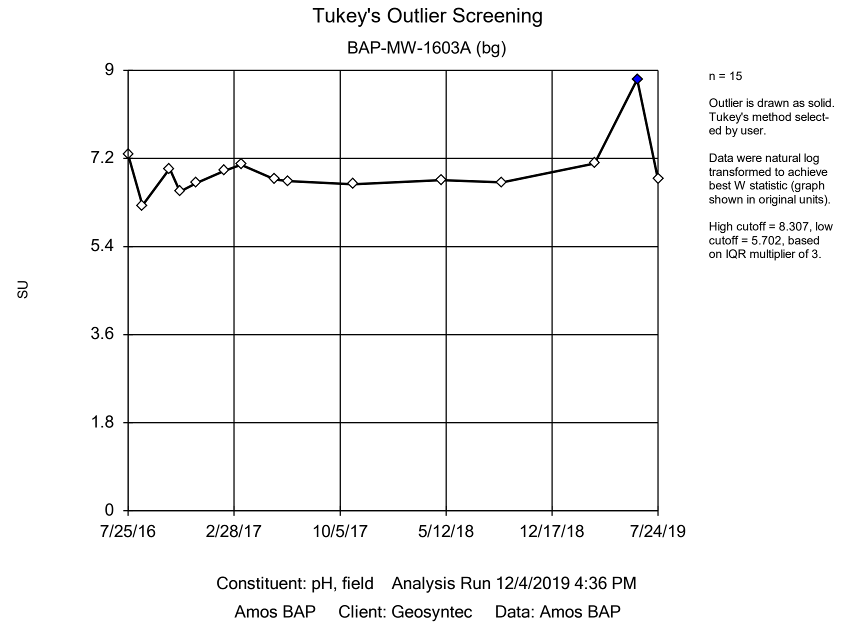
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1
11
8.8
6.6
4.4
2.2
0
SU
7/26/16
3/1/17
10/5/17
5/11/18
12/15/18
7/22/19
n = 16
Outliers are drawn as solid.
Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 6.371, low cutoff = 4.162, based on IQR multiplier of 3.
Constituent: pH, field Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



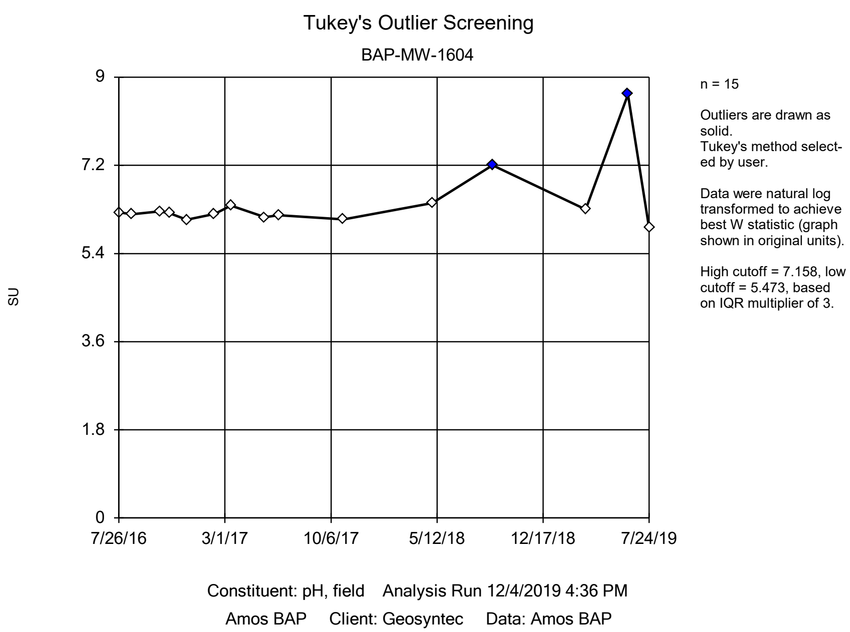
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
BAP-MW-1601 (bg)
8
6.4
4.8
3.2
1.6
0
SU
7/26/16
3/1/17
10/6/17
5/12/18
12/17/18
7/24/19
n = 15
Outliers are drawn as solid.
Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 6.598, low cutoff = 5.265, based on IQR multiplier of 3.
Constituent: pH, field Analysis Run 12/4/2019 4:36 PM
Amos BAP Client: Geosyntec Data: Amos BAP



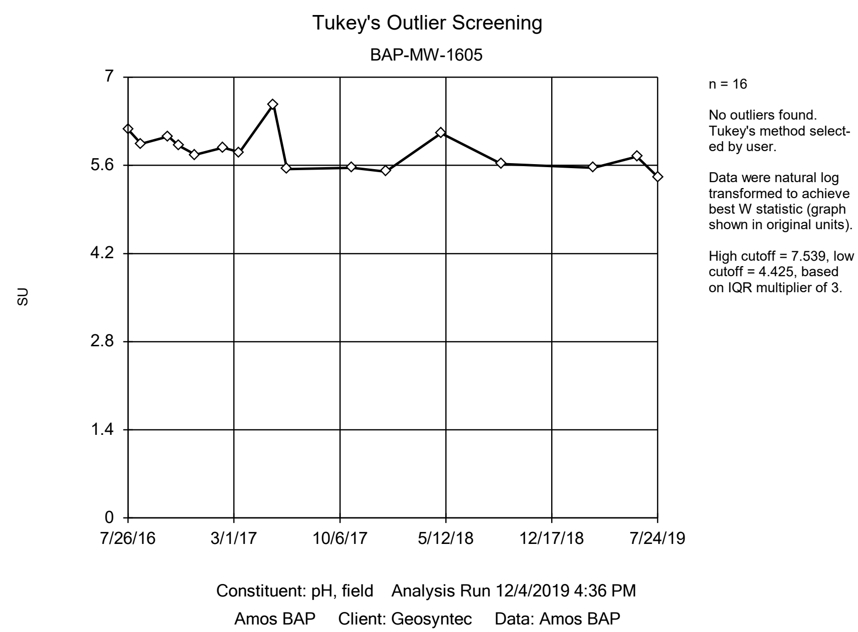
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



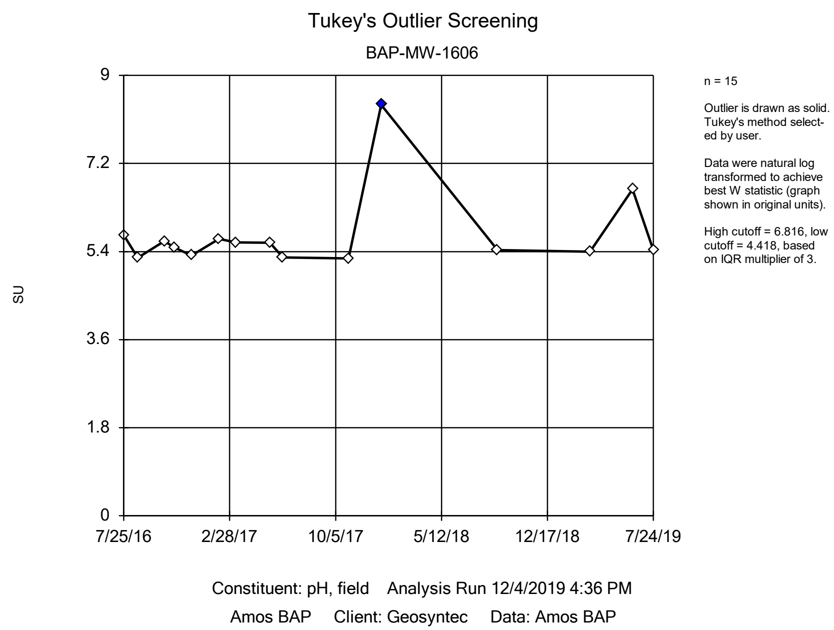
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



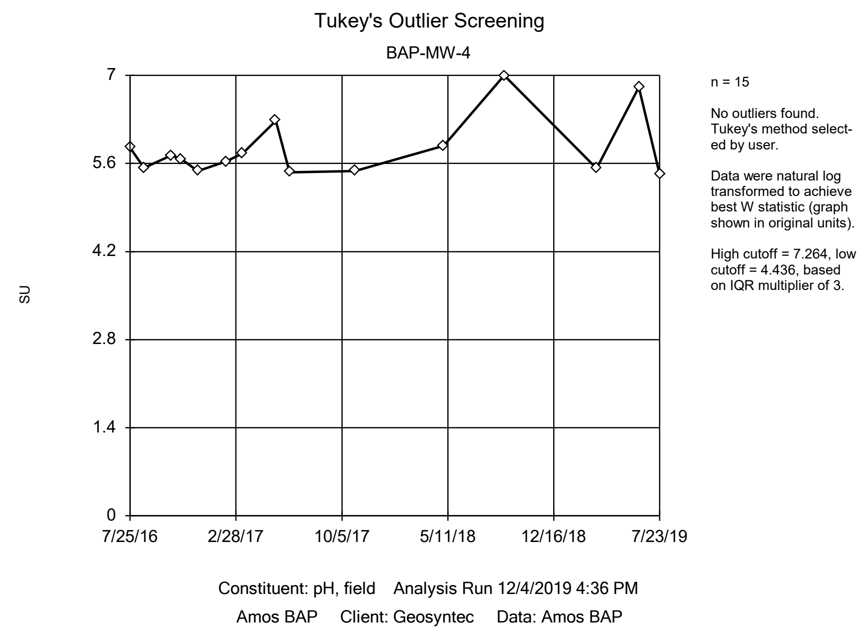
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



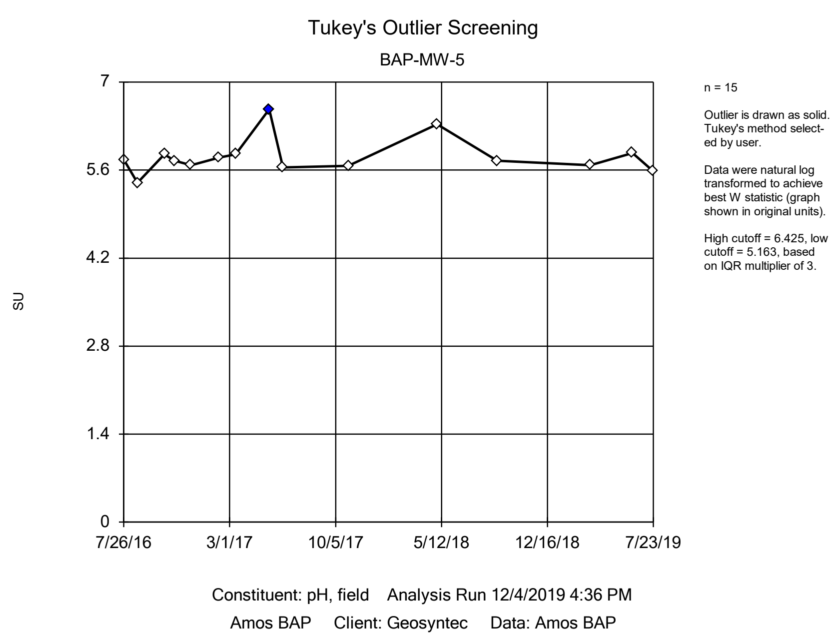
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



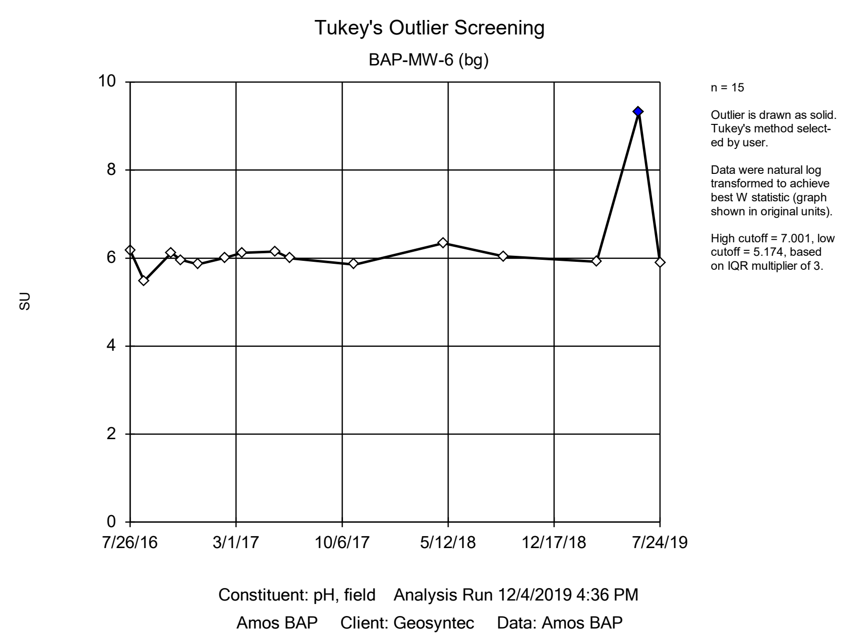
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

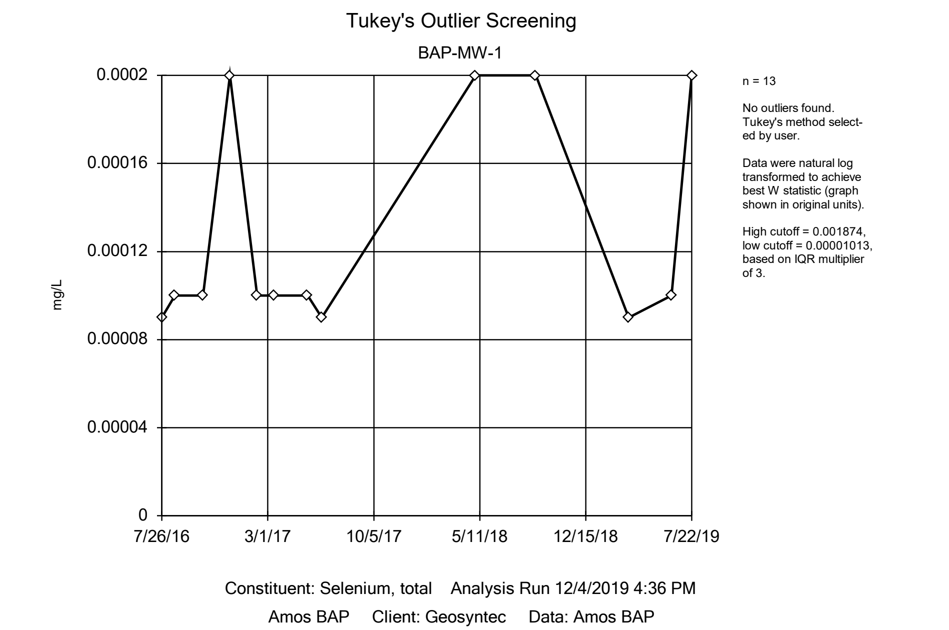


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

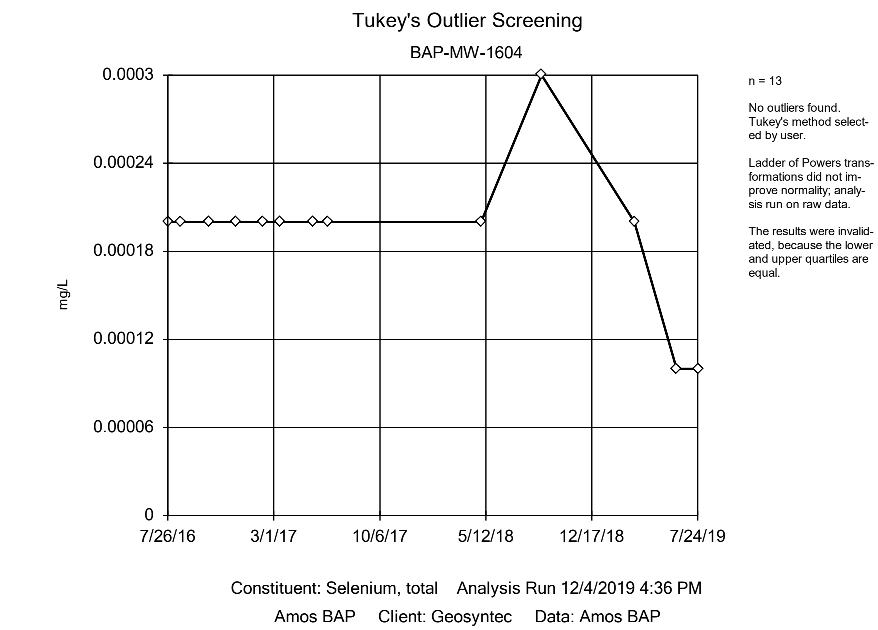


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

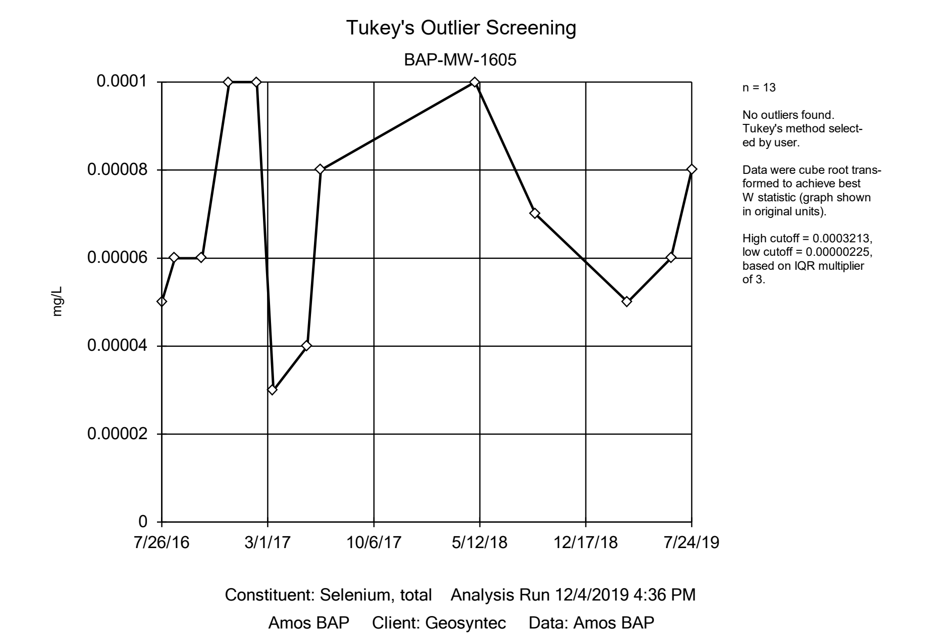




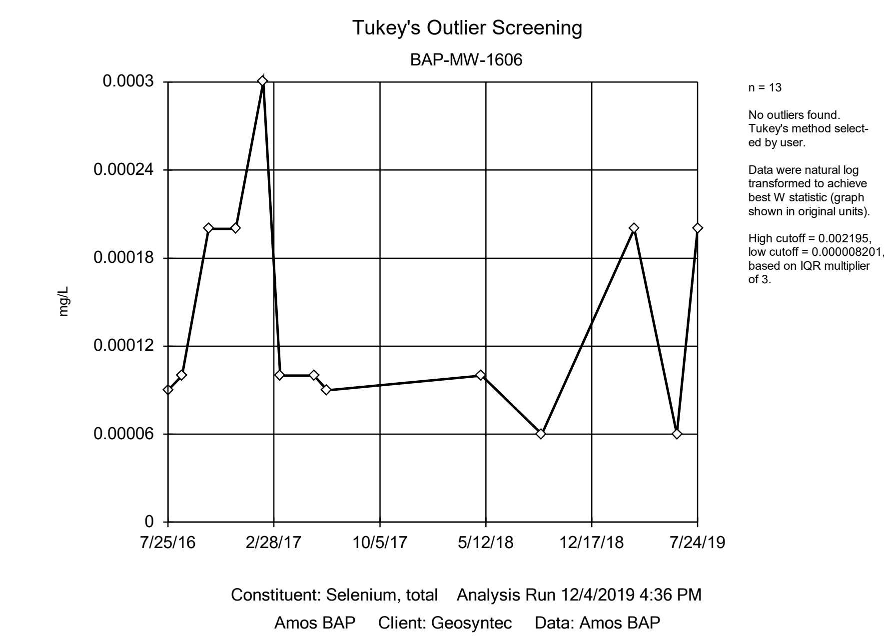
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

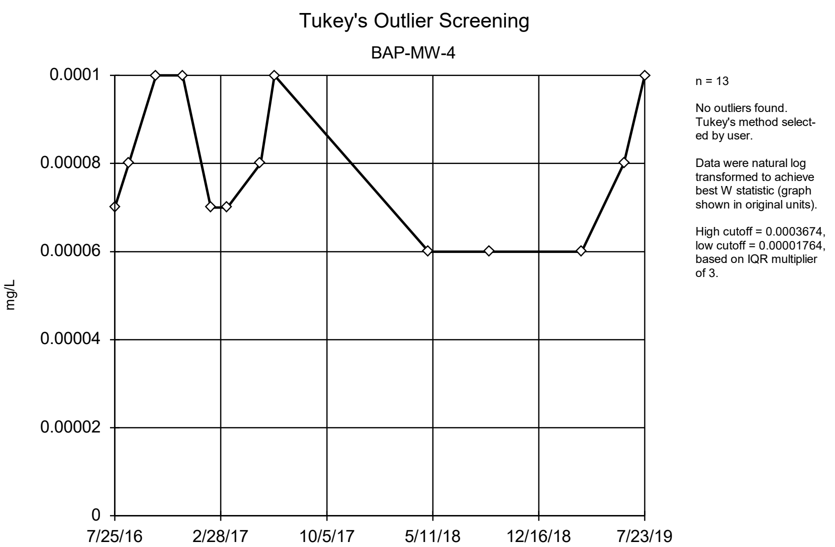


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



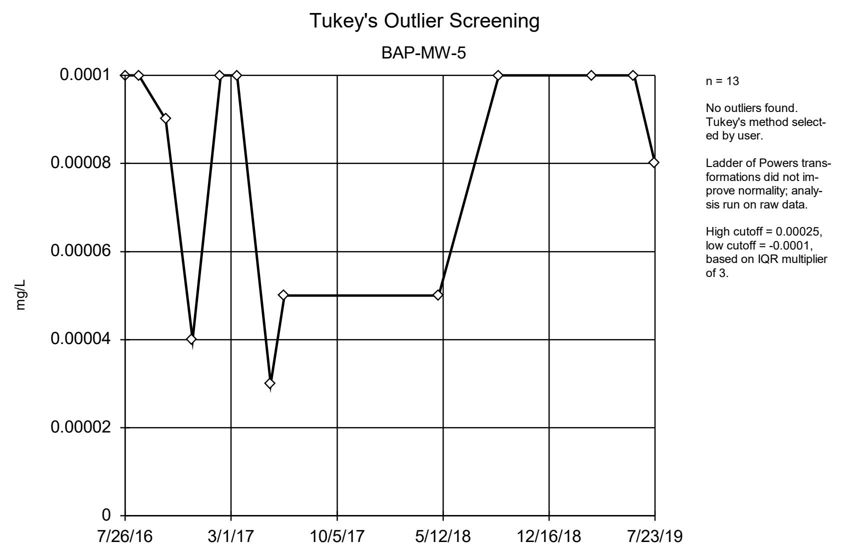
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG





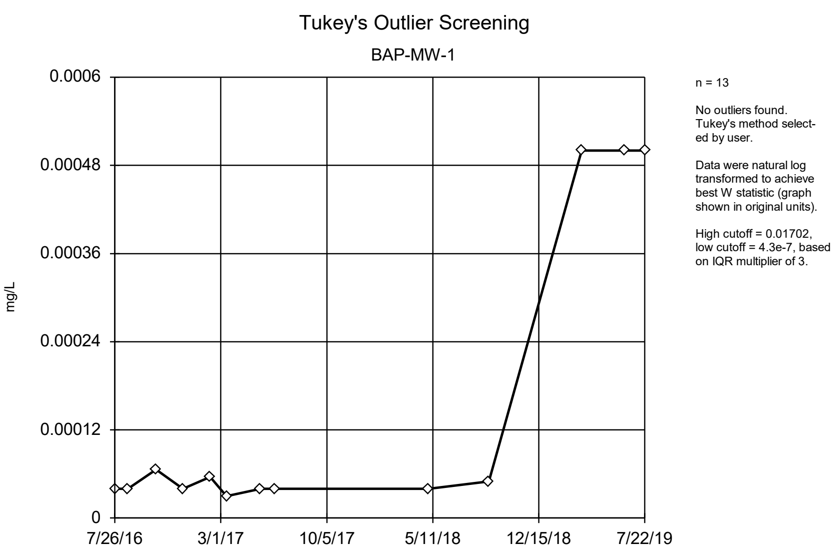
Constituent: Selenium, total   Analysis Run 12/4/2019 4:37 PM
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



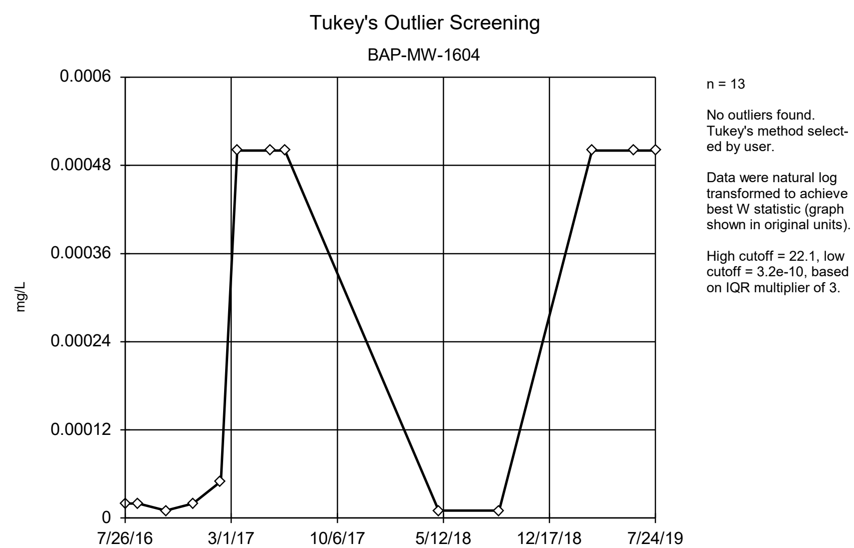
Constituent: Selenium, total   Analysis Run 12/4/2019 4:37 PM
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



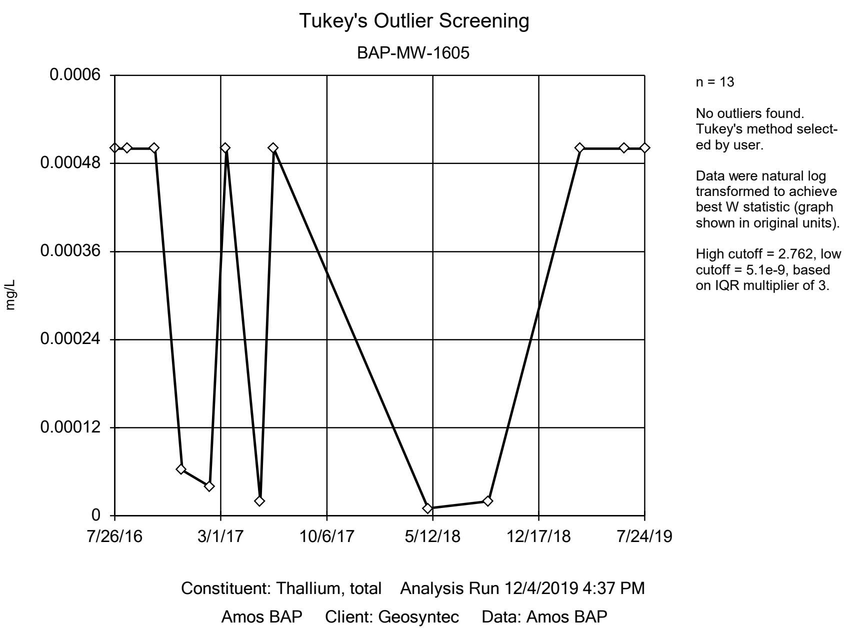
Constituent: Thallium, total   Analysis Run 12/4/2019 4:37 PM
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

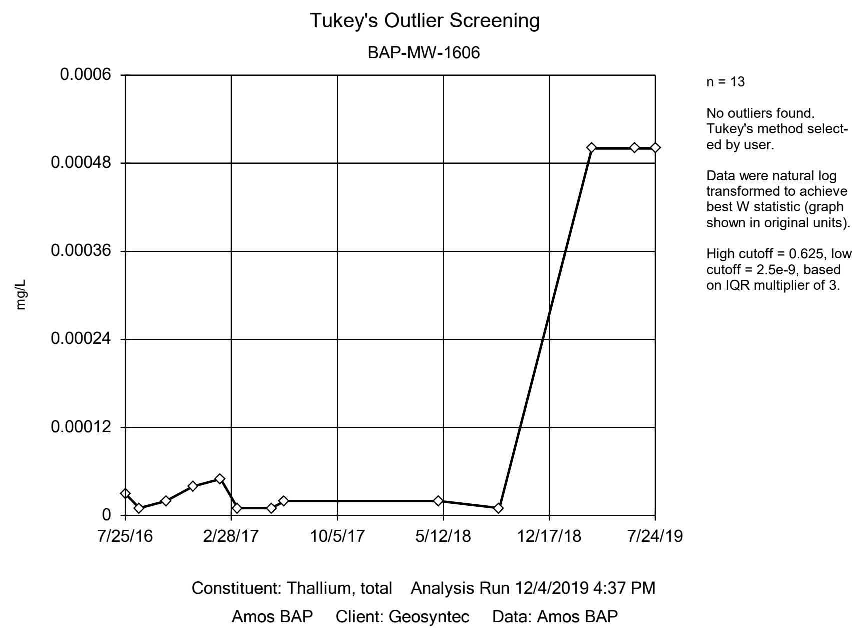


Constituent: Thallium, total   Analysis Run 12/4/2019 4:37 PM
Amos BAP   Client: Geosyntec   Data: Amos BAP

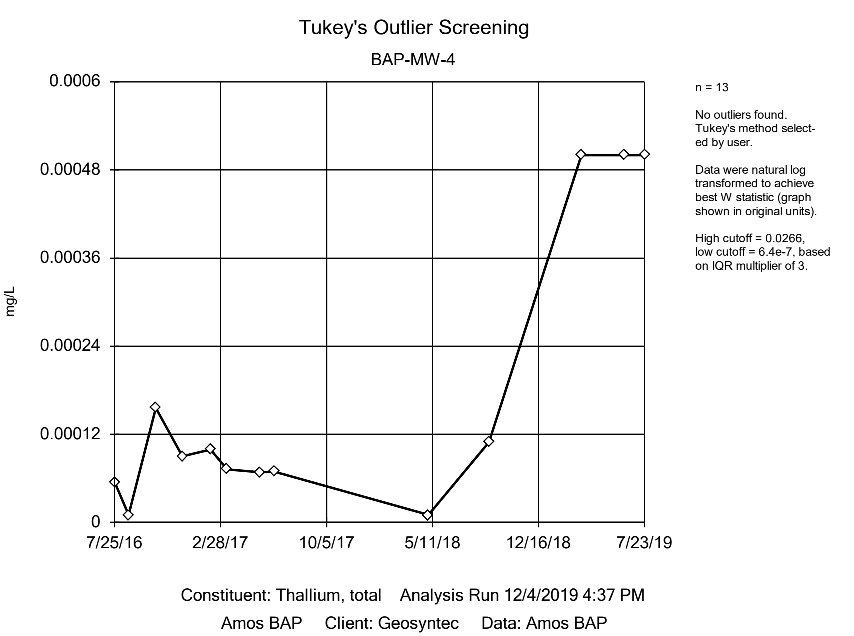
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

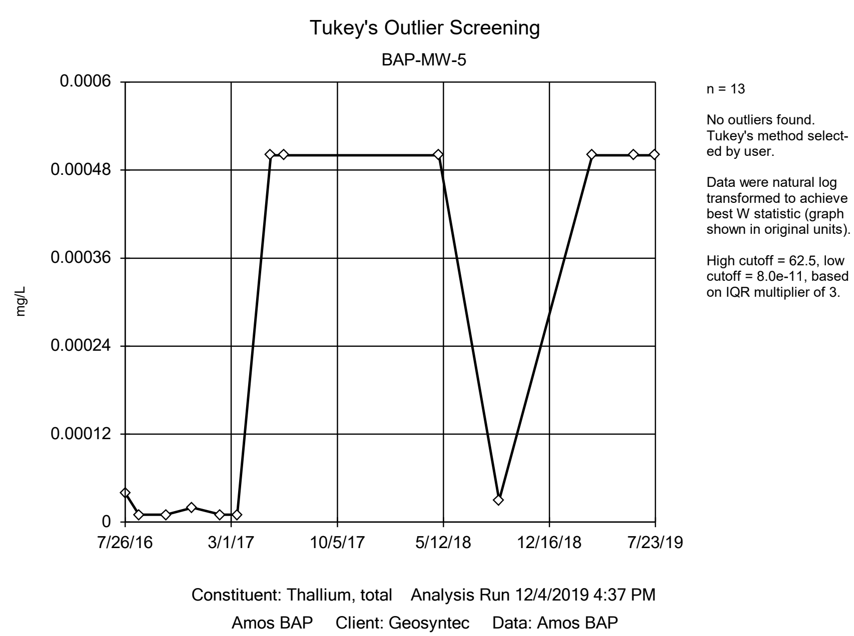


FIGURE D: MANN-WHITNEY ANALYSIS

Welch's t-test/Mann-Whitney - All Results (No Significant Results)

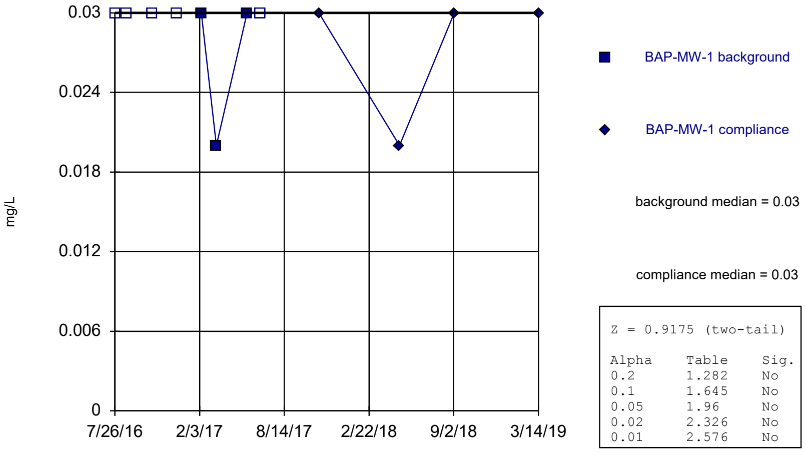
Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 12/9/2019, 8:51 AM

Constituent	Well	Calc.	0.01	Method
Fluoride, total (mg/L)	BAP-MW-1	0.9175	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-1601 (bg)	-0.7536	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-1602A (bg)	0.8541	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-1603A (bg)	0.4714	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-1604	2.367	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-1605	-1.21	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-1606	0.3933	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-4	1.689	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-5	1.628	No	Mann-W
Fluoride, total (mg/L)	BAP-MW-6 (bg)	1.553	No	Mann-W
pH, field (SU)	BAP-MW-1	0.06674	No	Mann-W
pH, field (SU)	BAP-MW-1601 (bg)	0.3863	No	Mann-W
pH, field (SU)	BAP-MW-1602A (bg)	-0.07726	No	Mann-W
pH, field (SU)	BAP-MW-1603A (bg)	-0.2315	No	Mann-W
pH, field (SU)	BAP-MW-1604	1.312	No	Mann-W
pH, field (SU)	BAP-MW-1605	-1.735	No	Mann-W
pH, field (SU)	BAP-MW-1606	-1.479	No	Mann-W
pH, field (SU)	BAP-MW-4	0.309	No	Mann-W
pH, field (SU)	BAP-MW-5	-0.3874	No	Mann-W
pH, field (SU)	BAP-MW-6 (bg)	-0.2318	No	Mann-W

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1

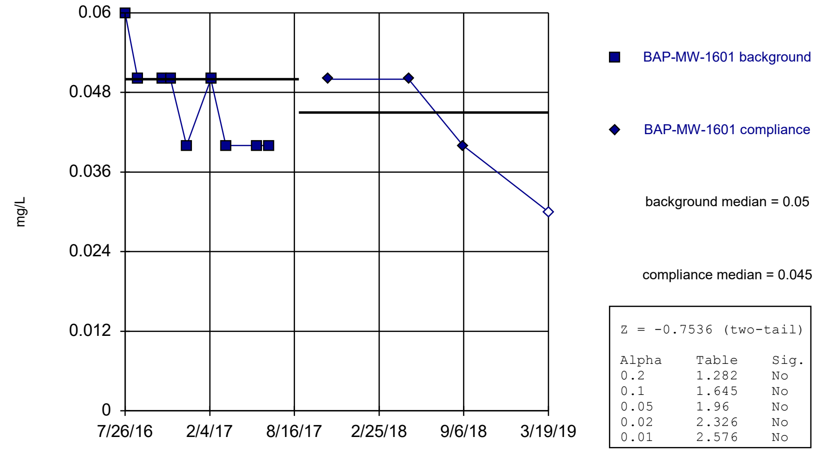


Constituent: Fluoride, total Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1601 (bg)

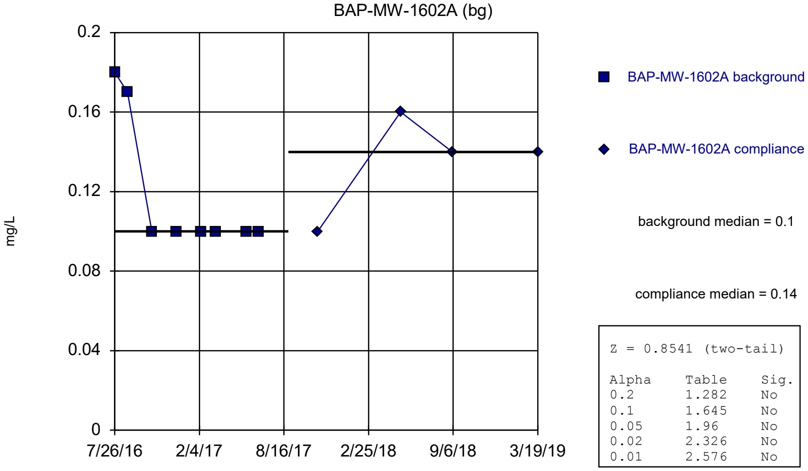


Constituent: Fluoride, total Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1602A (bg)

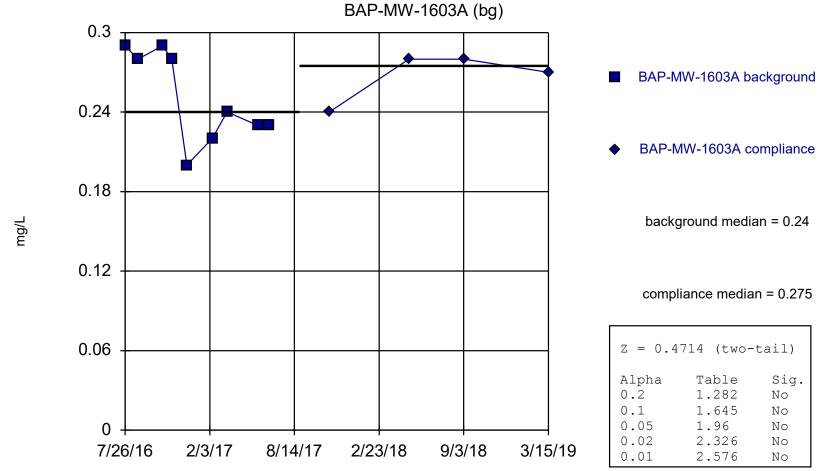


Constituent: Fluoride, total Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1603A (bg)

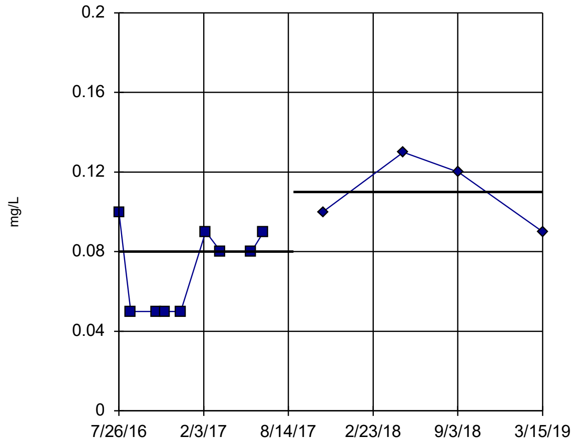


Constituent: Fluoride, total Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1604



BAP-MW-1604 background

BAP-MW-1604 compliance

background median = 0.08

compliance median = 0.11

Z = 2.367 (two-tail)

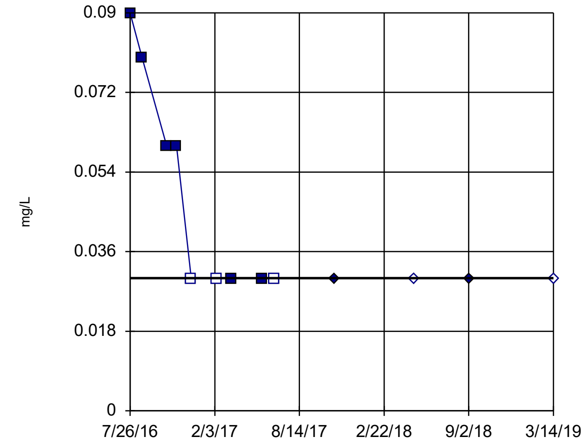
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	No

Constituent: Fluoride, total   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1605



BAP-MW-1605 background

BAP-MW-1605 compliance

background median = 0.03

compliance median = 0.03

Z = -1.21 (two-tail)

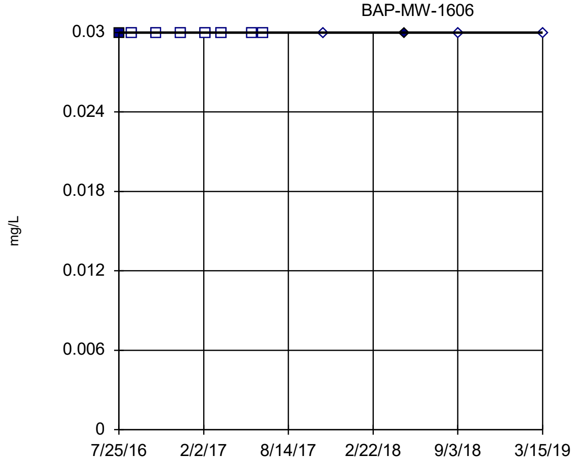
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Fluoride, total   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1606



BAP-MW-1606 background

BAP-MW-1606 compliance

background median = 0.03

compliance median = 0.03

Z = 0.3933 (two-tail)

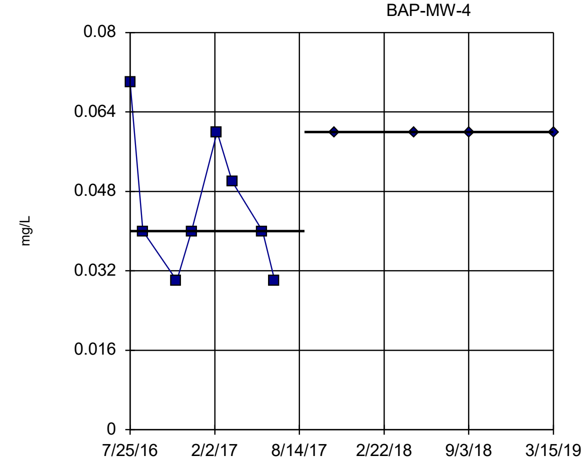
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: Fluoride, total   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-4



BAP-MW-4 background

BAP-MW-4 compliance

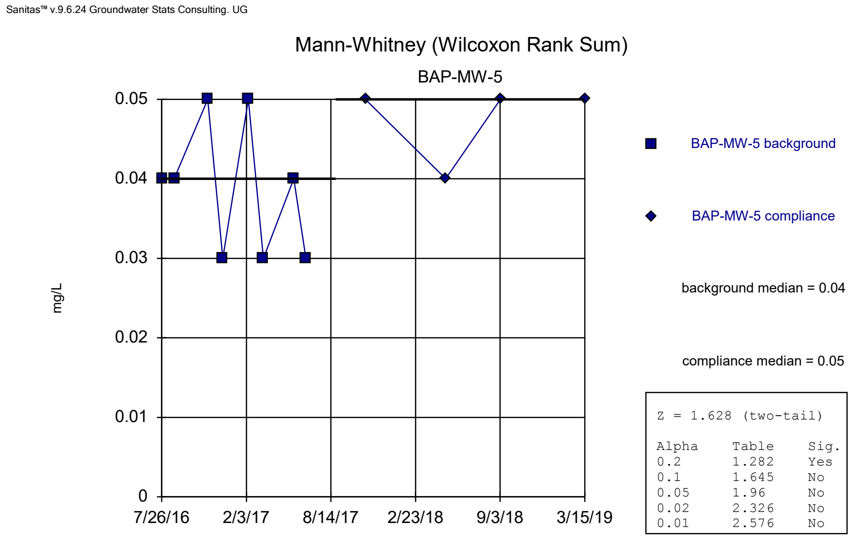
background median = 0.04

compliance median = 0.06

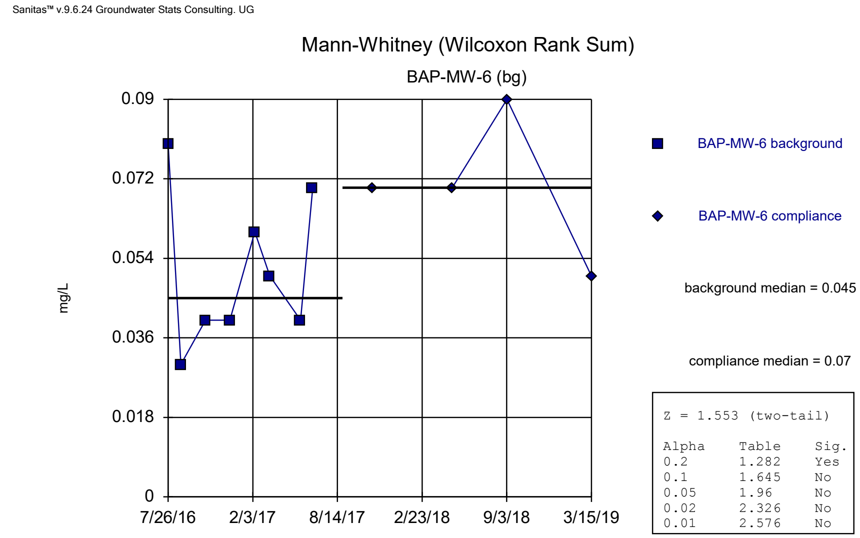
Z = 1.689 (two-tail)

Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

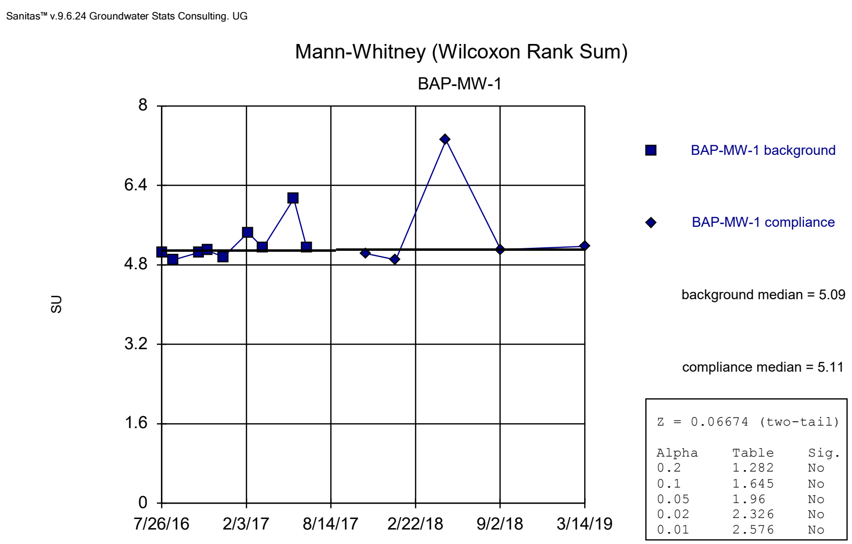
Constituent: Fluoride, total   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP



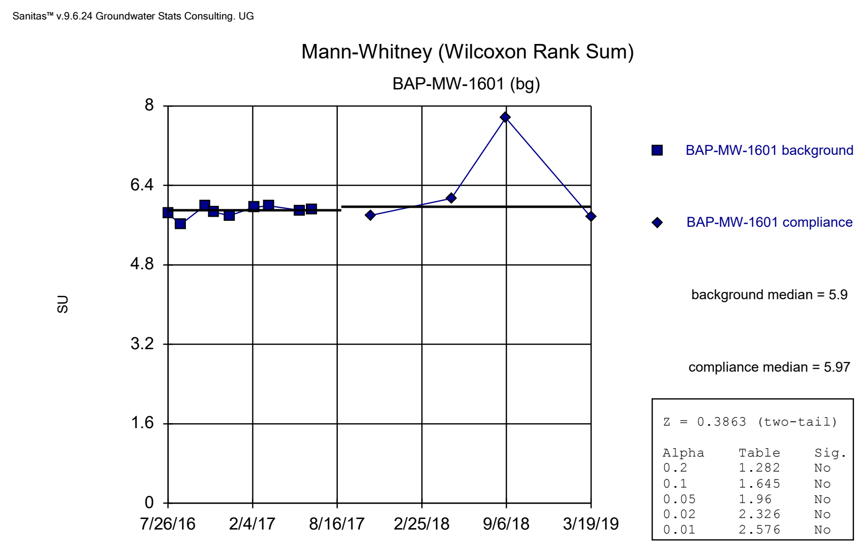
Constituent: Fluoride, total Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: Fluoride, total Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP



Constituent: pH, field Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

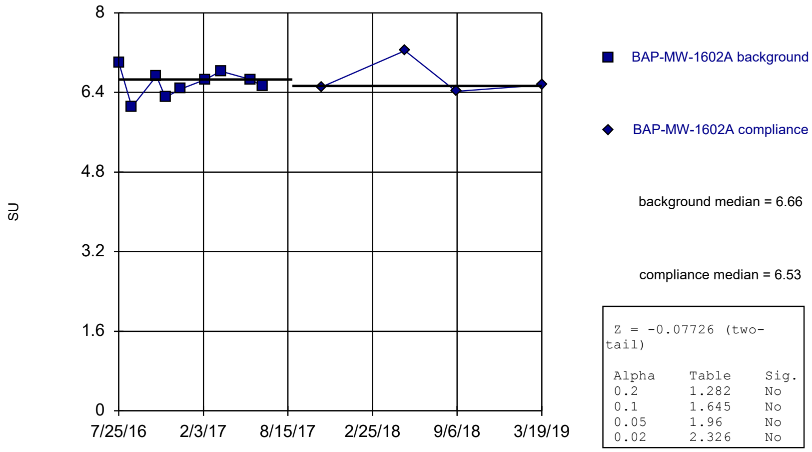


Constituent: pH, field Analysis Run 12/9/2019 8:50 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1602A (bg)

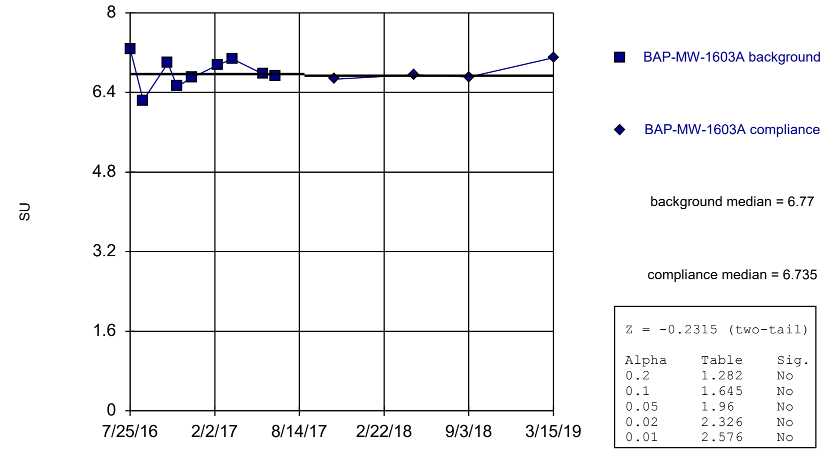


Constituent: pH, field   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1603A (bg)

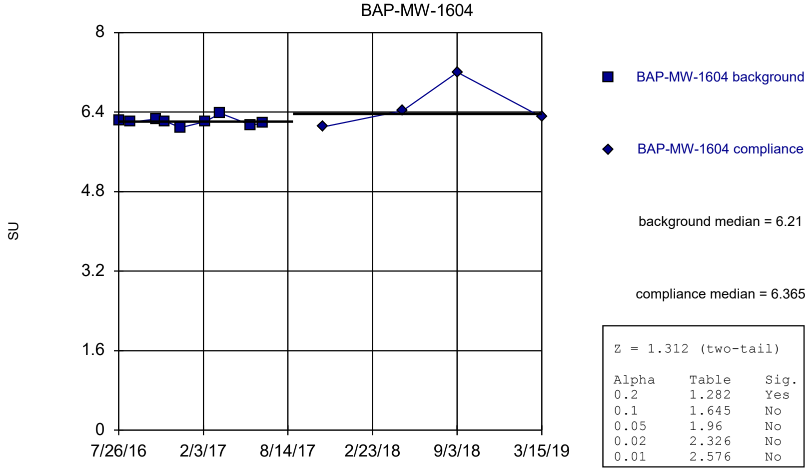


Constituent: pH, field   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1604

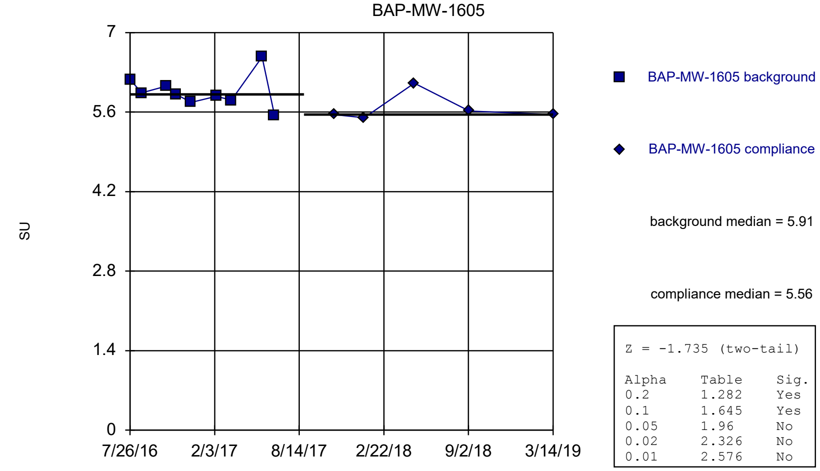


Constituent: pH, field   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1605

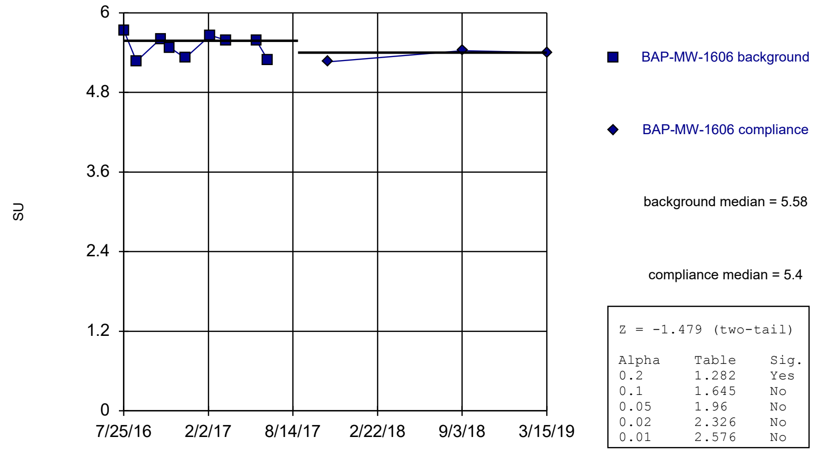


Constituent: pH, field   Analysis Run 12/9/2019 8:50 AM   View: Intrawell
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-1606



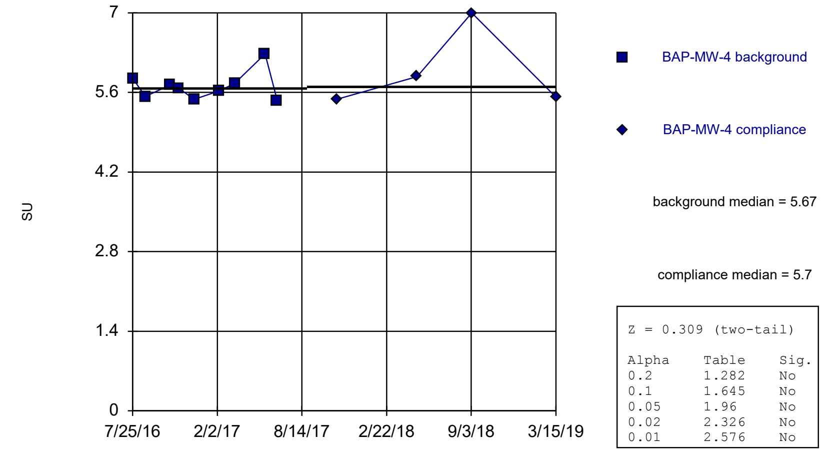
Constituent: pH, field Analysis Run 12/9/2019 8:50 AM View: Intrawell

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-4



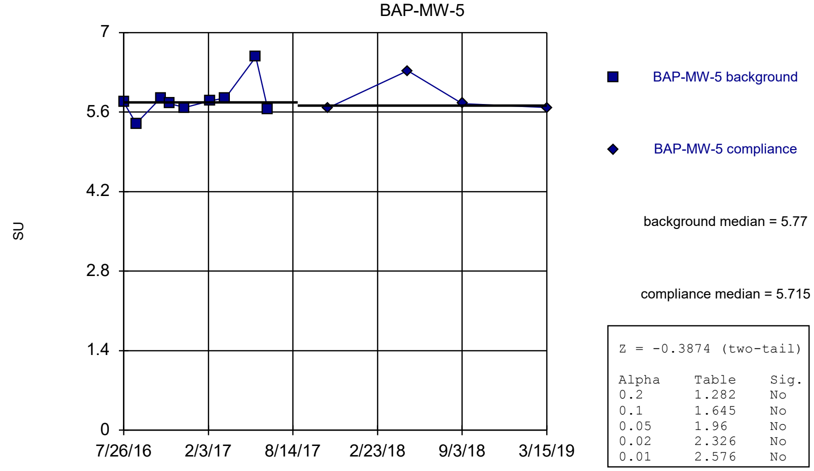
Constituent: pH, field Analysis Run 12/9/2019 8:50 AM View: Intrawell

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-5



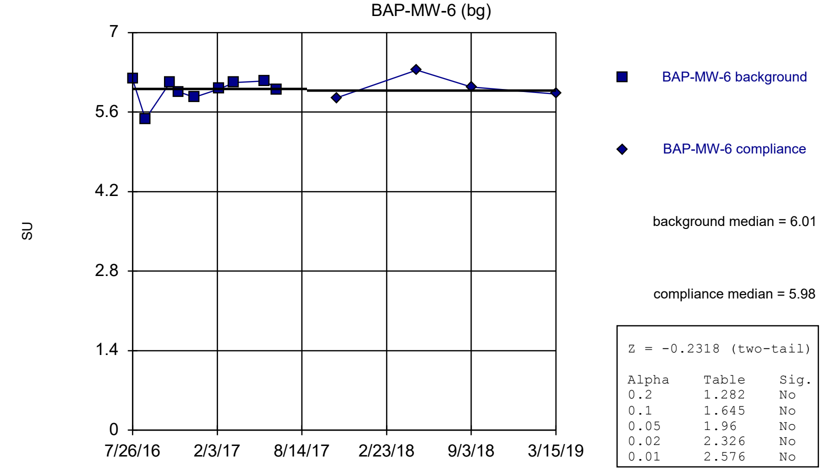
Constituent: pH, field Analysis Run 12/9/2019 8:50 AM View: Intrawell

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

BAP-MW-6 (bg)



Constituent: pH, field Analysis Run 12/9/2019 8:50 AM View: Intrawell

Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE E: INTRAWELL PREDICTION LIMITS

Intrawell Prediction Limit Summary Table - All Results

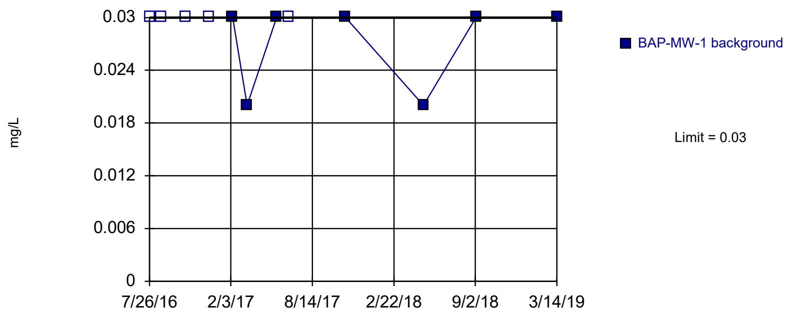
Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/9/2019, 8:52 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride, total (mg/L)	BAP-MW-1	0.03	n/a	n/a	1 future	n/a	12	n/a	n/a	41.67	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1601	0.06355	n/a	n/a	1 future	n/a	13	0.04538	0.007763	7.692	None	No	0.001254	Param Intra 1 of 2
Fluoride, total (mg/L)	BAP-MW-1602A	0.18	n/a	n/a	1 future	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1603A	0.3274	n/a	n/a	1 future	n/a	13	0.2562	0.03042	0	None	No	0.001254	Param Intra 1 of 2
Fluoride, total (mg/L)	BAP-MW-1604	0.146	n/a	n/a	1 future	n/a	13	0.08308	0.02689	0	None	No	0.001254	Param Intra 1 of 2
Fluoride, total (mg/L)	BAP-MW-1605	0.09	n/a	n/a	1 future	n/a	13	n/a	n/a	38.46	n/a	n/a	0.009692	NP Intra (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-1606	0.03	n/a	n/a	1 future	n/a	12	n/a	n/a	83.33	n/a	n/a	0.01077	NP Intra (NDs) 1 of 2
Fluoride, total (mg/L)	BAP-MW-4	0.08216	n/a	n/a	1 future	n/a	12	0.05	0.01348	0	None	No	0.001254	Param Intra 1 of 2
Fluoride, total (mg/L)	BAP-MW-5	0.05	n/a	n/a	1 future	n/a	12	n/a	n/a	0	n/a	n/a	0.01077	NP Intra (normality) 1 of 2
Fluoride, total (mg/L)	BAP-MW-6	0.102	n/a	n/a	1 future	n/a	12	0.0575	0.01865	0	None	No	0.001254	Param Intra 1 of 2
pH, field (SU)	BAP-MW-1	7.31	4.9	n/a	1 future	n/a	14	n/a	n/a	0	n/a	n/a	0.01722	NP Intra (normality) 1 of 2
pH, field (SU)	BAP-MW-1601	7.76	5.62	n/a	1 future	n/a	13	n/a	n/a	0	n/a	n/a	0.01938	NP Intra (normality) 1 of 2
pH, field (SU)	BAP-MW-1602A	7.308	5.925	n/a	1 future	n/a	13	6.616	0.2955	0	None	No	0.0006268	Param Intra 1 of 2
pH, field (SU)	BAP-MW-1603A	7.443	6.172	n/a	1 future	n/a	13	6.808	0.2715	0	None	No	0.0006268	Param Intra 1 of 2
pH, field (SU)	BAP-MW-1604	7.2	6.09	n/a	1 future	n/a	13	n/a	n/a	0	n/a	n/a	0.01938	NP Intra (normality) 1 of 2
pH, field (SU)	BAP-MW-1605	6.552	5.162	n/a	1 future	n/a	14	5.857	0.3028	0	None	No	0.0006268	Param Intra 1 of 2
pH, field (SU)	BAP-MW-1606	5.865	5.072	n/a	1 future	n/a	12	5.468	0.1663	0	None	No	0.0006268	Param Intra 1 of 2
pH, field (SU)	BAP-MW-4	7	5.46	n/a	1 future	n/a	13	n/a	n/a	0	n/a	n/a	0.01938	NP Intra (normality) 1 of 2
pH, field (SU)	BAP-MW-5	6.545	5.153	n/a	1 future	n/a	13	1.799	0.03062	0	None	x^(1/3)	0.0006268	Param Intra 1 of 2
pH, field (SU)	BAP-MW-6	6.49	5.514	n/a	1 future	n/a	13	6.002	0.2085	0	None	No	0.0006268	Param Intra 1 of 2

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, BAP-MW-1



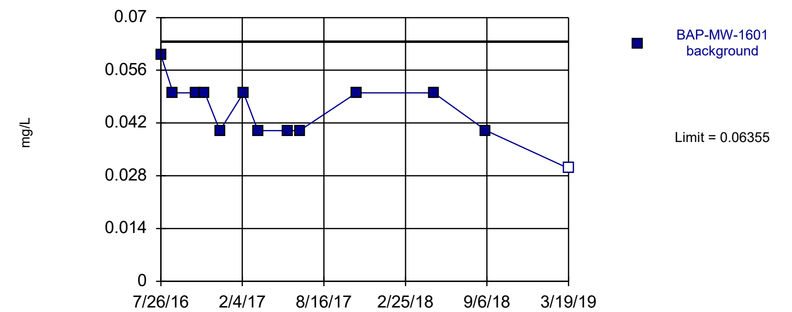
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. 41.67% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, BAP-MW-1601 (bg)



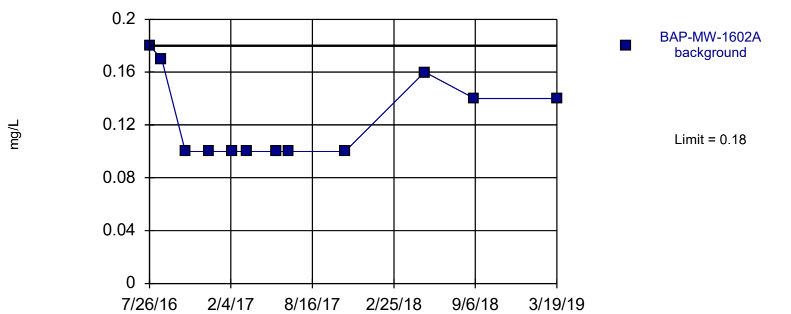
Background Data Summary: Mean=0.04538, Std. Dev.=0.007763, n=13, 7.692% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8754, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, BAP-MW-1602A (bg)



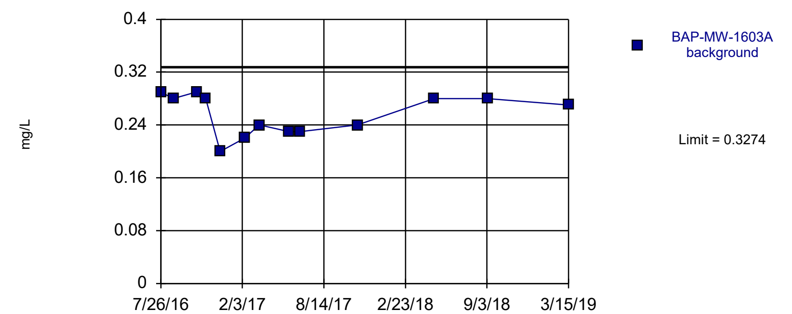
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Prediction Limit

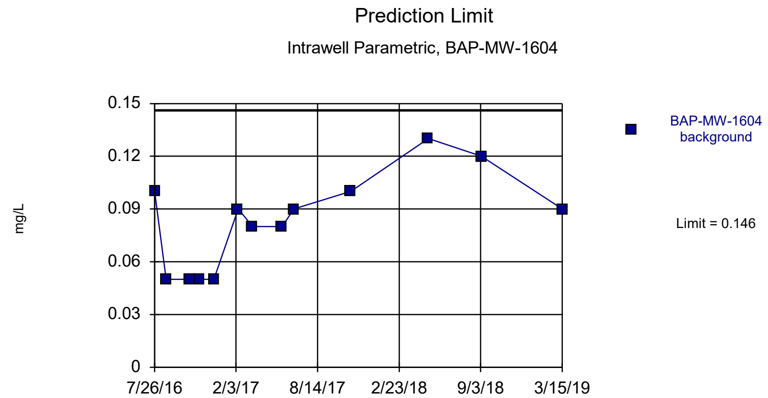
Intrawell Parametric, BAP-MW-1603A (bg)



Background Data Summary: Mean=0.2562, Std. Dev.=0.03042, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8762, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

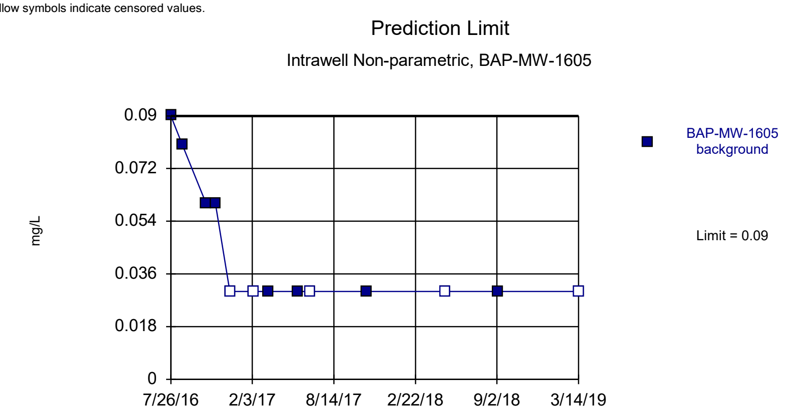
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Background Data Summary: Mean=0.08308, Std. Dev.=0.02689, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9002, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

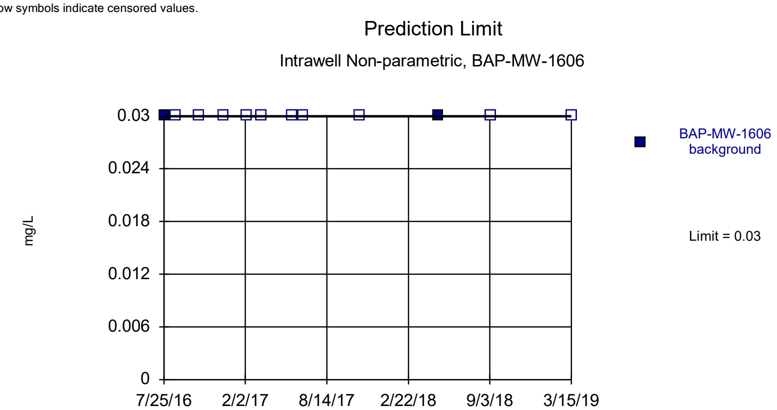
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 13 background values. 38.46% NDs. Well-constituent pair annual alpha = 0.01929. Individual comparison alpha = 0.009692 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

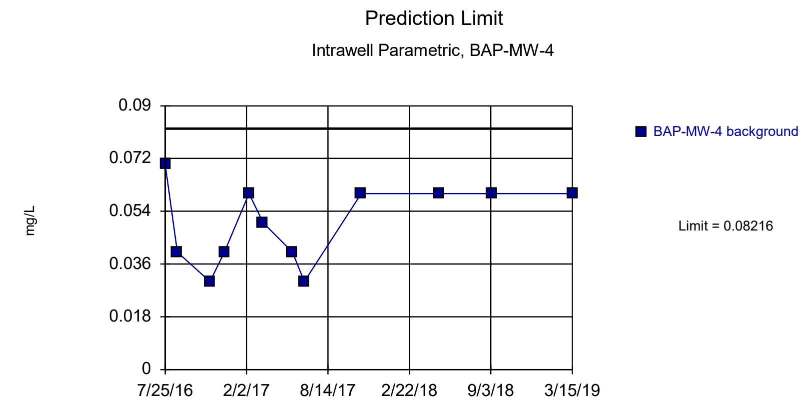
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 12 background values. 83.33% NDs. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



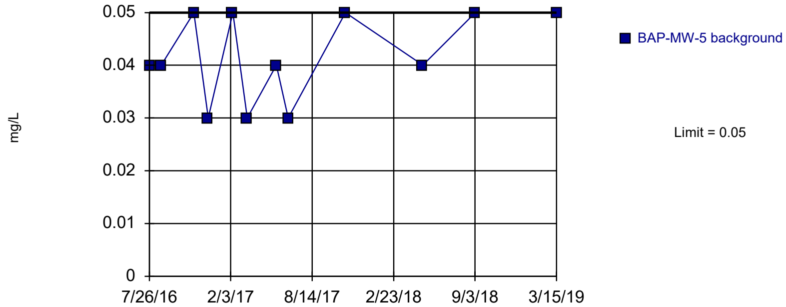
Background Data Summary: Mean=0.05, Std. Dev.=0.01348, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8773, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, BAP-MW-5



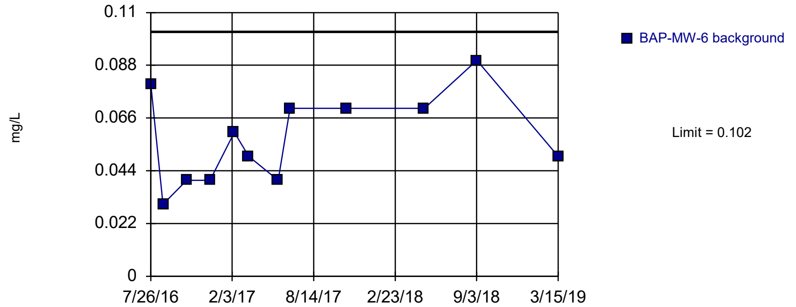
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 12 background values. Well-constituent pair annual alpha = 0.02143. Individual comparison alpha = 0.01077 (1 of 2). Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, BAP-MW-6 (bg)



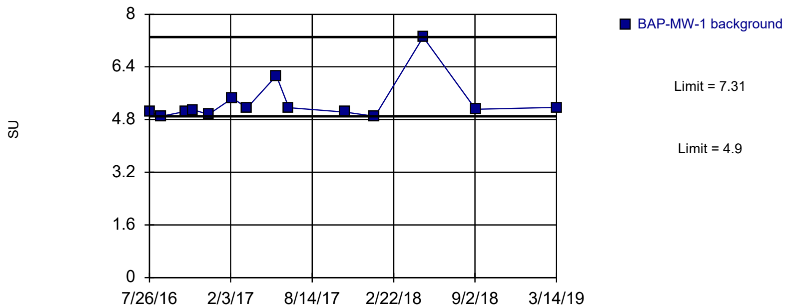
Background Data Summary: Mean=0.0575, Std. Dev.=0.01865, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9442, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, BAP-MW-1



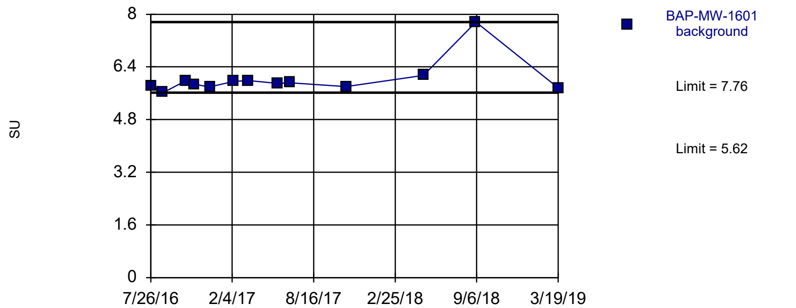
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 14 background values. Well-constituent pair annual alpha = 0.0343. Individual comparison alpha = 0.01722 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, BAP-MW-1601 (bg)

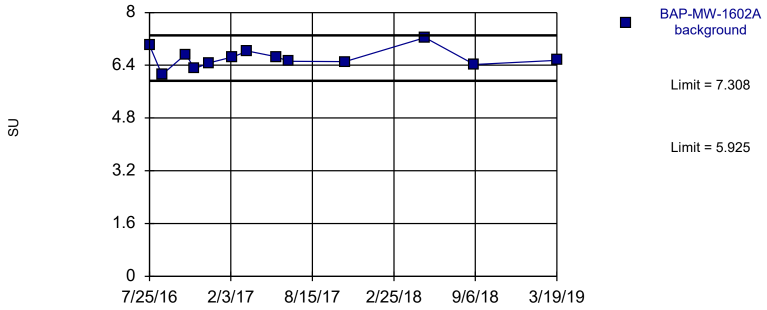


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 13 background values. Well-constituent pair annual alpha = 0.03858. Individual comparison alpha = 0.01938 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Prediction Limit

Intrawell Parametric, BAP-MW-1602A (bg)

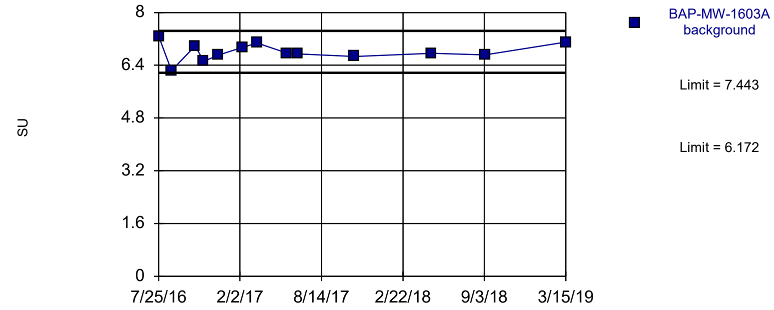


Background Data Summary: Mean=6.616, Std. Dev.=0.2955, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9716, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Prediction Limit

Intrawell Parametric, BAP-MW-1603A (bg)

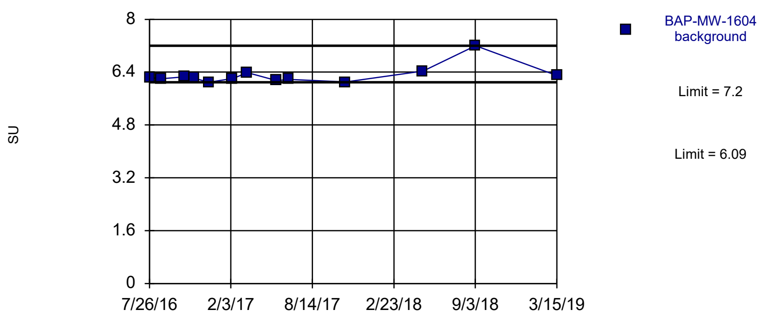


Background Data Summary: Mean=6.808, Std. Dev.=0.2715, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9659, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Prediction Limit

Intrawell Non-parametric, BAP-MW-1604

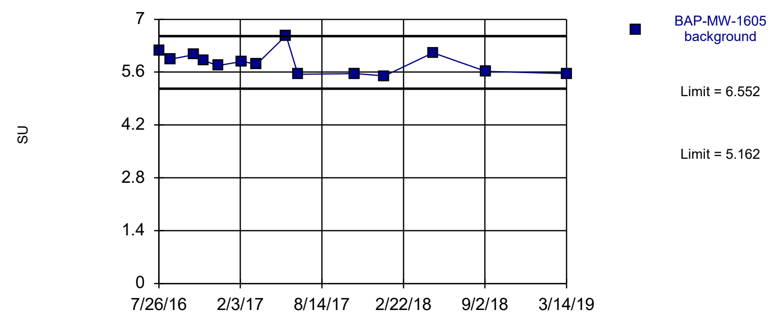


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 13 background values. Well-constituent pair annual alpha = 0.03858. Individual comparison alpha = 0.01938 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Prediction Limit

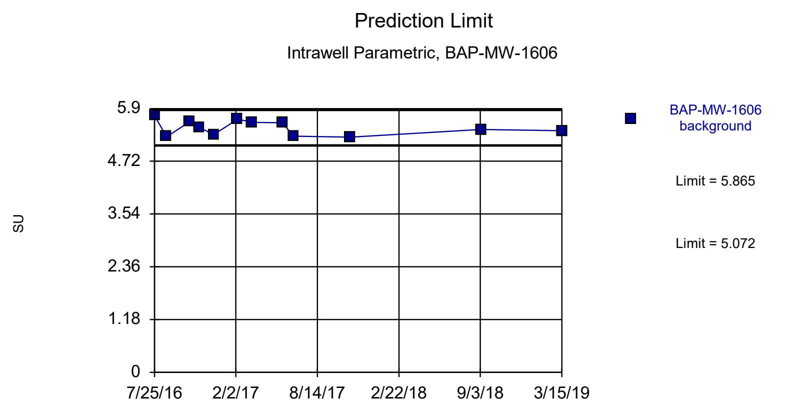
Intrawell Parametric, BAP-MW-1605



Background Data Summary: Mean=5.857, Std. Dev.=0.3028, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.921, critical = 0.825. Kappa = 2.295 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

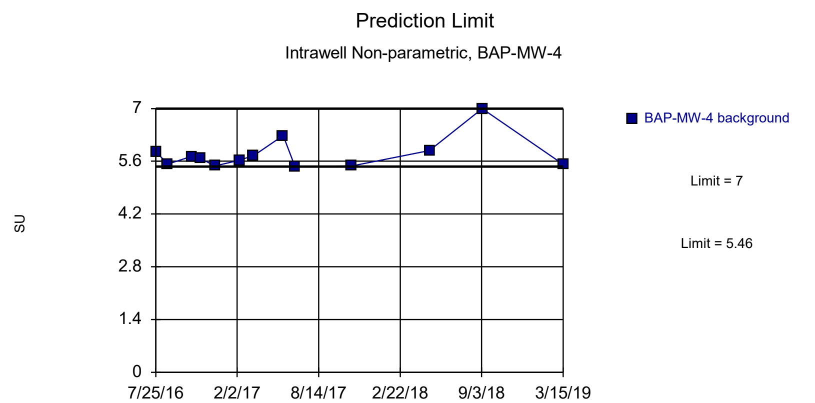
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Background Data Summary: Mean=5.468, Std. Dev.=0.1663, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9259, critical = 0.805. Kappa = 2.385 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

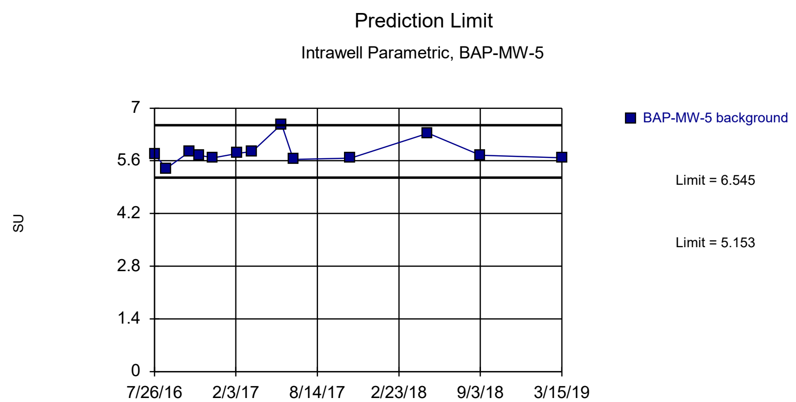
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 13 background values. Well-constituent pair annual alpha = 0.03858. Individual comparison alpha = 0.01938 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:51 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

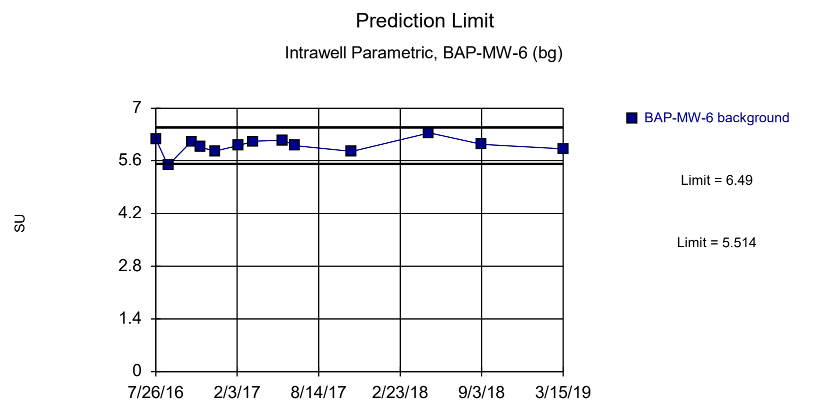
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Background Data Summary (based on cube root transformation): Mean=1.799, Std. Dev.=0.03062, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8146, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:52 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Background Data Summary: Mean=6.002, Std. Dev.=0.2085, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9248, critical = 0.814. Kappa = 2.34 (c=7, w=6, 1 of 2, event alpha = 0.05132). Report alpha = 0.001254. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/9/2019 8:52 AM View: Intrawell
Amos BAP Client: Geosyntec Data: Amos BAP

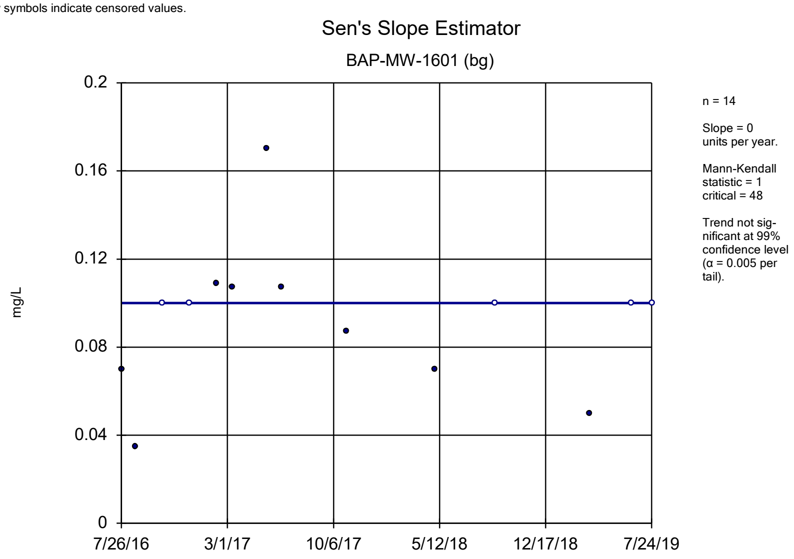
FIGURE F: TREND TESTS

Trend Tests Summary Table - Upgradient Well Trend Tests

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 12/9/2019, 2:26 PM

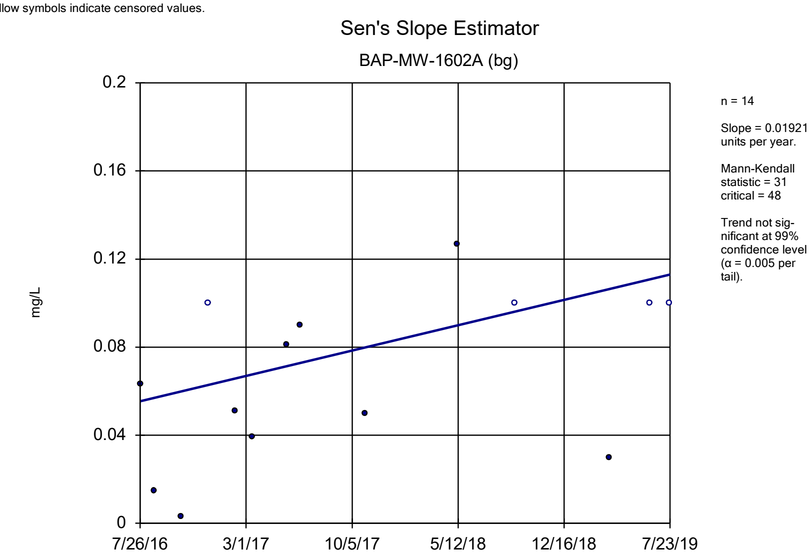
Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	BAP-MW-1601 (bg)	0	1	48	No	14	35.71	n/a	n/a	0.01	NP
Boron, total (mg/L)	BAP-MW-1602A (bg)	0.01921	31	48	No	14	28.57	n/a	n/a	0.01	NP
Boron, total (mg/L)	BAP-MW-1603A (bg)	0.0167	23	43	No	13	38.46	n/a	n/a	0.01	NP
Boron, total (mg/L)	BAP-MW-6 (bg)	0.002724	5	43	No	13	23.08	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1601 (bg)	0	-3	-48	No	14	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1602A (bg)	0.2547	20	48	No	14	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-1603A (bg)	-0.6605	-44	-48	No	14	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	BAP-MW-6 (bg)	0	1	48	No	14	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	**BAP-MW-1601 (bg)**	**1.237**	**72**	**53**	**Yes**	**15**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	**BAP-MW-1602A (bg)**	**0.9012**	**50**	**48**	**Yes**	**14**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride, total (mg/L)	BAP-MW-1603A (bg)	0.1163	33	53	No	15	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	BAP-MW-6 (bg)	0.04777	7	48	No	14	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1601 (bg)	-0.3433	-5	-53	No	15	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1602A (bg)	-0.5076	-15	-48	No	14	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-1603A (bg)	0	-1	-53	No	15	86.67	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	BAP-MW-6 (bg)	-0.5046	-26	-48	No	14	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1601 (bg)	15.36	45	53	No	15	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1602A (bg)	6.759	17	48	No	14	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-1603A (bg)	0	0	53	No	15	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	BAP-MW-6 (bg)	-1.58	-3	-48	No	14	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



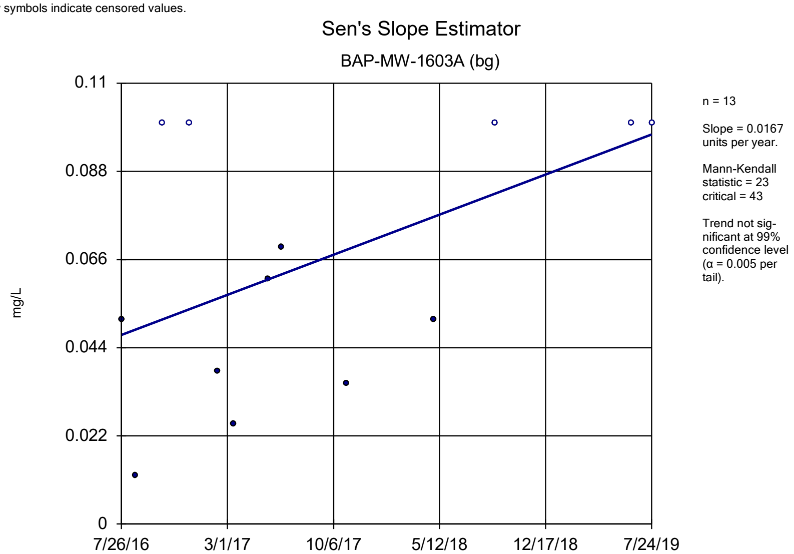
Constituent: Boron, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



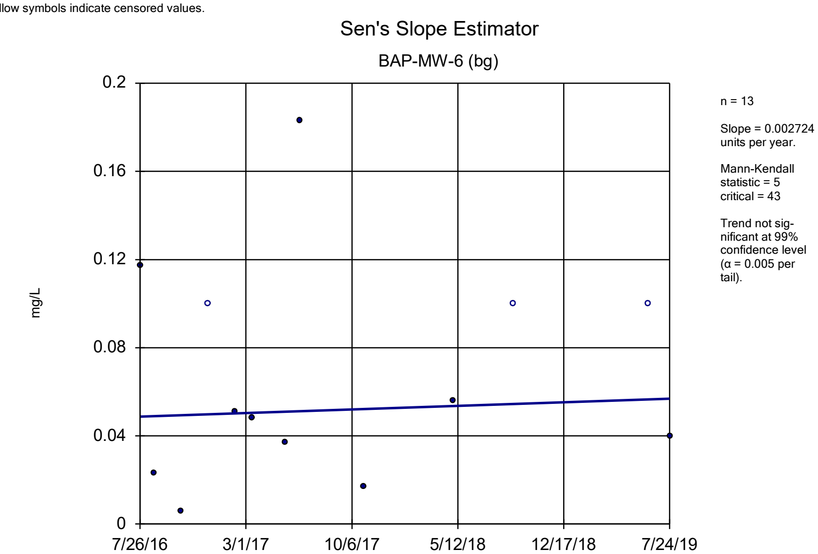
Constituent: Boron, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



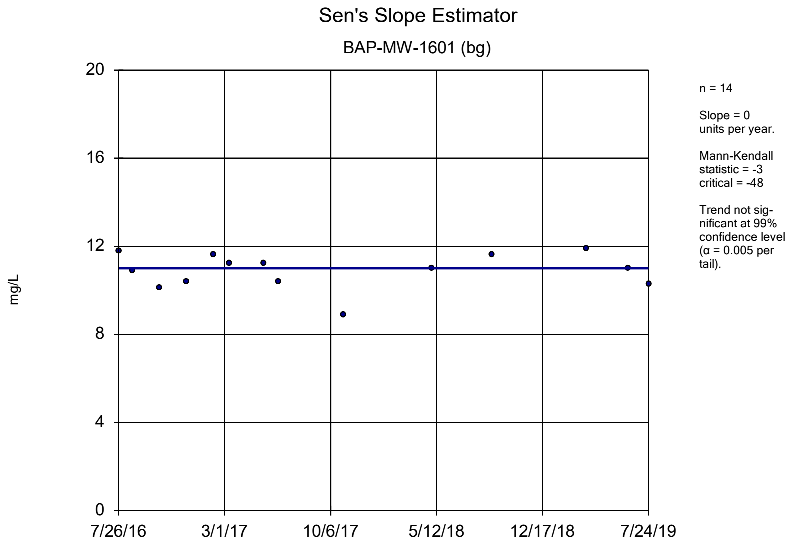
Constituent: Boron, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



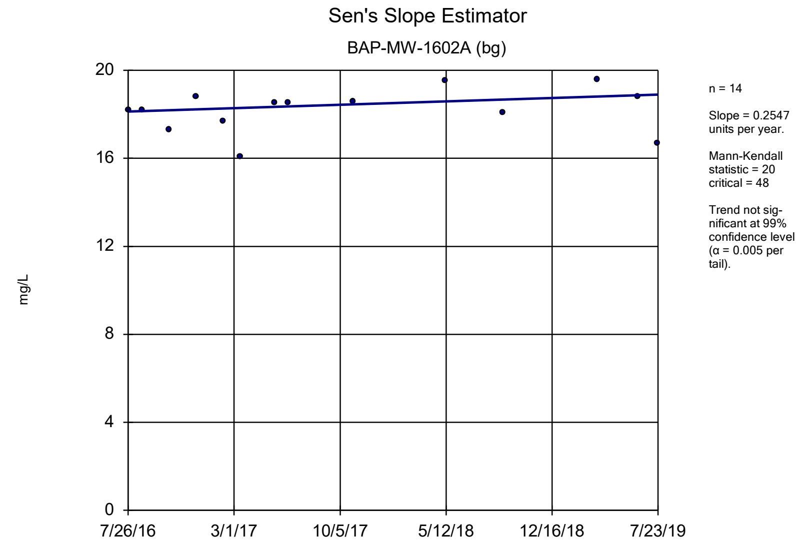
Constituent: Boron, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



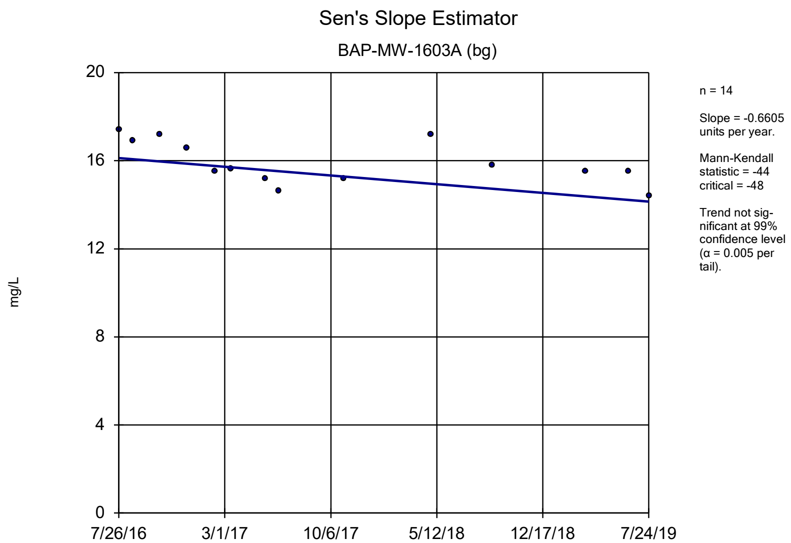
Constituent: Calcium, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



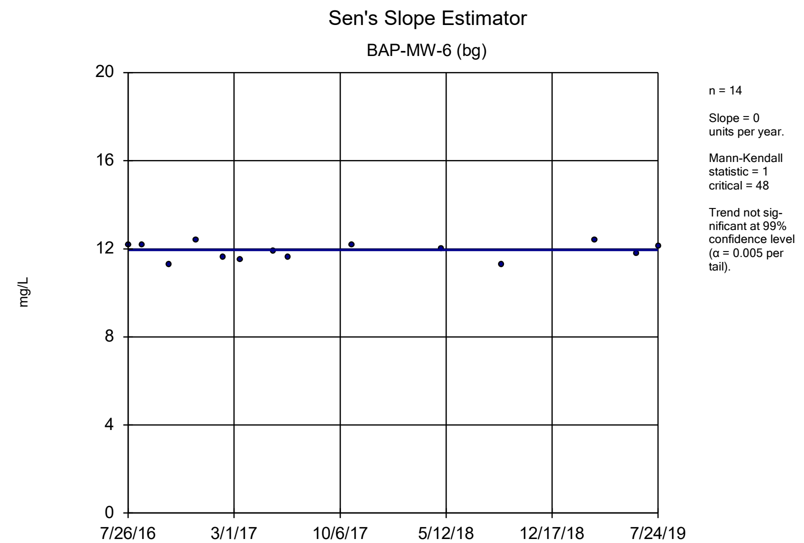
Constituent: Calcium, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Calcium, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

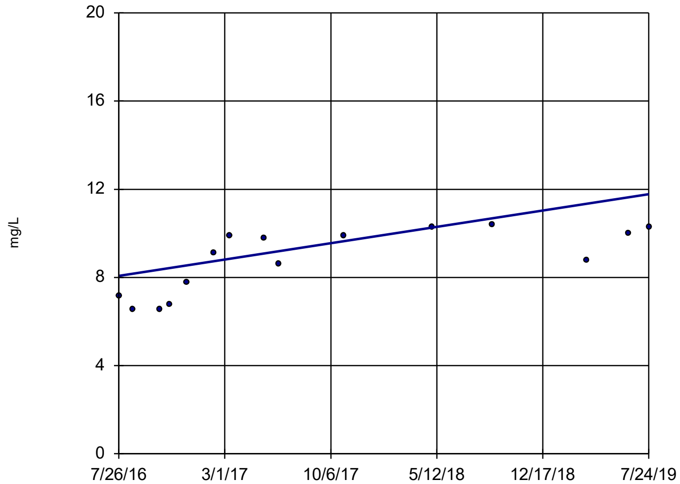


Constituent: Calcium, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-1601 (bg)



n = 15

Slope = 1.237 units per year.

Mann-Kendall statistic = 72 critical = 53

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

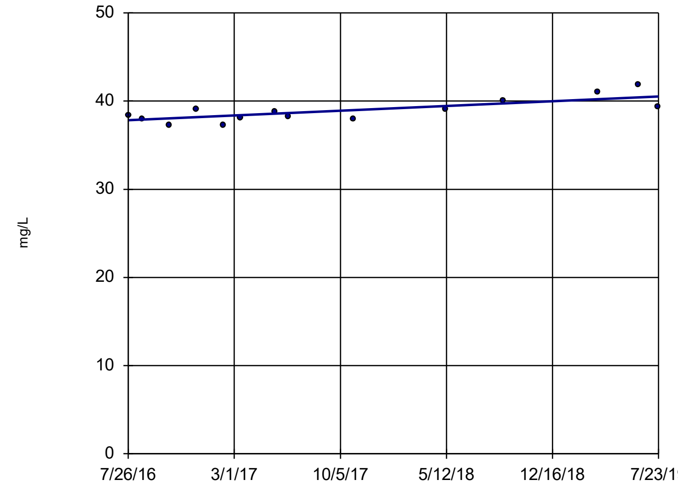
Constituent: Chloride, total   Analysis Run 12/9/2019 2:26 PM   View: Interwell

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-1602A (bg)



n = 14

Slope = 0.9012 units per year.

Mann-Kendall statistic = 50 critical = 48

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

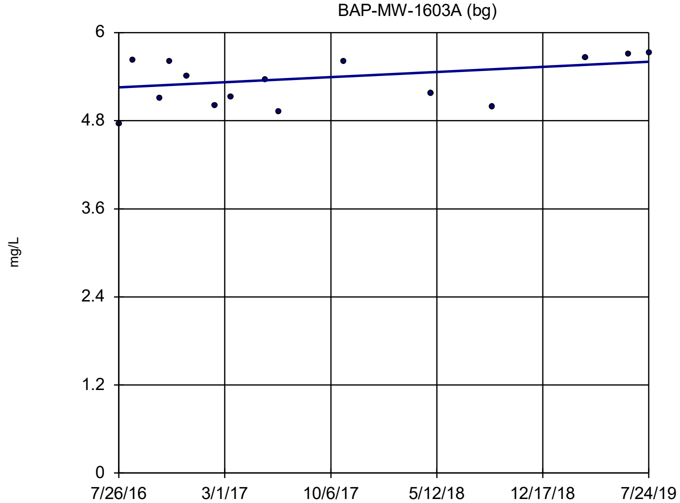
Constituent: Chloride, total   Analysis Run 12/9/2019 2:26 PM   View: Interwell

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-1603A (bg)



n = 15

Slope = 0.1163 units per year.

Mann-Kendall statistic = 33 critical = 53

Trend not significant at 99% confidence level (α = 0.005 per tail).

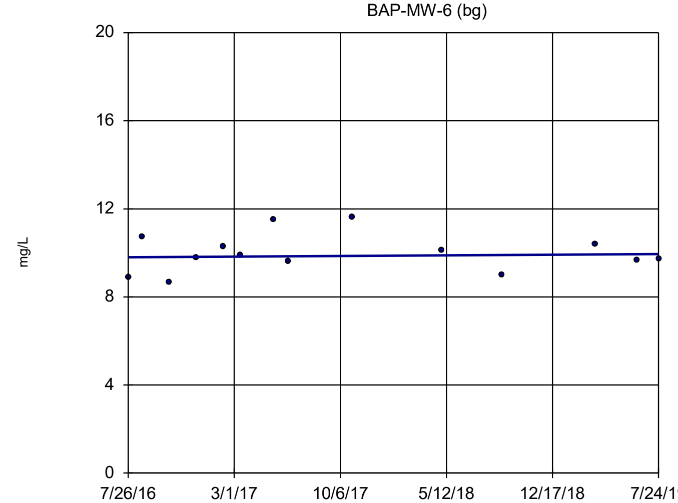
Constituent: Chloride, total   Analysis Run 12/9/2019 2:26 PM   View: Interwell

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Sen's Slope Estimator

BAP-MW-6 (bg)



n = 14

Slope = 0.04777 units per year.

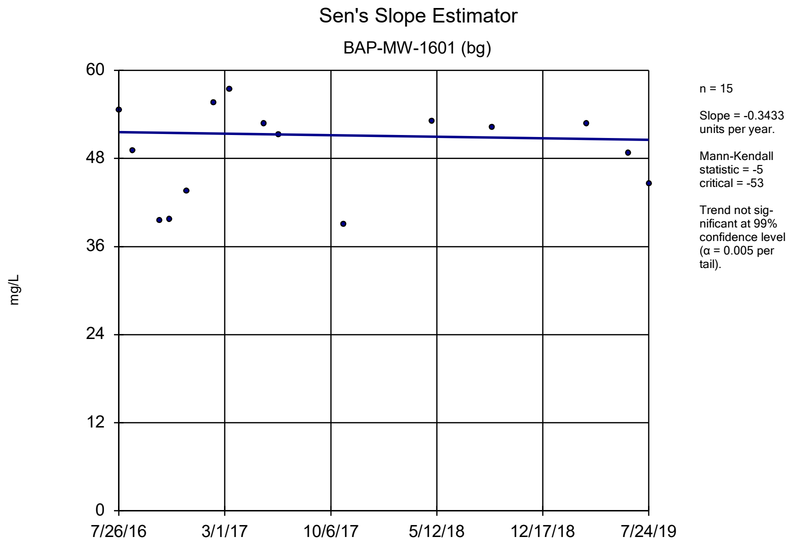
Mann-Kendall statistic = 7 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total   Analysis Run 12/9/2019 2:26 PM   View: Interwell

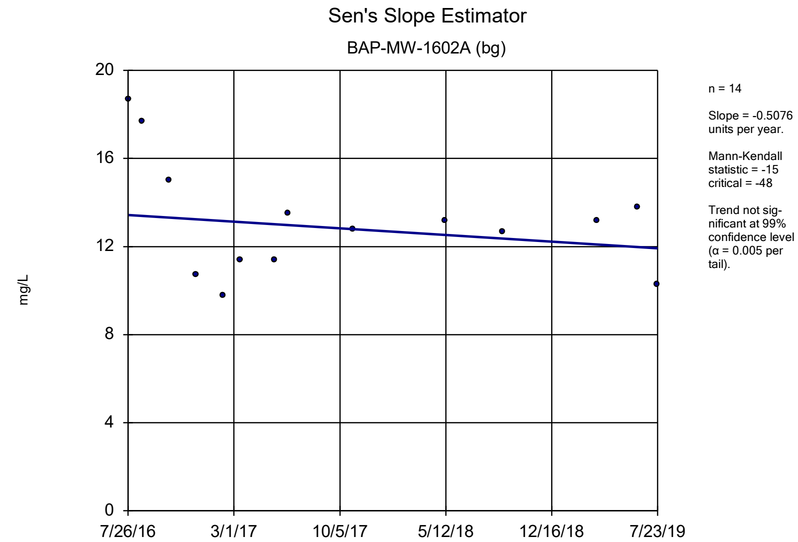
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



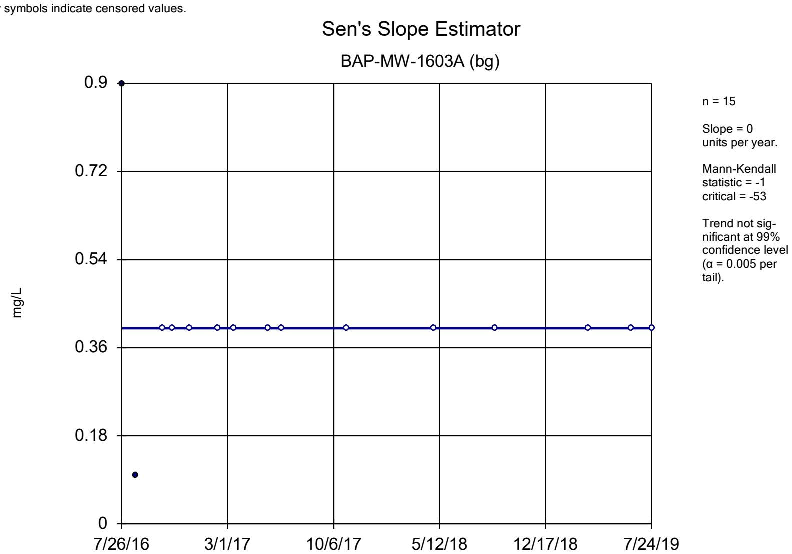
Constituent: Sulfate, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



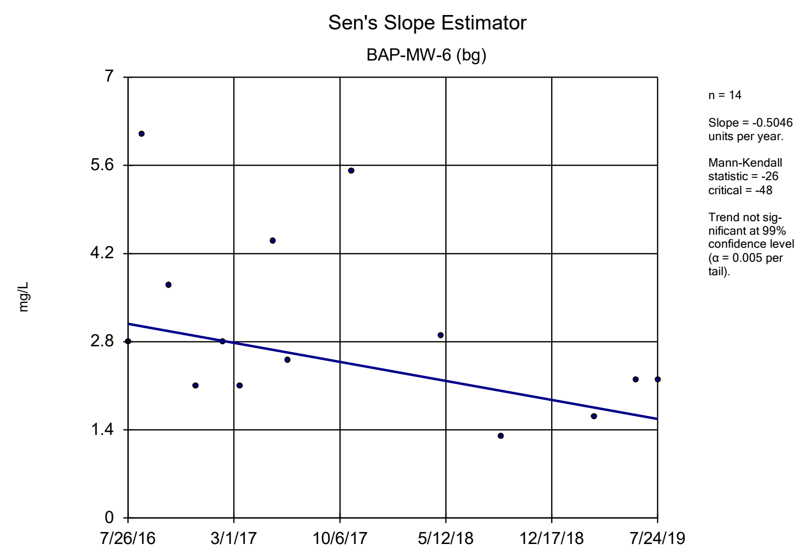
Constituent: Sulfate, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

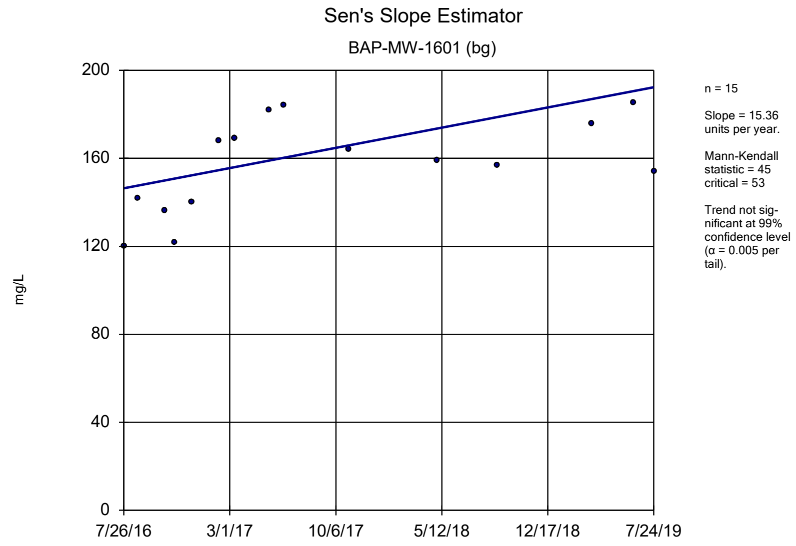


Constituent: Sulfate, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

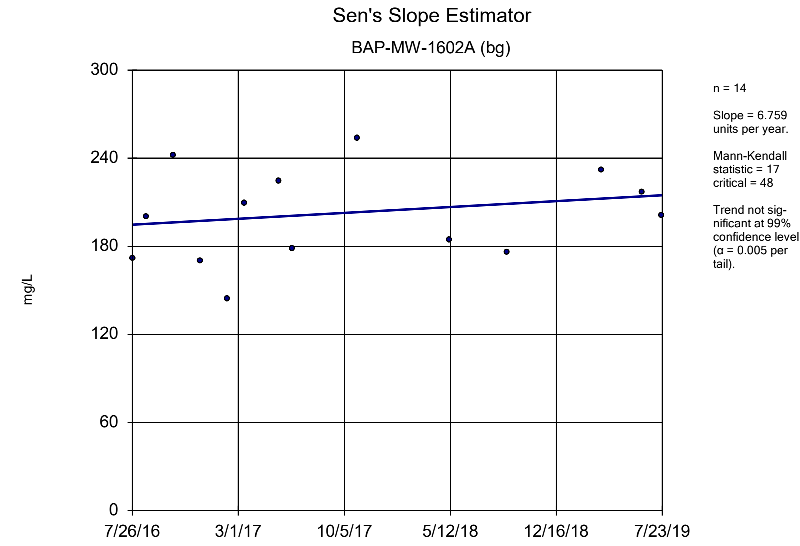


Constituent: Sulfate, total Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP



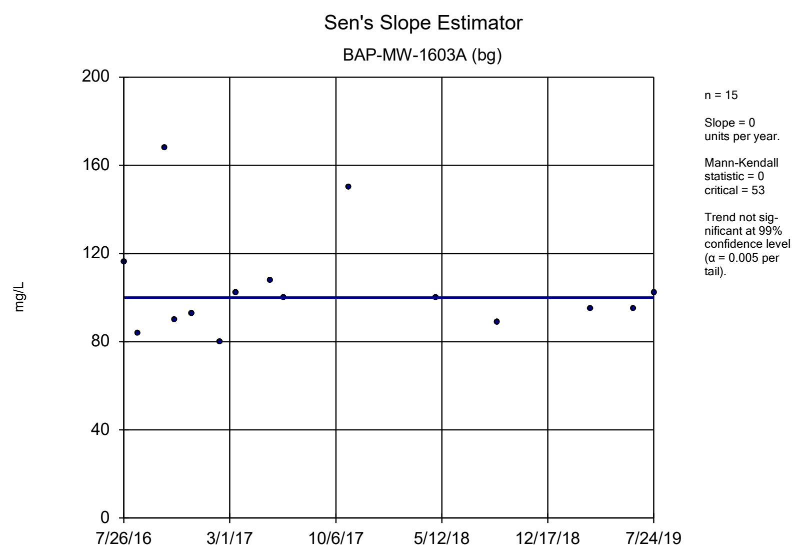
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



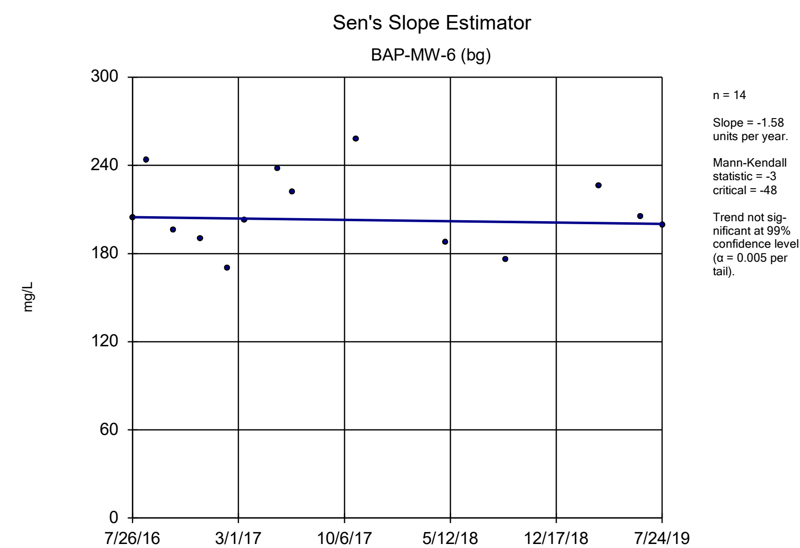
Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 12/9/2019 2:26 PM View: Interwell
Amos BAP Client: Geosyntec Data: Amos BAP

FIGURE G: INTERWELL PREDICTION LIMITS

Interwell Prediction Limit Summary Table - All Results

Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/9/2019, 2:19 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	n/a	0.183	n/a	n/a	6 future	n/a	46	n/a	n/a	21.74	n/a	n/a	0.0008958	NP Inter (normality) 1 of 2
Calcium, total (mg/L)	n/a	19.6	n/a	n/a	6 future	n/a	48	n/a	n/a	0	n/a	n/a	0.000818	NP Inter (normality) 1 of 2
Chloride, total (mg/L)	n/a	41	n/a	n/a	6 future	n/a	50	n/a	n/a	0	n/a	n/a	0.0007403	NP Inter (normality) 1 of 2
Sulfate, total (mg/L)	n/a	57.4	n/a	n/a	6 future	n/a	50	n/a	n/a	22	n/a	n/a	0.0007403	NP Inter (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	n/a	259.6	n/a	n/a	6 future	n/a	50	165.9	49.25	0	None	No	0.001254	Param Inter 1 of 2

FIGURE H: TOLERANCE LIMITS

Upper Tolerance Limits - App IV

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 11/19/2019, 10:33 AM

Constituent	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	0.00016	52	n/a	n/a	23.08	n/a	n/a	0.06944	NP Inter(normality)
Arsenic, total (mg/L)	0.0903	52	n/a	n/a	0	n/a	n/a	0.06944	NP Inter(normality)
Barium, total (mg/L)	0.2992	52	0.1891	0.05365	0	None	No	0.05	Inter
Beryllium, total (mg/L)	0.00009697	52	0.006347	0.001705	9.615	None	sqrt(x)	0.05	Inter
Cadmium, total (mg/L)	0.00005	52	n/a	n/a	21.15	n/a	n/a	0.06944	NP Inter(normality)
Chromium, total (mg/L)	0.00219	51	0.02697	0.00963	0	None	sqrt(x)	0.05	Inter
Cobalt, total (mg/L)	0.01839	52	0.1494	0.05577	0	None	x^(1/3)	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	7.914	54	n/a	n/a	0	n/a	n/a	0.06267	NP Inter(normality)
Fluoride, total (mg/L)	0.31	58	n/a	n/a	1.724	n/a	n/a	0.05105	NP Inter(normality)
Lead, total (mg/L)	0.00868	52	-7.404	1.294	0	None	ln(x)	0.05	Inter
Lithium, total (mg/L)	0.01115	52	-6.822	1.132	23.08	Kaplan-Meier	ln(x)	0.05	Inter
Mercury, total (mg/L)	0.000005	40	n/a	n/a	90	n/a	n/a	0.1285	NP Inter(NDs)
Molybdenum, total (mg/L)	0.002628	52	0.02922	0.01073	7.692	None	sqrt(x)	0.05	Inter
Selenium, total (mg/L)	0.0003	51	n/a	n/a	3.922	n/a	n/a	0.0731	NP Inter(normality)
Thallium, total (mg/L)	0.0005	52	n/a	n/a	28.85	n/a	n/a	0.06944	NP Inter(normality)

FIGURE I: GROUNDWATER PROTECTION STANDARDS

AMOS BAP GWPS				
Constituent Name	MCL	Rule-Based	Background	GWPS
Antimony, Total (mg/L)	0.006		0.00016	0.006
Arsenic, Total (mg/L)	0.01		0.09	0.09
Barium, Total (mg/L)	2		0.3	2
Beryllium, Total (mg/L)	0.004		0.0001	0.004
Cadmium, Total (mg/L)	0.005		0.00005	0.005
Chromium, Total (mg/L)	0.1		0.0022	0.1
Cobalt, Total (mg/L)	n/a	0.006	0.018	0.018
Combined Radium, Total (pCi/L)	5		7.9	7.9
Fluoride, Total (mg/L)	4		0.31	4
Lead, Total (mg/L)	0.015		0.0087	0.015
Lithium, Total (mg/L)	n/a	0.04	0.011	0.04
Mercury, Total (mg/L)	0.002		0.000005	0.002
Molybdenum, Total (mg/L)	n/a	0.1	0.0026	0.1
Selenium, Total (mg/L)	0.05		0.0003	0.05
Thallium, Total (mg/L)	0.002		0.0005	0.002

Grey cell indicates Background is higher than MCL.

MCL = Maximum Contaminant Level

GWPS - Groundwater Protection Standard

FIGURE J: CONFIDENCE INTERVALS

Confidence Intervals - All Results (No Significant Results)

Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/4/2019, 5:01 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Trans...	Alpha	Method
Antimony, total (mg/L)	BAP-MW-1	0.00005	0.00001	0.006	No	13	0.00003769	0.00005644	7.692	None	No	0.01	NP (normality)
Antimony, total (mg/L)	BAP-MW-1604	0.00005	0.00002	0.006	No	13	0.00003308	0.00001251	7.692	None	No	0.01	NP (normality)
Antimony, total (mg/L)	BAP-MW-1605	0.00007764	0.0000136	0.006	No	13	0.00002923	0.00001498	23.08	Cohen`s	No	0.01	Param.
Antimony, total (mg/L)	BAP-MW-1606	0.00003517	0.00001867	0.006	No	13	0.00002692	0.00001109	7.692	None	No	0.01	Param.
Antimony, total (mg/L)	BAP-MW-4	0.00005	0.00002	0.006	No	13	0.00004231	0.00002386	23.08	None	No	0.01	NP (Cohens/xfrm)
Antimony, total (mg/L)	BAP-MW-5	0.00005508	0.0000206	0.006	No	13	0.00003923	0.00002597	7.692	None	sqrt(x)	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1	0.0001572	0.0001074	0.09	No	13	0.0001323	0.00003345	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1604	0.005567	0.004369	0.09	No	13	0.004995	0.0008646	0	None	ln(x)	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1605	0.004519	0.003178	0.09	No	13	0.003848	0.0009016	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1606	0.003229	0.002573	0.09	No	13	0.002901	0.0004412	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-4	0.009726	0.002799	0.09	No	13	0.006262	0.004658	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-5	0.004	0.00242	0.09	No	13	0.003332	0.001128	0	None	No	0.01	NP (normality)
Barium, total (mg/L)	BAP-MW-1	0.02912	0.02655	2	No	13	0.02784	0.001727	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1604	0.1487	0.1302	2	No	13	0.1395	0.01248	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1605	0.092	0.07303	2	No	13	0.08252	0.01276	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1606	0.06925	0.06013	2	No	13	0.06469	0.006131	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-4	0.09424	0.08542	2	No	13	0.08983	0.00593	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-5	0.1627	0.151	2	No	13	0.1568	0.007883	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1	0.0001297	0.0001127	0.004	No	13	0.0001212	0.00001143	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1604	0.00006197	0.00003966	0.004	No	12	0.00005125	0.00001553	0	None	x^(1/3)	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1605	0.00007382	0.00004634	0.004	No	13	0.00006008	0.00001848	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1606	0.0001245	0.00008625	0.004	No	13	0.0001054	0.00002573	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-4	0.00005901	0.00004499	0.004	No	13	0.000052	0.000009434	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-5	0.00006834	0.00003664	0.004	No	13	0.00005331	0.00002427	0	None	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1	0.002864	0.002236	0.005	No	13	0.00255	0.0004225	0	None	No	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1604	0.00005	0.000007	0.005	No	13	0.00004092	0.00001757	76.92	None	No	0.01	NP (NDs)
Cadmium, total (mg/L)	BAP-MW-1605	0.00005	0.000009	0.005	No	13	0.000038	0.000019	69.23	None	No	0.01	NP (normality)
Cadmium, total (mg/L)	BAP-MW-1606	0.0002001	0.0001336	0.005	No	13	0.0001685	0.00005047	0	None	x^(1/3)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-4	0.0001862	0.00005172	0.005	No	13	0.0001308	0.0001323	0	None	x^(1/3)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-5	0.00005	0.000006	0.005	No	13	0.00001708	0.00001882	23.08	None	No	0.01	NP (normality)
Chromium, total (mg/L)	BAP-MW-1	0.0004568	0.0001049	0.1	No	13	0.0003153	0.0003324	0	None	x^(1/3)	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1604	0.001294	0.0006716	0.1	No	13	0.0009828	0.0004185	0	None	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1605	0.0004012	0.0001851	0.1	No	13	0.0002932	0.0001453	0	None	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1606	0.001255	0.0004662	0.1	No	13	0.0008608	0.0005306	0	None	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-4	0.0006	0.0002	0.1	No	13	0.0003634	0.0002748	0	None	No	0.01	NP (normality)
Chromium, total (mg/L)	BAP-MW-5	0.0004043	0.0001565	0.1	No	13	0.0003128	0.0002541	0	None	ln(x)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1	0.01468	0.01107	0.018	No	13	0.01287	0.002431	0	None	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1604	0.0008878	0.0004373	0.018	No	13	0.0007052	0.0004492	0	None	ln(x)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1605	0.0245	0.00877	0.018	No	13	0.01293	0.00725	0	None	No	0.01	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1606	0.01626	0.01391	0.018	No	13	0.01508	0.001582	0	None	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-4	0.02193	0.009637	0.018	No	12	0.01579	0.007836	0	None	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-5	0.001176	0.0009904	0.018	No	13	0.001086	0.000135	0	None	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1	1.097	0.4897	7.9	No	14	0.8191	0.4609	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1604	1.603	0.6347	7.9	No	14	1.165	0.808	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1605	1.498	0.6194	7.9	No	14	1.208	1.158	0	None	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1606	1.175	0.3908	7.9	No	14	0.8276	0.6118	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-4	1.57	0.46	7.9	No	14	0.9033	0.5816	0	None	No	0.01	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-5	1.236	0.6856	7.9	No	14	0.9609	0.3888	0	None	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1	0.03	0.02	4	No	14	0.02786	0.004258	35.71	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1604	0.1017	0.06629	4	No	15	0.084	0.02613	0	None	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1605	0.06	0.02	4	No	15	0.04	0.02171	33.33	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1606	0.03	0.02	4	No	14	0.02857	0.003631	71.43	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-4	0.07	0.03	4	No	14	0.05	0.01301	0	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-5	0.05	0.03	4	No	14	0.04214	0.008018	0	None	No	0.01	NP (normality)
Lead, total (mg/L)	BAP-MW-1	0.000252	0.000066	0.015	No	13	0.0001877	0.0002965	0	None	No	0.01	NP (normality)

Confidence Intervals - All Results (No Significant Results)

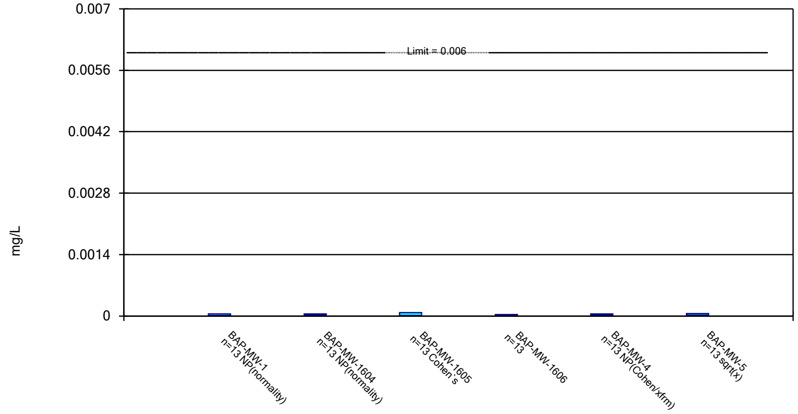
Amos BAP Client: Geosyntec Data: Amos BAP Printed 12/4/2019, 5:01 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Trans...	Alpha	Method
Lead, total (mg/L)	BAP-MW-1604	0.0009707	0.0003299	0.015	No	13	0.0006503	0.0004308	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1605	0.0001808	0.00006334	0.015	No	13	0.0001221	0.000079	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1606	0.001038	0.0003839	0.015	No	13	0.0007109	0.0004398	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-4	0.0003714	0.0001902	0.015	No	13	0.0002808	0.0001218	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-5	0.0003444	0.00006525	0.015	No	13	0.0002232	0.000233	0	None	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1	0.014	0.002	0.04	No	13	0.008336	0.01013	15.38	None	No	0.01	NP (Cohens/xfrm)
Lithium, total (mg/L)	BAP-MW-1604	0.03	0.0008	0.04	No	13	0.01116	0.01316	30.77	None	No	0.01	NP (Cohens/xfrm)
Lithium, total (mg/L)	BAP-MW-1605	0.011	0.003	0.04	No	13	0.008888	0.009646	15.38	None	No	0.01	NP (normality)
Lithium, total (mg/L)	BAP-MW-1606	0.03	0.003	0.04	No	13	0.0108	0.01114	23.08	None	No	0.01	NP (normality)
Lithium, total (mg/L)	BAP-MW-4	0.012	0.0008	0.04	No	13	0.007686	0.01047	15.38	None	No	0.01	NP (Cohens/xfrm)
Lithium, total (mg/L)	BAP-MW-5	0.013	0.0005	0.04	No	13	0.007572	0.01047	15.38	None	No	0.01	NP (Cohens/xfrm)
Mercury, total (mg/L)	BAP-MW-1	0.000005	0.000005	0.002	No	10	0.0000047	9.5e-7	90	None	No	0.011	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1604	0.000005	0.000005	0.002	No	10	0.0000047	9.5e-7	90	None	No	0.011	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1605	0.000005	0.000005	0.002	No	10	0.000005	0	100	None	No	0.011	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1606	0.000005	0.000005	0.002	No	10	0.0000047	9.5e-7	90	None	No	0.011	NP (NDs)
Mercury, total (mg/L)	BAP-MW-4	0.000005	0.000005	0.002	No	10	0.000005	0	100	None	No	0.011	NP (NDs)
Mercury, total (mg/L)	BAP-MW-5	0.000005	0.000005	0.002	No	10	0.000005	0	100	None	No	0.011	NP (NDs)
Molybdenum, total (mg/L)	BAP-MW-1	0.00182	0.000608	0.1	No	13	0.001147	0.0007142	15.38	Cohen`s	No	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-1604	0.00074	0.00021	0.1	No	13	0.0005962	0.0006452	15.38	None	No	0.01	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-1605	0.002	0.0001	0.1	No	13	0.0006592	0.0007801	23.08	None	No	0.01	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-1606	0.002	0.00007	0.1	No	13	0.0005723	0.0008167	23.08	None	No	0.01	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-4	0.002	0.00031	0.1	No	11	0.001093	0.0008377	27.27	None	No	0.006	NP (Cohens/xfrm)
Molybdenum, total (mg/L)	BAP-MW-5	0.0022	0.00022	0.1	No	13	0.001262	0.0009074	23.08	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-1	0.0002	0.00009	0.05	No	13	0.0001285	0.00004981	0	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-1604	0.0003	0.0001	0.05	No	13	0.0001923	0.00004935	0	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-1605	0.00008491	0.00005048	0.05	No	13	0.00006769	0.00002315	0	None	No	0.01	Param.
Selenium, total (mg/L)	BAP-MW-1606	0.0001858	0.00008449	0.05	No	13	0.0001385	0.00007313	0	None	sqrt(x)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-4	0.0001	0.00006	0.05	No	13	0.00007923	0.00001605	0	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-5	0.0001	0.00004	0.05	No	13	0.00008	0.00002708	53.85	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-1	0.0005	0.00003	0.002	No	13	0.0001494	0.0002001	23.08	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-1604	0.0005	0.00001	0.002	No	13	0.0002415	0.0002493	46.15	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-1605	0.0005	0.00002	0.002	No	13	0.0003194	0.0002381	61.54	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-1606	0.0005	0.00001	0.002	No	13	0.0001323	0.00021	23.08	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-4	0.0005	0.000055	0.002	No	13	0.0001722	0.0001908	23.08	None	No	0.01	NP (Cohens/xfrm)
Thallium, total (mg/L)	BAP-MW-5	0.0005	0.00001	0.002	No	13	0.0002408	0.0002499	46.15	None	No	0.01	NP (normality)

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



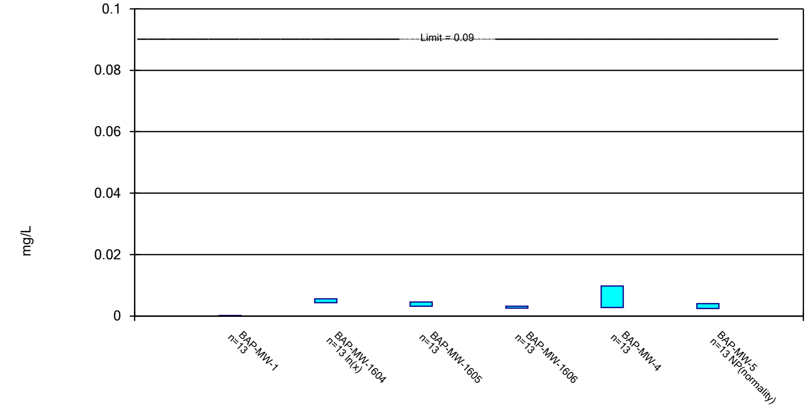
Constituent: Antimony, total   Analysis Run 12/4/2019 5:00 PM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



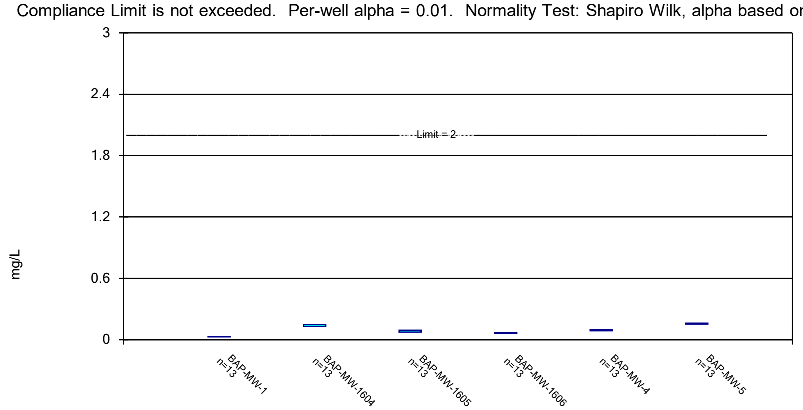
Constituent: Arsenic, total   Analysis Run 12/4/2019 5:00 PM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



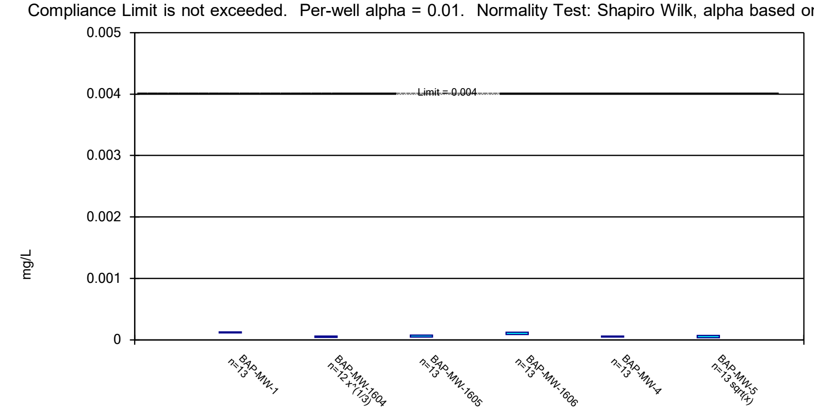
Constituent: Barium, total   Analysis Run 12/4/2019 5:00 PM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



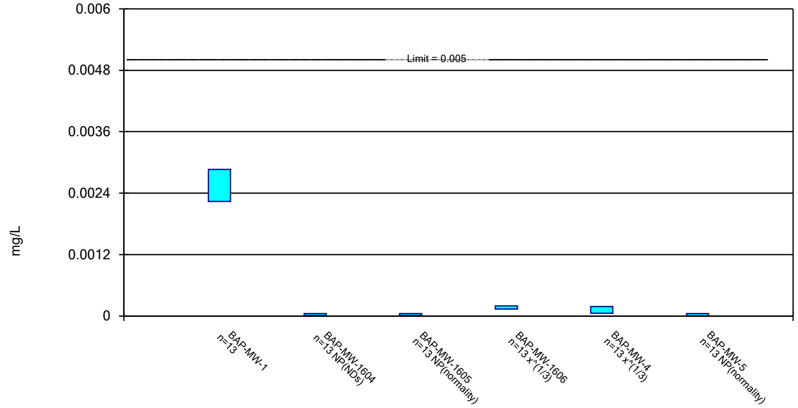
Constituent: Beryllium, total   Analysis Run 12/4/2019 5:00 PM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



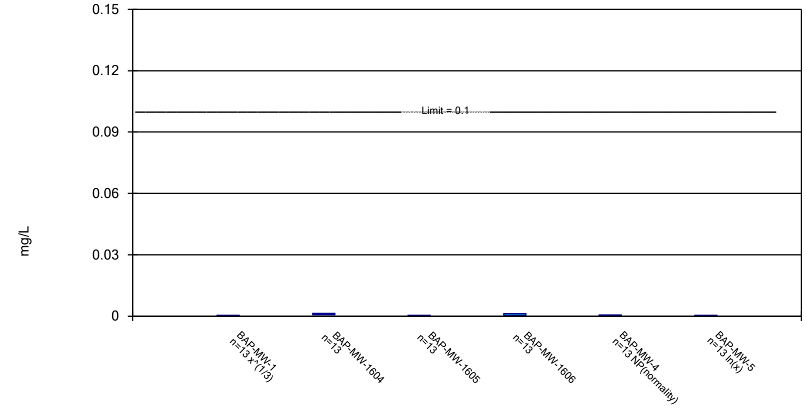
Constituent: Cadmium, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



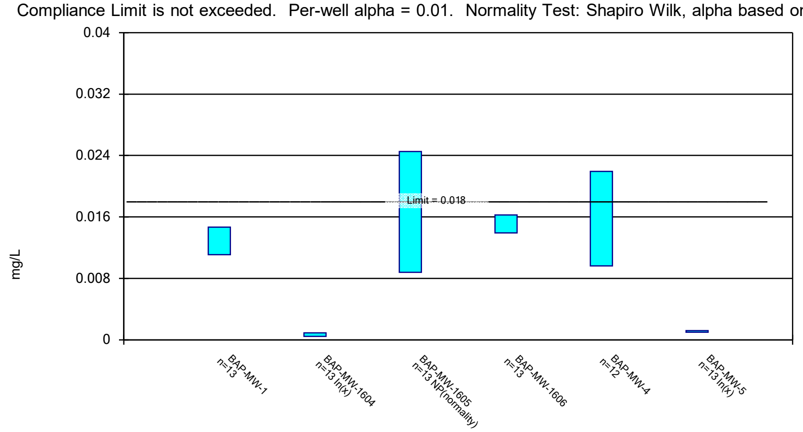
Constituent: Chromium, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



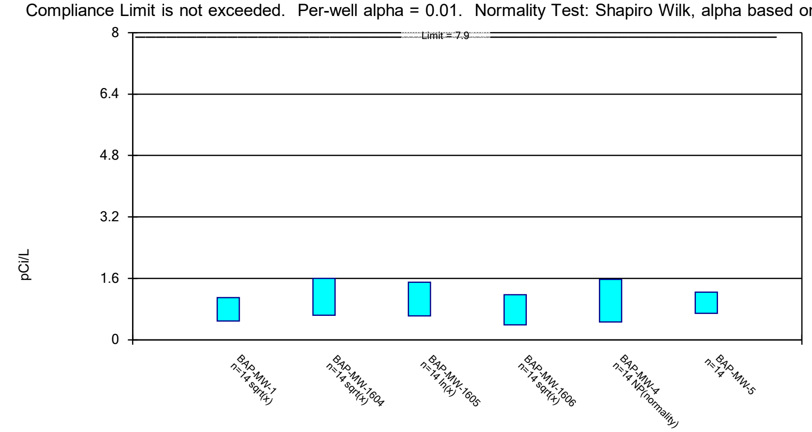
Constituent: Cobalt, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



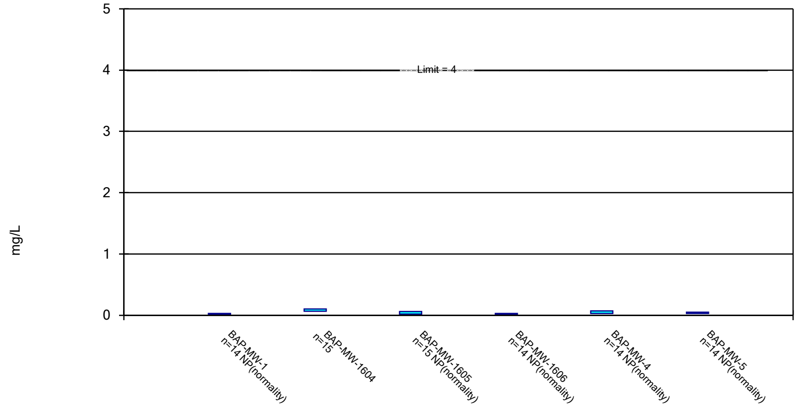
Constituent: Combined Radium 226 + 228 Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

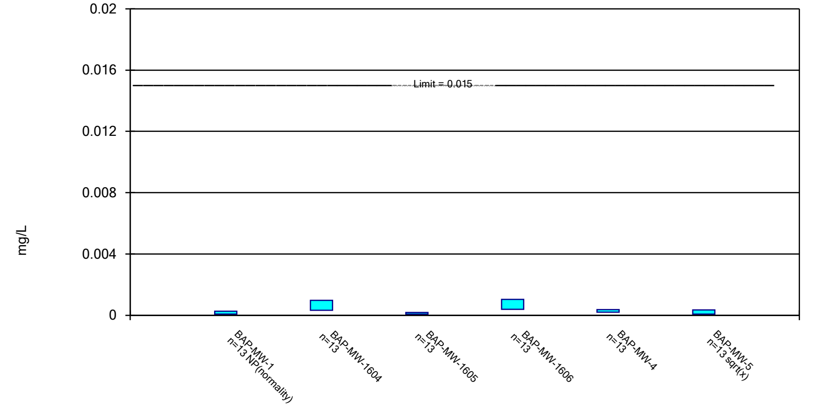


Constituent: Fluoride, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

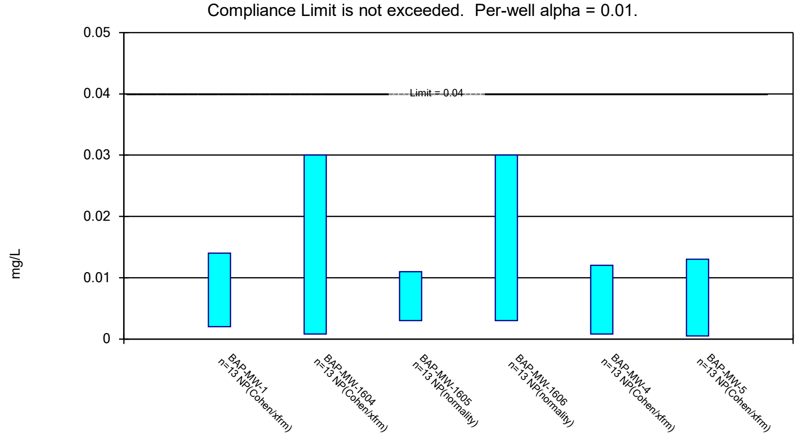


Constituent: Lead, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

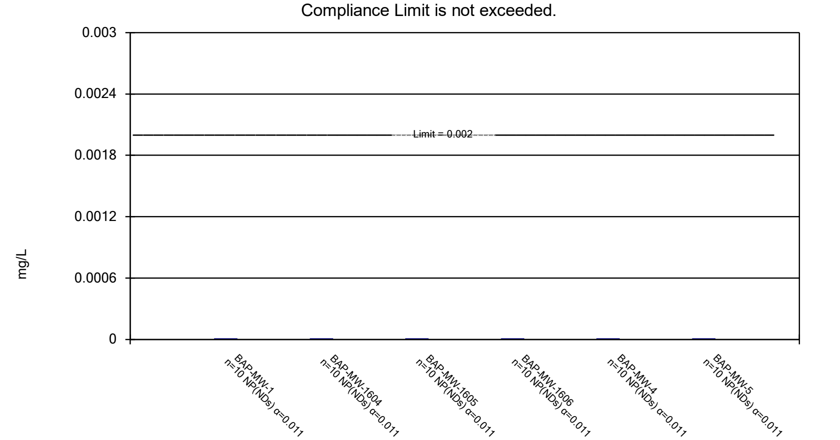


Constituent: Lithium, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

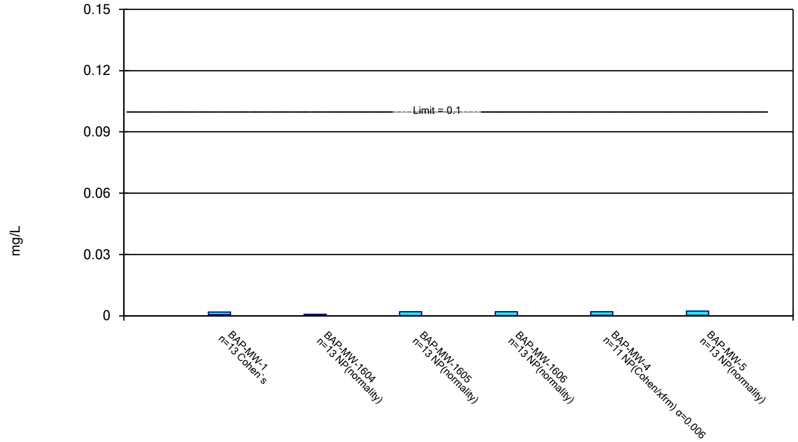


Constituent: Mercury, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



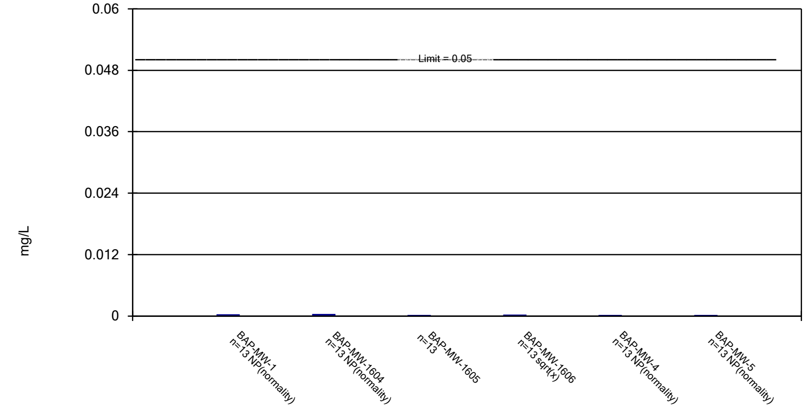
Constituent: Molybdenum, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



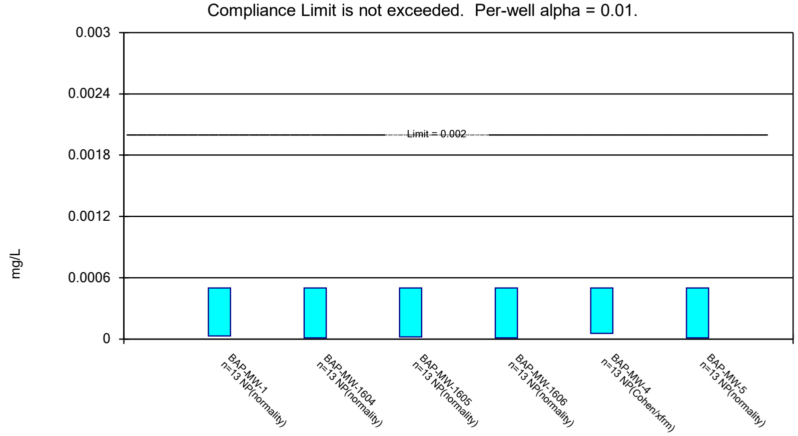
Constituent: Selenium, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium, total Analysis Run 12/4/2019 5:00 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

APPENDIX 3 – Alternative Source Demonstrations

Not applicable.

APPENDIX 4 – Notice of Transition between Monitoring Programs

Not applicable.

APPENDIX 5 – Well Installation/Decommissioning Logs

Not applicable.

Annual Groundwater Monitoring Report

Appalachian Power Company

John E. Amos Plant

Fly Ash Pond CCR Management Unit

Winfield, West Virginia

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

APPALACHIAN POWER

An AEP Company

BOUNDLESS ENERGY

Table of Contents Page

I. Overview

This *Annual Groundwater Monitoring and Corrective Action Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Appalachian Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), John E. Amos Power Plant. The USEPA's CCR rules require that the initial Annual Groundwater Monitoring and Corrective Action Report for inactive surface impoundments be posted to the operating record no later than August 1, 2019 and then annually, thereafter. This second Annual Groundwater Monitoring and Corrective Action Report covers all activities required by the CCR Rule through all of 2019.

In general, the following activities were completed:

- Monitoring wells were installed and developed to establish a certified groundwater monitoring system around each CCR unit, in accordance with the requirements of 40 CFR 257.91 pursuant AEP's *Groundwater Monitoring System Design and Construction Certification (April 2019)*;
- Groundwater samples were collected and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016, Revised 2019)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Background values for each Appendix III and Appendix IV constituent were established;
- A statistical process in accordance with 40 CFR 257.93 to evaluate groundwater data was prepared, certified, and posted to AEP's CCR website in April 2017. The plan was revised in April 2019 and posted to AEP's CCR website in May 2019. AEP's *Statistical Method Selection Certification (2019*). The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* (*"Unified Guidance", USEPA, 2009*);
- Detection Monitoring sampling was initiated. The initial detection monitoring sampling event resulted in no statistically significant increases (SSIs) of appendix III parameters;
- A second detection monitoring event was completed in the second half of 2019. Results are pending. If potential SSIs are observed, the site will undergo verification sampling per the published *Statistical Method Selection Certification (2019)*.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers.

- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened, if applicable (**Appendix 5**).
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (**Appendix 1**).
- Results of the required statistical analysis of groundwater monitoring results (**Appendix 2**).
- Discussion of any alternative source demonstrations completed, if applicable (**Appendix 3**).
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations, if applicable (**Appendix 4**).
- Other information required to be included in the annual report such as an alternate monitoring frequency or assessment of corrective measures, if applicable.

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. Groundwater Monitoring Well Locations and Identification Numbers

Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers. The groundwater monitoring network has been determined to adequately monitor upgradient, downgradient, and background areas adjacent to the Fly Ash Pond, as detailed in the *Groundwater Monitoring System Design and Construction Certification* that was placed on the AEP CCR public internet site on May 1, 2019. The groundwater quality monitoring network includes the following:

- Five upgradient or sidegradient monitoring wells: MW-1807A, MW-1807B, MW-1808A, MW-1809A, and MW-1810A.
- Ten downgradient monitoring wells: MW-1, MW-2, MW-5, MW-6, MW-7, MW-8, MW-9, MW-1801A, MW-1804A, and MW-1806A.

MW-1807B is screened in the Clarksburg shale to provide background groundwater quality in a deeper secondary groundwater-bearing zone that is hydraulically connected to the uppermost aquifer. Since this monitoring well is not located within the uppermost aquifer or a hydraulically connected aquifer, it is shown only on the site figure and not included in the groundwater flow direction maps.

Legend
- Upgradient Sampling Location
- Downgradient Sampling Location
- Fly Ash Pond

Notes
- Monitoring well coordinates and site features provided by AEP.

Site Layout
Fly Ash Pond

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/07/30

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2018\AEP-Amos_FAP_Site_Layout.mxd. ARevezzo. 7/30/2019. CHA8423.

III. Monitoring Wells Installed or Decommissioned

From November 2017 to July 2018 a total of 22 monitoring wells were installed in order to address gaps in the monitoring well network at the Amos Fly Ash Pond. The network design, as summarized in the *Groundwater Monitoring System Design and Construction Certification* (April 2019) posted at the CCR web site for Amos Plant, details the monitoring well installation activities, boring logs, well construction diagrams, and additional tests that were performed. That design report, viewable on the AEP CCR web site at https://aep.com/environment/ccr, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, downgradient monitoring well locations and the upgradient/background monitoring well locations.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction Calculations and Discussion

Appendix 1 contains Table 1 which displays the groundwater quality data collected during the establishment of background quality and the first detection monitoring event. **Appendix 1** also contains Table 2 which displays the groundwater velocity and residence time determinations for each completed sampling event, to date. Static water elevation data from each monitoring event are used to develop potentiometric maps and determine the groundwater flow direction for each respective sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the first detection monitoring samples taken in March 2019 was completed in July 2019. There were no statistically significant increases (SSIs) for the Appendix III parameters. **Appendix 2** of this report includes the *Statistical Analysis Summary* (*July 2019*) and the memorandum summarizing the evaluation of the first detection monitoring event data at the Amos Fly Ash Pond. The second detection monitoring event of 2019 is still on-going. Completion of that event and the statistical analysis report will be completed in early 2020.

VI. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

As of this annual groundwater report date there has been no transition between detection monitoring and assessment monitoring. Detection monitoring will continue throughout 2020. The sampling frequency of twice per year will be maintained for the Appendix III parameters (boron, calcium, chloride, fluoride, pH, sulfate and total dissolved solids).

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production is high enough at this facility that no modification of the twice-per-year detection monitoring effort is needed.

VII. Other Information Required

Existing monitoring wells MW-1, MW-2, MW-5, MW-6, MW-8, and MW-9 had the concrete pads replaced during June and July 2019. All other required information is included in this report.

VIII. Description of Any Problems Encountered and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support this first annual groundwater report preparation.

IX. A Projection of Key Activities for 2020

Key activities for the upcoming year include:

- Completion of the second 2019 detection monitoring event statistical report;
- Detection monitoring on a twice per year schedule;
- Responding to any new data received in light of what the CCR rule requires; and
- Preparation of the second annual groundwater report.

APPENDIX 1

Tables follow, showing a summary of the number of samples collected per monitoring well and the groundwater monitoring data collected, the groundwater velocity, and the direction of groundwater flow. The dates that the samples were collected also is shown.

Table 1 - Groundwater Data Summary: MW-1
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.182	2.83	11.7	0.42	8.2	473	30.6
8/28/2018	Background	0.135	2.80	11.3	0.45	8.5	435	31.6
10/3/2018	Background	0.138	2.95	11.1	0.40	8.3	457	30.8
10/22/2018	Background	0.180	2.36	11.4	0.42	8.3	434	30.7
11/13/2018	Background	0.209	3.03	11.5	0.45	8.0	444	32.2
12/19/2018	Background	0.117	2.71	10.7	0.43	8.1	428	30.9
1/23/2019	Background	0.115	2.29	14.6	0.41	8.2	453	55.9
2/19/2019	Background	0.126	2.36	10.9	0.44	8.5	457	31.3
3/12/2019	Detection	0.110	2.60	11.0	0.43	8.2	458	31.6

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.02 J	7.65	52.9	<0.004 U	0.008 J	0.075	0.031	1.086	0.42	0.041	0.012	<0.002 U	1.94	<0.03 U	0.03 J
8/28/2018	Background	0.02 J	7.90	49.5	<0.004 U	<0.005 U	0.092	0.039	0.261	0.45	0.047	0.009	<0.002 U	1.48	<0.03 U	0.01 J
10/3/2018	Background	<0.02 U	7.98	51.5	<0.02 U	<0.01 U	0.1 J	0.03 J	1.782	0.40	0.02 J	<0.009 U	<0.002 U	1 J	<0.03 U	<0.1 U
10/22/2018	Background	<0.02 U	6.84	44.7	<0.02 U	<0.01 U	0.1 J	0.05 J	0.608	0.42	0.07 J	<0.009 U	<0.002 U	1 J	<0.03 U	<0.1 U
11/13/2018	Background	<0.02 U	8.04	51.9	<0.02 U	<0.01 U	0.583	0.03 J	0.4563	0.45	0.06 J	<0.009 U	<0.002 U	1 J	<0.03 U	<0.1 U
12/19/2018	Background	0.03 J	7.65	48.6	<0.02 U	<0.01 U	0.08 J	0.03 J	0.3156	0.43	0.02 J	0.02 J	<0.002 U	1 J	<0.03 U	<0.1 U
1/23/2019	Background	0.06 J	7.64	43.7	<0.02 U	<0.01 U	0.09 J	0.03 J	0.688	0.41	0.03 J	<0.009 U	<0.002 U	1 J	<0.03 U	<0.1 U
2/19/2019	Background	0.05 J	7.83	44.7	<0.02 U	<0.01 U	0.1 J	0.03 J	0.00538	0.44	0.111	0.01 J	<0.002 U	1 J	0.05 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-2
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/27/2018	Background	0.259	4.24	471	3.08	8.4	1260	2.4
8/29/2018	Background	0.249	3.98	443	2.99	8.6	1310	17.4
10/4/2018	Background	0.256	4.31	435	2.99	8.5	1280	14.8
10/23/2018	Background	0.262	3.95	438	3.08	8.5	1250	7.4
11/15/2018	Background	0.328	4.07	469	3.3	8.5	1250	13.5
12/19/2018	Background	0.225	3.81	430	3.03	8.5	1250	6.4
1/23/2019	Background	0.318	3.67	441	3.00	8.2	1310	6.4
2/22/2019	Background	0.237	3.95	447	3.06	8.7	1310	2.3
3/13/2019	Detection	0.230	3.98	441	3.02	8.7	1300	1.8

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-2
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/27/2018	Background	0.06	1.68	202	0.008 J	0.02 J	0.312	0.102	1.354	3.08	0.406	0.019	<0.002 U	27.2	0.04 J	0.02 J
8/29/2018	Background	0.02 J	1.62	178	<0.004 U	<0.005 U	0.129	0.034	1.70	2.99	0.033	0.023	<0.002 U	34.5	<0.03 U	0.02 J
10/4/2018	Background	<0.02 U	1.76	192	<0.02 U	<0.01 U	0.2 J	0.05 J	1.288	2.99	0.1 J	<0.009 U	<0.002 U	30.8	<0.03 U	<0.1 U
10/23/2018	Background	<0.02 U	1.24	181	<0.02 U	<0.01 U	0.2 J	0.055	0.594	3.08	0.214	0.03 J	<0.002 U	26.1	<0.03 U	<0.1 U
11/15/2018	Background	<0.02 U	1.66	185	<0.02 U	<0.01 U	0.2 J	0.04 J	0.953	3.3	0.110	0.02 J	<0.002 U	29.2	<0.03 U	<0.1 U
12/19/2018	Background	0.03 J	1.33	182	<0.02 U	0.03 J	0.967	0.04 J	1.058	3.03	0.290	0.02 J	<0.002 U	25.5	<0.03 U	<0.1 U
1/23/2019	Background	<0.02 U	1.55	178	<0.02 U	<0.01 U	0.382	0.05	0.725	3.00	0.166	0.01 J	<0.002 U	29.2	0.04 J	<0.1 U
2/22/2019	Background	<0.10 U	1.35	169	<0.1 U	<0.05 U	<0.2 U	<0.1 U	0.2747	3.06	<0.1 U	0.02 J	<0.002 U	21.9	<0.2 U	<0.5 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-5
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.252	6.75	793	3.32	8.1	1890	0.2
8/29/2018	Background	0.240	6.71	780	3.33	8.2	1880	0.2
10/3/2018	Background	0.276	7.03	776	3.33	8.1	1860	0.1 J
10/24/2018	Background	0.249	7.09	811	3.44	8.1	1840	<0.06 U
11/13/2018	Background	0.264	6.79	832	3.63	8.0	1880	0.1 J
12/19/2018	Background	0.221	6.48	783	3.43	7.9	1890	<0.06 U
1/23/2019	Background	0.323	5.98	782	3.36	8.1	1910	<0.06 U
2/19/2019	Background	0.239	6.79	793	3.38	8.2	1920	<0.06 U
3/13/2019	Detection	0.229	6.85	804	3.44	8.0	1930	0.08 J

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-5
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.06	4.89	356	0.004 J	0.006 J	0.152	0.046	1.37	3.32	0.222	0.032	<0.002 U	36.5	<0.03 U	0.05 J
8/29/2018	Background	0.18	5.08	359	<0.004 U	0.01 J	0.278	0.085	1.805	3.33	0.284	0.030	<0.002 U	38.4	<0.03 U	0.02 J
10/3/2018	Background	<0.02 U	4.86	373	<0.02 U	<0.01 U	0.626	0.053	1.63	3.33	0.03 J	<0.009 U	<0.002 U	35.7	<0.03 U	<0.1 U
10/24/2018	Background	0.02 J	4.34	363	<0.02 U	<0.01 U	0.219	0.516	0.731	3.44	0.06 J	0.03 J	<0.002 U	35.1	0.04 J	<0.1 U
11/13/2018	Background	<0.02 U	4.37	353	<0.02 U	<0.01 U	0.1 J	0.04 J	1.824	3.63	0.03 J	0.02 J	<0.002 U	34.7	<0.03 U	<0.1 U
12/19/2018	Background	<0.02 U	4.39	364	<0.02 U	<0.01 U	0.07 J	0.04 J	1.514	3.43	<0.02 U	0.03 J	<0.002 U	34.8	<0.03 U	<0.1 U
1/23/2019	Background	<0.04 U	4.35	351	<0.04 U	<0.02 U	0.532	<0.04 U	1.052	3.36	<0.04 U	0.02 J	<0.002 U	35.0	<0.06 U	<0.2 U
2/19/2019	Background	<0.06 U	5.25	349	<0.06 U	<0.03 U	0.2 J	<0.06 U	1.454	3.38	<0.06 U	0.034	<0.002 U	33.6	<0.09 U	<0.3 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-6
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.120	61.0	19.3	0.22	6.9	392	44.4
8/28/2018	Background	0.096	59.7	19.4	0.24	6.9	398	44.6
10/3/2018	Background	0.125	60.7	18.9	0.21	6.8	402	43.4
10/24/2018	Background	0.1 J	61.5	18.4	0.23	6.9	400	42.0
11/13/2018	Background	0.111	64.9	19.8	0.24	6.7	390	44.6
12/19/2018	Background	0.07 J	55.8	17.7	0.23	6.7	376	41.7
1/23/2019	Background	0.08 J	54.1	17.8	0.22	6.6	411	41.3
2/19/2019	Background	0.09 J	55.8	17.3	0.24	7.0	406	40.4
3/12/2019	Detection	0.08 J	57.9	17.4	0.23	6.9	390	39.8

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-6
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.01 J	1.81	536	0.009 J	0.01 J	0.094	0.242	2.73	0.22	0.02 J	0.012	<0.002 U	0.58	<0.03 U	0.03 J
8/28/2018	Background	0.02 J	1.82	527	0.008 J	0.02	0.663	0.323	2.439	0.24	0.167	0.009	<0.002 U	0.60	<0.03 U	0.02 J
10/3/2018	Background	<0.02 U	1.91	523	<0.02 U	0.01 J	0.09 J	0.260	4.59	0.21	<0.02 U	<0.009 U	<0.002 U	0.5 J	<0.03 U	<0.1 U
10/24/2018	Background	<0.02 U	1.72	494	0.03 J	<0.01 U	0.07 J	0.258	2.202	0.23	0.03 J	0.01 J	<0.002 U	0.6 J	<0.03 U	<0.1 U
11/13/2018	Background	<0.02 U	2.12	524	<0.02 U	<0.01 U	0.08 J	0.233	2.325	0.24	0.03 J	<0.009 U	<0.002 U	0.7 J	<0.03 U	<0.1 U
12/19/2018	Background	<0.02 U	1.88	510	<0.02 U	0.01 J	0.06 J	0.234	2.53	0.23	0.02 J	0.01 J	<0.002 U	0.7 J	<0.03 U	<0.1 U
1/23/2019	Background	0.04 J	1.89	486	<0.02 U	<0.01 U	0.04 J	0.220	1.82	0.22	<0.02 U	<0.009 U	<0.002 U	0.6 J	<0.03 U	<0.1 U
2/19/2019	Background	<0.02 U	1.53	482	<0.02 U	<0.01 U	0.277	0.219	2.136	0.24	<0.02 U	0.02 J	<0.002 U	0.6 J	0.04 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-7
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.087	1.33	5.41	0.27	8.5	368	32.0
8/29/2018	Background	0.112	1.29	5.32	0.27	8.8	387	31.5
10/3/2018	Background	0.156	1.44	5.23	0.26	8.8	376	31.8
10/24/2018	Background	0.09 J	1.40	5.37	0.27	8.8	344	31.7
11/13/2018	Background	0.192	1.49	5.65	0.29	8.4	379	33.2
12/17/2018	Background	0.1 J	1.24	5.29	0.27	8.6	387	32.0
1/23/2019	Background	0.127	1.41	5.18	0.25	8.4	389	32.0
2/18/2019	Background	0.06 J	1.37	5.39	0.26	9.0	401	32.1
3/12/2019	Detection	0.06 J	1.47	5.49	0.27	8.9	385	32.5

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-7
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/26/2018	Background	0.04 J	5.31	34	<0.004 U	0.01 J	0.082	0.038	1.958	0.27	0.211	0.009	<0.002 U	1.12	<0.03 U	0.01 J
8/29/2018	Background	0.05 J	5.51	32.3	<0.004 U	0.01 J	0.190	0.023	0.745	0.27	0.121	0.010	<0.002 U	1.06	<0.03 U	0.02 J
10/3/2018	Background	0.07 J	5.65	33.9	<0.02 U	<0.01 U	0.07 J	<0.02 U	2.391	0.26	0.111	<0.009 U	<0.002 U	1 J	0.03 J	<0.1 U
10/24/2018	Background	0.18	5.13	37.0	<0.02 U	0.02 J	0.296	0.134	0.1126	0.27	0.476	<0.009 U	<0.002 U	1 J	0.05 J	<0.1 U
11/13/2018	Background	0.12	5.24	32.7	<0.02 U	<0.01 U	0.1 J	0.03 J	0.9538	0.29	0.146	<0.009 U	<0.002 U	1 J	<0.03 U	<0.1 U
12/17/2018	Background	0.06 J	5.21	33.5	<0.02 U	<0.01 U	0.1 J	<0.02 U	1.236	0.27	0.1 J	<0.009 U	<0.002 U	1 J	0.04 J	<0.1 U
1/23/2019	Background	0.44	5.86	36.8	<0.02 U	0.02 J	0.221	0.068	0.558	0.25	0.420	<0.009 U	<0.002 U	1 J	0.05 J	<0.1 U
2/18/2019	Background	0.27	5.33	34.3	0.03 J	0.02 J	0.1 J	0.057	0.543	0.26	0.230	0.01 J	<0.002 U	1 J	<0.03 U	<0.1 U

Notes:
μg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-8
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.233	2.15	- -	- -	- -	- -	- -
8/2/2018	Background	- -	- -	105	2.7	8.2	690	21.6
8/30/2018	Background	0.225	1.99	109	2.66	8.9	727	24.2
10/3/2018	Background	0.259	2.74	108	2.58	7.9	729	31.6
10/23/2018	Background	0.278	2.32	108	2.74	8.5	717	26.3
11/13/2018	Background	0.254	2.46	116	2.93	8.2	711	27.2
12/19/2018	Background	0.224	2.28	110	2.78	8.5	696	26.4
1/23/2019	Background	0.213	2.39	111	2.62	8.1	739	30.1
2/20/2019	Background	0.195	2.49	111	2.87	9.2	740	26.4
3/12/2019	Detection	0.192	2.32	110	2.87	8.5	716	27.4

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-8
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.04 J	3.02	63.7	0.005 J	<0.005 U	0.114	0.21	1.5625	2.7	0.237	0.013	<0.002 U	11.7	0.05 J	0.02 J
8/30/2018	Background	0.85	5.71	58.2	0.049	0.05	1.89	1.69	0.655	2.66	2.78	0.012	0.004 J	20.6	0.2	0.076
10/3/2018	Background	0.20	5.18	86.2	<0.02 U	0.02 J	0.2 J	0.27	3.981	2.58	0.427	<0.009 U	<0.002 U	8.76	0.08 J	<0.1 U
10/23/2018	Background	0.15	4.26	70.9	<0.02 U	<0.01 U	0.229	0.284	0.294	2.74	0.491	0.02 J	<0.002 U	10.2	0.08 J	<0.1 U
11/13/2018	Background	0.14	3.49	71.5	<0.02 U	<0.01 U	0.2 J	0.253	0.691	2.93	0.352	<0.009 U	<0.002 U	7.64	0.08 J	<0.1 U
12/19/2018	Background	0.26	2.91	73.3	<0.02 U	<0.01 U	0.264	0.231	0.956	2.78	0.357	0.02 J	<0.002 U	6.93	0.1 J	<0.1 U
1/23/2019	Background	0.27	3.49	76.8	<0.02 U	<0.01 U	0.463	0.513	0.3857	2.62	0.990	<0.009 U	<0.002 U	11.0	0.09 J	<0.1 U
2/20/2019	Background	0.40 J	2.41	71.9	<0.1 U	<0.05 U	0.4 J	0.538	0.736	2.87	0.770	0.009 J	<0.002 U	8 J	0.4 J	<0.5 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-9
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.157	1.03	- -	- -	- -	- -	- -
8/2/2018	Background	- -	- -	7.22	0.87	8.3	421	12.9
8/30/2018	Background	0.128	1.04	7.21	0.86	8.0	468	12.2
10/2/2018	Background	0.145	1.44	7.6	0.83	7.1	513	12.6
10/23/2018	Background	0.141	1.07	7.26	0.87	9.3	460	12.8
11/13/2018	Background	0.166	1.24	7.29	0.91	9.1	449	11.9
12/20/2018	Background	0.114	1.03	7.11	0.84	9.2	435	15.7
1/23/2019	Background	0.134	1.01	7.45	0.77	9.7	484	20.1
2/20/2019	Background	0.128	1.26	7.7	0.84	9.2	505	28.5
3/12/2019	Detection	0.122	1.18	7.50	0.91	9.0	463	24.0

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-9
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.21	5.23	46.8	0.004 J	0.01 J	0.218	1	0.912	0.87	1.12	0.01	<0.002 U	7.31	0.06 J	0.06
8/30/2018	Background	0.91	5.87	46.8	0.02 J	0.35	1.17	2.15	1.162	0.86	5.23	0.010	0.012	6.28	0.2	0.209
10/2/2018	Background	0.59	7.04	66.0	0.192	0.07	4.52	3.70	0.543	0.83	8.66	0.009 J	0.016	6.07	0.9	0.4 J
10/23/2018	Background	1.28	4.58	45.4	0.08 J	0.02 J	1.9	1.39	0.658	0.87	2.68	0.01 J	0.008	5.93	0.4	0.3 J
11/13/2018	Background	0.35	5.83	51.1	0.115	0.02 J	2.54	1.92	0.635	0.91	3.44	<0.009 U	0.004 J	6.06	0.6	0.2 J
12/20/2018	Background	0.33	4.47	35.8	<0.02 U	0.10	0.725	0.393	0.847	0.84	1.03	<0.009 U	0.010	6.51	0.4	0.1 J
1/23/2019	Background	1.08	5.84	44.6	0.09 J	0.03 J	2.46	1.43	1.464	0.77	2.45	<0.009 U	0.009	6.49	0.5	0.2 J
2/20/2019	Background	0.40 J	5.45	41.5	<0.1 U	<0.05 U	0.7 J	0.349	0.2514	0.84	0.955	0.01 J	0.006	6 J	0.3 J	<0.5 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1801A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.274	62.5	9.64	0.1 J	7.6	372	49.4
8/29/2018	Background	0.288	64.0	10.8	0.11	7.4	420	54.8
10/2/2018	Background	0.137	61.0	7.48	0.1 J	7.4	356	46.7
10/24/2018	Background	0.105	63.1	8.14	0.1 J	7.5	357	41.8
11/14/2018	Background	0.236	65.4	9.86	0.1 J	7.3	386	49.3
12/19/2018	Background	0.289	62.8	9.08	0.12	7.3	361	45.5
1/24/2019	Background	0.168	53.4	9.18	0.14	6.3	365	46.3
2/20/2019	Background	0.09 J	53.3	8.96	0.13	8.0	343	40.0
3/12/2019	Detection	0.09 J	51.2	9.40	0.16	7.5	306	41.7

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1801A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.13	0.36	54.4	<0.004 U	0.01 J	0.113	0.194	0.602	0.1 J	0.042	0.009	<0.002 U	4.97	0.09 J	0.04 J
8/29/2018	Background	0.05 J	0.57	56.5	<0.004 U	<0.005 U	0.143	0.260	1.222	0.11	0.024	0.007	<0.002 U	3.07	0.05 J	0.04 J
10/2/2018	Background	0.14	0.82	47.1	<0.02 U	<0.01 U	0.09 J	0.422	0.254	0.1 J	0.04 J	0.02 J	<0.002 U	4.79	0.1 J	<0.1 U
10/24/2018	Background	0.06 J	0.72	51.3	<0.02 U	<0.01 U	0.08 J	0.380	0.654	0.1 J	0.02 J	0.009 J	<0.002 U	2.08	0.2 J	<0.1 U
11/14/2018	Background	0.08 J	1.01	51.3	<0.02 U	0.03 J	0.08 J	0.414	0.6902	0.1 J	0.05 J	<0.009 U	<0.002 U	2.34	0.1 J	<0.1 U
12/19/2018	Background	0.04 J	1.11	56.0	<0.02 U	0.02 J	0.1 J	0.349	0.836	0.12	0.03 J	0.01 J	<0.002 U	2.77	0.09 J	<0.1 U
1/24/2019	Background	0.06 J	1.57	55.3	<0.02 U	<0.01 U	0.07 J	0.326	0.595	0.14	<0.02 U	<0.009 U	<0.002 U	2.22	0.1 J	<0.1 U
2/20/2019	Background	0.09 J	1.52	56.6	<0.02 U	<0.01 U	0.1 J	0.29	0.588	0.13	<0.02 U	<0.009 U	<0.002 U	3.57	0.2 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1801C
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2018	Background	0.133	2.29	10.4	0.88	9.0	533	30.3
8/29/2018	Background	0.106	4.67	12.4	0.87	8.8	456	33.1
10/4/2018	Background	0.121	4.61	15.4	0.89	8.7	538	33.9
10/24/2018	Background	0.131	4.44	18.3	0.93	8.7	640	36.3
11/14/2018	Background	0.151	3.51	22.4	1.04	8.5	558	42.8
12/19/2018	Background	0.124	2.69	22.0	1.06	8.7	541	44.8
1/24/2019	Background	0.134	2.52	25.5	1.08	8.7	563	52.0
2/20/2019	Background	0.133	3.74	36.2	1.21	9.4	616	76.1
3/12/2019	Detection	0.126	3.79	34.1	1.20	8.7	601	71.7

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1801C
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/25/2018	Background	0.41	9.66	74.9	0.224	0.02 J	2.23	0.609	2.304	0.88	2.44	0.008	0.003 J	8.14	1.1	0.03 J
8/29/2018	Background	0.23	11.2	170	0.638	0.26	5.01	1.23	2.245	0.87	6.50	0.013	0.003 J	9.50	3.6	0.054
10/4/2018	Background	0.45	10.3	112	0.469	0.03 J	1.05	0.435	28.386	0.89	3.57	<0.009 U	0.002 J	13.8	1.9	<0.1 U
10/24/2018	Background	0.32	8.48	125	0.532	0.03 J	3.50	0.664	0.992	0.93	4.21	0.01 J	0.002 J	17.2	2.1	<0.1 U
11/14/2018	Background	0.32	6.71	82.9	0.261	0.02 J	1.63	0.398	0.822	1.04	2.26	<0.009 U	<0.002 U	20.6	1.1	<0.1 U
12/19/2018	Background	0.28	6.14	50.1	0.112	0.02 J	0.955	0.238	0.412	1.06	1.10	0.01 J	<0.002 U	21.9	0.4	<0.1 U
1/24/2019	Background	0.23	5.44	38.7	0.08 J	0.01 J	0.937	0.252	0.496	1.08	0.703	<0.009 U	<0.002 U	26.4	0.2	<0.1 U
2/20/2019	Background	0.30	5.21	42.7	0.04 J	0.01 J	0.625	0.167	0.0902	1.21	0.462	<0.009 U	<0.002 U	33.9	0.3	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1804A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/27/2018	Background	0.672	28.1	- -	- -	- -	- -	- -
8/1/2018	Background	- -	- -	3.87	0.70	7.4	423	35.2
8/28/2018	Background	0.779	15.9	5.27	0.84	8.3	452	44.7
10/2/2018	Background	0.629	38.8	3.63	0.61	7.9	458	35.7
10/23/2018	Background	0.675	12.9	4.79	0.78	7.6	452	36.9
11/13/2018	Background	0.846	8.90	5.32	0.91	7.8	498	46
12/19/2018	Background	0.772	10.1	4.51	0.78	7.9	433	40.1
1/24/2019	Background	0.673	12.1	3.14	0.71	7.4	414	32.3
2/21/2019	Background	0.611	7.43	3.29	0.89	8.0	461	33.8
3/12/2019	Detection	0.568	10.2	3.55	0.85	7.9	411	34.0

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1804A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/27/2018	Background	0.54	2.48	245	0.008 J	<0.005 U	0.185	0.458	1.814	0.70	0.445	0.018	<0.002 U	136	1.8	0.069
8/28/2018	Background	0.15	3.59	204	<0.004 U	<0.005 U	0.304	0.314	1.559	0.84	0.031	0.015	<0.002 U	136	0.2	0.05 J
10/2/2018	Background	0.53	2.35	390	<0.02 U	<0.01 U	0.1 J	0.693	1.664	0.61	0.05 J	0.032	<0.002 U	111	3.1	<0.1 U
10/23/2018	Background	0.18	3.36	131	<0.02 U	<0.01 U	0.1 J	0.137	0.444	0.78	0.114	0.01 J	<0.002 U	116	0.7	<0.1 U
11/13/2018	Background	0.09 J	4.16	135	<0.02 U	<0.01 U	0.2 J	0.16	0.523	0.91	0.133	0.02 J	<0.002 U	129	0.2	<0.1 U
12/19/2018	Background	0.13	4.00	169	<0.02 U	<0.01 U	0.1 J	0.176	1.089	0.78	0.111	0.01 J	<0.002 U	130	0.5	<0.1 U
1/24/2019	Background	0.30	3.32	183	<0.02 U	<0.01 U	0.2 J	0.137	1.424	0.71	0.14	<0.009 U	<0.002 U	110	1.7	<0.1 U
2/21/2019	Background	0.19	4.48	116	<0.02 U	<0.01 U	0.2 J	0.096	0.894	0.89	0.219	<0.009 U	<0.002 U	115	0.6	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1806A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/27/2018	Background	0.164	12.9	- -	- -	- -	- -	- -
8/1/2018	Background	- -	- -	17.7	0.56	7.6	426	48.4
8/29/2018	Background	0.162	12.0	16.2	0.55	8.0	445	45.6
10/2/2018	Background	0.15	5.81	7.21	0.80	8.5	435	36.2
10/23/2018	Background	0.158	7.43	8.62	0.77	8.4	423	40.8
11/13/2018	Background	0.213	7.51	8.15	0.85	8.1	442	40.1
12/19/2018	Background	0.162	5.14	5.29	0.85	8.5	409	30.9
1/24/2019	Background	0.168	12.2	11.7	0.59	8.1	445	48.1
2/18/2019	Background	0.133	5.67	6.24	0.81	8.6	460	33.0
3/12/2019	Detection	0.130	4.98	5.51	0.83	8.8	430	32.9

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1806A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/27/2018	Background	1.16	2.65	163	0.01 J	0.01 J	0.416	0.240	0.998	0.56	0.368	0.012	<0.002 U	17.0	0.1	0.03 J
8/29/2018	Background	0.89	3.29	148	<0.004 U	0.008 J	1.54	0.161	1.533	0.55	0.154	0.010	<0.002 U	14.2	0.09 J	0.02 J
10/2/2018	Background	0.28	5.30	65.4	<0.02 U	<0.01 U	0.1 J	0.080	0.900	0.80	0.158	0.02 J	<0.002 U	7.73	0.07 J	<0.1 U
10/23/2018	Background	0.19	5.16	88.3	<0.02 U	<0.01 U	0.252	0.152	0.469	0.77	0.195	0.02 J	<0.002 U	6.66	0.07 J	<0.1 U
11/13/2018	Background	0.11	5.91	98.7	<0.02 U	<0.01 U	0.1 J	0.163	0.3442	0.85	0.137	<0.009 U	<0.002 U	7.44	0.05 J	<0.1 U
12/19/2018	Background	0.17	5.65	65.6	<0.02 U	<0.01 U	0.1 J	0.071	0.8606	0.85	0.122	<0.009 U	<0.002 U	6.02	0.06 J	<0.1 U
1/24/2019	Background	0.15	3.97	168	<0.02 U	<0.01 U	0.08 J	0.159	1.164	0.59	0.06 J	0.02 J	<0.002 U	5.62	0.04 J	<0.1 U
2/18/2019	Background	0.10 J	4.21	78.8	<0.02 U	<0.01 U	0.2 J	0.05	0.419	0.81	0.11	0.01 J	<0.002 U	4.74	0.03 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1807A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.17	146	9.57	0.21	7.5	929	334
8/28/2018	Background	0.137	136	11.8	0.21	6.9	953	356
10/4/2018	Background	0.129	166	12.5	0.16	6.7	985	367
10/24/2018	Background	0.199	144	10.3	0.20	6.9	838	308
11/14/2018	Background	0.175	155	10.5	0.21	6.8	904	326
12/20/2018	Background	0.208	151	9.68	0.19	7.2	931	315
1/25/2019	Background	0.183	156	11.3	0.15	8.2	876	361
2/21/2019	Background	0.08 J	150	12.0	0.14	7.2	1050	396
3/14/2019	Detection	0.09 J	160	11.1	0.15	6.7	1020	363

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1807A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.13	0.99	32.6	0.006 J	0.02	0.098	0.629	1.366	0.21	0.046	0.020	<0.002 U	1.65	0.3	0.03 J
8/28/2018	Background	0.87	1.13	32.6	0.005 J	0.06	0.253	0.565	1.507	0.21	0.300	0.018	0.002 J	9.07	0.6	0.054
10/4/2018	Background	0.14	1.10	30.1	<0.02 U	0.05 J	0.205	0.918	1.127	0.16	0.142	<0.009 U	<0.002 U	11.1	0.2 J	<0.1 U
10/24/2018	Background	0.18	0.84	27.8	<0.02 U	0.03 J	0.2 J	0.579	0.38891	0.20	0.105	0.02 J	<0.002 U	2 J	0.2 J	<0.1 U
11/14/2018	Background	0.17	0.96	28.8	<0.02 U	0.03 J	0.09 J	0.614	0.985	0.21	0.09 J	0.01 J	<0.002 U	2 J	0.2	<0.1 U
12/20/2018	Background	0.17	0.94	29.5	<0.02 U	0.03 J	0.403	0.616	1.016	0.19	0.251	0.02 J	<0.002 U	1 J	0.3	<0.1 U
1/25/2019	Background	0.12	0.92	27.4	<0.02 U	0.03 J	0.1 J	0.733	1.269	0.15	0.126	0.030	<0.002 U	1 J	0.1 J	<0.1 U
2/21/2019	Background	0.08 J	0.82	24.1	<0.02 U	0.03 J	0.1 J	0.811	0.735	0.14	0.118	0.01 J	<0.002 U	0.6 J	0.1 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1807B
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.195	8.76	8.46	0.75	8.3	732	218
8/28/2018	Background	0.178	8.39	10.8	1.13	8.1	706	219
10/5/2018	Background	0.201	9.21	9.94	1.01	7.9	752	219
10/24/2018	Background	0.176	8.92	7.93	0.81	8.3	735	220
11/14/2018	Background	0.211	8.87	8.52	0.91	7.7	732	230
12/20/2018	Background	0.164	11.6	9.88	1.16	8.2	738	230
1/25/2019	Background	0.277	9.33	7.68	0.79	6.9	742	227
2/21/2019	Background	0.168	11.0	9.53	1.06	8.4	791	238
3/14/2019	Detection	0.163	12.7	10.8	1.19	7.9	793	249

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1807B
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.27	1.93	49.6	0.049	0.01 J	1.40	0.525	0.719	0.75	0.756	0.021	<0.002 U	4.22	0.3	0.03 J
8/28/2018	Background	0.23	1.94	56.3	<0.004 U	<0.005 U	0.134	0.046	1.31	1.13	0.035	0.010	<0.002 U	23.9	0.08 J	0.01 J
10/5/2018	Background	0.15	1.70	59.6	0.03 J	<0.01 U	0.263	0.179	2.079	1.01	0.310	<0.009 U	<0.002 U	12.5	0.2 J	<0.1 U
10/24/2018	Background	0.25	1.26	42.3	<0.02 U	<0.01 U	0.381	0.139	0.305	0.81	0.203	0.02 J	<0.002 U	5.59	0.07 J	<0.1 U
11/14/2018	Background	0.16	1.28	41.4	<0.02 U	<0.01 U	0.247	0.073	0.348	0.91	0.08 J	0.02 J	<0.002 U	5.62	0.05 J	<0.1 U
12/20/2018	Background	0.43	1.75	73.7	<0.02 U	<0.01 U	0.335	0.114	0.2672	1.16	0.145	0.02 J	<0.002 U	13.5	0.1 J	<0.1 U
1/25/2019	Background	0.09 J	1.23	43.0	<0.02 U	<0.01 U	0.08 J	0.05 J	1.003	0.79	0.04 J	0.02 J	<0.002 U	4.21	0.06 J	<0.1 U
2/21/2019	Background	0.35	1.48	66.9	<0.02 U	<0.01 U	0.1 J	0.051	0.291	1.06	0.04 J	<0.009 U	<0.002 U	9.27	0.08 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1808A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2018	Background	0.182	40.4	19.6	0.52	7.7	734	184
8/28/2018	Background	0.142	38.5	19.4	0.57	7.6	740	227
10/4/2018	Background	0.135	38.6	16.7	0.41	7.4	790	216
10/24/2018	Background	0.103	41.5	17.1	0.55	7.7	614	126
11/13/2018	Background	0.152	40.2	18.4	0.51	7.4	770	210
12/20/2018	Background	0.172	40.3	21.6	0.47	7.6	834	242
1/25/2019	Background	0.173	47.4	18.3	0.40	6.1	840	231
2/21/2019	Background	0.122	39.4	17.4	0.40	7.2	821	213
3/14/2019	Detection	0.112	62.9	20.9	0.33	7.7	912	290

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1808A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/25/2018	Background	0.29	2.47	86.2	0.299	0.007 J	0.831	0.544	1.892	0.52	2.28	0.024	0.006	6.46	0.5	0.04 J
8/28/2018	Background	0.14	5.34	105	0.251	0.01 J	1.25	0.821	4.96	0.57	2.06	0.025	0.005 J	11.7	0.4	0.083
10/4/2018	Background	0.14	2.84	78.1	0.05 J	<0.01 U	0.500	0.231	2.082	0.41	0.392	<0.009 U	<0.002 U	4.56	0.07 J	<0.1 U
10/24/2018	Background	0.03 J	1.86	86.2	0.05 J	<0.01 U	0.443	0.117	1.04	0.55	0.397	0.02 J	<0.002 U	3.06	0.07 J	<0.1 U
11/13/2018	Background	0.04 J	3.83	74.1	0.03 J	<0.01 U	0.381	0.16	0.47	0.51	0.245	0.02 J	0.002 J	2.75	0.05 J	<0.1 U
12/20/2018	Background	0.05 J	4.37	71.0	0.04 J	<0.01 U	0.293	0.119	1.048	0.47	0.227	0.03 J	0.003 J	2 J	0.08 J	<0.1 U
1/25/2019	Background	0.06 J	2.27	80.3	0.102	<0.01 U	0.415	0.149	2.76	0.40	0.717	0.035	<0.002 U	1 J	0.2 J	<0.1 U
2/21/2019	Background	0.02 J	1.99	78.9	0.05 J	<0.01 U	0.213	0.076	0.535	0.40	0.316	0.01 J	<0.002 U	1 J	0.09 J	<0.1 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1809A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.085	173	26.1	0.16	7.2	1020	386
8/28/2018	Background	0.091	179	28.8	0.17	7.1	1020	386
10/3/2018	Background	0.09 J	191	26.8	0.14	7.1	1070	388
10/23/2018	Background	0.114	181	26.6	0.14	7.1	1050	390
11/14/2018	Background	0.09 J	188	28.4	0.16	7.2	1050	403
12/19/2018	Background	0.06 J	182	27.7	0.15	7.0	1040	384
1/25/2019	Background	0.08 J	188	28.1	0.14	5.1	1080	390
2/20/2019	Background	- -	- -	- -	- -	7.2	- -	- -
2/22/2019	Background	0.08 J	184	30.2	0.14	- -	1080	403
3/12/2019	Detection	0.05 J	189	31.0	0.14	7.2	1090	396

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1809A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.05	2.3	60.2	0.004 J	<0.005 U	0.119	0.555	1.561	0.16	0.035	0.02	<0.002 U	7.18	0.04 J	0.01 J
8/28/2018	Background	0.03 J	2.83	67.3	0.004 J	<0.005 U	0.200	0.754	1.193	0.17	0.01 J	0.024	<0.002 U	3.01	0.06 J	0.02 J
10/3/2018	Background	0.03 J	2.87	61.4	<0.02 U	<0.01 U	0.1 J	0.533	4.22	0.14	<0.02 U	<0.009 U	<0.002 U	2.27	0.05 J	<0.1 U
10/23/2018	Background	<0.02 U	2.59	53.0	<0.02 U	<0.01 U	0.09 J	0.424	1.501	0.14	<0.02 U	0.043	<0.002 U	2 J	0.03 J	<0.1 U
11/14/2018	Background	<0.02 U	3.10	58.0	<0.02 U	<0.01 U	0.08 J	0.447	1.717	0.16	<0.02 U	0.01 J	<0.002 U	2 J	<0.03 U	<0.1 U
12/19/2018	Background	<0.02 U	3.51	63.4	<0.02 U	<0.01 U	0.212	0.504	1.417	0.15	<0.02 U	0.032	<0.002 U	2.88	<0.03 U	<0.1 U
1/25/2019	Background	<0.02 U	3.39	57.2	<0.02 U	<0.01 U	0.06 J	0.375	2.99	0.14	<0.02 U	0.046	<0.002 U	2 J	<0.03 U	<0.1 U
2/22/2019	Background	<0.10 U	4.57	64.5	<0.1 U	<0.05 U	<0.2 U	0.559	1.56	0.14	<0.1 U	0.038	<0.002 U	2 J	<0.2 U	<0.5 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-1810A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.22	23.0	- -	- -	- -	- -	- -
8/2/2018	Background	- -	- -	23.4	0.93	7.4	565	170
8/27/2018	Background	0.271	25.9	21.6	0.93	7.5	525	129
10/3/2018	Background	0.245	28	19	0.89	7.3	542	114
10/24/2018	Background	0.211	23.7	18.6	0.86	7.7	473	93.1
11/13/2018	Background	0.238	30.2	19.5	1.04	7.3	544	160
12/20/2018	Background	0.21	30.1	17.0	0.98	7.1	548	160
1/23/2019	Background	0.319	24.8	16.3	0.9	7.5	494	112
2/22/2019	Background	0.245	32.3	15.4	1.01	7.4	580	170
3/12/2019	Detection	0.228	30.5	15.4	1.00	7.3	548	153

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1810A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.13	0.88	124	0.009 J	<0.005 U	0.442	0.150	0.382	0.93	0.149	0.018	<0.002 U	9.26	0.06 J	0.051
8/27/2018	Background	0.10	0.51	83.4	<0.004 U	<0.005 U	0.229	0.048	0.842	0.93	0.057	0.015	<0.002 U	8.52	0.04 J	0.02 J
10/3/2018	Background	0.11	0.49	83.0	<0.02 U	<0.01 U	0.2 J	0.03 J	1.218	0.89	0.09 J	<0.009 U	<0.002 U	7.06	0.05 J	<0.1 U
10/24/2018	Background	0.07 J	0.54	88.5	<0.02 U	<0.01 U	0.1 J	0.02 J	0.992	0.86	0.03 J	0.02 J	<0.002 U	6.28	0.04 J	<0.1 U
11/13/2018	Background	0.09 J	0.40	83.5	<0.02 U	<0.01 U	0.1 J	0.02 J	0.24	1.04	0.04 J	<0.009 U	<0.002 U	6.03	0.03 J	<0.1 U
12/20/2018	Background	0.08 J	0.43	87.9	<0.02 U	<0.01 U	0.1 J	0.03 J	0.5648	0.98	0.05 J	0.02 J	<0.002 U	5.24	0.03 J	<0.1 U
1/23/2019	Background	0.07 J	0.45	84.2	<0.02 U	<0.01 U	0.08 J	0.02 J	0.768	0.9	0.03 J	0.01 J	<0.002 U	5.94	0.03 J	<0.1 U
2/22/2019	Background	<0.10 U	0.4 J	87.8	<0.1 U	<0.05 U	0.3 J	<0.1 U	0.65	1.01	0.1 J	0.02 J	<0.002 U	4 J	<0.2 U	<0.5 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

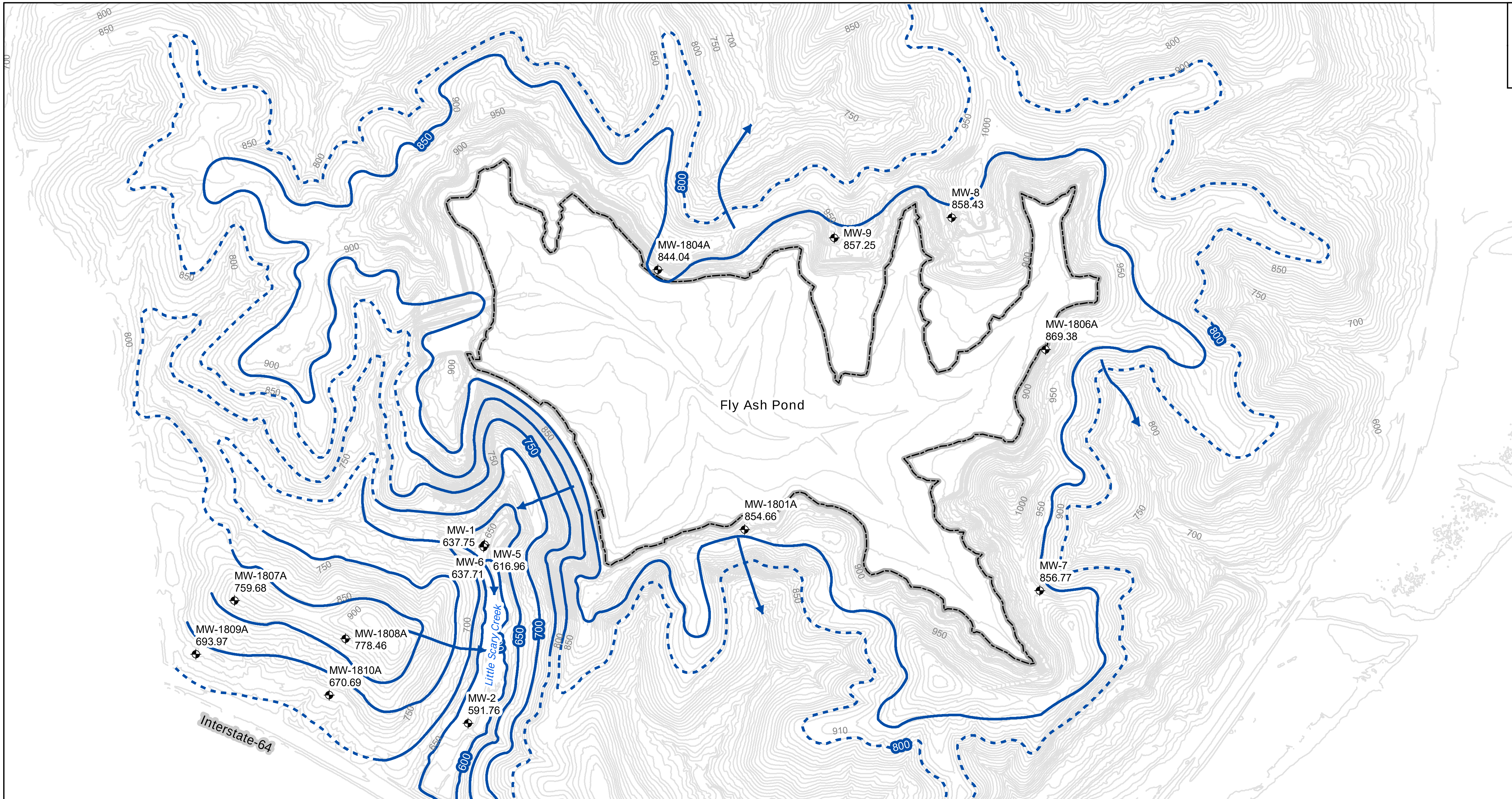
Table 2: Residence Time Calculation Summary
Amos Fly Ash Pond

Geosyntec Consultants, Inc.

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2018-07 Groundwater Velocity (ft/year)	2018-07 Groundwater Residence Time (days)	2018-08 Groundwater Velocity (ft/year)	2018-08 Groundwater Residence Time (days)	2018-10-01 Groundwater Velocity (ft/year)	2018-10-01 Groundwater Residence Time (days)	2018-10-22 Groundwater Velocity (ft/year)	2018-10-22 Groundwater Residence Time (days)	2018-11 Groundwater Velocity (ft/year)	2018-11 Groundwater Residence Time (days)
Fly Ash Pond	MW-1801A[1]	2.0	8.0	7.6	15.6	3.9	5.3	11.4	11.3	5.4	16.3	3.7
	MW-1804A[1]	2.0	19	3.2	32	1.9	33	1.8	23	2.7	32	1.9
	MW-1806A[1]	2.0	12.2	5.0	11.9	5.1	10.0	6.1	13.0	4.7	12.9	4.7
	MW-1807A[2]	2.0	10	6.2	37	1.7	31	2.0	11.4	5.3	13.1	4.6
	MW-1808A[2]	2.0	41	1.5	52	1.2	59	1.0	38	1.6	37	1.7
	MW-1809A[2]	2.0	11.4	5.3	15.4	4.0	6.7	9.1	7.9	7.7	12.4	4.9
	MW-1810A[2]	2.0	36	1.7	39	1.6	37	1.6	36	1.7	35	1.8
	MW-1 [1]	2.0	18	3.5	18.4	3.3	21	2.8	18.1	3.4	17.8	3.4
	MW-2 [1]	2.0	111	0.55	113	0.54	116	0.53	112	0.54	112	0.54
	MW-5 [1]	2.0	32	1.9	32	1.9	4.9	12.3	32	1.9	32	1.9
	MW-6 [1]	2.0	12	5.1	12.0	5.1	13.7	4.4	11.8	5.2	11.6	5.2
	MW-7 [1]	2.0	10.2	5.9	11.1	5.5	6.0	10.1	12.3	4.9	11.7	5.2
	MW-8 [1]	2.0	10.4	5.9	14.2	4.3	46	1.3	15.5	3.9	13.6	4.5
	MW-9 [1]	2.0	9.8	6.2	18.9	3.2	7.6	8.0	15.3	4.0	26	2.4

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2018-12 Groundwater Velocity (ft/year)	2018-12 Groundwater Residence Time (days)	2019-01 Groundwater Velocity (ft/year)	2019-01 Groundwater Residence Time (days)	2019-02 Groundwater Velocity (ft/year)	2019-02 Groundwater Residence Time (days)	2019-03 Groundwater Velocity (ft/year)	2019-03 Groundwater Residence Time (days)
Fly Ash Pond	MW-1801A[1]	2.0	11.2	5.4	15.7	3.9	9.1	6.7	11.0	5.5
	MW-1804A[1]	2.0	21	2.9	18.7	3.3	21	2.9	17.4	3.5
	MW-1806A[1]	2.0	13.4	4.5	13.0	4.7	12.6	4.8	13.8	4.4
	MW-1807A[2]	2.0	18.3	3.3	16.6	3.7	13.9	4.4	12.2	5.0
	MW-1808A[2]	2.0	39	1.5	46	1.3	35	1.7	40	1.5
	MW-1809A[2]	2.0	10.5	5.8	11.6	5.3	10.6	5.7	10.3	5.9
	MW-1810A[2]	2.0	35	1.7	36	1.7	36	1.7	1.1	56
	MW-1 [1]	2.0	17.9	3.4	17.9	3.4	18.0	3.4	25	2.5
	MW-2 [1]	2.0	110	0.55	111	0.55	111	0.55	112	0.55
	MW-5 [1]	2.0	32	1.9	32	1.9	32	1.9	32	1.9
	MW-6 [1]	2.0	11.7	5.2	11.7	5.2	11.7	5.2	11.6	5.2
	MW-7 [1]	2.0	14.0	4.4	16.0	3.8	17.7	3.4	15.0	4.0
	MW-8 [1]	2.0	16.5	3.7	16.8	3.6	13.3	4.6	10.8	5.6
	MW-9 [1]	2.0	16.5	3.7	12.8	4.8	13.0	4.7	11.6	5.2

Notes:
[1] - Upgradient/Sidegradient Well
[2] - Downgradient Well



Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes

- Monitoring well coordinates and water level data (collected on January 22, 2019) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

1,000 500 0 1,000 Feet

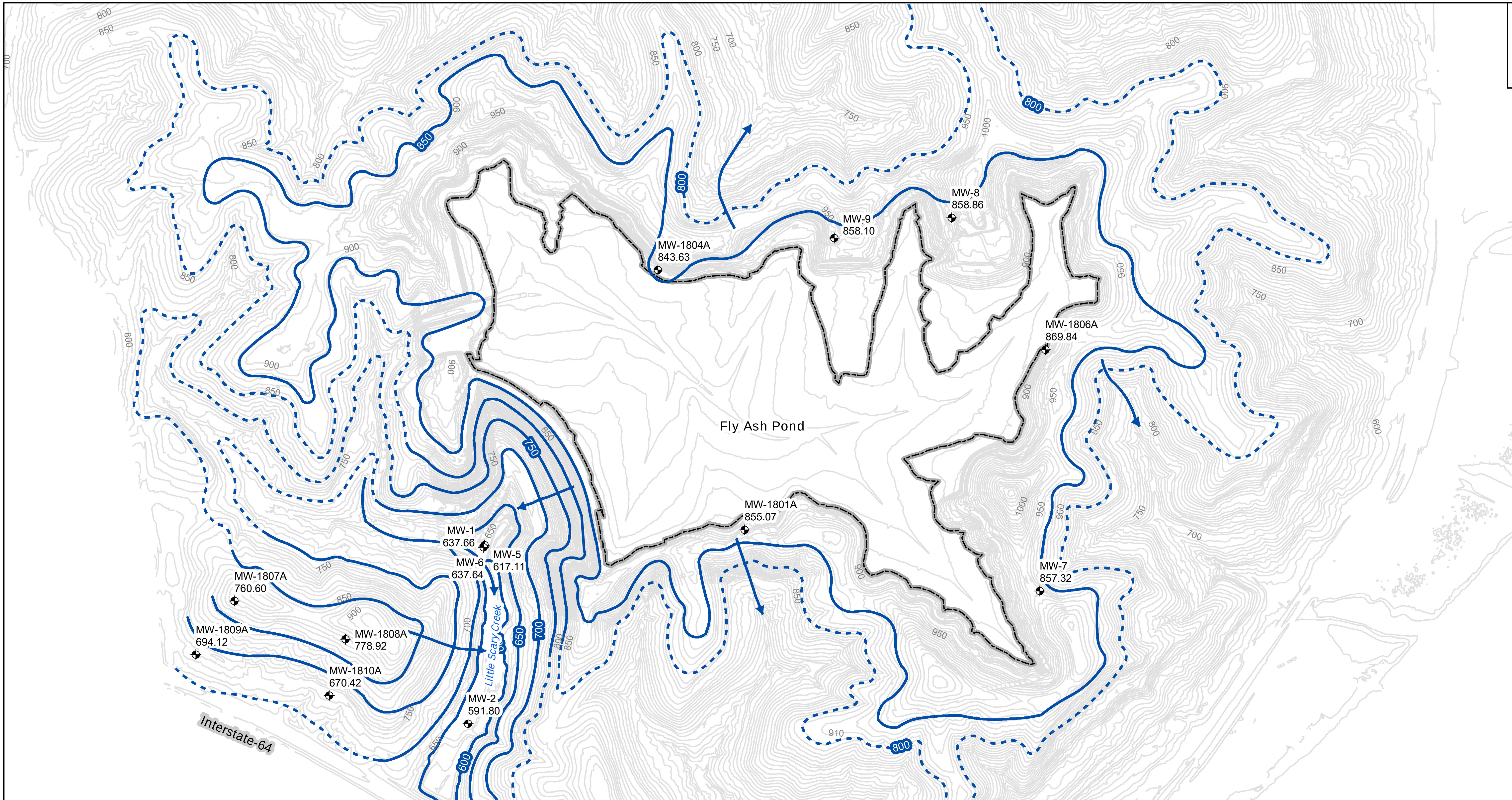
Potentioetric Surface Map - Uppermost Aquifer
January 2019

AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio	2019/07/29	Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2019-01Jan.mxd. ARevezzo. 7/29/2019. CHA8423.



Legend

- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes

- Monitoring well coordinates and water level data (collected on February 8, 2019) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

Potentioetric Surface Map - Uppermost Aquifer
February 2019

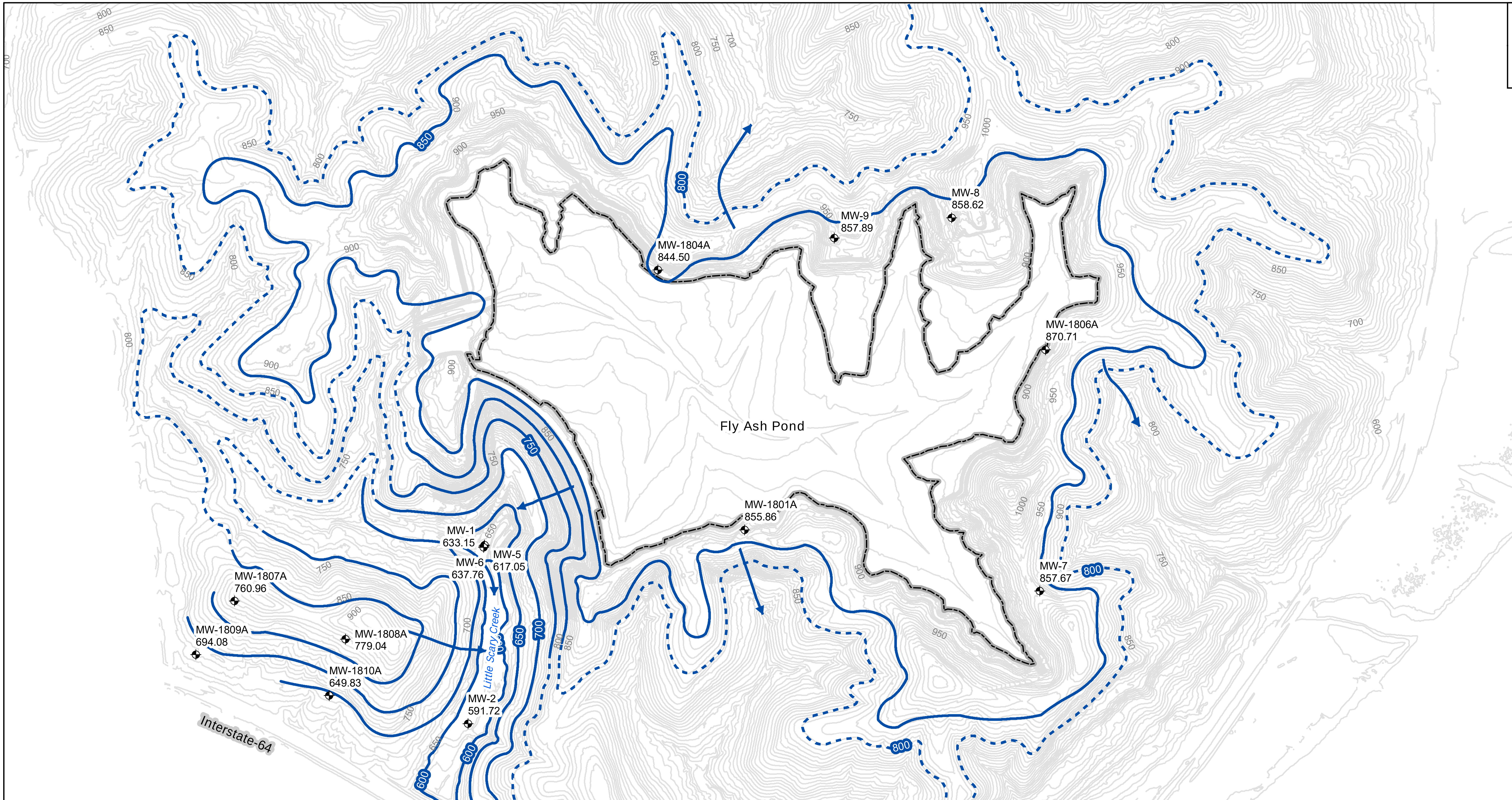
AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/07/29

Figure
2

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2019-02Feb.mxd. ARevezzo. 7/29/2019. CHA8423.



Legend
- Groundwater Monitoring Well
- Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)
- Fly Ash Pond

Notes
- Monitoring well coordinates and water level data (collected on March 14, 2019) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

1,000 500 0 1,000 Feet

Potentioetric Surface Map - Uppermost Aquifer
March 2019

AEP Amos Generating Plant - Fly Ash Pond
Winfield, West Virginia

Geosyntec consultants

Figure 3

Columbus, Ohio | 2019/07/29

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_FAP_GW_2019-03Mar.mxd. ARevezzo. 7/29/2019. CHA8423.

APPENDIX 2

The background statistical analysis summary report and the first detection monitoring event statistical analysis determination follow.

STATISTICAL ANALYSIS SUMMARY
FLY ASH POND
John E. Amos Plant
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

July 15, 2019

CHA8474

TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ANOVA	Analysis of Variance
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
GWPS	Groundwater Protection Standard
FAP	Fly Ash Pond
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
RSL	Regional Screening Level
SSI	Statistically Significant Increase
SWFPR	Site-Wide False-Positive Rate
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), groundwater monitoring has been conducted at the Fly Ash Pond (FAP), an inactive CCR unit at the John E. Amos Power Plant located in Winfield, West Virginia.

Eight monitoring events were completed to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The background data were reviewed for outliers, which were removed (when appropriate) prior to calculating upper prediction limits (UPLs) for each Appendix III parameter to represent background values.

Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

FLY ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the background monitoring program, eight sets of samples were collected for analysis from each background and compliance well. A summary of data collected during background monitoring sampling may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.12 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

The background data used to conduct the statistical analyses and the detection monitoring data are summarized in Table 1. Statistical analyses for the FAP were conducted in accordance with the April 2019 *Statistical Analysis Plan* (AEP, 2019), except where noted below. Results for all completed statistical tests are provided in Attachment B.

Time series plots of Appendix III and IV parameters are included in Attachment B. Mann-Kendall analyses ($\alpha = 0.01$) were conducted to evaluate trends in the background data. The following statistically significant trends were observed:

- Chloride was found to be significantly decreasing at background well MW-1810A.
- Sulfate was found to be significantly increasing at background well MW-1807B.

No other significant increasing or decreasing trends were observed for other parameters or at other monitoring wells.

2.2.1 Background Outlier Evaluation

Potential outliers were identified using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$	individual data point
$\tilde{x}_{0.25} =$	first quartile
$\tilde{x}_{0.75} =$	third quartile
$IQR =$	the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Background well data were first pooled, and Tukey's outlier test was performed on the pooled dataset. For the compliance wells, Tukey's outlier test was applied individually to each compliance well.

Data that were evaluated as potential outliers are summarized in Attachment B. Tukey's outlier test indicated eleven potential outliers, which are summarized in Table 2. Next, the data were reviewed to identify possible sources of errors or discrepancies, including data recording errors, unusual sampling conditions, laboratory quality, or inconsistent sample turbidity. The findings of this data review are summarized below.

The following values were identified as potential outliers:

- The antimony concentration of 0.0005 mg/L from the February 22, 2019 sample at MW-1810A;
- The antimony concentration of 0.00087 mg/L from the August 28, 2018 sample at MW-1807A;
- The barium concentration of 0.124 mg/L from the July 26, 2018 sample at MW-1810A;
- The boron concentration of 0.213 mg/L from the November 13, 2018 sample at MW-1806A;
- The calcium concentration of 47.4 mg/L from the January 25, 2019 sample at MW-1808A;
- The chloride concentration of 14.6 mg/L from the January 23, 2019 sample at MW-1;

- The chromium concentration of 0.000583 mg/L from the November 13, 2018 sample at MW-1;
- The pH value of 5.12 SU from the January 25, 2019 sample at FAP-MW-1809A;
- The selenium concentration of 0.001 mg/L from the February 22, 2019 sample at MW-1810A;
- The sulfate concentration of 55.9 mg/L from the January 23,2019 sample at MW-1; and,
- The sulfate concentration of 33.2 mg/L from the November 13, 2018 sample at MW-7.

These values were similar to other observed concentrations within the wells or in neighboring wells, or otherwise represented non-detect results. Therefore, they were not removed from the dataset.

2.2.2 Establishment of Background Levels

Analysis of variance (ANOVA) was conducted to determine whether spatial variation was present among the five background wells (Attachment B). ANOVA indicated significant variation among the five background wells for all Appendix III parameters. Therefore, the appropriateness of using intrawell tests was evaluated for these parameters at the Amos FAP.

Intrawell tests presume that the groundwater quality in the compliance wells was not initially impacted by the CCR unit. To test this presumption, the data from the background wells were pooled, and the data from each compliance well were compared to a pooled background value. Tolerance limits were calculated using the pooled background data for each Appendix III parameter. Parametric tolerance limits with 99% confidence and 95% coverage were calculated for boron, chloride, pH, and TDS; non-parametric tolerance limits were calculated for calcium, fluoride, and sulfate, given that apparent non-normal distributions of data were observed for these three parameters. Confidence intervals were calculated for each of these seven parameters at each compliance monitoring well. If the lower confidence limit from a compliance well exceeded the upper tolerance limit for the pooled background data, it was concluded that groundwater concentrations at compliance wells were above background concentrations. In these instances, intrawell tests would not be appropriate.

Based on this statistical screening, intrawell methods would be recommended for calcium, pH, and sulfate and interwell methods would be recommended for boron, chloride, fluoride, and TDS. However, a review of site geochemistry identified differences in groundwater composition between upgradient and downgradient wells, which suggest differences in mineral make-up due to natural variation. These differences are illustrated in a Schoeller diagram (Figure 1), which compares the concentrations of major cations and anions at each well. The concentration units are milliequivalents per liter (meq/L), which allows the major ions to be compared on a charge-equivalent basis (the sum of the cations must equal the sum of the anions). Note that the concentrations are expressed in on a log scale, which moderates the fact that the concentrations range over several orders of magnitude. The diagram shows that several of the upgradient wells have significantly different geochemistry, with higher proportions of calcium, magnesium, and sulfate than the downgradient monitoring locations. Conversely, many of the downgradient groundwaters are high in sodium but are lower in calcium and magnesium. However, bicarbonate (HCO_3^-) concentrations tend to be similar for all groundwater, indicating that carbonate minerals (particularly calcite) are present throughout the area. If interwell statistical methods were used without consideration for these wide ranges in groundwater composition, which appear due to natural geochemical variation, the net outcome could result in false negatives or false positives. Therefore, intrawell tests were used to evaluate potential statistically significant increases (SSIs) for all Appendix III parameters.

After equality of variance was tested and identified outliers were removed (where appropriate), a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. A lower prediction limit (LPL) was also calculated for pH. To conduct the intrawell tests for the Appendix III parameters, a separate UPL was calculated for each compliance well for each of these parameters. The background data used for the UPL calculations are summarized in Table 1; the calculated UPLs are summarized in Table 3.

Although a significant decreasing trend in chloride concentrations was observed at background well MW-1810A and a significant increasing trend in sulfate concentrations was observed at background well MW-1807B, the UPLs were calculated as if no trend were present; i.e., the data were not limited to more recent data and were pooled with other background wells. This was done because the magnitudes of the trends are low relative to absolute concentrations, and the concentrations of chloride and sulfate at MW-1810A and MW-1807B, respectively, are similar to concentrations at other background wells. The possibility of an ongoing trend and the need for truncating the datasets for chloride at MW-1810A and sulfate at MW-1807B will be reevaluated after additional data are collected.

UPLs were calculated for a one-of-three retesting procedure; i.e., if at least one sample in a series of three does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where initial or secondary results did not exceed the UPL, a subsequent sample was not collected. The one-of-three retesting procedure allowed achieving an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less. Power curves were constructed for the intrawell parametric tests and are compared with the EPA Reference Power Curve in Attachment B. The power curve associated with the intrawell tests for the FAP exceeds the EPA Reference Power Curve at 3 and 4 standard deviations; this is considered a “good” level of statistical power according to USEPA’s *Unified Guidance* (USEPA, 2009).

2.3 Conclusions

Eight background monitoring events were completed in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified eleven potential outliers; however, no values were removed from the dataset. Prediction intervals were constructed based on the background data and a one-of-three retesting procedure. Intrawell tests were selected for all Appendix III parameters based on a review of site geochemistry.

SECTION 3

REFERENCES

American Electric Power (AEP). 2019. Statistical Analysis Plan – Amos Plant. April 2019.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

TABLES

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1							
		7/24/2018	8/28/2018	10/3/2018	10/22/2018	11/13/2018	12/19/2018	1/23/2019	2/19/2019
Antimony	ug/L	0.0200 J	0.0200 J	0.02 U	0.02 U	0.02 U	0.0300 J	0.0600 J	0.0500 J
Arsenic	ug/L	7.65	7.90	7.98	6.84	8.04	7.65	7.64	7.83
Barium	ug/L	52.9	49.5	51.5	44.7	51.9	48.6	43.7	44.7
Beryllium	ug/L	0.004 U	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.182	0.135	0.138	0.180	0.209	0.117	0.115	0.126
Cadmium	ug/L	0.00800 J	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Calcium	mg/L	2.83	2.80	2.95	2.36	3.03	2.71	2.29	2.36
Chloride	mg/L	11.7	11.3	11.1	11.4	11.5	10.7	14.6	10.9
Chromium	ug/L	0.0750	0.0920	0.100 J	0.100 J	0.583	0.0800 J	0.0900 J	0.100 J
Cobalt	ug/L	0.0310	0.0390	0.0300 J	0.0500 J	0.0300 J	0.0300 J	0.0300 J	0.0300 J
Combined Radium	pCi/L	1.09	0.261	1.78	0.608	0.456	0.316	0.688	0.00538
Fluoride	mg/L	0.420	0.450	0.400	0.420	0.450	0.430	0.410	0.440
Lead	ug/L	0.0410	0.0470	0.0200 J	0.0700 J	0.0600 J	0.0200 J	0.0300 J	0.111
Lithium	mg/L	0.0120	0.00900	0.009 U	0.009 U	0.009 U	0.0200 J	0.009 U	0.0100 J
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	1.94	1.48	1.00 J	1.00 J	1.00 J	1.00 J	1.00 J	1.00 J
Selenium	ug/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.0500 J
Total Dissolved Solids	mg/L	473	435	457	434	444	428	453	457
Sulfate	mg/L	30.6	31.6	30.8	30.7	32.2	30.9	55.9	31.3
Thallium	ug/L	0.0300 J	0.0100 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	8.15	8.50	8.29	8.33	8.03	8.12	8.17	8.45

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1801A							
		7/24/2018	8/29/2018	10/2/2018	10/24/2018	11/14/2018	12/19/2018	1/24/2019	2/20/2019
Antimony	ug/L	0.130	0.0500 J	0.140	0.0600 J	0.0800 J	0.0400 J	0.0600 J	0.0900 J
Arsenic	ug/L	0.360	0.570	0.820	0.720	1.01	1.11	1.57	1.52
Barium	ug/L	54.4	56.5	47.1	51.3	51.3	56.0	55.3	56.6
Beryllium	ug/L	0.004 U	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.274	0.288	0.137	0.105	0.236	0.289	0.168	0.0900 J
Cadmium	ug/L	0.0100 J	0.005 U	0.01 U	0.01 U	0.0300 J	0.0200 J	0.01 U	0.01 U
Calcium	mg/L	62.5	64.0	61.0	63.1	65.4	62.8	53.4	53.3
Chloride	mg/L	9.64	10.8	7.48	8.14	9.86	9.08	9.18	8.96
Chromium	ug/L	0.113	0.143	0.0900 J	0.0800 J	0.0800 J	0.100 J	0.0700 J	0.100 J
Cobalt	ug/L	0.194	0.260	0.422	0.380	0.414	0.349	0.326	0.290
Combined Radium	pCi/L	0.602	1.22	0.254	0.654	0.690	0.836	0.595	0.588
Fluoride	mg/L	0.100 J	0.110	0.100 J	0.100 J	0.100 J	0.120	0.140	0.130
Lead	ug/L	0.0420	0.0240	0.0400 J	0.0200 J	0.0500 J	0.0300 J	0.02 U	0.02 U
Lithium	mg/L	0.00900	0.00700	0.0200 J	0.00900 J	0.009 U	0.0100 J	0.009 U	0.009 U
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	4.97	3.07	4.79	2.08	2.34	2.77	2.22	3.57
Selenium	ug/L	0.0900 J	0.0500 J	0.100 J	0.200 J	0.100 J	0.0900 J	0.100 J	0.200 J
Total Dissolved Solids	mg/L	372	420	356	357	386	361	365	343
Sulfate	mg/L	49.4	54.8	46.7	41.8	49.3	45.5	46.3	40.0
Thallium	ug/L	0.0400 J	0.0400 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	7.56	7.43	7.42	7.45	7.29	7.27	6.33	8.01

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1804A								
		7/27/2018	8/1/2018	8/28/2018	10/2/2018	10/23/2018	11/13/2018	12/19/2018	1/24/2019	2/21/2019
Antimony	ug/L	0.540	-	0.150	0.530	0.180	0.0900 J	0.130	0.300	0.190
Arsenic	ug/L	2.48	-	3.59	2.35	3.36	4.16	4.00	3.32	4.48
Barium	ug/L	245	-	204	390	131	135	169	183	116
Beryllium	ug/L	0.00800 J	-	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.672	-	0.779	0.629	0.675	0.846	0.772	0.673	0.611
Cadmium	ug/L	0.005 U	-	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Calcium	mg/L	28.1	-	15.9	38.8	12.9	8.90	10.1	12.1	7.43
Chloride	mg/L	-	3.87	5.27	3.63	4.79	5.32	4.51	3.14	3.29
Chromium	ug/L	0.185	-	0.304	0.100 J	0.100 J	0.200 J	0.100 J	0.200 J	0.200 J
Cobalt	ug/L	0.458	-	0.314	0.693	0.137	0.160	0.176	0.137	0.0960
Combined Radium	pCi/L	1.81	-	1.56	1.66	0.444	0.523	1.09	1.42	0.894
Fluoride	mg/L	-	0.700	0.840	0.610	0.780	0.910	0.780	0.710	0.890
Lead	ug/L	0.445	-	0.0310	0.0500 J	0.114	0.133	0.111	0.140	0.219
Lithium	mg/L	0.0180	-	0.0150	0.0320	0.0100 J	0.0200 J	0.0100 J	0.009 U	0.009 U
Mercury	ug/L	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	136	-	136	111	116	129	130	110	115
Selenium	ug/L	1.80	-	0.200	3.10	0.700	0.200	0.500	1.70	0.600
Total Dissolved Solids	mg/L	-	423	452	458	452	498	433	414	461
Sulfate	mg/L	-	35.2	44.7	35.7	36.9	46.0	40.1	32.3	33.8
Thallium	ug/L	0.0690	-	0.0500 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	-	7.39	8.28	7.90	7.61	7.84	7.90	7.37	8.03

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1806A								
		7/27/2018	8/1/2018	8/29/2018	10/2/2018	10/23/2018	11/13/2018	12/19/2018	1/24/2019	2/18/2019
Antimony	ug/L	1.16	-	0.890	0.280	0.190	0.110	0.170	0.150	0.100 J
Arsenic	ug/L	2.65	-	3.29	5.30	5.16	5.91	5.65	3.97	4.21
Barium	ug/L	163	-	148	65.4	88.3	98.7	65.6	168	78.8
Beryllium	ug/L	0.0100 J	-	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.164	-	0.162	0.150	0.158	0.213	0.162	0.168	0.133
Cadmium	ug/L	0.0100 J	-	0.00800 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Calcium	mg/L	12.9	-	12.0	5.81	7.43	7.51	5.14	12.2	5.67
Chloride	mg/L	-	17.7	16.2	7.21	8.62	8.15	5.29	11.7	6.24
Chromium	ug/L	0.416	-	1.54	0.100 J	0.252	0.100 J	0.100 J	0.0800 J	0.200 J
Cobalt	ug/L	0.240	-	0.161	0.0800	0.152	0.163	0.0710	0.159	0.0500
Combined Radium	pCi/L	0.998	-	1.53	0.900	0.469	0.344	0.861	1.16	0.419
Fluoride	mg/L	-	0.560	0.550	0.800	0.770	0.850	0.850	0.590	0.810
Lead	ug/L	0.368	-	0.154	0.158	0.195	0.137	0.122	0.0600 J	0.110
Lithium	mg/L	0.0120	-	0.0100	0.0200 J	0.0200 J	0.009 U	0.009 U	0.0200 J	0.0100 J
Mercury	ug/L	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	17.0	-	14.2	7.73	6.66	7.44	6.02	5.62	4.74
Selenium	ug/L	0.100	-	0.0900 J	0.0700 J	0.0700 J	0.0500 J	0.0600 J	0.0400 J	0.0300 J
Total Dissolved Solids	mg/L	-	426	445	435	423	442	409	445	460
Sulfate	mg/L	-	48.4	45.6	36.2	40.8	40.1	30.9	48.1	33.0
Thallium	ug/L	0.0300 J	-	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	-	7.55	8.02	8.50	8.42	8.12	8.47	8.11	8.56

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1807A							
		7/26/2018	8/28/2018	10/4/2018	10/24/2018	11/14/2018	12/20/2018	1/25/2019	2/21/2019
Antimony	ug/L	0.130	0.870	0.140	0.180	0.170	0.170	0.120	0.0800 J
Arsenic	ug/L	0.990	1.13	1.10	0.840	0.960	0.940	0.920	0.820
Barium	ug/L	32.6	32.6	30.1	27.8	28.8	29.5	27.4	24.1
Beryllium	ug/L	0.00600 J	0.00500 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.170	0.137	0.129	0.199	0.175	0.208	0.183	0.0800 J
Cadmium	ug/L	0.0200	0.0600	0.0500 J	0.0300 J	0.0300 J	0.0300 J	0.0300 J	0.0300 J
Calcium	mg/L	146	136	166	144	155	151	156	150
Chloride	mg/L	9.57	11.8	12.5	10.3	10.5	9.68	11.3	12.0
Chromium	ug/L	0.0980	0.253	0.205	0.200 J	0.0900 J	0.403	0.100 J	0.100 J
Cobalt	ug/L	0.629	0.565	0.918	0.579	0.614	0.616	0.733	0.811
Combined Radium	pCi/L	1.37	1.51	1.13	0.389	0.985	1.02	1.27	0.735
Fluoride	mg/L	0.210	0.210	0.160	0.200	0.210	0.190	0.150	0.140
Lead	ug/L	0.0460	0.300	0.142	0.105	0.0900 J	0.251	0.126	0.118
Lithium	mg/L	0.0200	0.0180	0.009 U	0.0200 J	0.0100 J	0.0200 J	0.0300	0.0100 J
Mercury	ug/L	0.002 U	0.00200 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	1.65	9.07	11.1	2.00 J	2.00 J	1.00 J	1.00 J	0.600 J
Selenium	ug/L	0.300	0.600	0.200 J	0.200 J	0.200	0.300	0.100 J	0.100 J
Total Dissolved Solids	mg/L	929	953	985	838	904	931	876	1050
Sulfate	mg/L	334	356	367	308	326	315	361	396
Thallium	ug/L	0.0300 J	0.0540	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	7.51	6.94	6.68	6.92	6.82	7.16	8.24	7.18

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Geosyntec Consultants

Parameter	Unit	FAP-MW-1807B							
		7/26/2018	8/28/2018	10/5/2018	10/24/2018	11/14/2018	12/20/2018	1/25/2019	2/21/2019
Antimony	ug/L	0.270	0.230	0.150	0.250	0.160	0.430	0.0900 J	0.350
Arsenic	ug/L	1.93	1.94	1.70	1.26	1.28	1.75	1.23	1.48
Barium	ug/L	49.6	56.3	59.6	42.3	41.4	73.7	43.0	66.9
Beryllium	ug/L	0.0490	0.004 U	0.0300 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.195	0.178	0.201	0.176	0.211	0.164	0.277	0.168
Cadmium	ug/L	0.0100 J	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Calcium	mg/L	8.76	8.39	9.21	8.92	8.87	11.6	9.33	11.0
Chloride	mg/L	8.46	10.8	9.94	7.93	8.52	9.88	7.68	9.53
Chromium	ug/L	1.40	0.134	0.263	0.381	0.247	0.335	0.0800 J	0.100 J
Cobalt	ug/L	0.525	0.0460	0.179	0.139	0.0730	0.114	0.0500 J	0.0510
Combined Radium	pCi/L	0.719	1.31	2.08	0.305	0.348	0.267	1.00	0.291
Fluoride	mg/L	0.750	1.13	1.01	0.810	0.910	1.16	0.790	1.06
Lead	ug/L	0.756	0.0350	0.310	0.203	0.0800 J	0.145	0.0400 J	0.0400 J
Lithium	mg/L	0.0210	0.0100	0.009 U	0.0200 J	0.0200 J	0.0200 J	0.0200 J	0.009 U
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	4.22	23.9	12.5	5.59	5.62	13.5	4.21	9.27
Selenium	ug/L	0.300	0.0800 J	0.200 J	0.0700 J	0.0500 J	0.100 J	0.0600 J	0.0800 J
Total Dissolved Solids	mg/L	732	706	752	735	732	738	742	791
Sulfate	mg/L	218	219	219	220	230	230	227	238
Thallium	ug/L	0.0300 J	0.0100 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	8.29	8.07	7.87	8.34	7.73	8.18	6.91	8.35

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1808A							
		7/25/2018	8/28/2018	10/4/2018	10/24/2018	11/13/2018	12/20/2018	1/25/2019	2/21/2019
Antimony	ug/L	0.290	0.140	0.140	0.0300 J	0.0400 J	0.0500 J	0.0600 J	0.0200 J
Arsenic	ug/L	2.47	5.34	2.84	1.86	3.83	4.37	2.27	1.99
Barium	ug/L	86.2	105	78.1	86.2	74.1	71.0	80.3	78.9
Beryllium	ug/L	0.299	0.251	0.0500 J	0.0500 J	0.0300 J	0.0400 J	0.102	0.0500 J
Boron	mg/L	0.182	0.142	0.135	0.103	0.152	0.172	0.173	0.122
Cadmium	ug/L	0.00700 J	0.0100 J	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U
Calcium	mg/L	40.4	38.5	38.6	41.5	40.2	40.3	47.4	39.4
Chloride	mg/L	19.6	19.4	16.7	17.1	18.4	21.6	18.3	17.4
Chromium	ug/L	0.831	1.25	0.500	0.443	0.381	0.293	0.415	0.213
Cobalt	ug/L	0.544	0.821	0.231	0.117	0.160	0.119	0.149	0.0760
Combined Radium	pCi/L	1.89	4.96	2.08	1.04	0.470	1.05	2.76	0.535
Fluoride	mg/L	0.520	0.570	0.410	0.550	0.510	0.470	0.400	0.400
Lead	ug/L	2.28	2.06	0.392	0.397	0.245	0.227	0.717	0.316
Lithium	mg/L	0.0240	0.0250	0.009 U	0.0200 J	0.0200 J	0.0300 J	0.0350	0.0100 J
Mercury	ug/L	0.00600	0.00500 J	0.002 U	0.002 U	0.00200 J	0.00300 J	0.002 U	0.002 U
Molybdenum	ug/L	6.46	11.7	4.56	3.06	2.75	2.00 J	1.00 J	1.00 J
Selenium	ug/L	0.500	0.400	0.0700 J	0.0700 J	0.0500 J	0.0800 J	0.200 J	0.0900 J
Total Dissolved Solids	mg/L	734	740	790	614	770	834	840	821
Sulfate	mg/L	184	227	216	126	210	242	231	213
Thallium	ug/L	0.0400 J	0.0830	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	7.70	7.56	7.43	7.72	7.43	7.58	6.11	7.21

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1809A							
		7/26/2018	8/28/2018	10/3/2018	10/23/2018	11/14/2018	12/19/2018	1/25/2019	2/22/2019
Antimony	ug/L	0.0500	0.0300 J	0.0300 J	0.02 U	0.02 U	0.02 U	0.02 U	0.1 U
Arsenic	ug/L	2.30	2.83	2.87	2.59	3.10	3.51	3.39	4.57
Barium	ug/L	60.2	67.3	61.4	53.0	58.0	63.4	57.2	64.5
Beryllium	ug/L	0.00400 J	0.00400 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.1 U
Boron	mg/L	0.0850	0.0910	0.0900 J	0.114	0.0900 J	0.0600 J	0.0800 J	0.0800 J
Cadmium	ug/L	0.005 U	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05 U
Calcium	mg/L	173	179	191	181	188	182	188	184
Chloride	mg/L	26.1	28.8	26.8	26.6	28.4	27.7	28.1	30.2
Chromium	ug/L	0.119	0.200	0.100 J	0.0900 J	0.0800 J	0.212	0.0600 J	0.2 U
Cobalt	ug/L	0.555	0.754	0.533	0.424	0.447	0.504	0.375	0.559
Combined Radium	pCi/L	1.56	1.19	4.22	1.50	1.72	1.42	2.99	1.56
Fluoride	mg/L	0.160	0.170	0.140	0.140	0.160	0.150	0.140	0.140
Lead	ug/L	0.0350	0.0100 J	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.1 U
Lithium	mg/L	0.0200	0.0240	0.009 U	0.0430	0.0100 J	0.0320	0.0460	0.0380
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	7.18	3.01	2.27	2.00 J	2.00 J	2.88	2.00 J	2.00 J
Selenium	ug/L	0.0400 J	0.0600 J	0.0500 J	0.0300 J	0.03 U	0.03 U	0.03 U	0.2 U
Total Dissolved Solids	mg/L	1020	1020	1070	1050	1050	1040	1080	1080
Sulfate	mg/L	386	386	388	390	403	384	390	403
Thallium	ug/L	0.0100 J	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.5 U
pH	SU	7.22	7.14	7.14	7.11	7.18	6.97	5.12	7.20

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-1810A								
		7/26/2018	8/2/2018	8/27/2018	10/3/2018	10/24/2018	11/13/2018	12/20/2018	1/23/2019	2/22/2019
Antimony	ug/L	0.130	-	0.100	0.110	0.0700 J	0.0900 J	0.0800 J	0.0700 J	0.1 U
Arsenic	ug/L	0.880	-	0.510	0.490	0.540	0.400	0.430	0.450	0.400 J
Barium	ug/L	124	-	83.4	83.0	88.5	83.5	87.9	84.2	87.8
Beryllium	ug/L	0.00900 J	-	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.1 U
Boron	mg/L	0.220	-	0.271	0.245	0.211	0.238	0.210	0.319	0.245
Cadmium	ug/L	0.005 U	-	0.005 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.05 U
Calcium	mg/L	23.0	-	25.9	28.0	23.7	30.2	30.1	24.8	32.3
Chloride	mg/L	-	23.4	21.6	19.0	18.6	19.5	17.0	16.3	15.4
Chromium	ug/L	0.442	-	0.229	0.200 J	0.100 J	0.100 J	0.100 J	0.0800 J	0.300 J
Cobalt	ug/L	0.150	-	0.0480	0.0300 J	0.0200 J	0.0200 J	0.0300 J	0.0200 J	0.1 U
Combined Radium	pCi/L	0.382	-	0.842	1.22	0.992	0.240	0.565	0.768	0.650
Fluoride	mg/L	-	0.930	0.930	0.890	0.860	1.04	0.980	0.900	1.01
Lead	ug/L	0.149	-	0.0570	0.0900 J	0.0300 J	0.0400 J	0.0500 J	0.0300 J	0.100 J
Lithium	mg/L	0.0180	-	0.0150	0.009 U	0.0200 J	0.009 U	0.0200 J	0.0100 J	0.0200 J
Mercury	ug/L	0.002 U	-	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	9.26	-	8.52	7.06	6.28	6.03	5.24	5.94	4.00 J
Selenium	ug/L	0.0600 J	-	0.0400 J	0.0500 J	0.0400 J	0.0300 J	0.0300 J	0.0300 J	0.2 U
Total Dissolved Solids	mg/L	-	565	525	542	473	544	548	494	580
Sulfate	mg/L	-	170	129	114	93.1	160	160	112	170
Thallium	ug/L	0.0510	-	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.5 U
pH	SU	-	7.43	7.49	7.27	7.70	7.28	7.06	7.52	7.37

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-2							
		7/27/2018	8/29/2018	10/4/2018	10/23/2018	11/15/2018	12/19/2018	1/23/2019	2/22/2019
Antimony	ug/L	0.0600	0.0200 J	0.02 U	0.02 U	0.02 U	0.0300 J	0.02 U	0.1 U
Arsenic	ug/L	1.68	1.62	1.76	1.24	1.66	1.33	1.55	1.35
Barium	ug/L	202	178	192	181	185	182	178	169
Beryllium	ug/L	0.00800 J	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.1 U
Boron	mg/L	0.259	0.249	0.256	0.262	0.328	0.225	0.318	0.237
Cadmium	ug/L	0.0200 J	0.005 U	0.01 U	0.01 U	0.01 U	0.0300 J	0.01 U	0.05 U
Calcium	mg/L	4.24	3.98	4.31	3.95	4.07	3.81	3.67	3.95
Chloride	mg/L	471	443	435	438	469	430	441	447
Chromium	ug/L	0.312	0.129	0.200 J	0.200 J	0.200 J	0.967	0.382	0.2 U
Cobalt	ug/L	0.102	0.0340	0.0500 J	0.0550	0.0400 J	0.0400 J	0.0500	0.1 U
Combined Radium	pCi/L	1.35	1.70	1.29	0.594	0.953	1.06	0.725	0.275
Fluoride	mg/L	3.08	2.99	2.99	3.08	3.30	3.03	3.00	3.06
Lead	ug/L	0.406	0.0330	0.100 J	0.214	0.110	0.290	0.166	0.1 U
Lithium	mg/L	0.0190	0.0230	0.009 U	0.0300 J	0.0200 J	0.0200 J	0.0100 J	0.0200 J
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	27.2	34.5	30.8	26.1	29.2	25.5	29.2	21.9
Selenium	ug/L	0.0400 J	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.0400 J	0.2 U
Total Dissolved Solids	mg/L	1260	1310	1280	1250	1250	1250	1310	1310
Sulfate	mg/L	2.40	17.4	14.8	7.40	13.5	6.40	6.40	2.30
Thallium	ug/L	0.0200 J	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.5 U
pH	SU	8.36	8.60	8.51	8.54	8.45	8.52	8.21	8.69

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-5							
		7/24/2018	8/29/2018	10/3/2018	10/24/2018	11/13/2018	12/19/2018	1/23/2019	2/19/2019
Antimony	ug/L	0.0600	0.180	0.02 U	0.0200 J	0.02 U	0.02 U	0.04 U	0.06 U
Arsenic	ug/L	4.89	5.08	4.86	4.34	4.37	4.39	4.35	5.25
Barium	ug/L	356	359	373	363	353	364	351	349
Beryllium	ug/L	0.00400 J	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04 U	0.06 U
Boron	mg/L	0.252	0.240	0.276	0.249	0.264	0.221	0.323	0.239
Cadmium	ug/L	0.00600 J	0.0100 J	0.01 U	0.01 U	0.01 U	0.01 U	0.02 U	0.03 U
Calcium	mg/L	6.75	6.71	7.03	7.09	6.79	6.48	5.98	6.79
Chloride	mg/L	793	780	776	811	832	783	782	793
Chromium	ug/L	0.152	0.278	0.626	0.219	0.100 J	0.0700 J	0.532	0.200 J
Cobalt	ug/L	0.0460	0.0850	0.0530	0.516	0.0400 J	0.0400 J	0.04 U	0.06 U
Combined Radium	pCi/L	1.37	1.81	1.63	0.731	1.82	1.51	1.05	1.45
Fluoride	mg/L	3.32	3.33	3.33	3.44	3.63	3.43	3.36	3.38
Lead	ug/L	0.222	0.284	0.0300 J	0.0600 J	0.0300 J	0.02 U	0.04 U	0.06 U
Lithium	mg/L	0.0320	0.0300	0.009 U	0.0300 J	0.0200 J	0.0300 J	0.0200 J	0.0340
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	36.5	38.4	35.7	35.1	34.7	34.8	35.0	33.6
Selenium	ug/L	0.03 U	0.03 U	0.03 U	0.0400 J	0.03 U	0.03 U	0.06 U	0.09 U
Total Dissolved Solids	mg/L	1890	1880	1860	1840	1880	1890	1910	1920
Sulfate	mg/L	0.200	0.200	0.100 J	0.06 U	0.100 J	0.06 U	0.06 U	0.06 U
Thallium	ug/L	0.0500 J	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.2 U	0.3 U
pH	SU	8.13	8.16	8.12	8.06	7.97	7.94	8.08	8.19

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-6							
		7/24/2018	8/28/2018	10/3/2018	10/24/2018	11/13/2018	12/19/2018	1/23/2019	2/19/2019
Antimony	ug/L	0.0100 J	0.0200 J	0.02 U	0.02 U	0.02 U	0.02 U	0.0400 J	0.02 U
Arsenic	ug/L	1.81	1.82	1.91	1.72	2.12	1.88	1.89	1.53
Barium	ug/L	536	527	523	494	524	510	486	482
Beryllium	ug/L	0.00900 J	0.00800 J	0.02 U	0.0300 J	0.02 U	0.02 U	0.02 U	0.02 U
Boron	mg/L	0.120	0.0960	0.125	0.100 J	0.111	0.0700 J	0.0800 J	0.0900 J
Cadmium	ug/L	0.0100 J	0.0200	0.0100 J	0.01 U	0.01 U	0.0100 J	0.01 U	0.01 U
Calcium	mg/L	61.0	59.7	60.7	61.5	64.9	55.8	54.1	55.8
Chloride	mg/L	19.3	19.4	18.9	18.4	19.8	17.7	17.8	17.3
Chromium	ug/L	0.0940	0.663	0.0900 J	0.0700 J	0.0800 J	0.0600 J	0.0400 J	0.277
Cobalt	ug/L	0.242	0.323	0.260	0.258	0.233	0.234	0.220	0.219
Combined Radium	pCi/L	2.73	2.44	4.59	2.20	2.33	2.53	1.82	2.14
Fluoride	mg/L	0.220	0.240	0.210	0.230	0.240	0.230	0.220	0.240
Lead	ug/L	0.0200 J	0.167	0.02 U	0.0300 J	0.0300 J	0.0200 J	0.02 U	0.02 U
Lithium	mg/L	0.0120	0.00900	0.009 U	0.0100 J	0.009 U	0.0100 J	0.009 U	0.0200 J
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	0.580	0.600	0.500 J	0.600 J	0.700 J	0.700 J	0.600 J	0.600 J
Selenium	ug/L	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.03 U	0.0400 J
Total Dissolved Solids	mg/L	392	398	402	400	390	376	411	406
Sulfate	mg/L	44.4	44.6	43.4	42.0	44.6	41.7	41.3	40.4
Thallium	ug/L	0.0300 J	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	6.91	6.93	6.82	6.85	6.67	6.67	6.59	7.00

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-7							
		7/26/2018	8/29/2018	10/3/2018	10/24/2018	11/13/2018	12/17/2018	1/23/2019	2/18/2019
Antimony	ug/L	0.0400 J	0.0500 J	0.0700 J	0.180	0.120	0.0600 J	0.440	0.270
Arsenic	ug/L	5.31	5.51	5.65	5.13	5.24	5.21	5.86	5.33
Barium	ug/L	34.0	32.3	33.9	37.0	32.7	33.5	36.8	34.3
Beryllium	ug/L	0.004 U	0.004 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.0300 J
Boron	mg/L	0.0870	0.112	0.156	0.0900 J	0.192	0.100 J	0.127	0.0600 J
Cadmium	ug/L	0.0100 J	0.0100 J	0.01 U	0.0200 J	0.01 U	0.01 U	0.0200 J	0.0200 J
Calcium	mg/L	1.33	1.29	1.44	1.40	1.49	1.24	1.41	1.37
Chloride	mg/L	5.41	5.32	5.23	5.37	5.65	5.29	5.18	5.39
Chromium	ug/L	0.0820	0.190	0.0700 J	0.296	0.100 J	0.100 J	0.221	0.100 J
Cobalt	ug/L	0.0380	0.0230	0.02 U	0.134	0.0300 J	0.02 U	0.0680	0.0570
Combined Radium	pCi/L	1.96	0.745	2.39	0.113	0.954	1.24	0.558	0.543
Fluoride	mg/L	0.270	0.270	0.260	0.270	0.290	0.270	0.250	0.260
Lead	ug/L	0.211	0.121	0.111	0.476	0.146	0.100 J	0.420	0.230
Lithium	mg/L	0.00900	0.0100	0.009 U	0.009 U	0.009 U	0.009 U	0.009 U	0.0100 J
Mercury	ug/L	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	1.12	1.06	1.00 J	1.00 J	1.00 J	1.00 J	1.00 J	1.00 J
Selenium	ug/L	0.03 U	0.03 U	0.0300 J	0.0500 J	0.03 U	0.0400 J	0.0500 J	0.03 U
Total Dissolved Solids	mg/L	368	387	376	344	379	387	389	401
Sulfate	mg/L	32.0	31.5	31.8	31.7	33.2	32.0	32.0	32.1
Thallium	ug/L	0.0100 J	0.0200 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
pH	SU	8.53	8.75	8.75	8.82	8.36	8.62	8.44	8.96

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-8								
		7/26/2018	8/2/2018	8/30/2018	10/3/2018	10/23/2018	11/13/2018	12/19/2018	1/23/2019	2/20/2019
Antimony	ug/L	0.0400 J	-	0.850	0.200	0.150	0.140	0.260	0.270	0.400 J
Arsenic	ug/L	3.02	-	5.71	5.18	4.26	3.49	2.91	3.49	2.41
Barium	ug/L	63.7	-	58.2	86.2	70.9	71.5	73.3	76.8	71.9
Beryllium	ug/L	0.00500 J	-	0.0490	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.1 U
Boron	mg/L	0.233	-	0.225	0.259	0.278	0.254	0.224	0.213	0.195
Cadmium	ug/L	0.005 U	-	0.0500	0.0200 J	0.01 U	0.01 U	0.01 U	0.01 U	0.05 U
Calcium	mg/L	2.15	-	1.99	2.74	2.32	2.46	2.28	2.39	2.49
Chloride	mg/L	-	105	109	108	108	116	110	111	111
Chromium	ug/L	0.114	-	1.89	0.200 J	0.229	0.200 J	0.264	0.463	0.400 J
Cobalt	ug/L	0.210	-	1.69	0.270	0.284	0.253	0.231	0.513	0.538
Combined Radium	pCi/L	1.56	-	0.655	3.98	0.294	0.691	0.956	0.386	0.736
Fluoride	mg/L	-	2.70	2.66	2.58	2.74	2.93	2.78	2.62	2.87
Lead	ug/L	0.237	-	2.78	0.427	0.491	0.352	0.357	0.990	0.770
Lithium	mg/L	0.0130	-	0.0120	0.009 U	0.0200 J	0.009 U	0.0200 J	0.009 U	0.00900 J
Mercury	ug/L	0.002 U	-	0.00400 J	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
Molybdenum	ug/L	11.7	-	20.6	8.76	10.2	7.64	6.93	11.0	8.00 J
Selenium	ug/L	0.0500 J	-	0.200	0.0800 J	0.0800 J	0.0800 J	0.100 J	0.0900 J	0.400 J
Total Dissolved Solids	mg/L	-	690	727	729	717	711	696	739	740
Sulfate	mg/L	-	21.6	24.2	31.6	26.3	27.2	26.4	30.1	26.4
Thallium	ug/L	0.0200 J	-	0.0760	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.5 U
pH	SU	-	8.20	8.90	7.86	8.45	8.15	8.45	8.08	9.15

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 1 - Groundwater Data Summary
Amos - Fly Ash Pond

Parameter	Unit	FAP-MW-9								
		7/26/2018	8/2/2018	8/30/2018	10/2/2018	10/23/2018	11/13/2018	12/20/2018	1/23/2019	2/20/2019
Antimony	ug/L	0.210	-	0.910	0.590	1.28	0.350	0.330	1.08	0.400 J
Arsenic	ug/L	5.23	-	5.87	7.04	4.58	5.83	4.47	5.84	5.45
Barium	ug/L	46.8	-	46.8	66.0	45.4	51.1	35.8	44.6	41.5
Beryllium	ug/L	0.00400 J	-	0.0200 J	0.192	0.0800 J	0.115	0.02 U	0.0900 J	0.1 U
Boron	mg/L	0.157	-	0.128	0.145	0.141	0.166	0.114	0.134	0.128
Cadmium	ug/L	0.0100 J	-	0.350	0.0700	0.0200 J	0.0200 J	0.100	0.0300 J	0.05 U
Calcium	mg/L	1.03	-	1.04	1.44	1.07	1.24	1.03	1.01	1.26
Chloride	mg/L	-	7.22	7.21	7.60	7.26	7.29	7.11	7.45	7.70
Chromium	ug/L	0.218	-	1.17	4.52	1.90	2.54	0.725	2.46	0.700 J
Cobalt	ug/L	1.00	-	2.15	3.70	1.39	1.92	0.393	1.43	0.349
Combined Radium	pCi/L	0.912	-	1.16	0.543	0.658	0.635	0.847	1.46	0.251
Fluoride	mg/L	-	0.870	0.860	0.830	0.870	0.910	0.840	0.770	0.840
Lead	ug/L	1.12	-	5.23	8.66	2.68	3.44	1.03	2.45	0.955
Lithium	mg/L	0.0100	-	0.0100	0.00900 J	0.0100 J	0.009 U	0.009 U	0.009 U	0.0100 J
Mercury	ug/L	0.002 U	-	0.0120	0.0160	0.00800	0.00400 J	0.0100	0.00900	0.00600
Molybdenum	ug/L	7.31	-	6.28	6.07	5.93	6.06	6.51	6.49	6.00 J
Selenium	ug/L	0.0600 J	-	0.200	0.900	0.400	0.600	0.400	0.500	0.300 J
Total Dissolved Solids	mg/L	-	421	468	513	460	449	435	484	505
Sulfate	mg/L	-	12.9	12.2	12.6	12.8	11.9	15.7	20.1	28.5
Thallium	ug/L	0.0600	-	0.209	0.400 J	0.300 J	0.200 J	0.100 J	0.200 J	0.5 U
pH	SU	-	8.27	8.00	7.14	9.28	9.10	9.17	9.65	9.18

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL).
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not sampled
For statistical analysis, parameters which were not detected were replaced with the reporting limit.

Table 2: Outlier Analysis Summary
Amos Plant - Fly Ash Pond

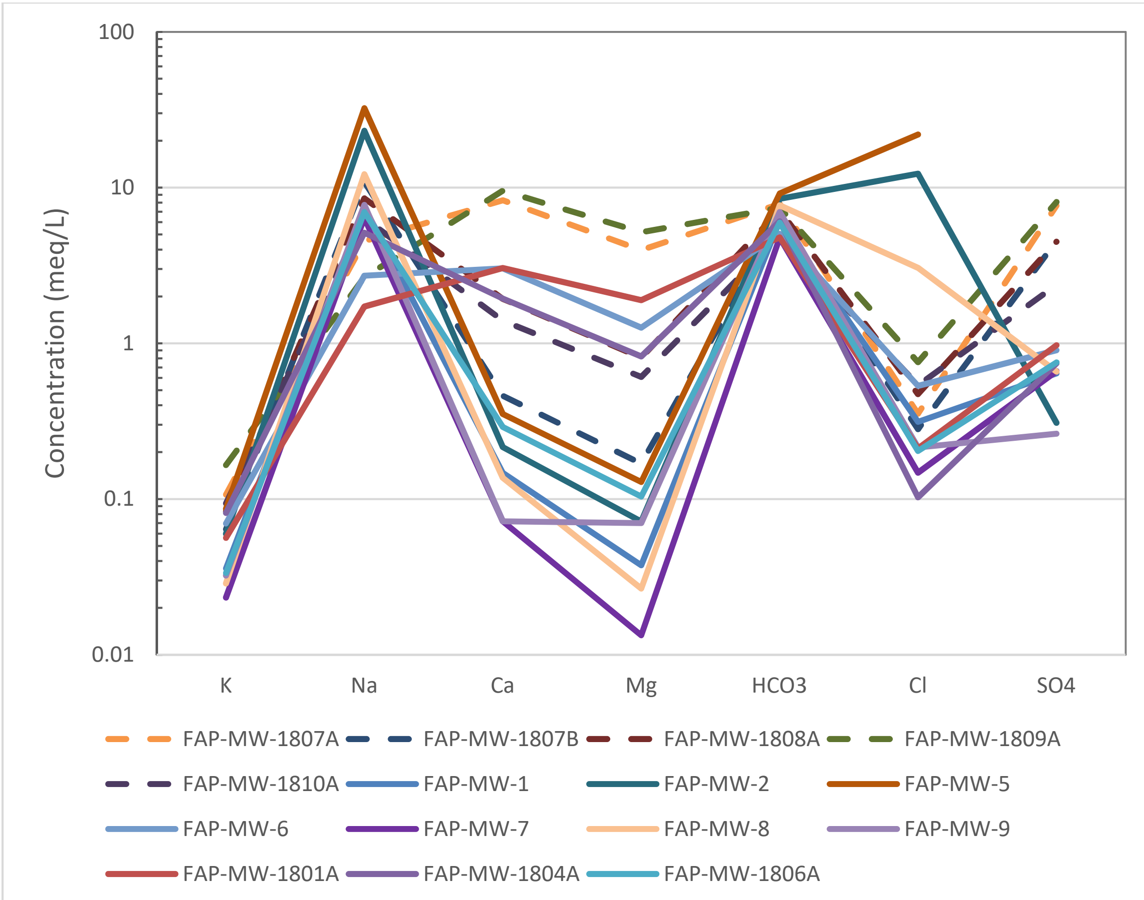
Location	Well ID	Sample Date	Parameter	Reported Value	Units	Conclusions
Background	MW-1810A	2/22/2019	Antimony	0.0005	mg/L	Antimony was not detected in this sample and was replaced with the reporting limit for the statistical evaluation. This value was similar to those reported nearby and was not removed from the dataset.
Background	MW-1807A	8/28/2018	Antimony	0.00087	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Background	MW-1810A	7/26/2018	Barium	0.124	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Compliance	MW-1806A	11/13/2018	Boron	0.213	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Background	FAP-MW-1808A	1/25/2019	Calcium	47.4	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Compliance	MW-1	1/23/2019	Chloride	14.6	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Compliance	MW-1	11/13/2019	Chromium	0.000583	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Background	MW-1809A	1/25/2019	pH	5.12	SU	This value was similar to those reported in nearby wells and was not removed from the dataset.
Background	MW-1810A	2/22/2019	Selenium	0.001	mg/L	Selenium was not detected in this sample and was replaced with the reporting limit for the statistical evaluation. This value was similar to those reported nearby and was not removed from the dataset.
Compliance	MW-1	1/23/2019	Sulfate	55.9	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.
Compliance	MW-7	11/13/2018	Sulfate	33.2	mg/L	This value was similar to those reported in nearby wells and was not removed from the dataset.

Table 3: Background Level Summary
Amos Plant - Fly Ash Pond

Parameter	Units	Description	MW-1801A	MW-1804A	MW-1806A	MW-1	MW-2	MW-5	MW-6	MW-7	MW-8	MW-9
			3/12/2019	3/12/2019	3/12/2019	3/12/2019	3/13/2019	3/13/2019	3/12/2019	3/12/2019	3/12/2019	3/12/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.459	0.965	0.235	0.261	0.382	0.355	0.159	0.248	0.320	0.192
Calcium	mg/L	Intrawell Background Value (UPL)	75.4	51.2	18.8	3.58	4.66	7.79	70.6	1.63	3.06	1.63
Chloride	mg/L	Intrawell Background Value (UPL)	12.4	6.93	24.6	14.6	495	853	21.4	5.80	120	8.00
Fluoride	mg/L	Intrawell Background Value (UPL)	0.162	1.10	1.14	0.485	3.39	3.72	0.264	0.304	3.11	0.976
pH	SU	Intrawell Background Value (UPL)	8.8	8.8	9.3	8.8	8.9	8.4	7.3	9.3	9.8	11.4
		Intrawell Background Value (LPL)	5.9	6.8	7.2	7.7	8.0	7.8	6.3	8.0	7.0	6.1
Sulfate	mg/L	Intrawell Background Value (UPL)	61.2	53.9	61.4	55.9	26.7	0.20	48	33.6	36.5	36.2
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	518	599	485	536	1405	1976	424	458	798	640

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

FIGURES



Notes: Groundwater samples were collected on November 13-15, 2018 to represent groundwater quality at each monitoring location. Dashed lines represent background monitoring locations.

Schoeller Diagram

Amos Fly Ash Pond

Geosyntec consultants

AMERICAN ELECTRIC POWER

Columbus, Ohio

31-May-2019

Figure 1

internal info: path, date revised, author

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Amos Fly Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

22663

License Number

WEST VIRGINIA

Licensing State

07.15.19

Date

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

July 14, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Amos Fly Ash Pond (FAP)
Background Screening

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the screening and statistical analysis of background groundwater data for American Electric Power Company's Amos Fly Ash Pond (FAP). The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began for the CCR program in 2018, and 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- Upgradient Wells: FAP-MW-1807A, FAP-MW-1807B, FAP-MW-1808A, FAP-MW-1809A, and FAP-MW-1810A
- Downgradient Wells: FAP-MW-1, FAP-MW-2, FAP-MW-5, FAP-MW-7, FAP-MW-8, FAP-MW-6, FAP-MW-9, FAP-MW-1801A, FAP-MW-1804A; and FAP-MW-1806A

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University, both Senior Advisors to Groundwater Stats Consulting.

The following constituents were evaluated: Appendix III parameters – boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and Appendix IV parameters - antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 & 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium.

Time series plots for Appendix III and IV parameters at all wells are provided for the purpose of screening data at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

Data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves are provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Method:

1) Intrawell prediction limits, combined with a 1-of-3 resample plan for all Appendix III parameters.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.

- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Background Screening

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III and Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits (Figure C).

Using the Tukey box plot method, several values were identified as possible outliers. A summary of those findings is included with the tests (Figure C). Typically, when the most recent value is identified as an outlier, values are not flagged in the database at this time as they may represent a possible trend. If future values do not remain at similar concentrations, these values will be flagged as outliers and deselected. In this particular case, the values identified were reported nondetects requiring no further action. Several low values exist in the data sets and appear on the graphs as possible low outliers relative to the laboratory's Practical Quantitation Limit. However, these values are observed trace values (i.e. measurements reported by the laboratory between the Method Detection Limit and the Practical Quantitation Limit) and, therefore, were not flagged as outliers.

Of the outliers identified by Tukey's method, none of the values were flagged as all observations are similar to remaining measurements within a given well or neighboring wells, or were reported nondetects. If values are flagged as outliers in the future, a list of those values will be included with the Tukey test results in Figure C. Additionally, these values would be plotted in a disconnected and lighter symbol on the time series graph. The accompanying data pages will display the flagged value in a lighter font as well. A substitution of the most recent reporting limit was applied when varying detection limits existed in data. When the reporting limit is higher than the CCR-rule specified levels (40 CFR 257.95(h)) for parameters without Maximum Contaminant Levels as discussed below, nondetects are substituted with one half the reporting limit.

No seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be visually apparent, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure D). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed a statistically significant decreasing trend for chloride and an increasing trend for sulfate as may be seen on the Trend Test Summary Table that accompanies the trend tests. Both of these trends are relatively low in magnitude when compared to average concentrations within these wells. Additionally, the short background period of record makes it difficult to separate trends from normal year-to-year variation. Therefore, no adjustments were made to the data sets.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach (Figure E). Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified variation among upgradient well data for all of the Appendix III parameters. Therefore, all other data were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results is included with the reports.

Appendix III - Statistical Limits

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps are required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits are used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits are in most cases selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility. A special situation occurs, however, at this site and is discussed below.

For normal or transformed normal data, parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters recommended for intrawell analyses (Figure F). In cases where transformations cannot achieve normality, nonparametric tolerance limits are used. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented, and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters using the tolerance limits discussed above, to determine intrawell eligibility for those parameters exhibiting spatial variation (Figure G). When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards are eligible for intrawell prediction limits.

Confidence intervals for the Appendix III parameters (boron, calcium, chloride, fluoride, pH, sulfate and TDS) were found to be within their respective background limit for calcium, pH and sulfate; while the confidence intervals for boron, chloride, fluoride and TDS were above the background standards for one or more downgradient wells. Based on the statistical screening, intrawell methods would be recommended for calcium, pH and sulfate, and interwell methods would be recommended for boron, chloride, fluoride and TDS. However, supporting documentation provided by Geosyntec Consultants demonstrates that a review of the geochemistry at the site found two different types of groundwater chemistry between the upgradient and downgradient wells, indicating that interwell methods would lead to either false positive (identifying impacts when there are none) or false negative (not identifying impacts to groundwater when present in downgradient wells) results. Therefore, intrawell prediction limits are recommended presently for all Appendix III parameters.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent and in cases of unexplained increasing trends in downgradient concentrations, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to conclusively validate an intrawell approach. This method assumes that practices at the site are not influencing background groundwater quality downgradient of the site. If background water quality has historically been affected by the facility, the intrawell limits will serve to detect changes from current, impacted conditions rather than to initially identify such impacts.

All available data through February 2019 for Appendix III parameters at each well were used to establish intrawell background limits based on a 1-of-3 resample plan that will be used for future comparisons (Figure H). Intrawell methods construct statistical limits from historical data within a given well for comparison of future data at the same well.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits will be necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs. As more data are collected, the resample plan will be re-evaluated for appropriateness of the 1-of-2 plan for intrawell analyses.

In the event of an initial exceedance of compliance well data, the 1-of-3 resample plan allows for collection of up to two additional samples to determine whether the initial exceedance is confirmed. When both resamples confirm the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of the exceedance (i.e. impact from the site, natural variation, or an off-site source). In the 1-of-2 resample plan, one additional sample may be collected to confirm the initial exceedance. If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary. A summary table of the background prediction limits follows this letter.

<u>Appendix IV – Assessment Monitoring Program</u>

During an Assessment Monitoring program, confidence intervals are constructed at all wells for detected Appendix IV parameters and compared to a Groundwater Protection Standard (GWPS). A minimum of 4 samples is required to construct confidence intervals; however, 8 samples are recommended for better representation of the true average population. The GWPS includes the established Maximum Contaminant Levels (MCLs), the CCR-rule specified levels for parameters without MCLs (cobalt, lead, lithium and molybdenum), or background as discussed below. Parametric confidence intervals are constructed with 99% confidence when data follow a normal or transformed-normal distribution. For all other cases, nonparametric confidence intervals are constructed, with the confidence level based on the number of samples available. The GWPS is exceeded only when the entire confidence interval exceeds its respective GWPS.

Background limits are established for the Appendix IV parameters using upper tolerance limits constructed with 95% confidence/95% coverage for normally distributed data, using all upgradient well data, for comparison against established MCLs. When background limits, or Alternate Contaminant Levels (ACLs), are higher than established MCLs or CCR-rule specified limits, the CCR Rule recommends using these ACLs as the GWPS for the confidence interval comparisons. Since the scope of this project included screening and development of background limits for Appendix III Detection Monitoring statistics, no confidence intervals were constructed in this report.

Recommendations

In summary, as a result of the background screening described in this letter, intrawell prediction limits combined with a 1-of-3 resample plan are recommended for all Appendix III parameters. The statistical analyses will be constructed according to the USEPA Unified Guidance, based on 7 Appendix III parameters and 10 downgradient wells.

Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Amos Fly Ash Pond. If you have any questions or comments, please feel free to contact me.

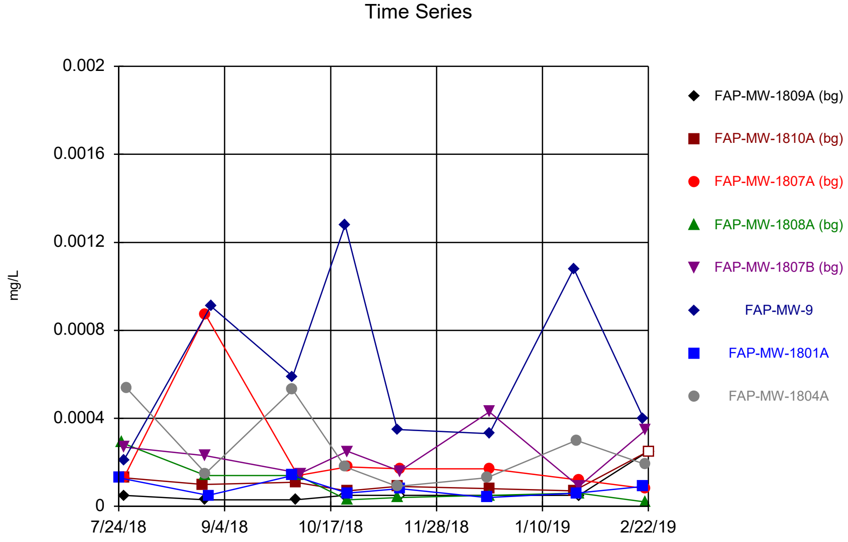
For Groundwater Stats Consulting,

Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

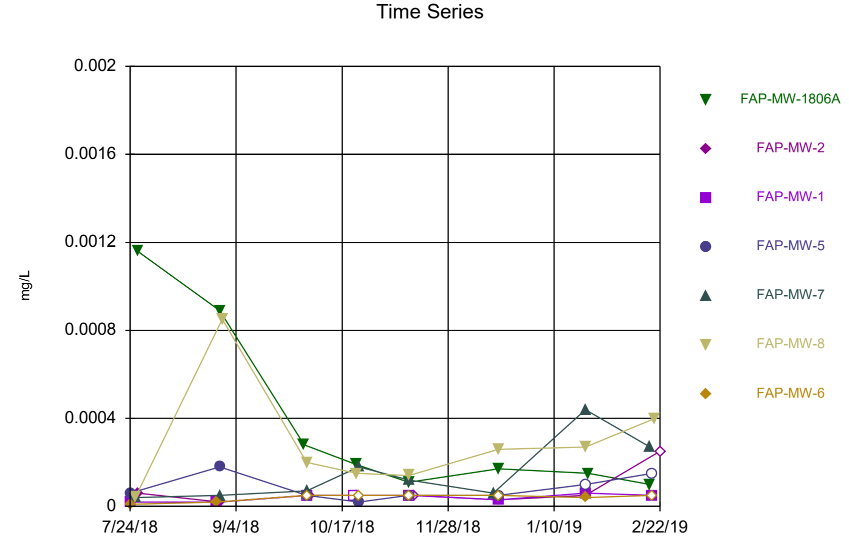
FIGURE A: TIME SERIES

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



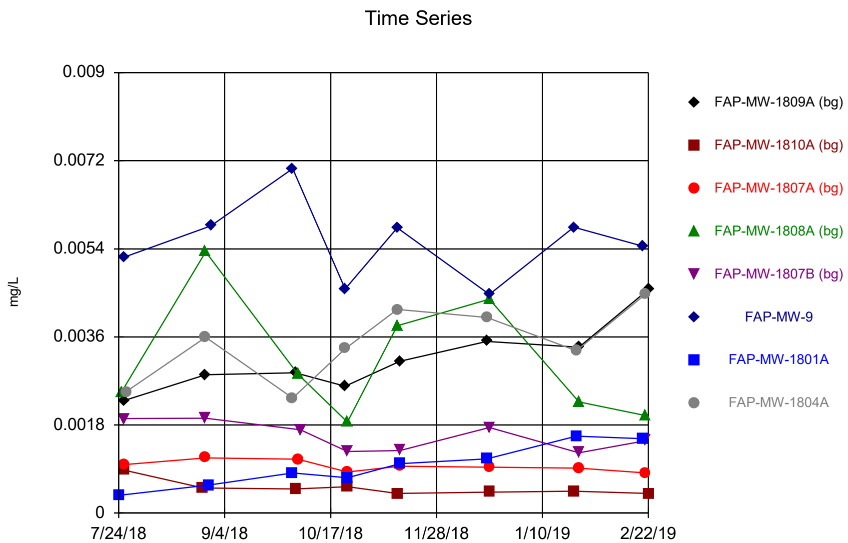
Constituent: Antimony Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



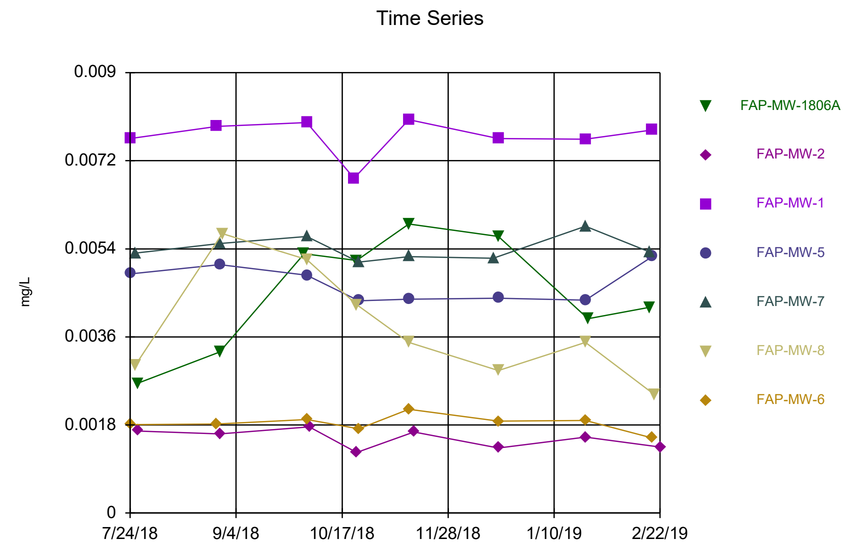
Constituent: Antimony Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Arsenic Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

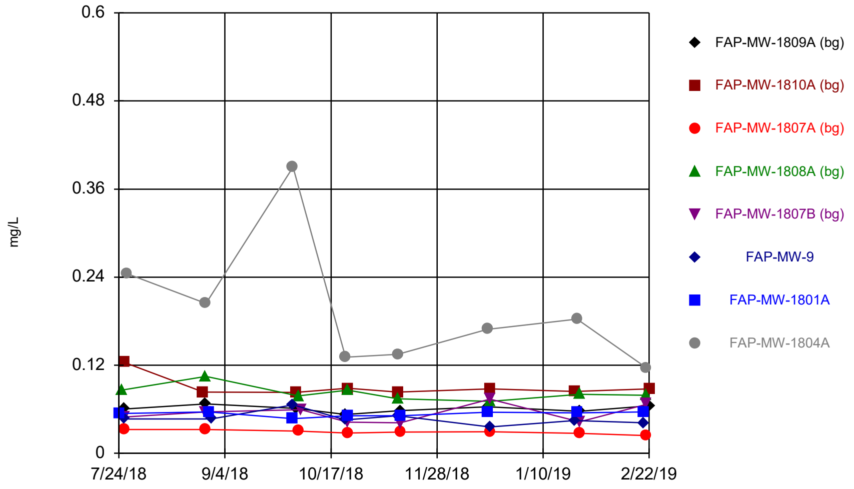
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Arsenic Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

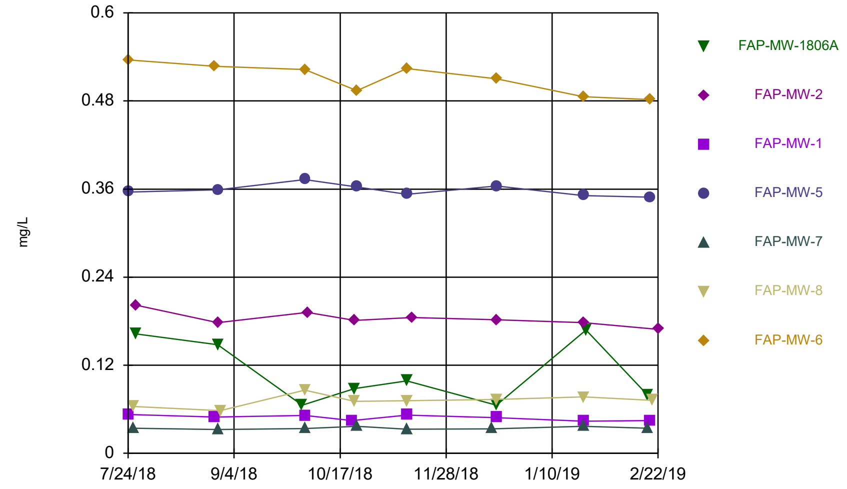
Time Series



Constituent: Barium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

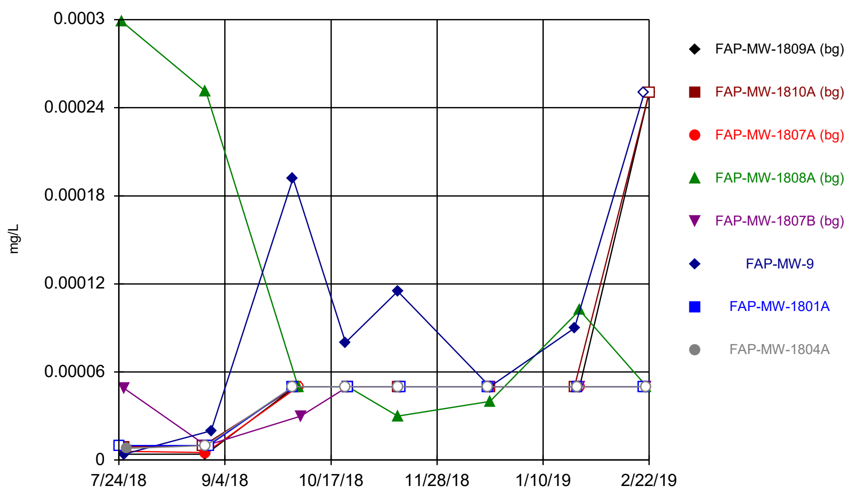
Time Series



Constituent: Barium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

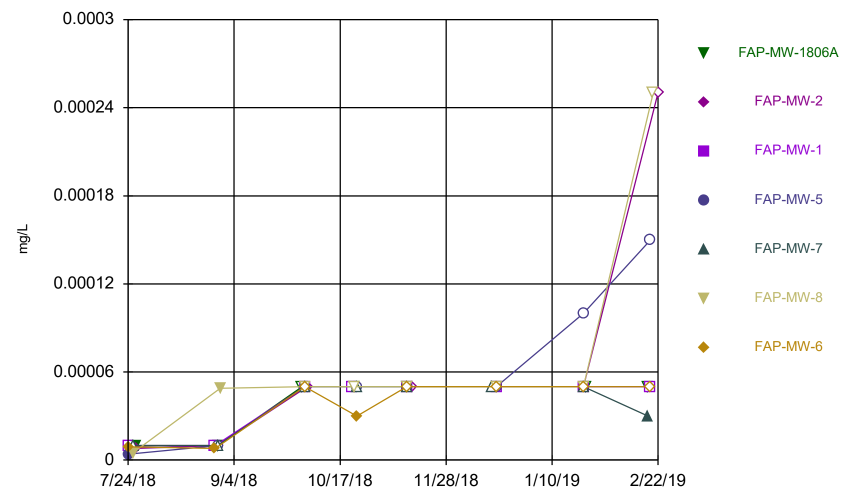
Time Series



Constituent: Beryllium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

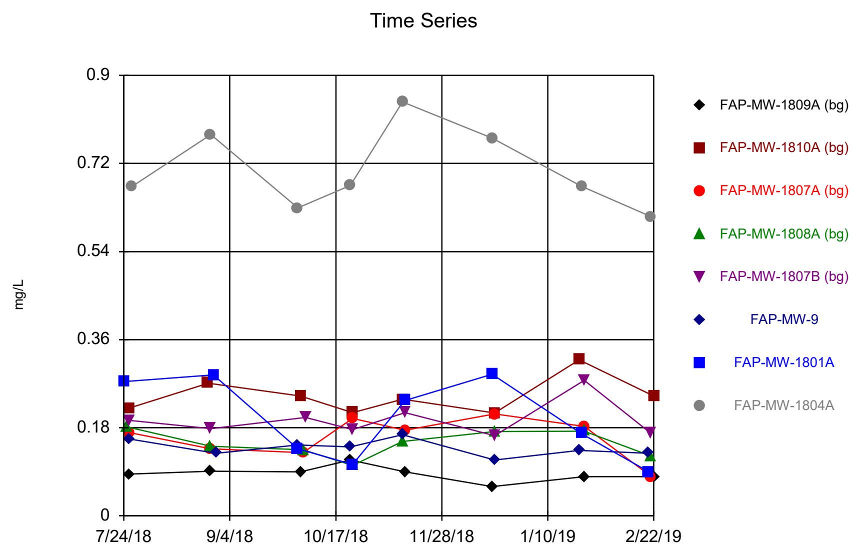
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



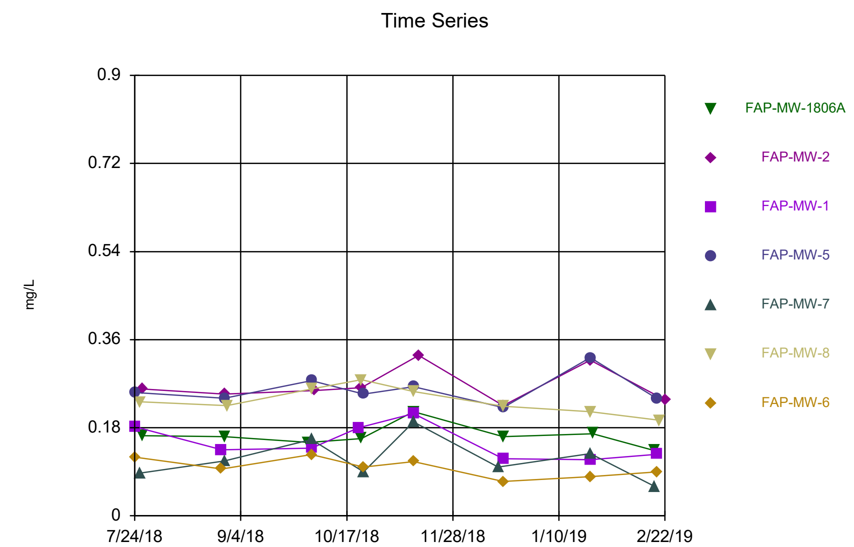
Constituent: Beryllium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



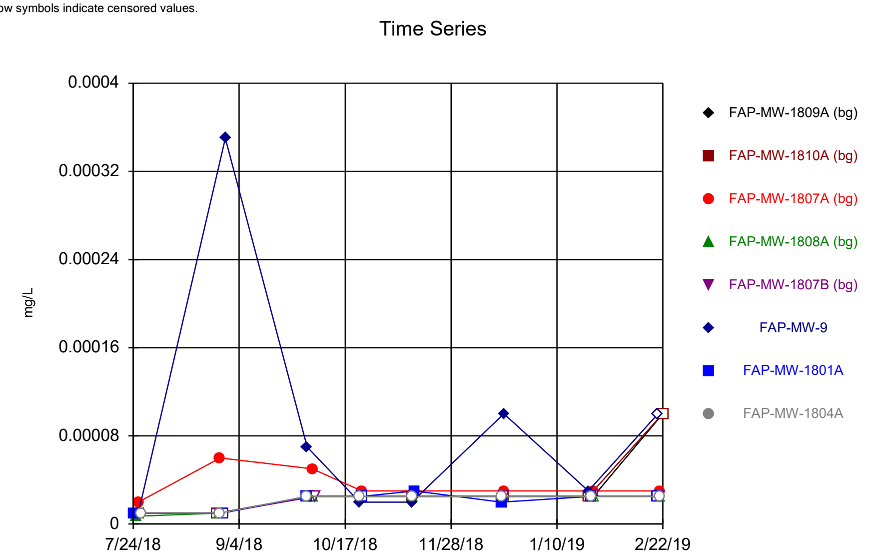
Constituent: Boron Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



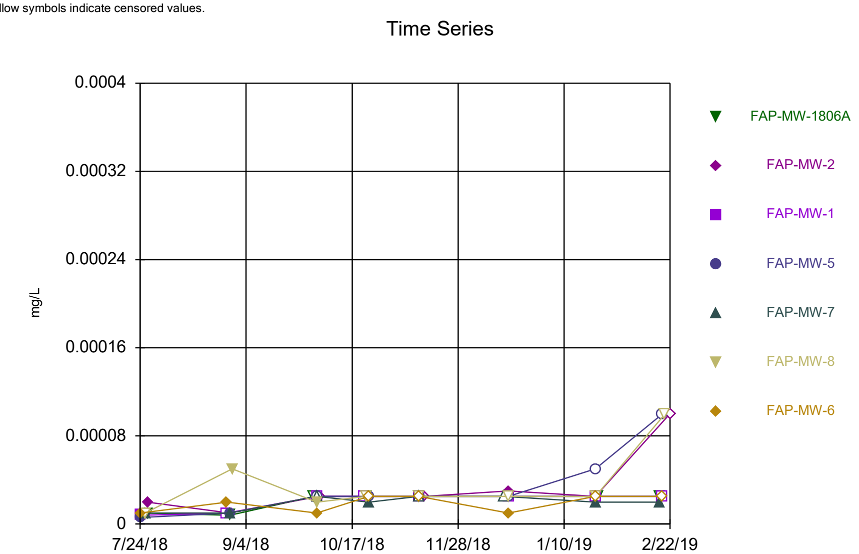
Constituent: Boron Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

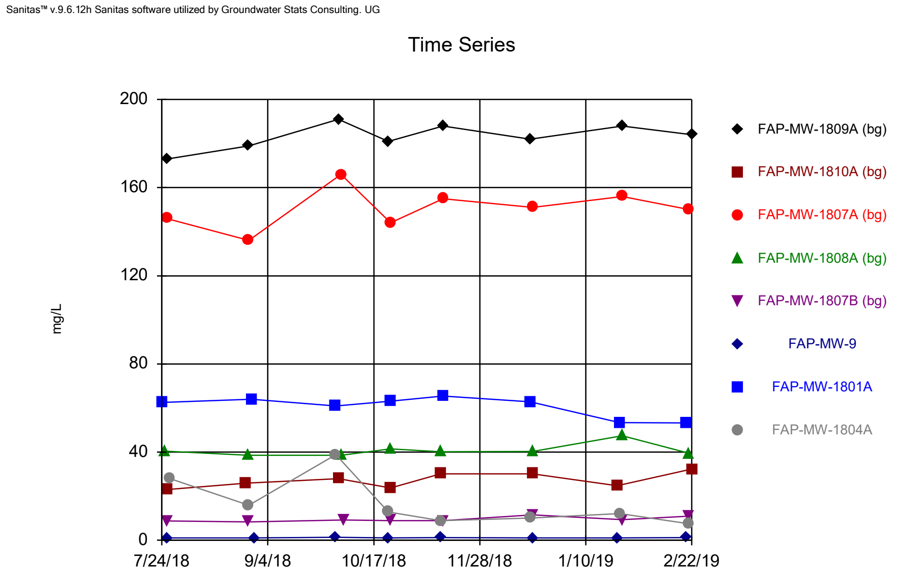


Constituent: Cadmium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

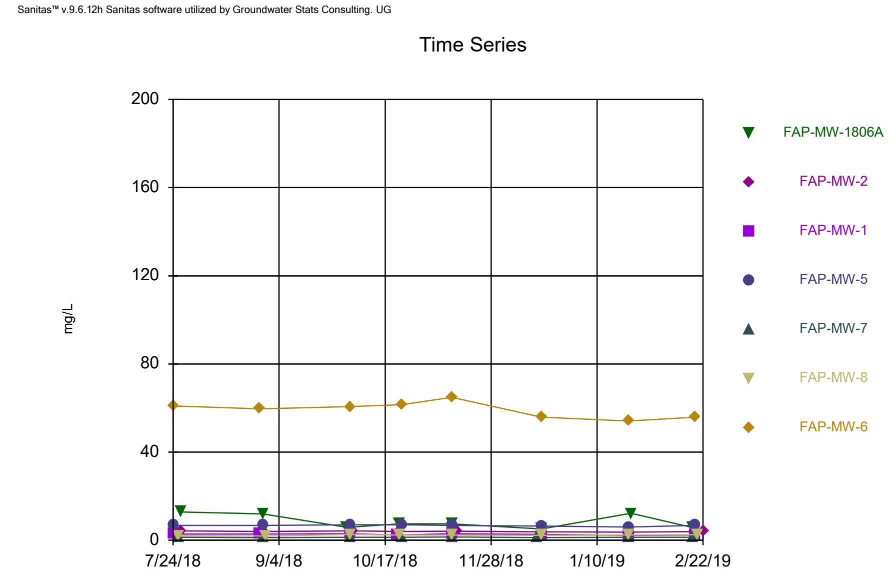
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



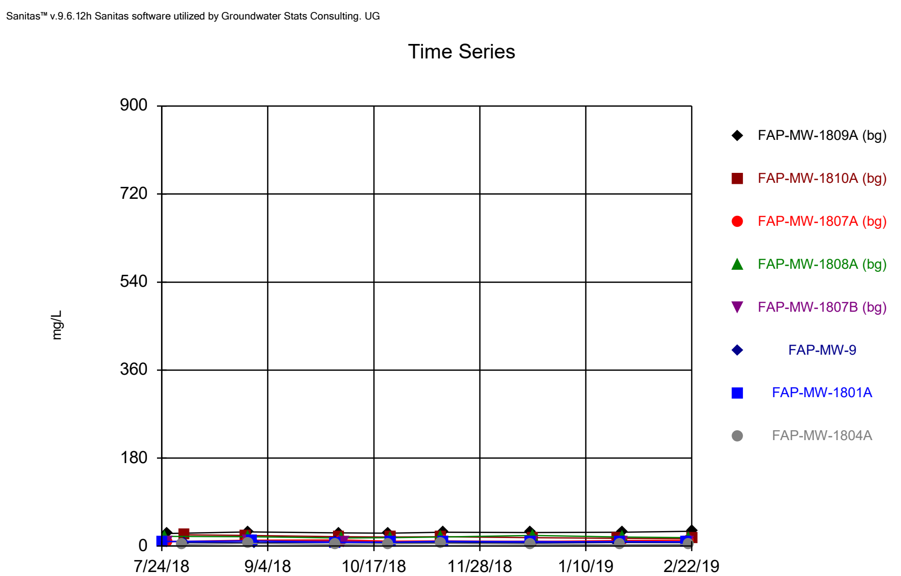
Constituent: Cadmium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



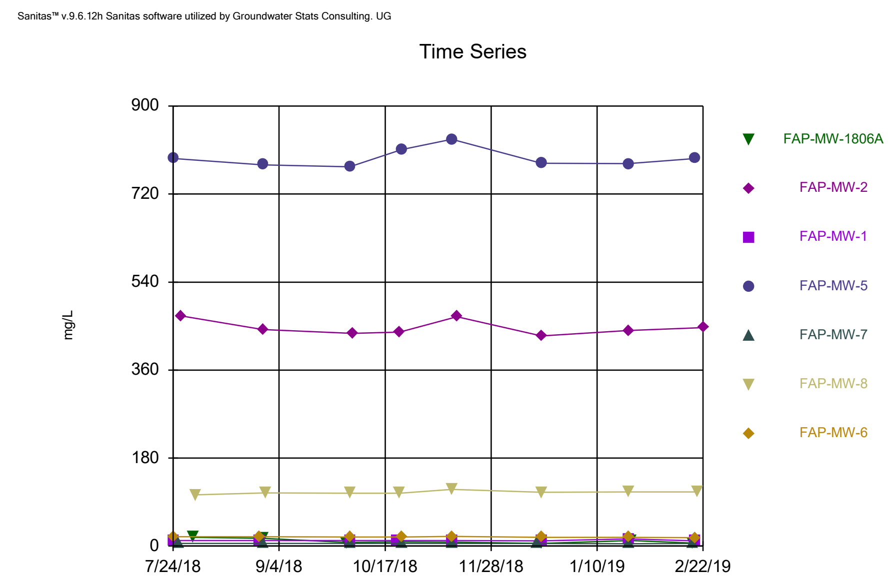
Constituent: Calcium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Constituent: Calcium Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



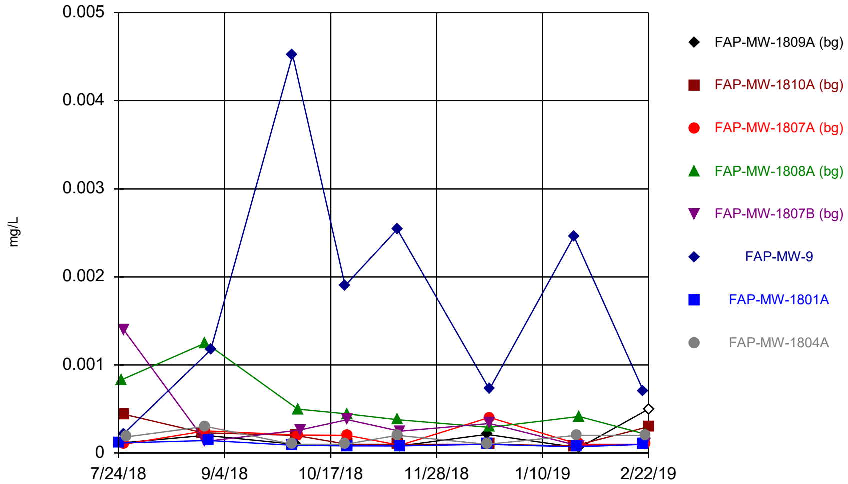
Constituent: Chloride Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Constituent: Chloride Analysis Run 4/18/2019 10:04 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

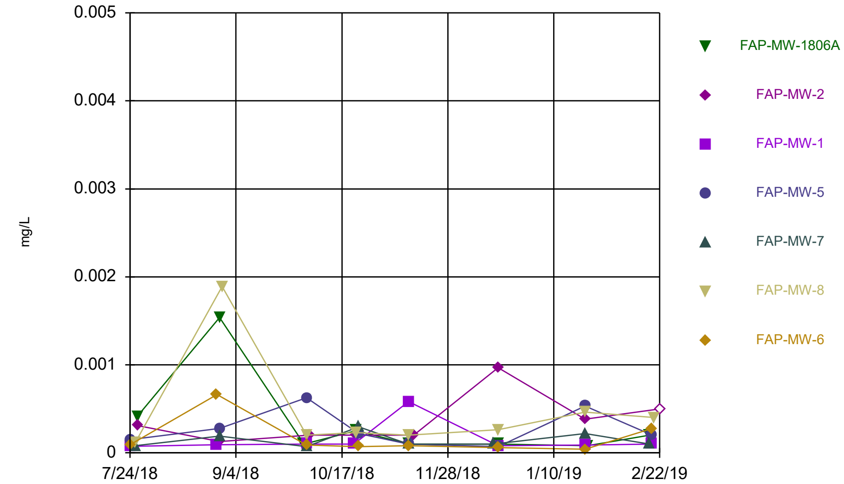
Time Series



Constituent: Chromium   Analysis Run 4/18/2019 10:04 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

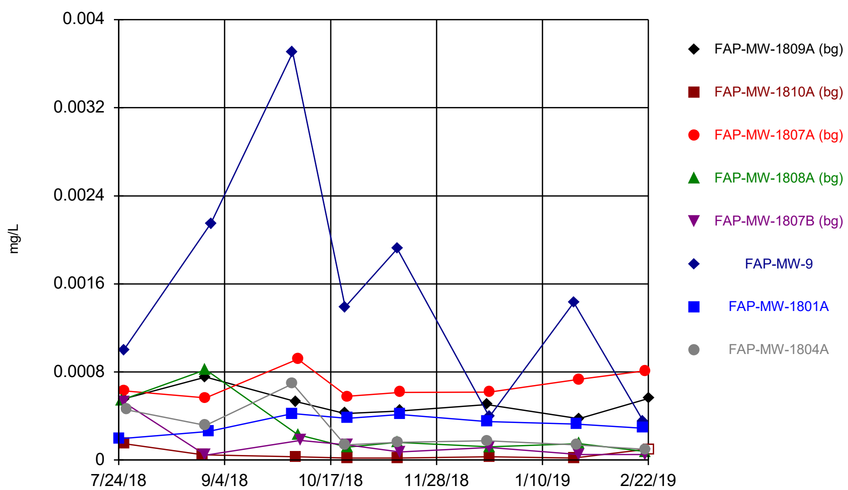
Time Series



Constituent: Chromium   Analysis Run 4/18/2019 10:04 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

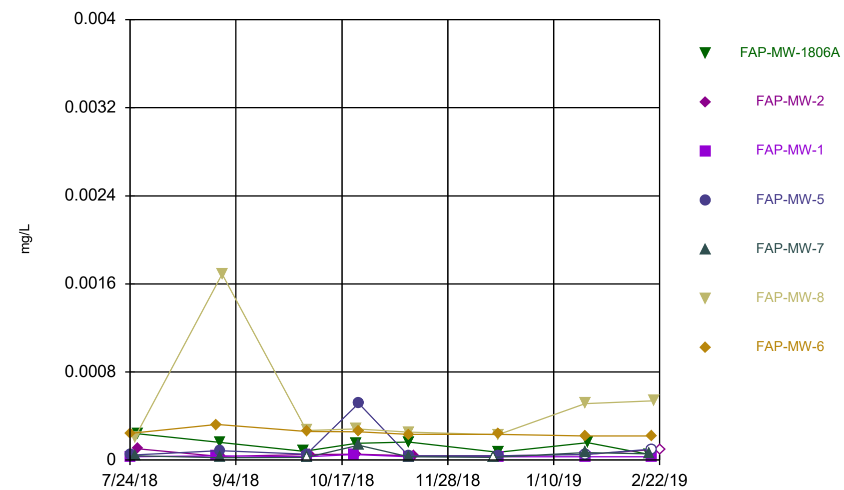
Time Series



Constituent: Cobalt   Analysis Run 4/18/2019 10:04 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

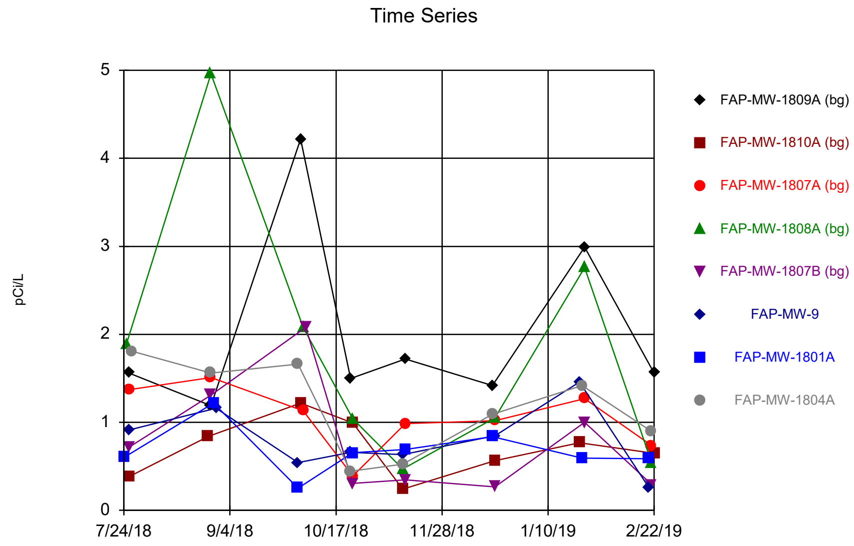
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



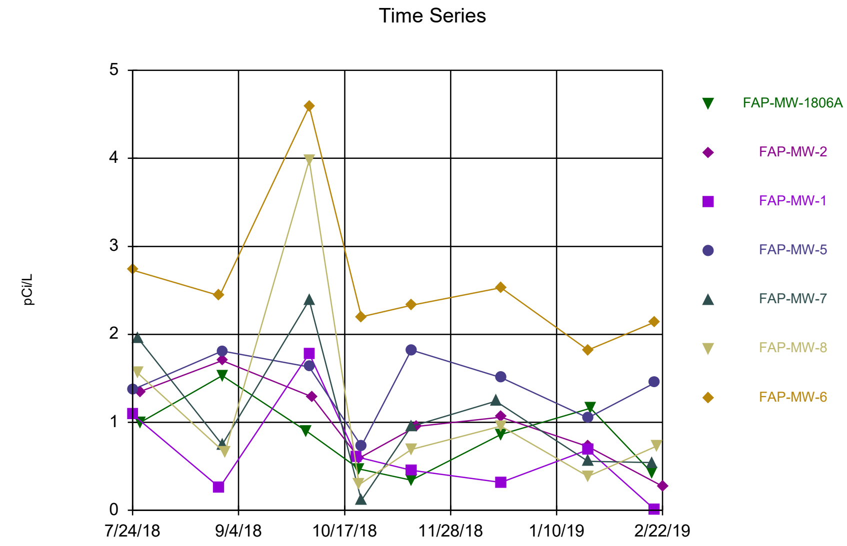
Constituent: Cobalt   Analysis Run 4/18/2019 10:04 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



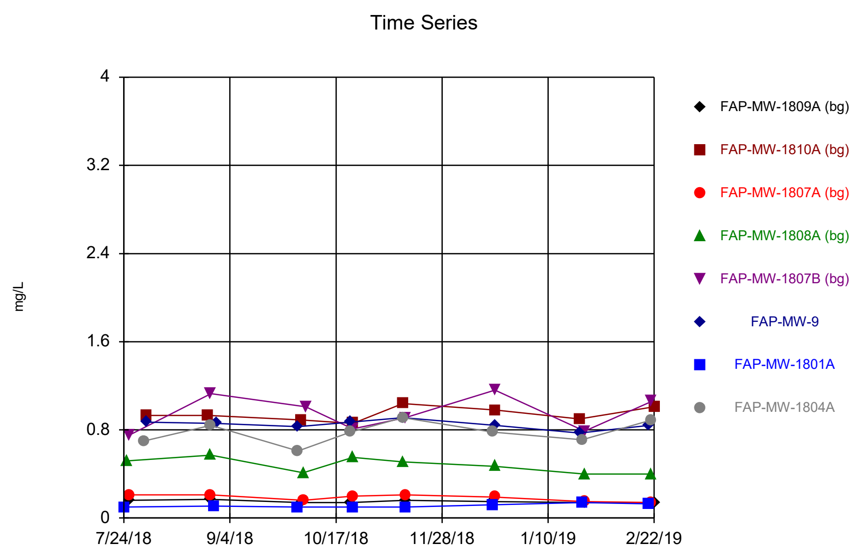
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



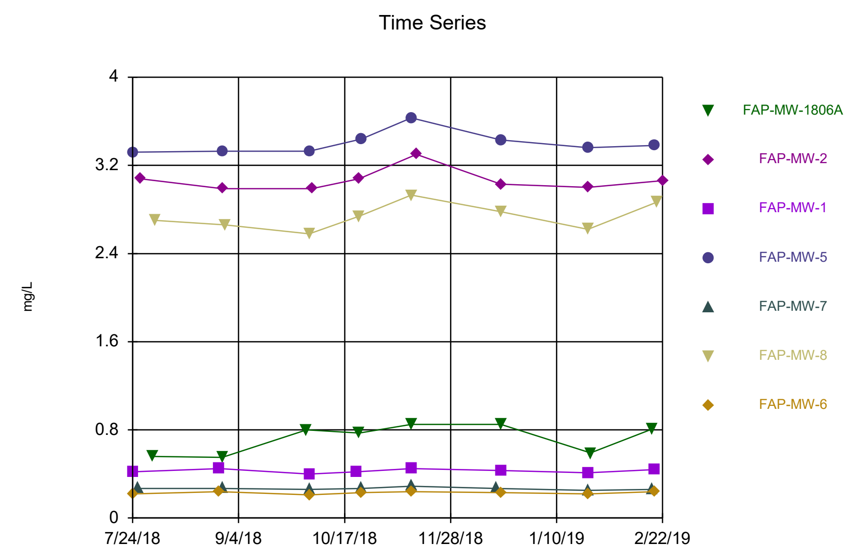
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

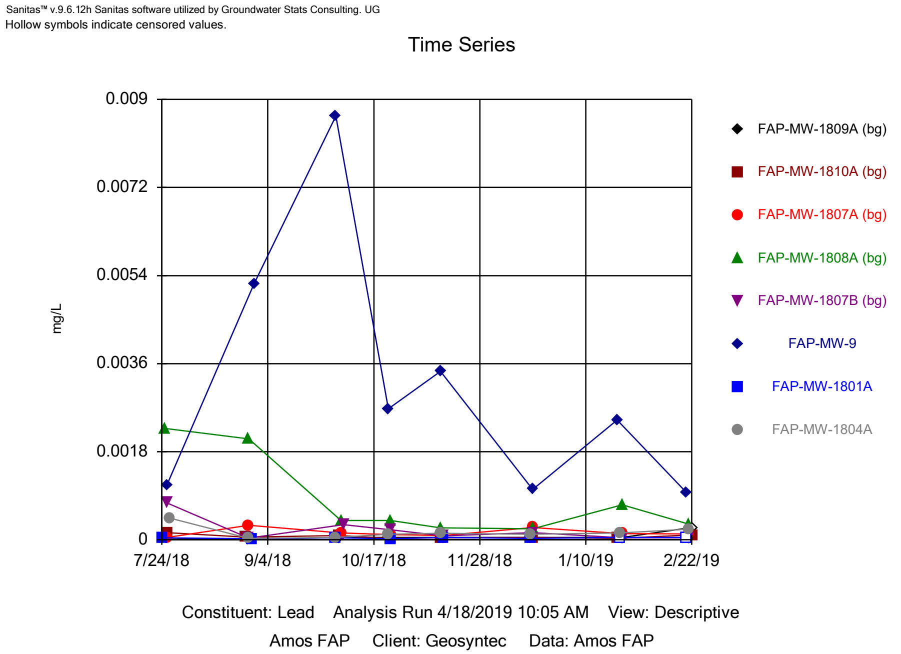


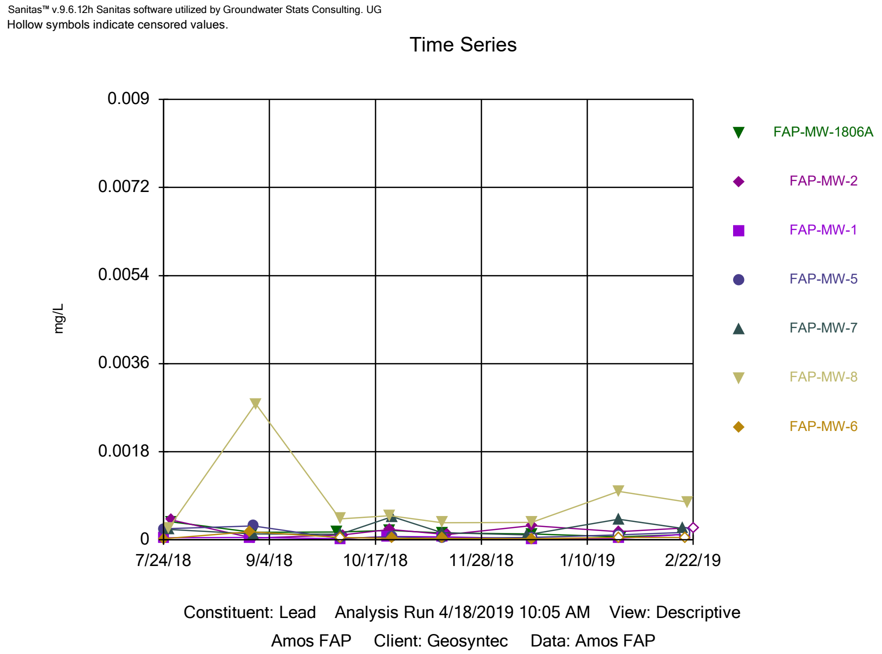
Constituent: Fluoride Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

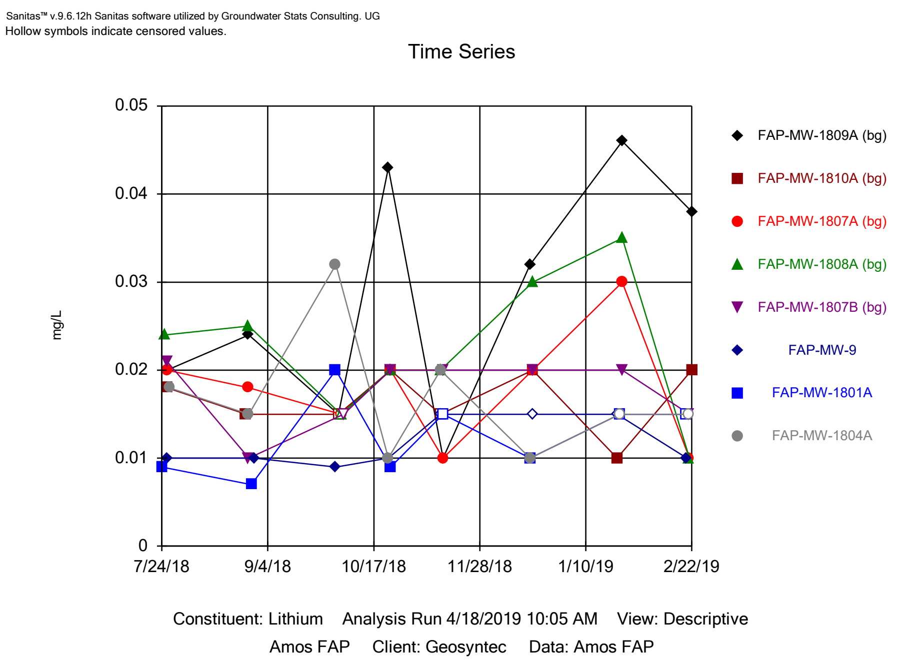
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

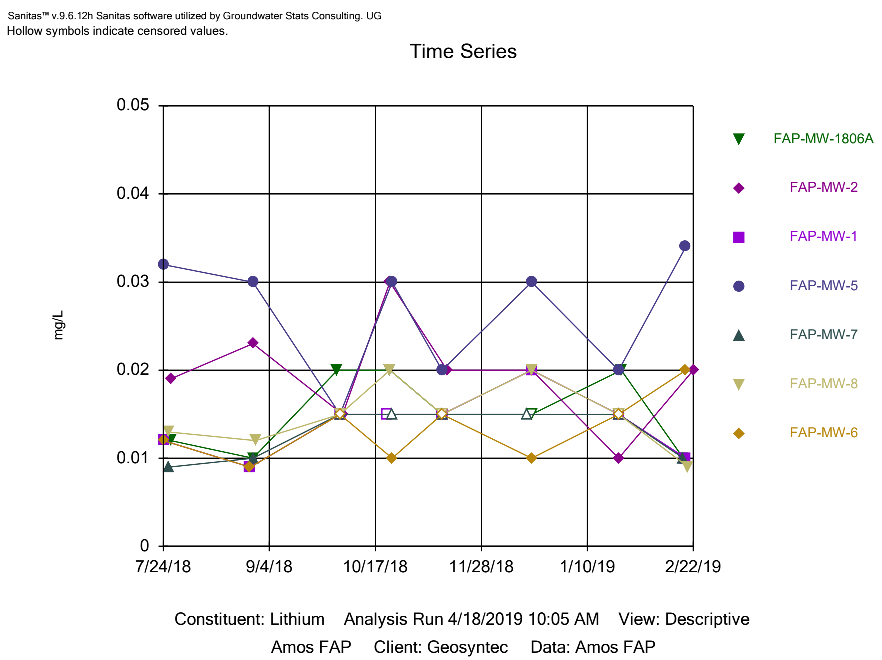


Constituent: Fluoride Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

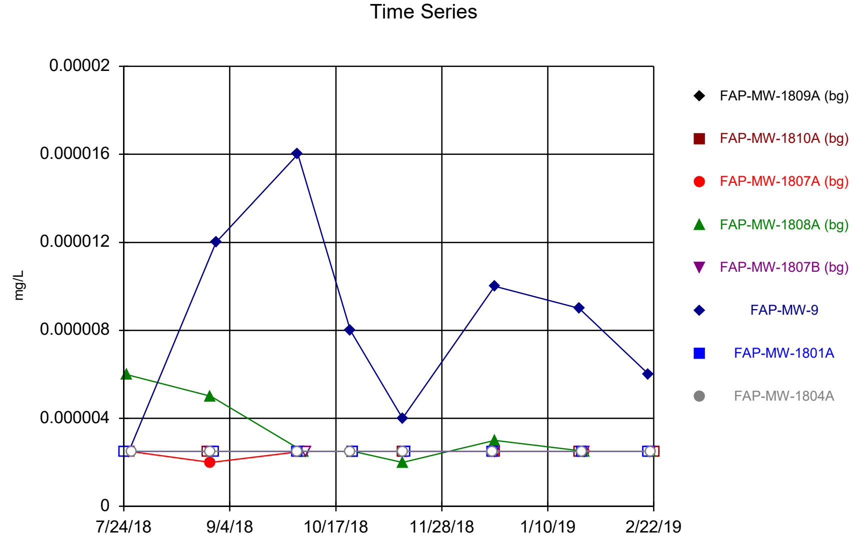

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.009
0.0072
0.0054
0.0036
0.0018
0
7/24/18
9/4/18
10/17/18
11/28/18
1/10/19
2/22/19
FAP-MW-1809A (bg)
FAP-MW-1810A (bg)
FAP-MW-1807A (bg)
FAP-MW-1808A (bg)
FAP-MW-1807B (bg)
FAP-MW-9
FAP-MW-1801A
FAP-MW-1804A
Constituent: Lead Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.009
0.0072
0.0054
0.0036
0.0018
0
7/24/18
9/4/18
10/17/18
11/28/18
1/10/19
2/22/19
FAP-MW-1806A
FAP-MW-2
FAP-MW-1
FAP-MW-5
FAP-MW-7
FAP-MW-8
FAP-MW-6
Constituent: Lead Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.05
0.04
0.03
0.02
0.01
0
7/24/18
9/4/18
10/17/18
11/28/18
1/10/19
2/22/19
FAP-MW-1809A (bg)
FAP-MW-1810A (bg)
FAP-MW-1807A (bg)
FAP-MW-1808A (bg)
FAP-MW-1807B (bg)
FAP-MW-9
FAP-MW-1801A
FAP-MW-1804A
Constituent: Lithium Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

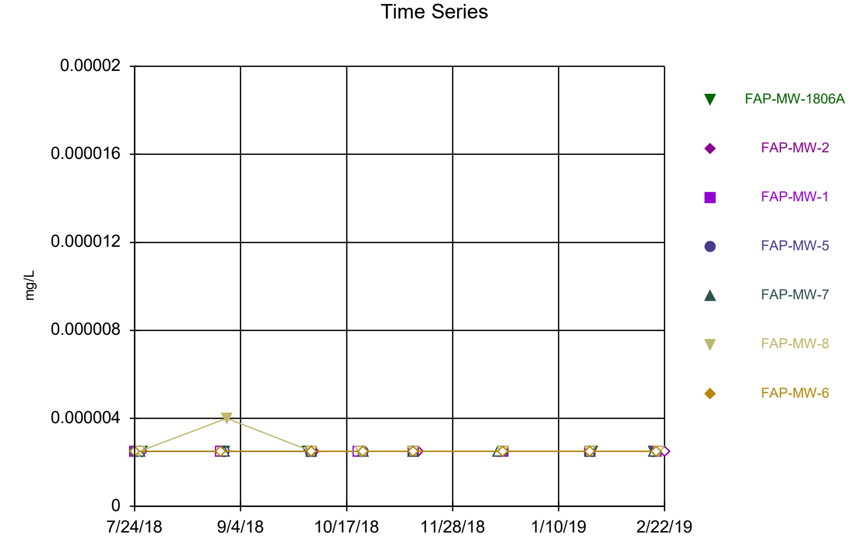

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.
Time Series
mg/L
0.05
0.04
0.03
0.02
0.01
0
7/24/18
9/4/18
10/17/18
11/28/18
1/10/19
2/22/19
FAP-MW-1806A
FAP-MW-2
FAP-MW-1
FAP-MW-5
FAP-MW-7
FAP-MW-8
FAP-MW-6
Constituent: Lithium Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



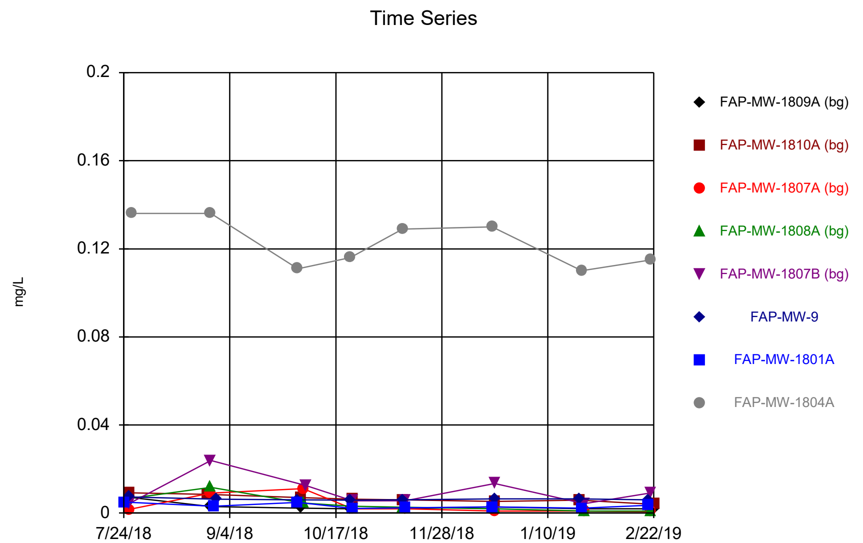
Constituent: Mercury   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



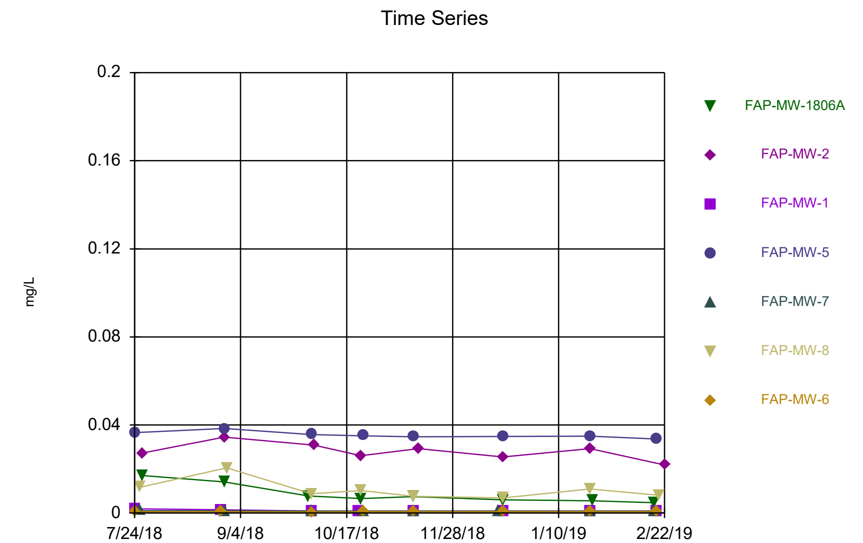
Constituent: Mercury   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



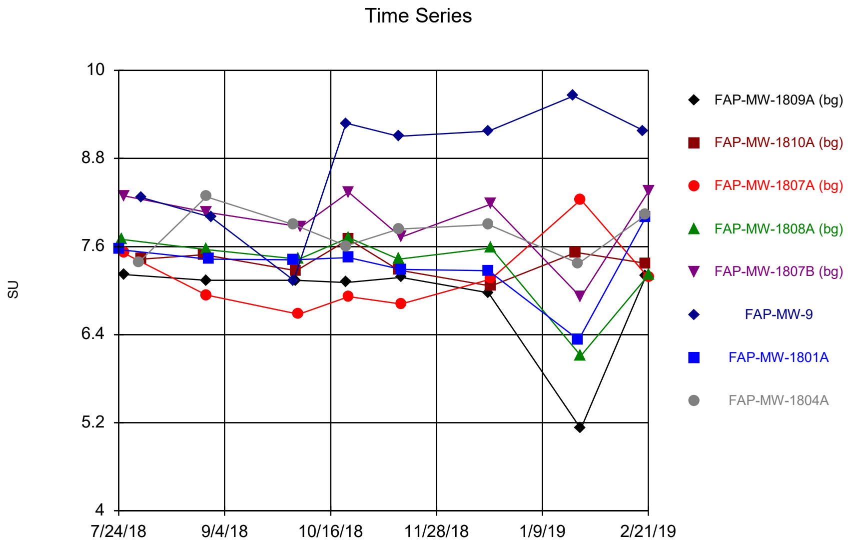
Constituent: Molybdenum   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



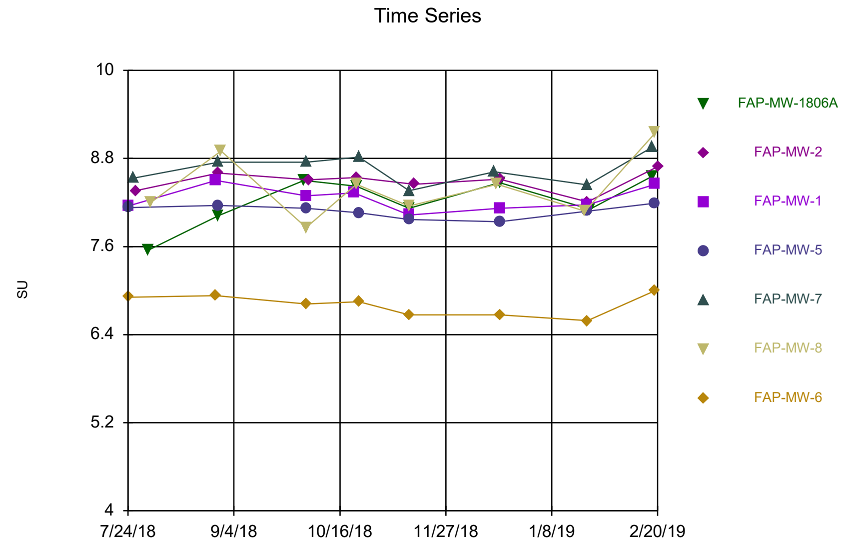
Constituent: Molybdenum   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



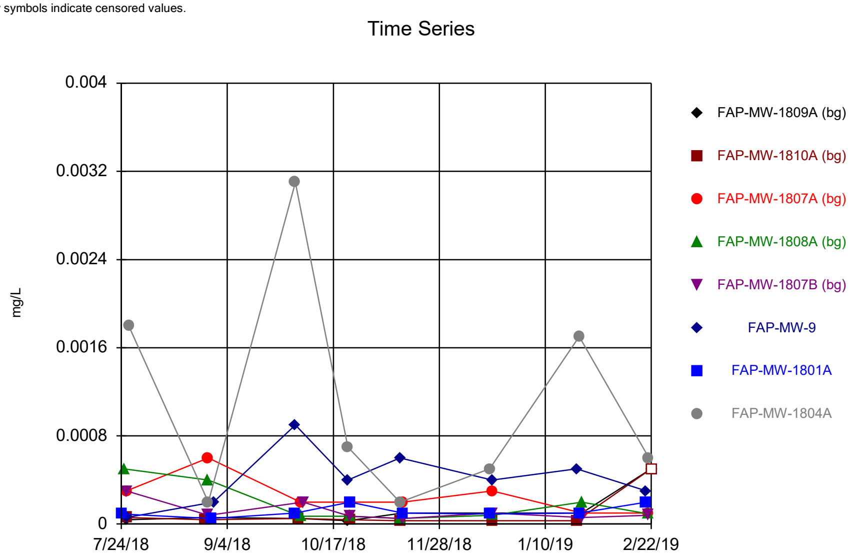
Constituent: pH   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



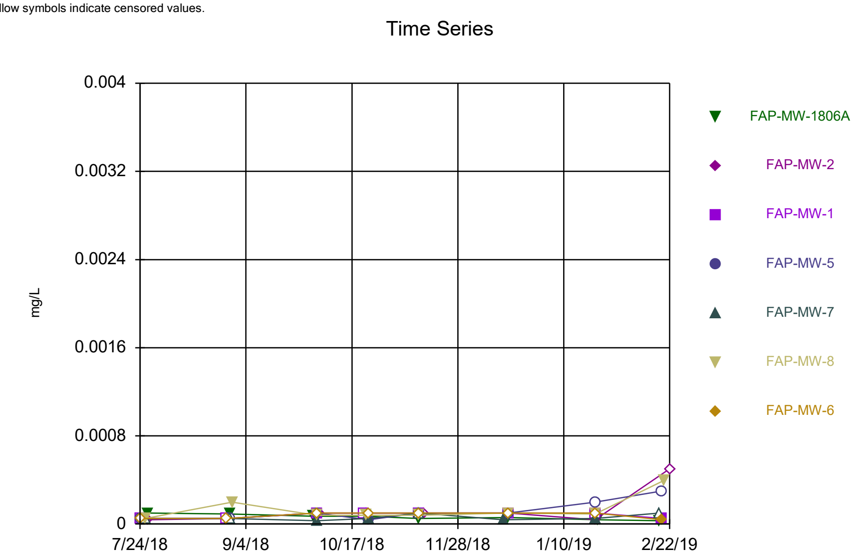
Constituent: pH   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Selenium   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

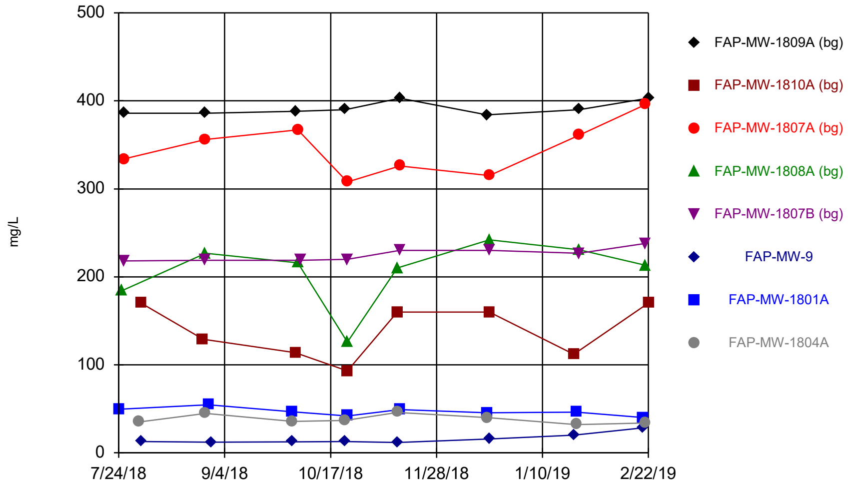
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Selenium   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

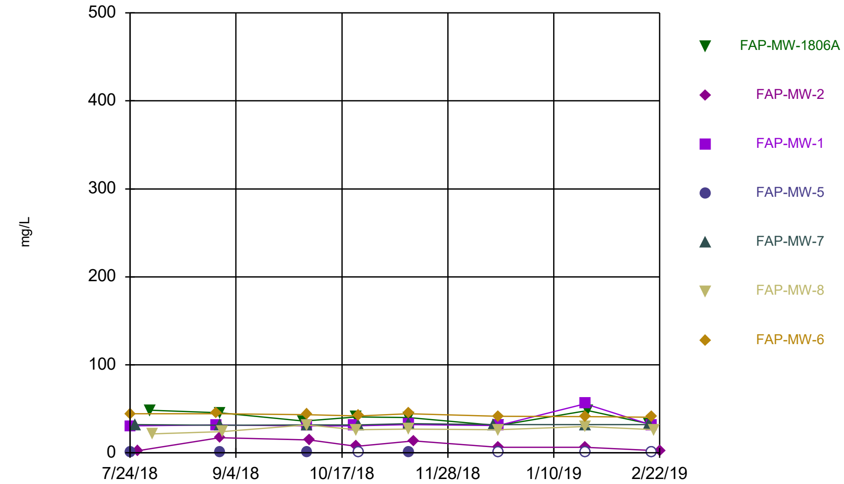
Time Series



Constituent: Sulfate Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

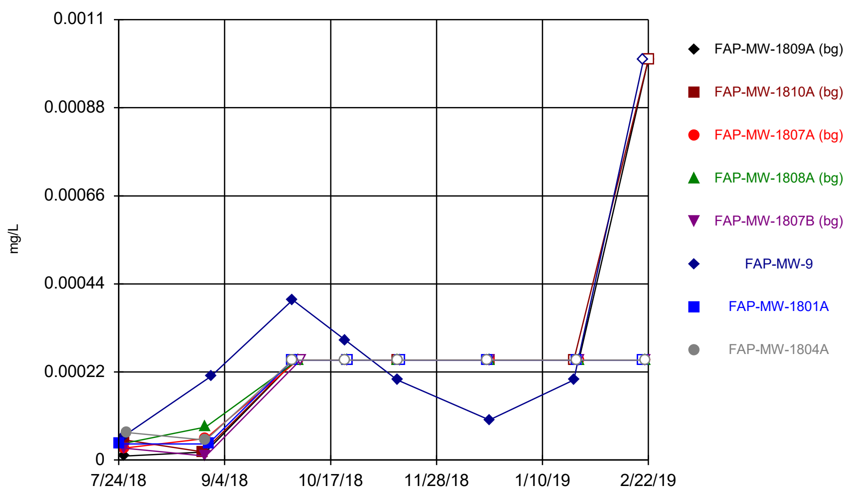
Time Series



Constituent: Sulfate Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

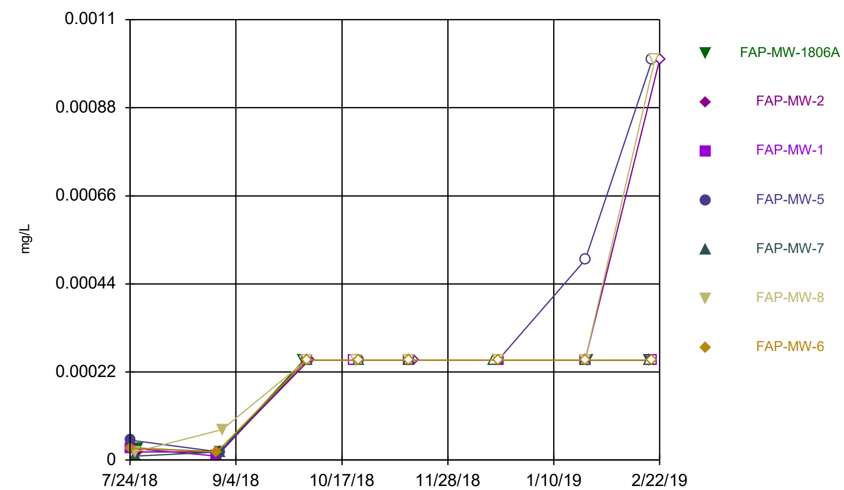
Time Series



Constituent: Thallium Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

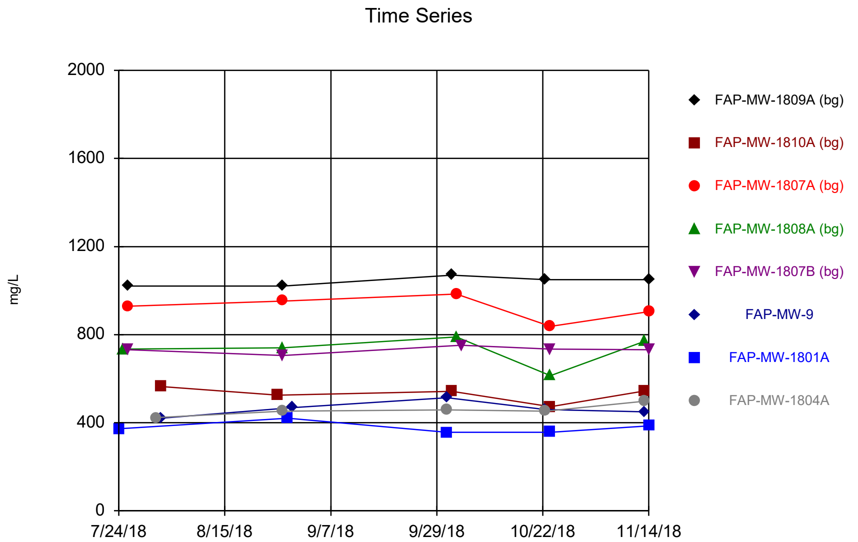
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



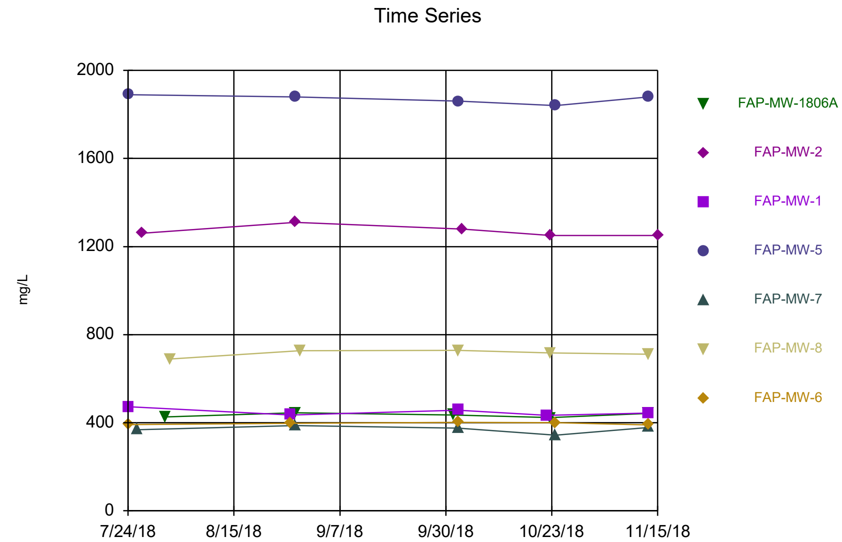
Constituent: Thallium Analysis Run 4/18/2019 10:05 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

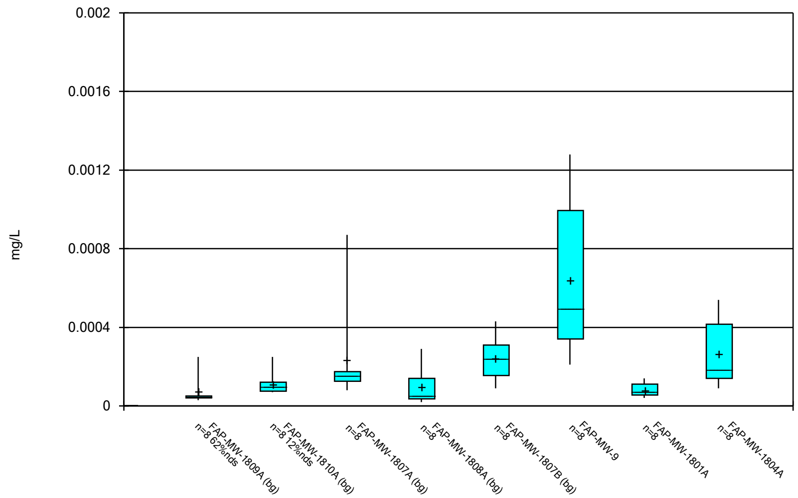


Constituent: Total Dissolved Solids   Analysis Run 4/18/2019 10:05 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

FIGURE B: BOX PLOTS

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

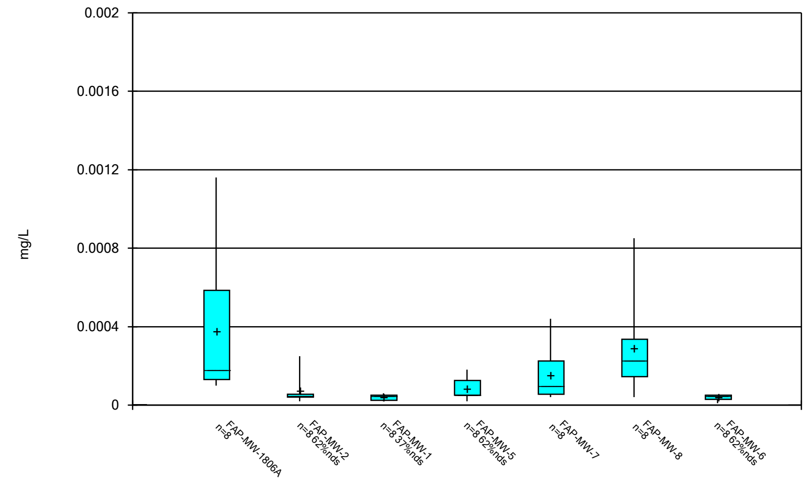
Box & Whiskers Plot



Constituent: Antimony Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

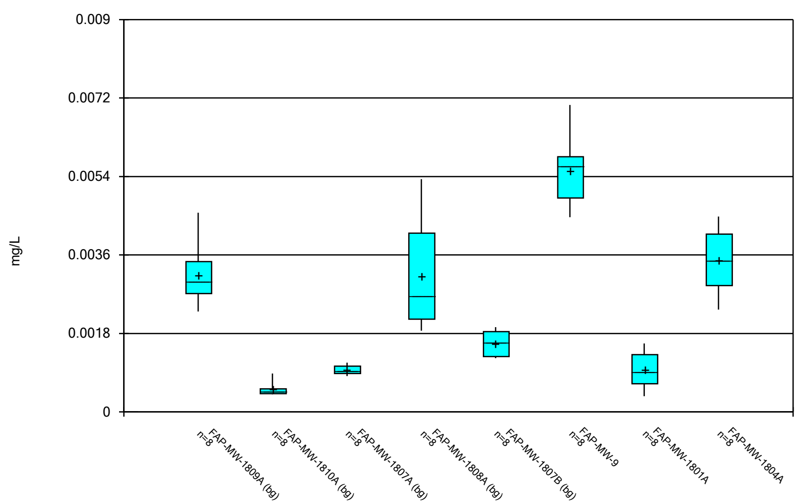
Box & Whiskers Plot



Constituent: Antimony Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

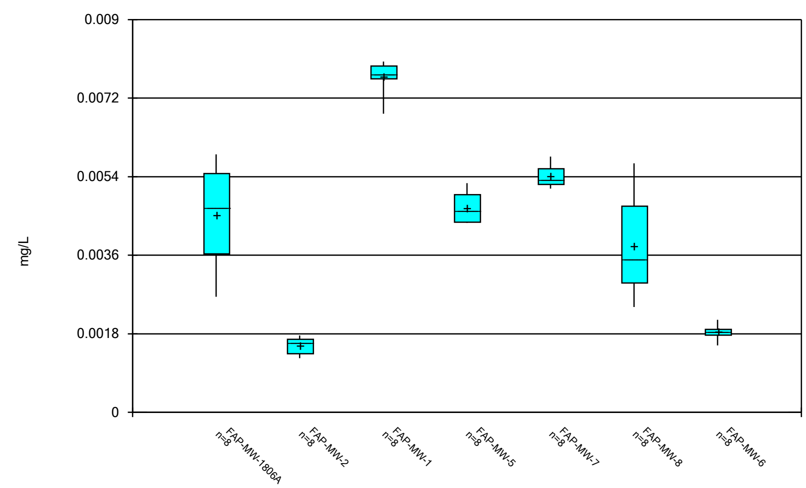
Box & Whiskers Plot



Constituent: Arsenic Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

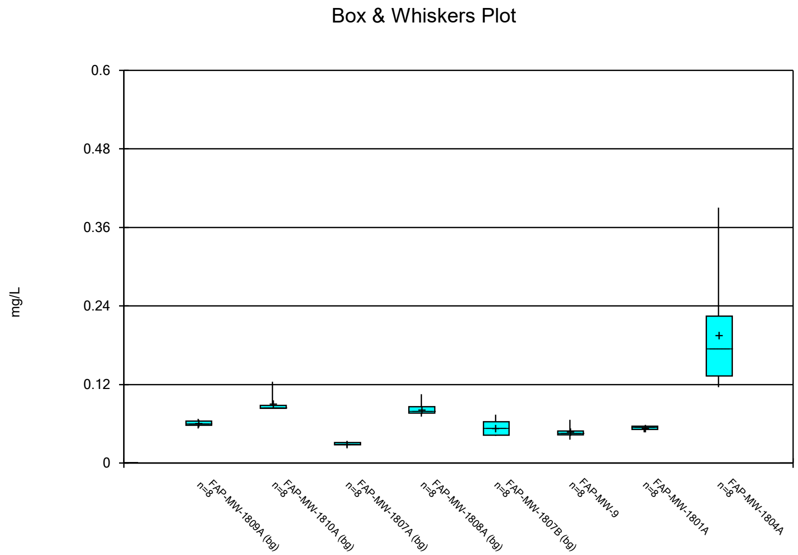
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



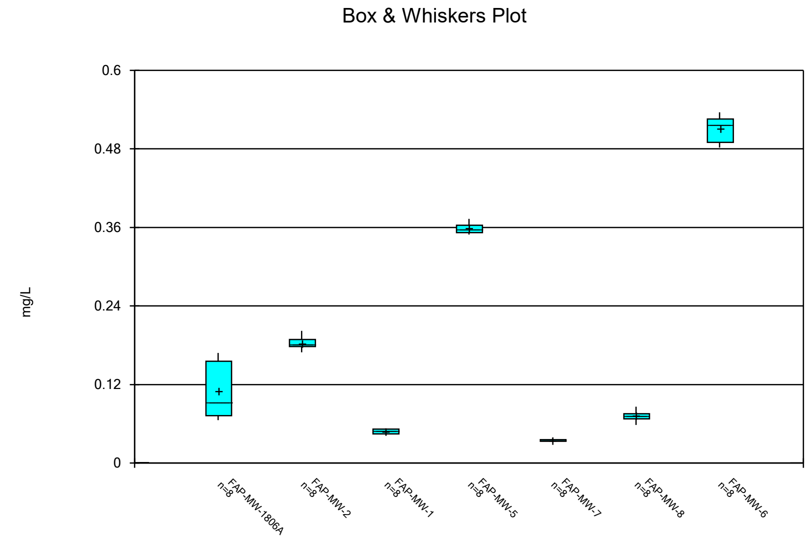
Constituent: Arsenic Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



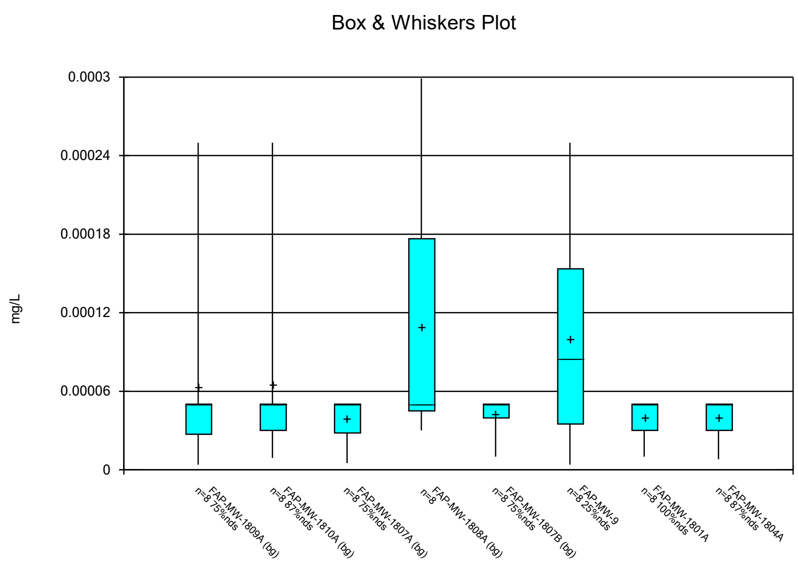
Constituent: Barium Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



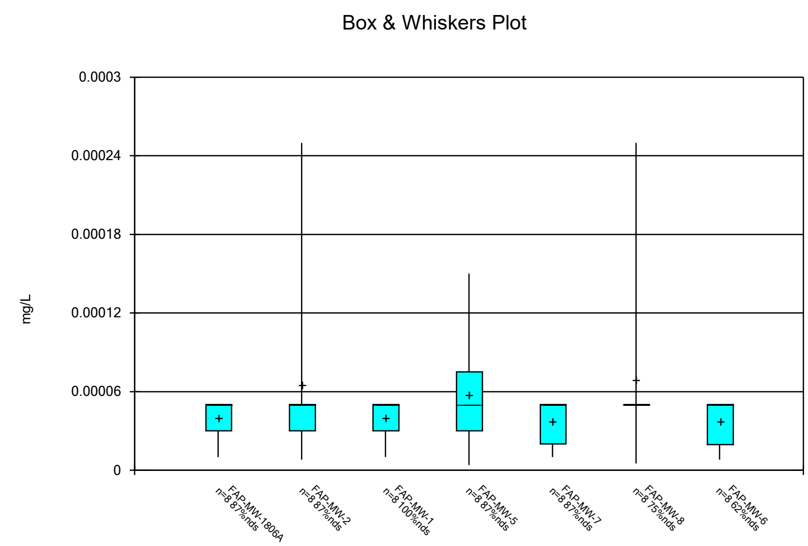
Constituent: Barium Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Beryllium Analysis Run 4/18/2019 10:19 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

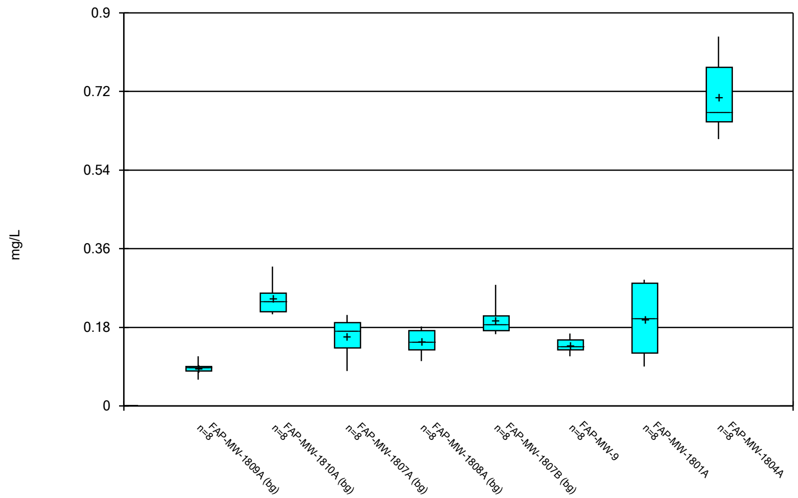
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Beryllium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

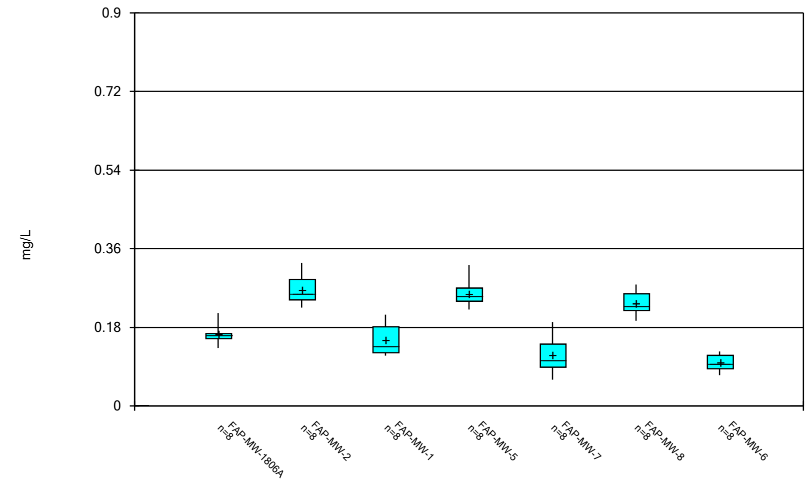
Box & Whiskers Plot



Constituent: Boron Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

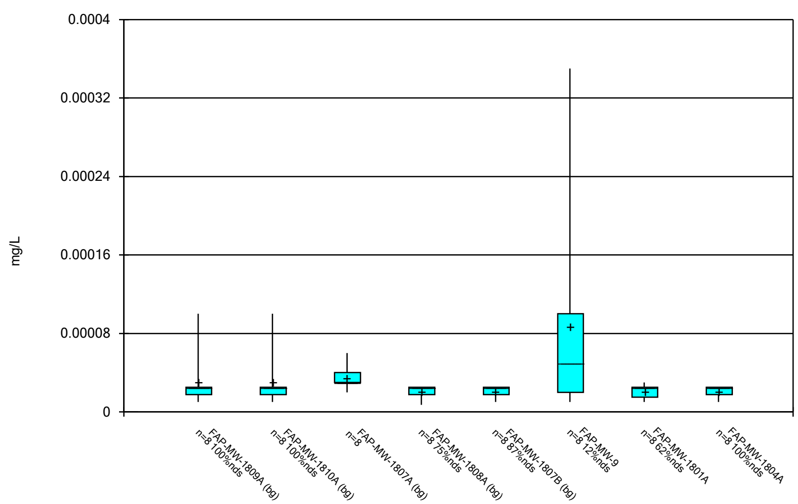
Box & Whiskers Plot



Constituent: Boron Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

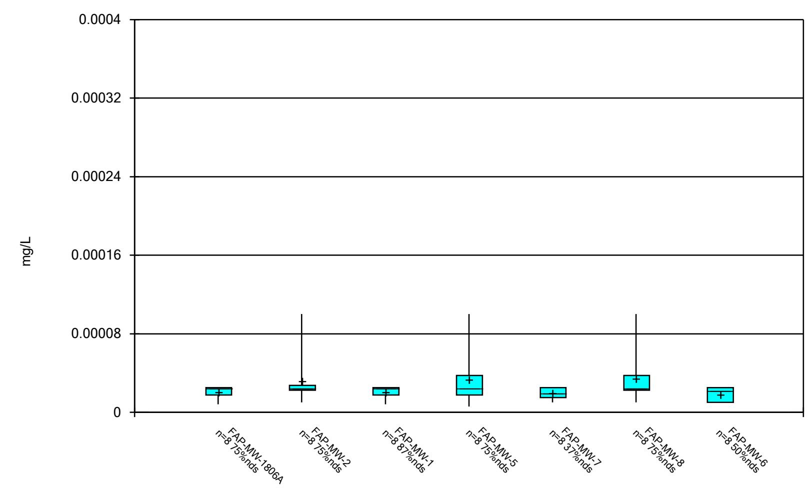
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

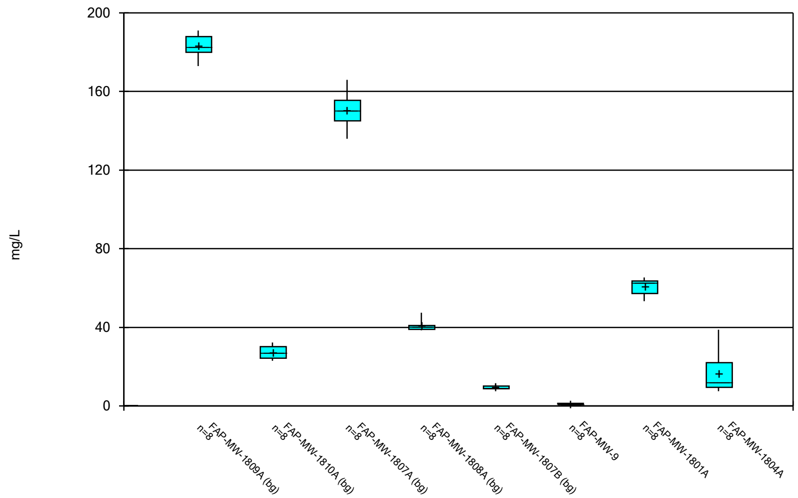
Box & Whiskers Plot



Constituent: Cadmium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

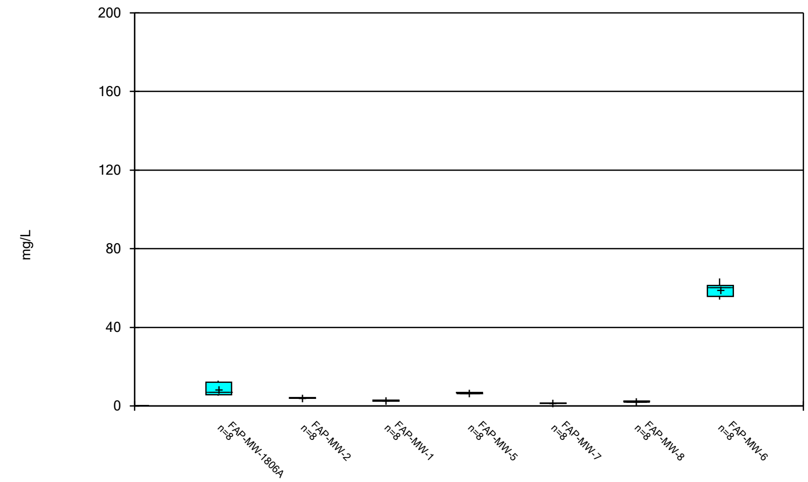
Box & Whiskers Plot



Constituent: Calcium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

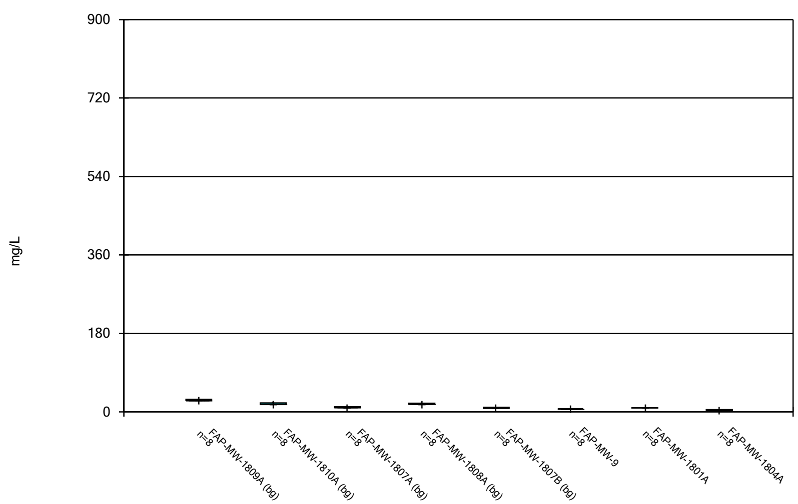
Box & Whiskers Plot



Constituent: Calcium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

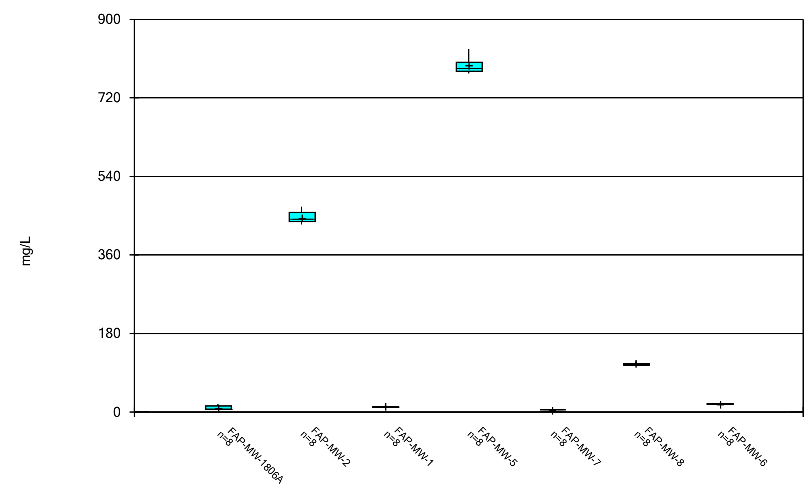
Box & Whiskers Plot



Constituent: Chloride Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

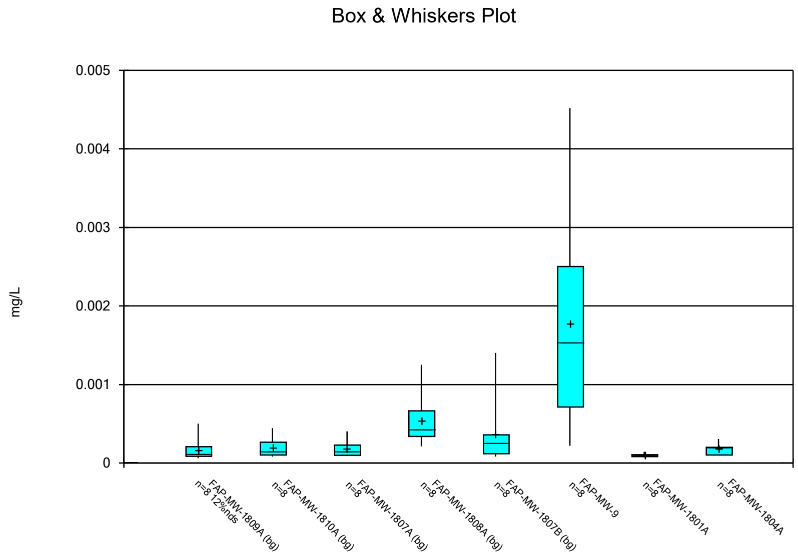
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



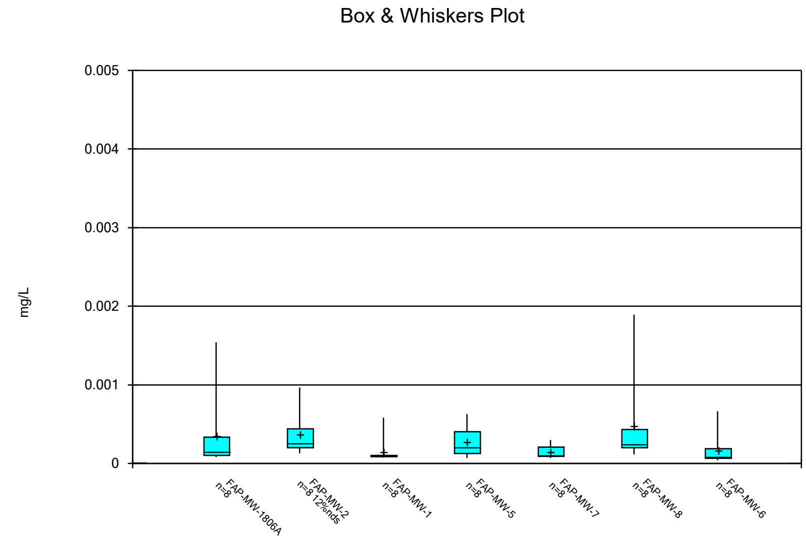
Constituent: Chloride Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



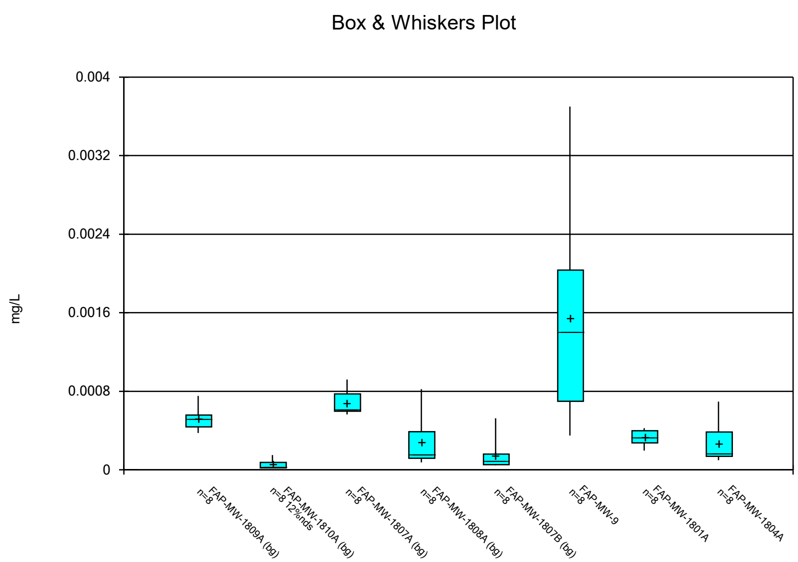
Constituent: Chromium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



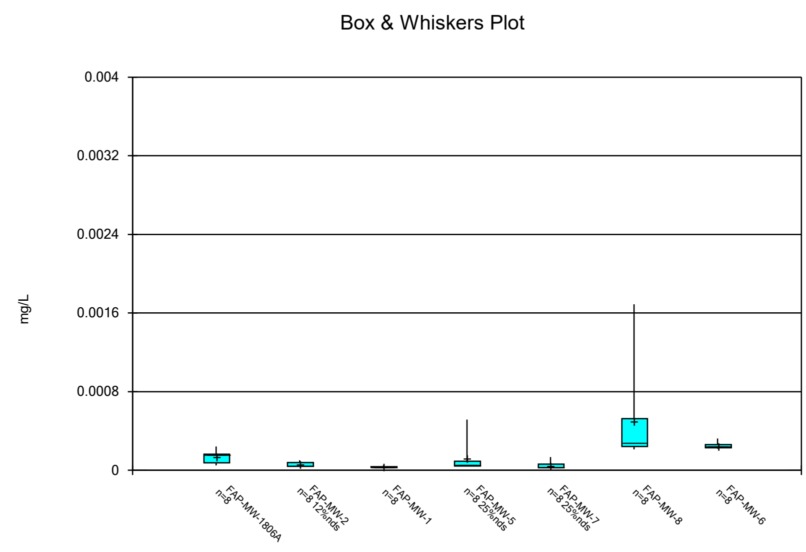
Constituent: Chromium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



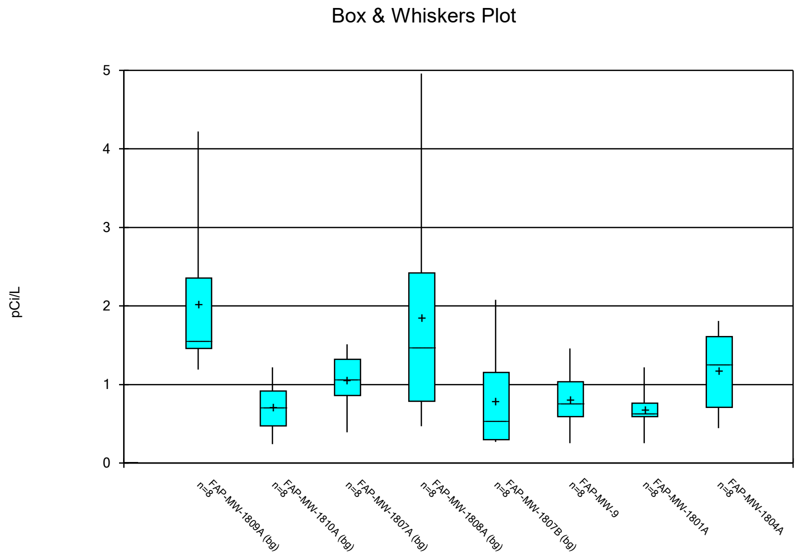
Constituent: Cobalt Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



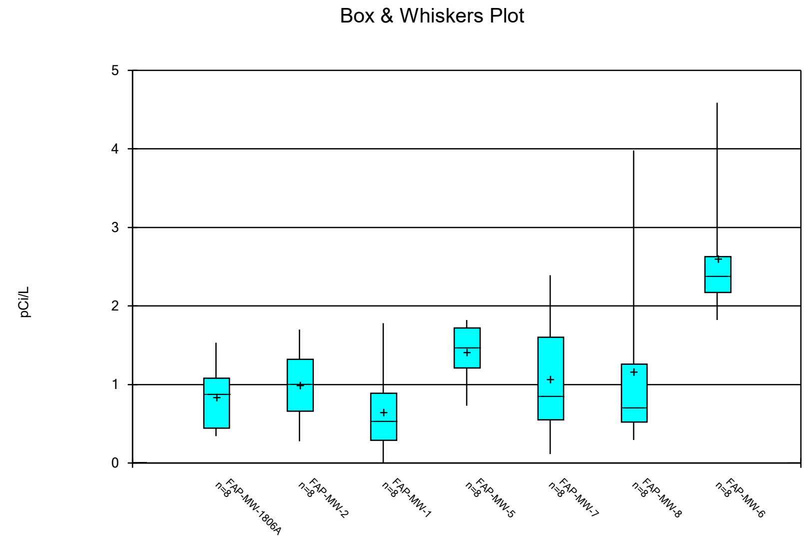
Constituent: Cobalt Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



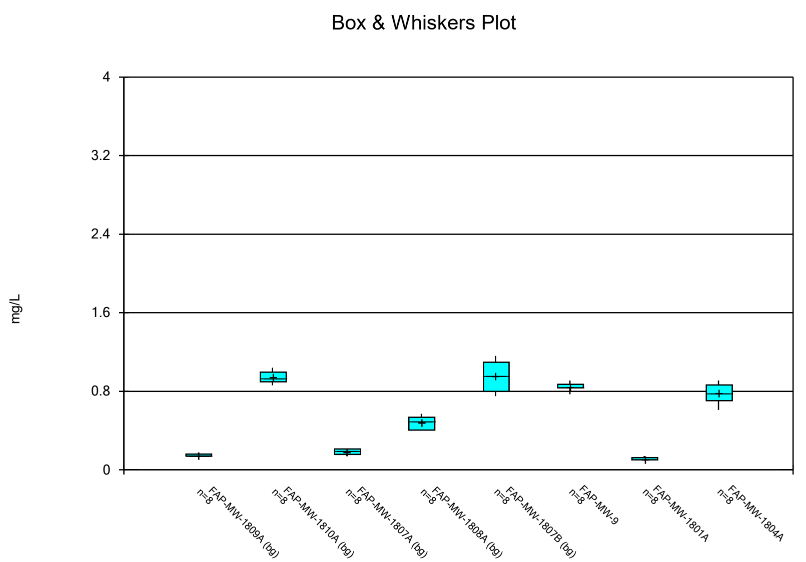
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



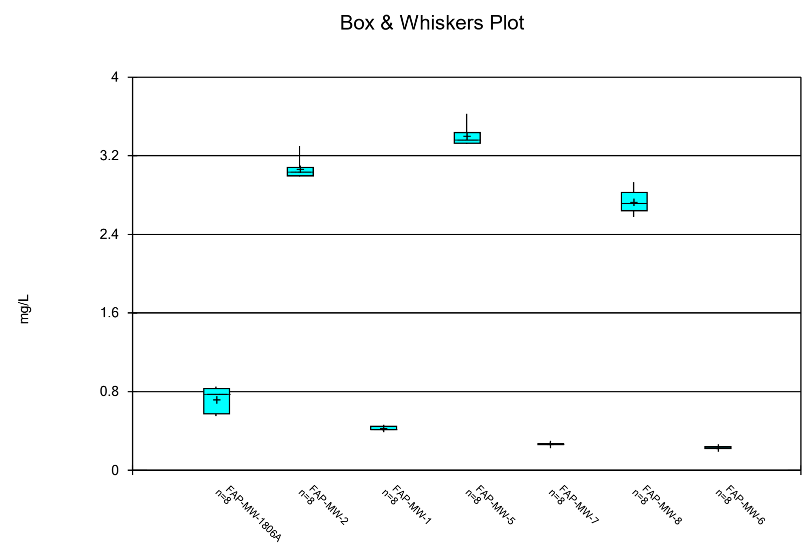
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

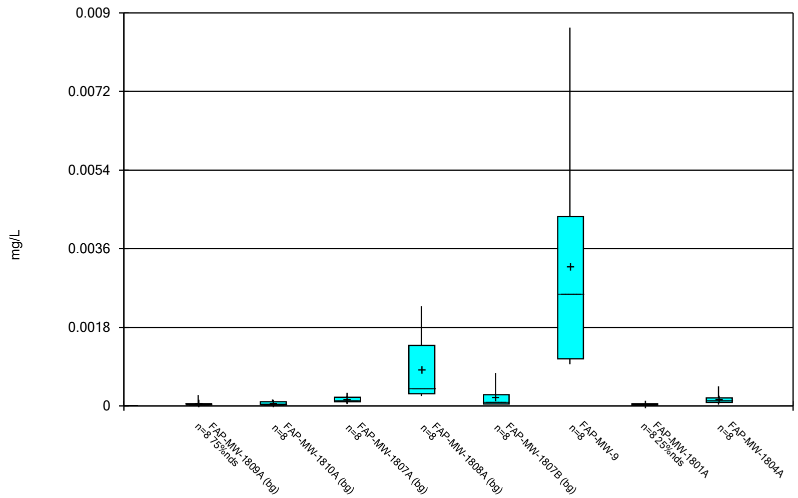
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

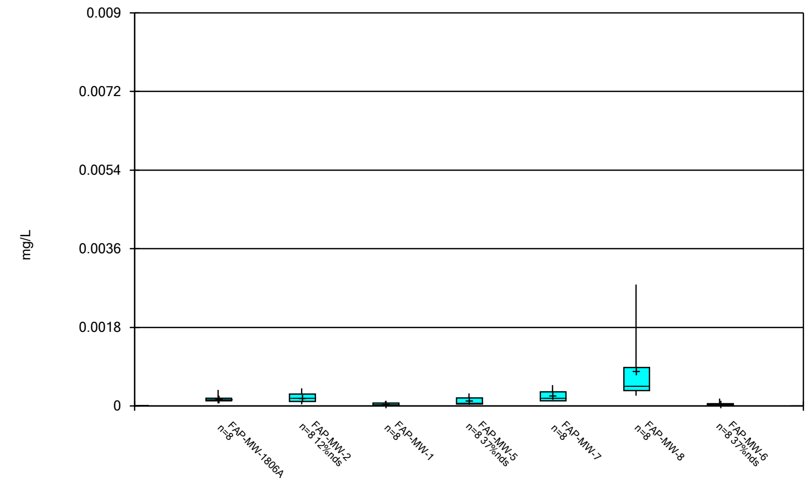
Box & Whiskers Plot



Constituent: Lead Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

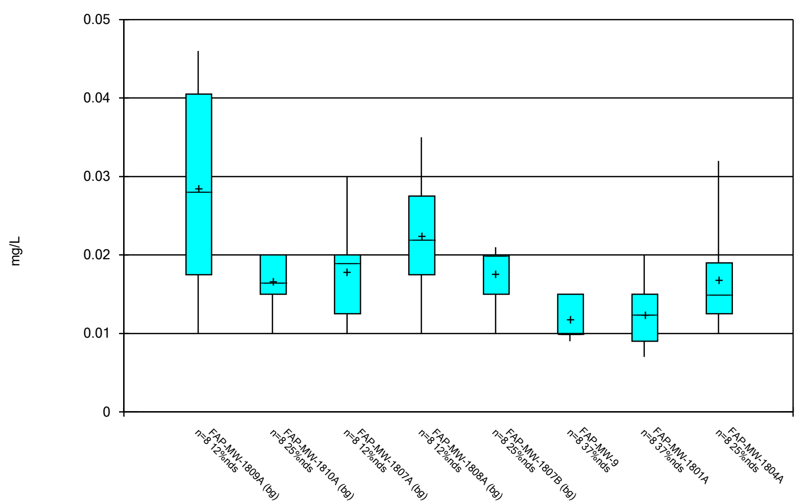
Box & Whiskers Plot



Constituent: Lead Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

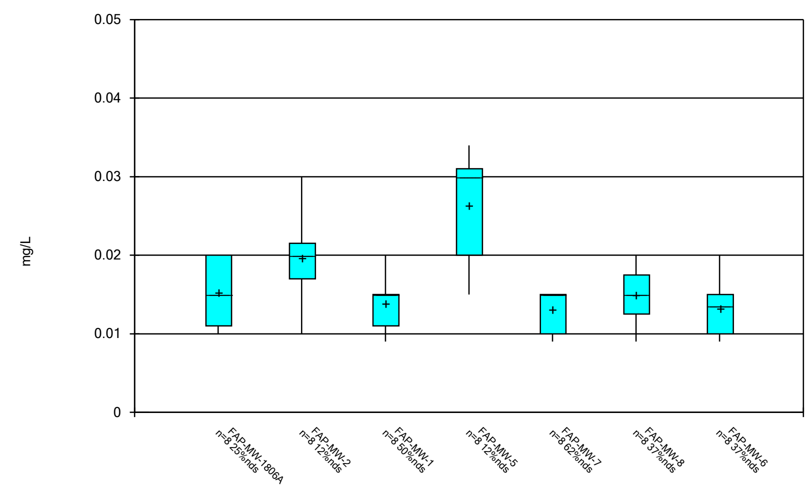
Box & Whiskers Plot



Constituent: Lithium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

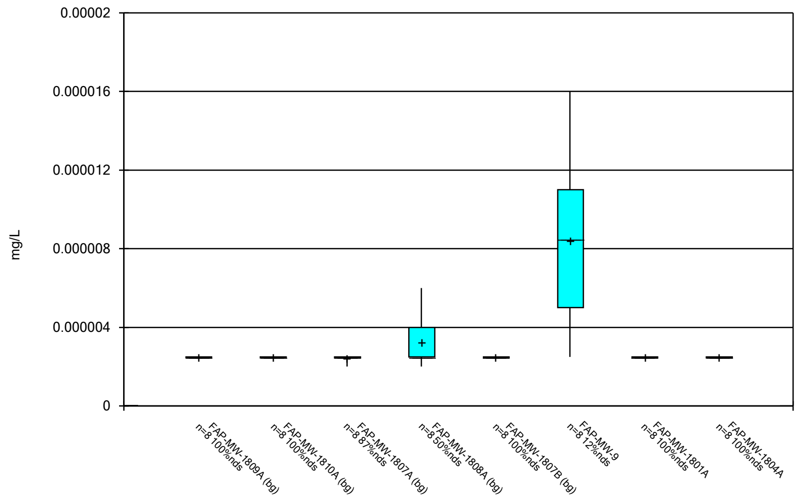
Box & Whiskers Plot



Constituent: Lithium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

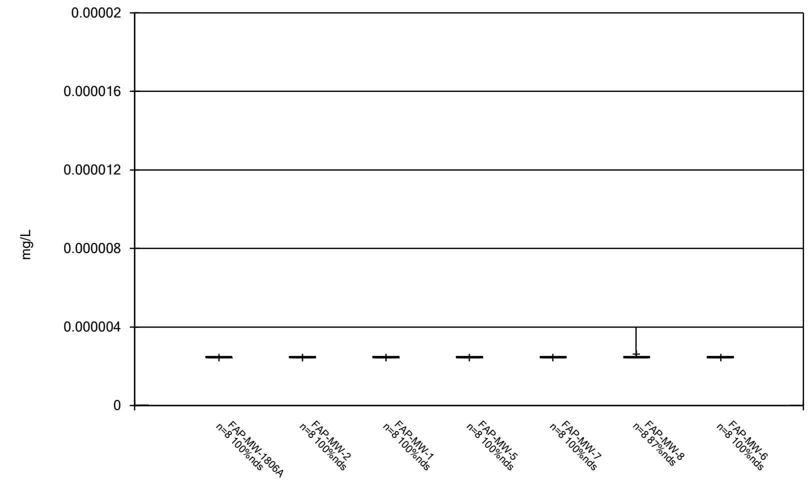
Box & Whiskers Plot



Constituent: Mercury Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

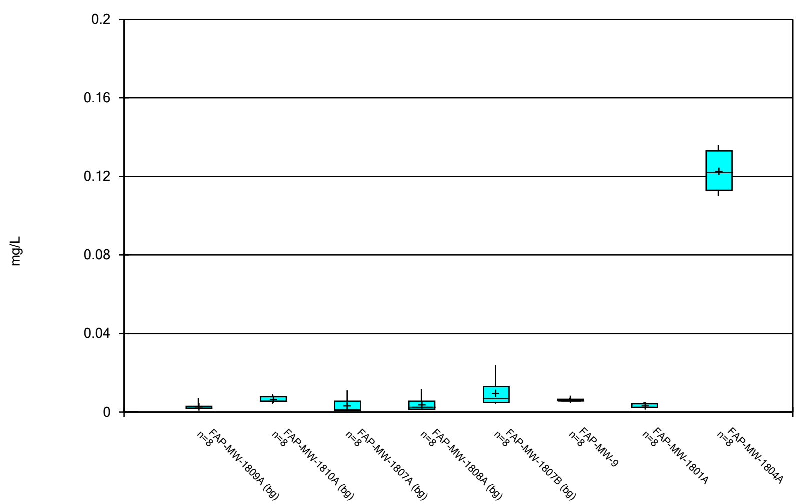
Box & Whiskers Plot



Constituent: Mercury Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

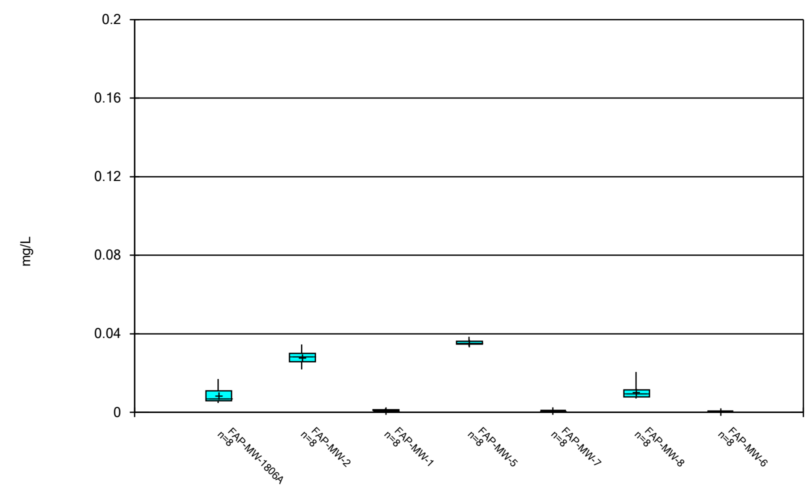
Box & Whiskers Plot



Constituent: Molybdenum Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

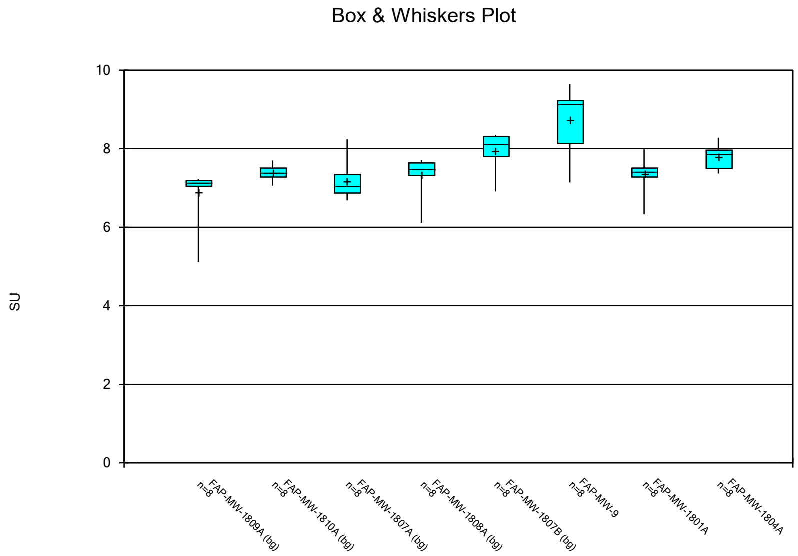
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



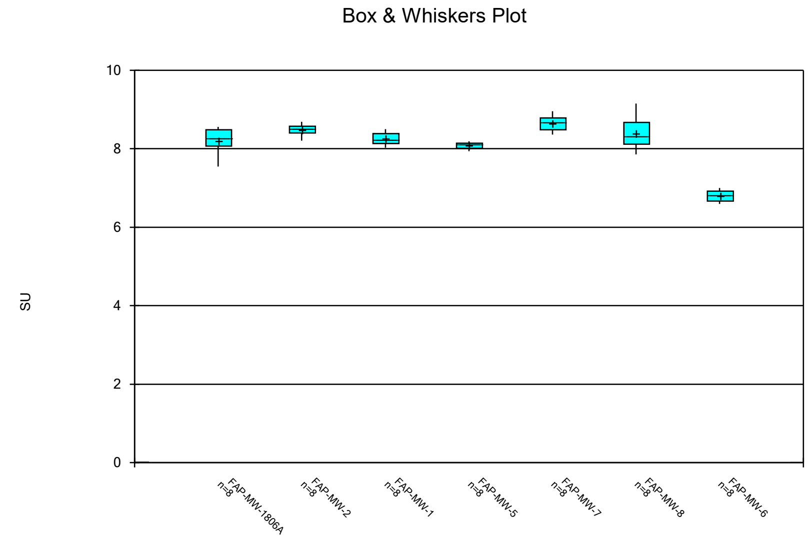
Constituent: Molybdenum Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



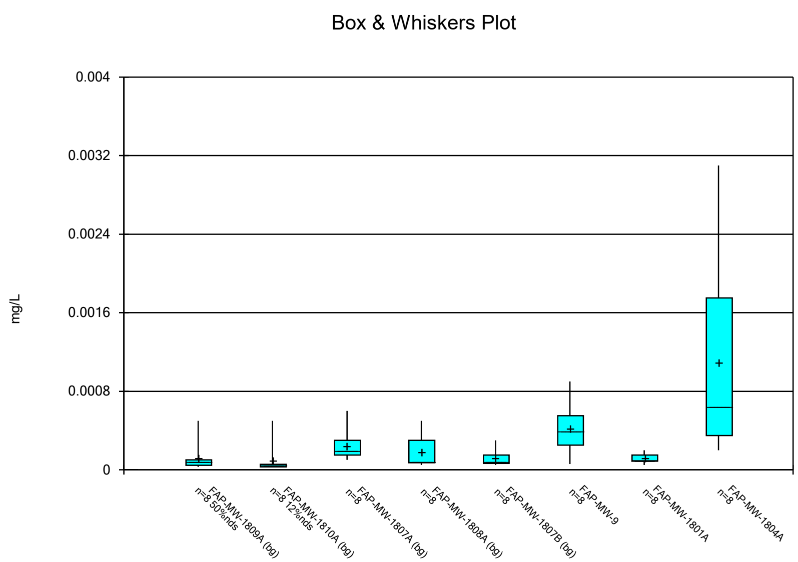
Constituent: pH Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



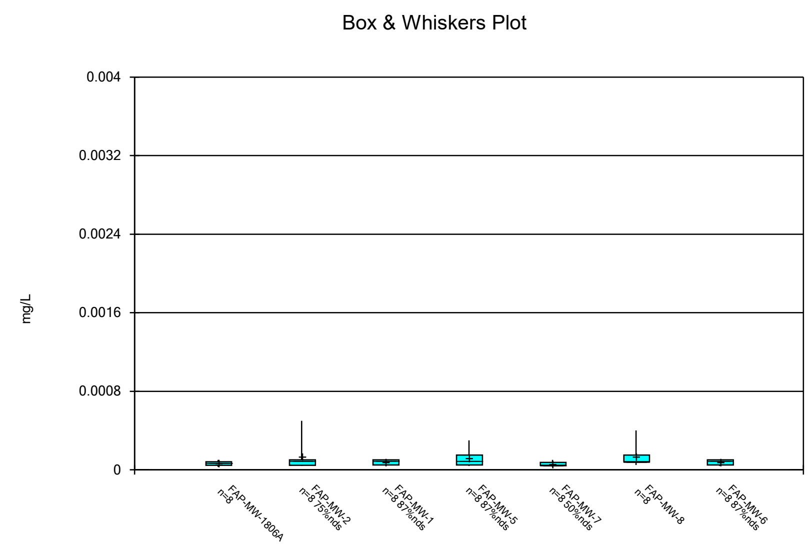
Constituent: pH Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Selenium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

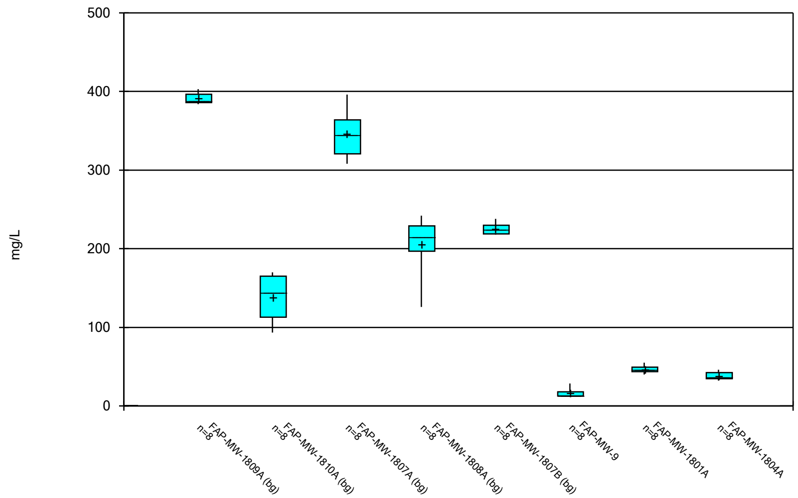
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Selenium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

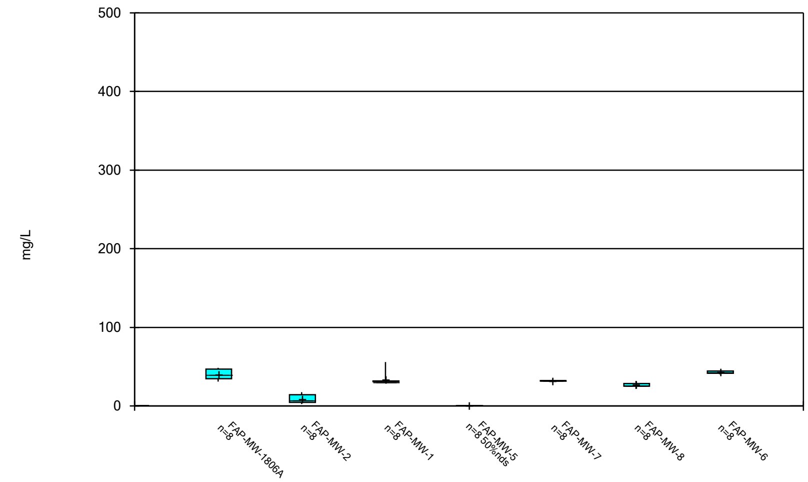
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

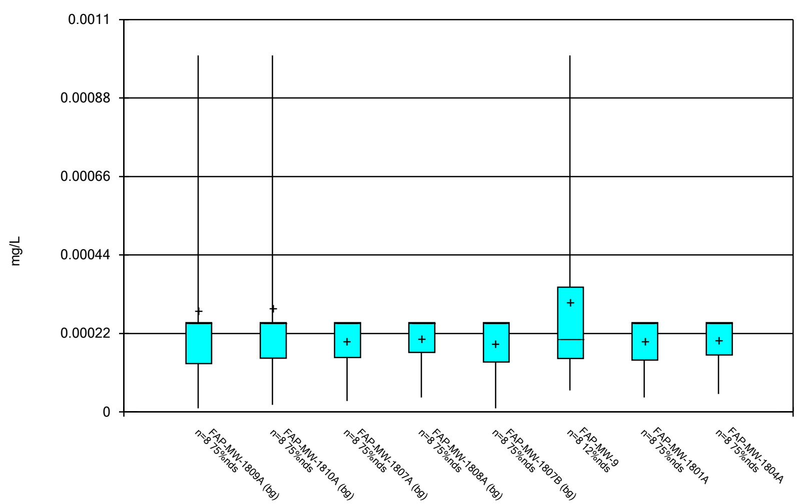
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

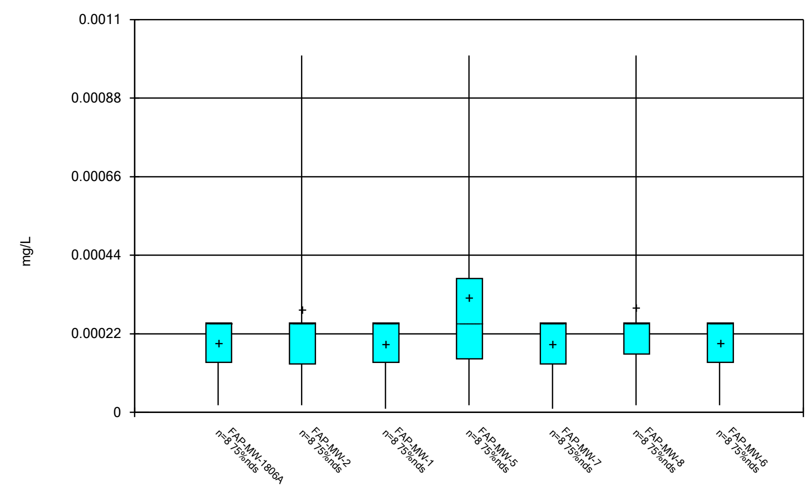
Box & Whiskers Plot



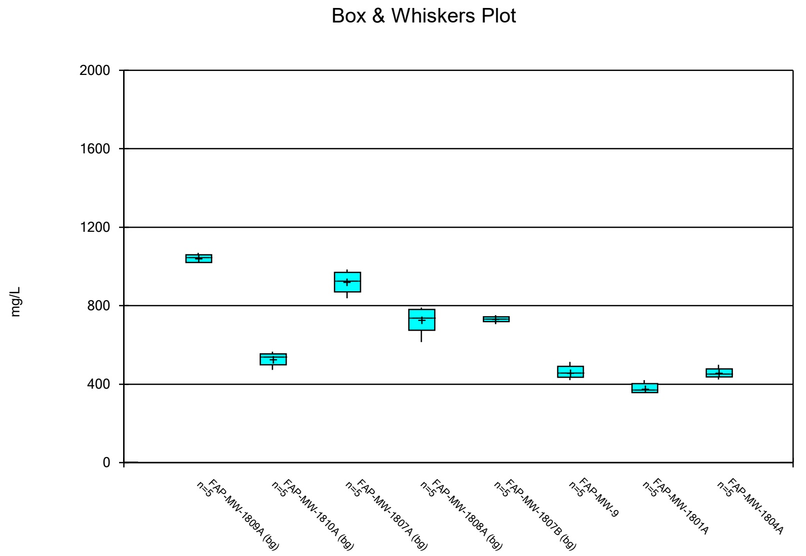
Constituent: Thallium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot

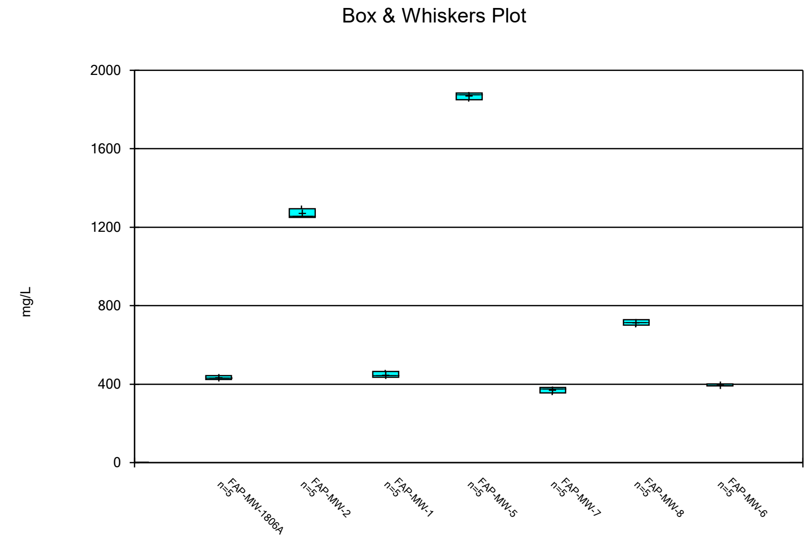


Constituent: Thallium Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Constituent: Total Dissolved Solids Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids Analysis Run 4/18/2019 10:20 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

FIGURE C: TUKEY'S OUTLIER TESTS

Outlier Analysis - Significant Results

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony (mg/L)	**FAP-MW-1810A (bg)**	**Yes**	**0.0005**	**NP**	**8**	**0.0001438**	**0.0001454**	**ln(x)**	**ShapiroWilk**
Antimony (mg/L)	**FAP-MW-1807A (bg)**	**Yes**	**0.00087**	**NP**	**8**	**0.0002325**	**0.0002597**	**ln(x)**	**ShapiroWilk**
Barium (mg/L)	**FAP-MW-1810A (bg)**	**Yes**	**0.124**	**NP**	**8**	**0.09029**	**0.01381**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	**FAP-MW-1806A**	**Yes**	**0.213**	**NP**	**8**	**0.1638**	**0.02273**	**ln(x)**	**ShapiroWilk**
Calcium (mg/L)	**FAP-MW-1808A (bg)**	**Yes**	**47.4**	**NP**	**8**	**40.79**	**2.851**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	**FAP-MW-1**	**Yes**	**14.6**	**NP**	**8**	**11.65**	**1.235**	**ln(x)**	**ShapiroWilk**
Chromium (mg/L)	**FAP-MW-1**	**Yes**	**0.000583**	**NP**	**8**	**0.0001525**	**0.0001742**	**ln(x)**	**ShapiroWilk**
pH (SU)	**FAP-MW-1809A (bg)**	**Yes**	**5.12**	**NP**	**8**	**6.885**	**0.7173**	**x^6**	**ShapiroWilk**
Selenium (mg/L)	**FAP-MW-1810A (bg)**	**Yes**	**0.001**	**NP**	**8**	**0.00016**	**0.0003396**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**FAP-MW-1**	**Yes**	**55.9**	**NP**	**8**	**34.25**	**8.764**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	**FAP-MW-7**	**Yes**	**33.2**	**NP**	**8**	**32.04**	**0.5097**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.0003263	0.0002399	ln(x)	ShapiroWilk
Antimony (mg/L)	**FAP-MW-1810A (bg)**	**Yes**	**0.0005**	**NP**	**8**	**0.0001438**	**0.0001454**	**ln(x)**	**ShapiroWilk**
Antimony (mg/L)	**FAP-MW-1807A (bg)**	**Yes**	**0.00087**	**NP**	**8**	**0.0002325**	**0.0002597**	**ln(x)**	**ShapiroWilk**
Antimony (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.00009625	0.00009117	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.0002413	0.000111	sqrt(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-9	No	n/a	NP	8	0.0006438	0.0003966	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.00008125	0.00003682	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.0002638	0.0001781	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.0003813	0.0004076	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-2	No	n/a	NP	8	0.0003263	0.0002401	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-1	No	n/a	NP	8	0.00006	0.00003586	x^(1/3)	ShapiroWilk
Antimony (mg/L)	FAP-MW-5	No	n/a	NP	8	0.00022	0.000119	normal	ShapiroWilk
Antimony (mg/L)	FAP-MW-7	No	n/a	NP	8	0.0001538	0.0001398	ln(x)	ShapiroWilk
Antimony (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0002888	0.0002506	x^(1/3)	ShapiroWilk
Antimony (mg/L)	FAP-MW-6	No	n/a	NP	8	0.00007125	0.00004051	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.003145	0.0006993	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.0005125	0.0001569	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.0009625	0.0001104	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.003121	0.001258	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.001571	0.0002975	normal	ShapiroWilk
Arsenic (mg/L)	FAP-MW-9	No	n/a	NP	8	0.005539	0.0008197	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.00096	0.0004309	sqrt(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.003468	0.0007616	x^2	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.004518	0.001173	x^2	ShapiroWilk
Arsenic (mg/L)	FAP-MW-2	No	n/a	NP	8	0.001524	0.0001916	x^6	ShapiroWilk
Arsenic (mg/L)	FAP-MW-1	No	n/a	NP	8	0.007691	0.0003777	x^6	ShapiroWilk
Arsenic (mg/L)	FAP-MW-5	No	n/a	NP	8	0.004691	0.0003713	x^5	ShapiroWilk
Arsenic (mg/L)	FAP-MW-7	No	n/a	NP	8	0.005405	0.0002489	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-8	No	n/a	NP	8	0.003809	0.001152	ln(x)	ShapiroWilk
Arsenic (mg/L)	FAP-MW-6	No	n/a	NP	8	0.001835	0.0001686	x^2	ShapiroWilk
Barium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.06063	0.004548	x^3	ShapiroWilk
Barium (mg/L)	**FAP-MW-1810A (bg)**	**Yes**	**0.124**	**NP**	**8**	**0.09029**	**0.01381**	**ln(x)**	**ShapiroWilk**
Barium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.02911	0.002811	x^2	ShapiroWilk
Barium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.08248	0.01051	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.0541	0.01211	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.04725	0.008794	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.05356	0.00337	x^6	ShapiroWilk
Barium (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.1966	0.08892	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.1095	0.04334	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-2	No	n/a	NP	8	0.1834	0.00997	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-1	No	n/a	NP	8	0.04844	0.003641	x^6	ShapiroWilk
Barium (mg/L)	FAP-MW-5	No	n/a	NP	8	0.3585	0.007964	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-7	No	n/a	NP	8	0.03431	0.001732	ln(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.07156	0.008329	sqrt(x)	ShapiroWilk
Barium (mg/L)	FAP-MW-6	No	n/a	NP	8	0.5103	0.02051	x^6	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.000376	0.0002296	ln(x)	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1810A (bg)	n/a	n/a	NP	8	0.0004386	0.0001736	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.00007637	0.00004375	ln(x)	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.000109	0.0001054	ln(x)	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.00008487	0.00002846	x^(1/3)	ShapiroWilk
Beryllium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.0001876	0.0002012	x^(1/3)	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1801A	n/a	n/a	NP	8	0.0001	0	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1804A	n/a	n/a	NP	8	0.0000885	0.00003253	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-1806A	n/a	n/a	NP	8	0.00008875	0.00003182	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-2	n/a	n/a	NP	8	0.0004385	0.0001739	unknown	ShapiroWilk

Outlier Analysis - All Results

Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Beryllium (mg/L)	FAP-MW-1	n/a	n/a	NP	8	0.0001	0	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-5	n/a	n/a	NP	8	0.000263	0.0001047	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-7	n/a	n/a	NP	8	0.00009125	0.00002475	unknown	ShapiroWilk
Beryllium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0003818	0.0002193	x^(1/3)	ShapiroWilk
Beryllium (mg/L)	FAP-MW-6	No	n/a	NP	8	0.00006837	0.00004415	x^(1/3)	ShapiroWilk
Boron (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.08625	0.01507	normal	ShapiroWilk
Boron (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.2449	0.03627	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.1601	0.04237	x^3	ShapiroWilk
Boron (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.1476	0.02746	x^2	ShapiroWilk
Boron (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.1963	0.03653	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-9	No	n/a	NP	8	0.1391	0.01684	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.1984	0.08327	x^(1/3)	ShapiroWilk
Boron (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.7071	0.08232	ln(x)	ShapiroWilk
Boron (mg/L)	**FAP-MW-1806A**	**Yes**	**0.213**	**NP**	**8**	**0.1638**	**0.02273**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	FAP-MW-2	No	n/a	NP	8	0.2668	0.03688	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-1	No	n/a	NP	8	0.1503	0.03518	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-5	No	n/a	NP	8	0.258	0.03107	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-7	No	n/a	NP	8	0.1155	0.04212	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-8	No	n/a	NP	8	0.2351	0.02698	ln(x)	ShapiroWilk
Boron (mg/L)	FAP-MW-6	No	n/a	NP	8	0.099	0.0191	normal	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1809A (bg)	n/a	n/a	NP	8	0.0002	0	unknown	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1810A (bg)	n/a	n/a	NP	8	0.0002	0	unknown	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.000035	0.00001309	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.00003962	0.00001923	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1807B (bg)	n/a	n/a	NP	8	0.000045	0.00001414	unknown	ShapiroWilk
Cadmium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.0001	0.000119	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.00003875	0.00001642	sqrt(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1804A	n/a	n/a	NP	8	0.00005	0	unknown	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.00003975	0.00001899	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-2	No	n/a	NP	8	0.0001562	0.00008105	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-1	n/a	n/a	NP	8	0.00004475	0.00001485	unknown	ShapiroWilk
Cadmium (mg/L)	FAP-MW-5	No	n/a	NP	8	0.000152	0.00008889	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-7	No	n/a	NP	8	0.00002875	0.00001808	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0001587	0.0000768	ln(x)	ShapiroWilk
Cadmium (mg/L)	FAP-MW-6	No	n/a	NP	8	0.00003125	0.00002031	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	183.3	5.8	x^6	ShapiroWilk
Calcium (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	27.25	3.41	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	150.5	8.976	ln(x)	ShapiroWilk
Calcium (mg/L)	**FAP-MW-1808A (bg)**	**Yes**	**47.4**	**NP**	**8**	**40.79**	**2.851**	**ln(x)**	**ShapiroWilk**
Calcium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	9.51	1.152	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-9	No	n/a	NP	8	1.14	0.156	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	60.69	4.698	x^6	ShapiroWilk
Calcium (mg/L)	FAP-MW-1804A	No	n/a	NP	8	16.78	10.99	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	8.583	3.249	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-2	No	n/a	NP	8	3.998	0.2101	ln(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-1	No	n/a	NP	8	2.666	0.29	x^6	ShapiroWilk
Calcium (mg/L)	FAP-MW-5	No	n/a	NP	8	6.703	0.3478	x^6	ShapiroWilk
Calcium (mg/L)	FAP-MW-7	No	n/a	NP	8	1.371	0.08167	x^4	ShapiroWilk
Calcium (mg/L)	FAP-MW-8	No	n/a	NP	8	2.353	0.227	sqrt(x)	ShapiroWilk
Calcium (mg/L)	FAP-MW-6	No	n/a	NP	8	59.19	3.638	x^2	ShapiroWilk
Chloride (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	27.84	1.338	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	18.85	2.689	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	10.96	1.101	x^2	ShapiroWilk
Chloride (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	18.56	1.606	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	9.093	1.103	ln(x)	ShapiroWilk

Outlier Analysis - All Results

Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Chloride (mg/L)	FAP-MW-9	No	n/a	NP	8	7.355	0.2072	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-1801A	No	n/a	NP	8	9.143	1.022	normal	ShapiroWilk
Chloride (mg/L)	FAP-MW-1804A	No	n/a	NP	8	4.228	0.8638	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-1806A	No	n/a	NP	8	10.14	4.628	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-2	No	n/a	NP	8	446.8	15.24	ln(x)	ShapiroWilk
Chloride (mg/L)	**FAP-MW-1**	**Yes**	**14.6**	**NP**	**8**	**11.65**	**1.235**	**ln(x)**	**ShapiroWilk**
Chloride (mg/L)	FAP-MW-5	No	n/a	NP	8	793.8	18.97	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-7	No	n/a	NP	8	5.355	0.143	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-8	No	n/a	NP	8	109.8	3.196	ln(x)	ShapiroWilk
Chloride (mg/L)	FAP-MW-6	No	n/a	NP	8	18.58	0.913	x^4	ShapiroWilk
Chromium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.0001701	0.0001443	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.0001939	0.0001273	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.0001811	0.0001093	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.0005408	0.0003399	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.0003675	0.0004312	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.001779	0.001397	x^(1/3)	ShapiroWilk
Chromium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.000097	0.00002313	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.0001736	0.00007119	normal	ShapiroWilk
Chromium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.0003485	0.0004947	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-2	No	n/a	NP	8	0.0003613	0.0002728	ln(x)	ShapiroWilk
Chromium (mg/L)	**FAP-MW-1**	**Yes**	**0.000583**	**NP**	**8**	**0.0001525**	**0.0001742**	**ln(x)**	**ShapiroWilk**
Chromium (mg/L)	FAP-MW-5	No	n/a	NP	8	0.0002721	0.000202	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-7	No	n/a	NP	8	0.0001449	0.0000813	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.00047	0.0005849	ln(x)	ShapiroWilk
Chromium (mg/L)	FAP-MW-6	No	n/a	NP	8	0.0001718	0.0002117	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.0005189	0.0001156	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.00005225	0.00004775	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.0006831	0.0001259	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.0002771	0.0002647	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.0001471	0.0001601	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-9	No	n/a	NP	8	0.001542	0.001085	sqrt(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.0003294	0.00007873	x^2	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.0002714	0.000208	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.0001345	0.0000629	normal	ShapiroWilk
Cobalt (mg/L)	FAP-MW-2	No	n/a	NP	8	0.00005887	0.00002687	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-1	No	n/a	NP	8	0.00003375	0.000007265	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-5	No	n/a	NP	8	0.0001225	0.000161	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-7	No	n/a	NP	8	0.00005	0.00003771	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0004986	0.0004978	ln(x)	ShapiroWilk
Cobalt (mg/L)	FAP-MW-6	No	n/a	NP	8	0.0002486	0.0000337	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	2.02	1.043	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.7074	0.3193	normal	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	1.051	0.3606	x^2	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	1.848	1.487	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.79	0.6477	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-9	No	n/a	NP	8	0.8083	0.3769	sqrt(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1801A	No	n/a	NP	8	0.6799	0.2725	sqrt(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1804A	No	n/a	NP	8	1.175	0.5199	x^2	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1806A	No	n/a	NP	8	0.8351	0.4085	sqrt(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-2	No	n/a	NP	8	0.9934	0.458	normal	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-1	No	n/a	NP	8	0.6505	0.5593	sqrt(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-5	No	n/a	NP	8	1.421	0.374	x^3	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-7	No	n/a	NP	8	1.063	0.7688	sqrt(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-8	No	n/a	NP	8	1.157	1.205	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	FAP-MW-6	No	n/a	NP	8	2.598	0.8502	ln(x)	ShapiroWilk

Outlier Analysis - All Results

Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Fluoride (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.15	0.01195	x^2	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.9425	0.06228	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.1838	0.02925	x^3	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.4788	0.06896	x^4	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.9525	0.1599	normal	ShapiroWilk
Fluoride (mg/L)	FAP-MW-9	No	n/a	NP	8	0.8488	0.04051	x^6	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.1125	0.01581	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.7775	0.1019	x^2	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.7225	0.1321	x^6	ShapiroWilk
Fluoride (mg/L)	FAP-MW-2	No	n/a	NP	8	3.066	0.1017	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-1	No	n/a	NP	8	0.4275	0.01832	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-5	No	n/a	NP	8	3.403	0.1025	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-7	No	n/a	NP	8	0.2675	0.01165	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-8	No	n/a	NP	8	2.735	0.1209	ln(x)	ShapiroWilk
Fluoride (mg/L)	FAP-MW-6	No	n/a	NP	8	0.2288	0.01126	x^2	ShapiroWilk
Lead (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.0001931	0.0001055	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.00006825	0.00004172	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.0001473	0.00008514	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.0008293	0.0008433	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.0002011	0.0002441	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-9	No	n/a	NP	8	0.003196	0.002643	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.00003825	0.00001216	normal	ShapiroWilk
Lead (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.0001554	0.0001303	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.000163	0.00009175	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-2	No	n/a	NP	8	0.0001961	0.0001197	sqrt(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-1	No	n/a	NP	8	0.00004988	0.0000305	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-5	No	n/a	NP	8	0.0001345	0.00009112	normal	ShapiroWilk
Lead (mg/L)	FAP-MW-7	No	n/a	NP	8	0.0002269	0.0001449	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0008005	0.0008372	ln(x)	ShapiroWilk
Lead (mg/L)	FAP-MW-6	No	n/a	NP	8	0.00005212	0.00004819	ln(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.03037	0.01212	normal	ShapiroWilk
Lithium (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.02037	0.006844	x^(1/3)	ShapiroWilk
Lithium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.01975	0.007592	normal	ShapiroWilk
Lithium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.02425	0.00776	x^2	ShapiroWilk
Lithium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.02137	0.006391	normal	ShapiroWilk
Lithium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.01737	0.01046	ln(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.01812	0.01058	ln(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.02062	0.009023	x^(1/3)	ShapiroWilk
Lithium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.019	0.008071	sqrt(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-2	No	n/a	NP	8	0.0215	0.006459	normal	ShapiroWilk
Lithium (mg/L)	FAP-MW-1	No	n/a	NP	8	0.02137	0.009782	ln(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-5	No	n/a	NP	8	0.02825	0.005285	x^6	ShapiroWilk
Lithium (mg/L)	FAP-MW-7	No	n/a	NP	8	0.02237	0.01053	ln(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0205	0.008718	ln(x)	ShapiroWilk
Lithium (mg/L)	FAP-MW-6	No	n/a	NP	8	0.01887	0.009819	ln(x)	ShapiroWilk
Mercury (mg/L)	FAP-MW-1809A (bg)	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-1810A (bg)	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-1807A (bg)	n/a	n/a	NP	8	0.000004625	0.000001061	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-1808A (bg)	n/a	n/a	NP	8	0.0000045	0.000001309	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-1807B (bg)	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-9	No	n/a	NP	8	0.00000875	0.000003955	ln(x)	ShapiroWilk
Mercury (mg/L)	FAP-MW-1801A	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-1804A	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-1806A	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-2	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk

Outlier Analysis - All Results

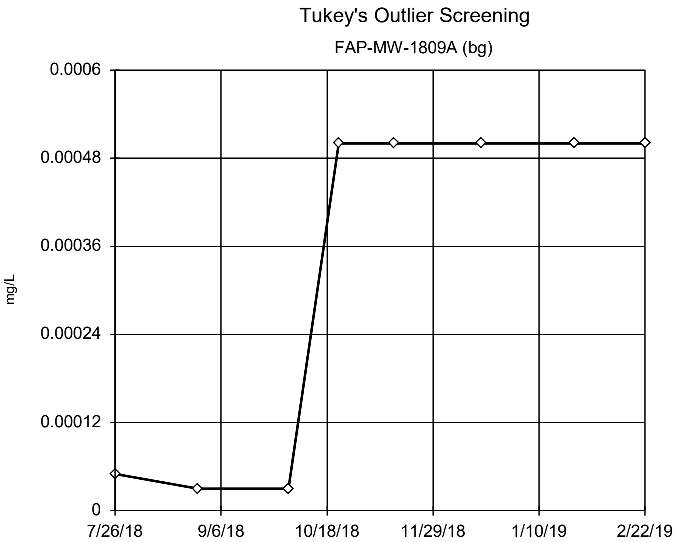
Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Mercury (mg/L)	FAP-MW-1	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-5	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-7	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-8	n/a	n/a	NP	8	0.000004875	3.5e-7	unknown	ShapiroWilk
Mercury (mg/L)	FAP-MW-6	n/a	n/a	NP	8	0.000005	0	unknown	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.002918	0.001771	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.006541	0.001708	x^(1/3)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.003553	0.004099	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.004066	0.003587	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.009851	0.006736	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-9	No	n/a	NP	8	0.006331	0.000452	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.003226	0.001131	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.1229	0.01101	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.008676	0.004443	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-2	No	n/a	NP	8	0.02805	0.003792	sqrt(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-1	No	n/a	NP	8	0.001178	0.0003509	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-5	No	n/a	NP	8	0.03548	0.001444	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-7	No	n/a	NP	8	0.001023	0.00004464	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-8	No	n/a	NP	8	0.0106	0.004374	ln(x)	ShapiroWilk
Molybdenum (mg/L)	FAP-MW-6	No	n/a	NP	8	0.00061	0.00006503	x^(1/3)	ShapiroWilk
pH (SU)	**FAP-MW-1809A (bg)**	**Yes**	**5.12**	**NP**	**8**	**6.885**	**0.7173**	**x^6**	**ShapiroWilk**
pH (SU)	FAP-MW-1810A (bg)	No	n/a	NP	8	7.39	0.1929	x^3	ShapiroWilk
pH (SU)	FAP-MW-1807A (bg)	No	n/a	NP	8	7.181	0.4982	ln(x)	ShapiroWilk
pH (SU)	FAP-MW-1808A (bg)	No	n/a	NP	8	7.343	0.5245	x^6	ShapiroWilk
pH (SU)	FAP-MW-1807B (bg)	No	n/a	NP	8	7.968	0.4824	x^6	ShapiroWilk
pH (SU)	FAP-MW-9	No	n/a	NP	8	8.724	0.8413	x^6	ShapiroWilk
pH (SU)	FAP-MW-1801A	No	n/a	NP	8	7.345	0.4707	x^6	ShapiroWilk
pH (SU)	FAP-MW-1804A	No	n/a	NP	8	7.79	0.3147	x^4	ShapiroWilk
pH (SU)	FAP-MW-1806A	No	n/a	NP	8	8.219	0.3396	x^6	ShapiroWilk
pH (SU)	FAP-MW-2	No	n/a	NP	8	8.485	0.1476	x^6	ShapiroWilk
pH (SU)	FAP-MW-1	No	n/a	NP	8	8.255	0.1656	ln(x)	ShapiroWilk
pH (SU)	FAP-MW-5	No	n/a	NP	8	8.081	0.08839	x^6	ShapiroWilk
pH (SU)	FAP-MW-7	No	n/a	NP	8	8.654	0.203	x^3	ShapiroWilk
pH (SU)	FAP-MW-8	No	n/a	NP	8	8.405	0.4332	ln(x)	ShapiroWilk
pH (SU)	FAP-MW-6	No	n/a	NP	8	6.805	0.1462	x^6	ShapiroWilk
Selenium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.0005225	0.0005105	ln(x)	ShapiroWilk
Selenium (mg/L)	**FAP-MW-1810A (bg)**	**Yes**	**0.001**	**NP**	**8**	**0.00016**	**0.0003396**	**ln(x)**	**ShapiroWilk**
Selenium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.00025	0.0001604	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.0001825	0.0001733	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.0001175	0.0000873	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.00042	0.000257	sqrt(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.0001163	0.00005423	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.0011	0.001017	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.00006375	0.00002387	sqrt(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-2	No	n/a	NP	8	0.00076	0.0004444	x^2	ShapiroWilk
Selenium (mg/L)	FAP-MW-1	n/a	n/a	NP	8	0.0001812	0.00005303	unknown	ShapiroWilk
Selenium (mg/L)	FAP-MW-5	n/a	n/a	NP	8	0.00053	0.000198	unknown	ShapiroWilk
Selenium (mg/L)	FAP-MW-7	No	n/a	NP	8	0.0001212	0.00008442	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.000135	0.0001159	ln(x)	ShapiroWilk
Selenium (mg/L)	FAP-MW-6	n/a	n/a	NP	8	0.00018	0.00005657	unknown	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	391.3	7.536	ln(x)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	138.5	30.15	x^(1/3)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	345.4	29.79	ln(x)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	206.1	36.67	x^6	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	225.1	7.259	ln(x)	ShapiroWilk

Outlier Analysis - All Results

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 5:07 AM

Constituent	Well	Outlier	Value(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Sulfate (mg/L)	FAP-MW-9	No	n/a	NP	8	15.84	5.801	ln(x)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1801A	No	n/a	NP	8	46.73	4.631	ln(x)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1804A	No	n/a	NP	8	38.09	5.039	ln(x)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-1806A	No	n/a	NP	8	40.39	6.689	sqrt(x)	ShapiroWilk
Sulfate (mg/L)	FAP-MW-2	No	n/a	NP	8	8.825	5.716	sqrt(x)	ShapiroWilk
Sulfate (mg/L)	**FAP-MW-1**	**Yes**	**55.9**	**NP**	**8**	**34.25**	**8.764**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	FAP-MW-5	No	n/a	NP	8	0.175	0.04629	x^6	ShapiroWilk
Sulfate (mg/L)	**FAP-MW-7**	**Yes**	**33.2**	**NP**	**8**	**32.04**	**0.5097**	**ln(x)**	**ShapiroWilk**
Sulfate (mg/L)	FAP-MW-8	No	n/a	NP	8	26.73	3.126	normal	ShapiroWilk
Sulfate (mg/L)	FAP-MW-6	No	n/a	NP	8	42.8	1.659	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	8	0.001504	0.0009189	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	8	0.001509	0.0009094	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	8	0.0003855	0.0002121	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	8	0.0003904	0.0002033	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	8	0.00038	0.0002223	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-9	No	n/a	NP	8	0.0004336	0.0006418	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1801A	No	n/a	NP	8	0.000385	0.0002129	sqrt(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1804A	No	n/a	NP	8	0.0003899	0.000204	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-1806A	No	n/a	NP	8	0.0003813	0.0002199	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-2	No	n/a	NP	8	0.001505	0.0009166	normal	ShapiroWilk
Thallium (mg/L)	FAP-MW-1	No	n/a	NP	8	0.00038	0.0002223	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-5	No	n/a	NP	8	0.001509	0.0009097	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-7	No	n/a	NP	8	0.0003788	0.0002245	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-8	No	n/a	NP	8	0.001512	0.0009037	ln(x)	ShapiroWilk
Thallium (mg/L)	FAP-MW-6	No	n/a	NP	8	0.0003813	0.0002199	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1809A (bg)	No	n/a	NP	5	1042	21.68	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1810A (bg)	No	n/a	NP	5	529.8	34.78	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1807A (bg)	No	n/a	NP	5	921.8	55.59	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1808A (bg)	No	n/a	NP	5	729.6	68.5	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1807B (bg)	No	n/a	NP	5	731.4	16.46	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-9	No	n/a	NP	5	462.2	33.51	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1801A	No	n/a	NP	5	378.2	26.4	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1804A	No	n/a	NP	5	456.6	26.87	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1806A	No	n/a	NP	5	434.2	9.628	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-2	No	n/a	NP	5	1270	25.5	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-1	No	n/a	NP	5	448.6	16.47	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-5	No	n/a	NP	5	1870	20	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-7	No	n/a	NP	5	370.8	16.45	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-8	No	n/a	NP	5	714.8	15.69	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	FAP-MW-6	No	n/a	NP	5	396.4	5.177	x^6	ShapiroWilk



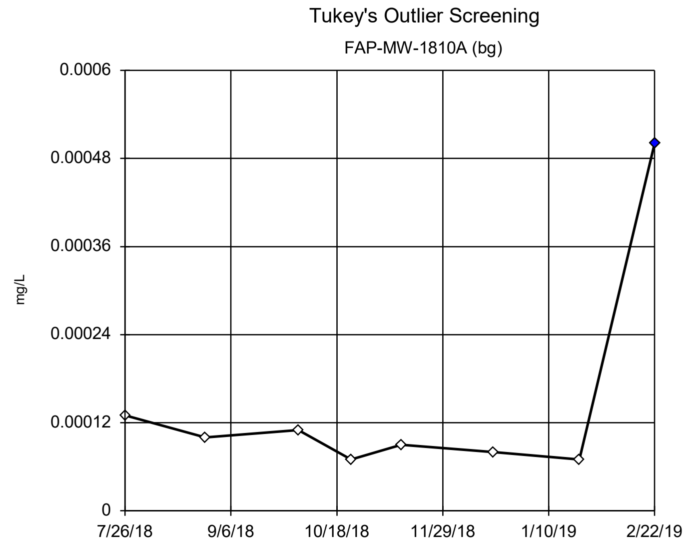
n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.076, low cutoff = 1.8e-8, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



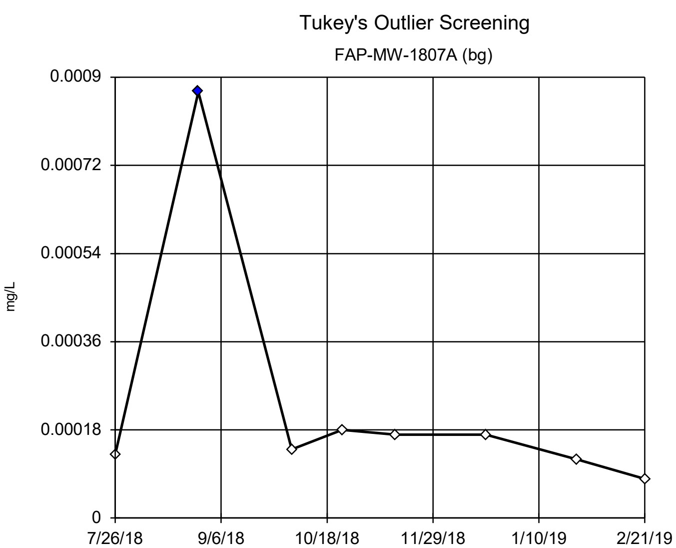
n = 8

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.000488, low cutoff = 0.00001834, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



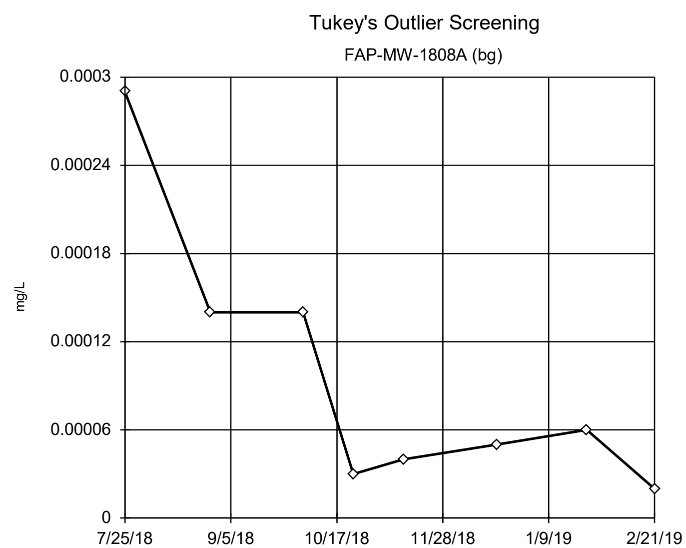
n = 8

Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0004806, low cutoff = 0.00004546, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



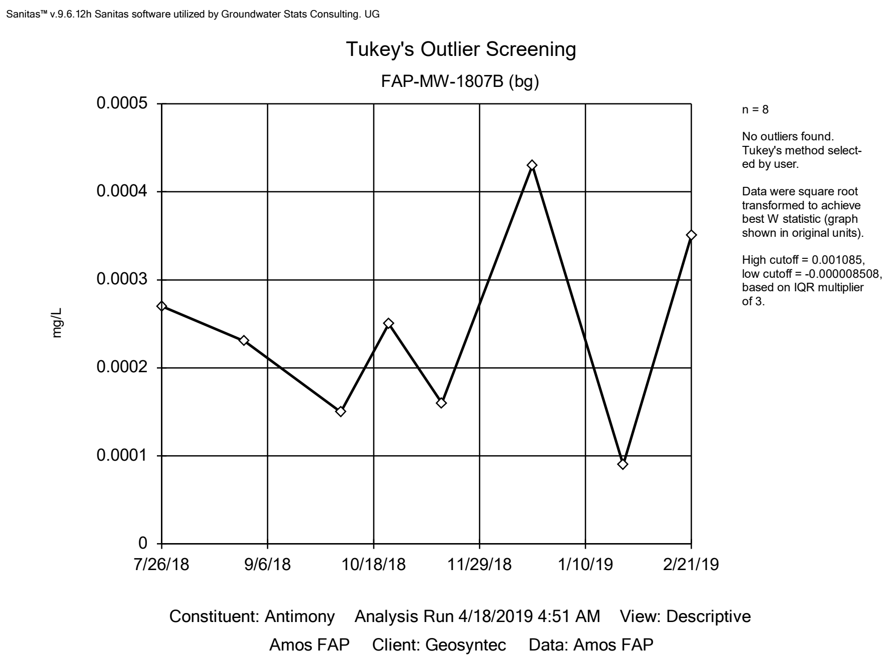
n = 8

No outliers found. Tukey's method selected by user.

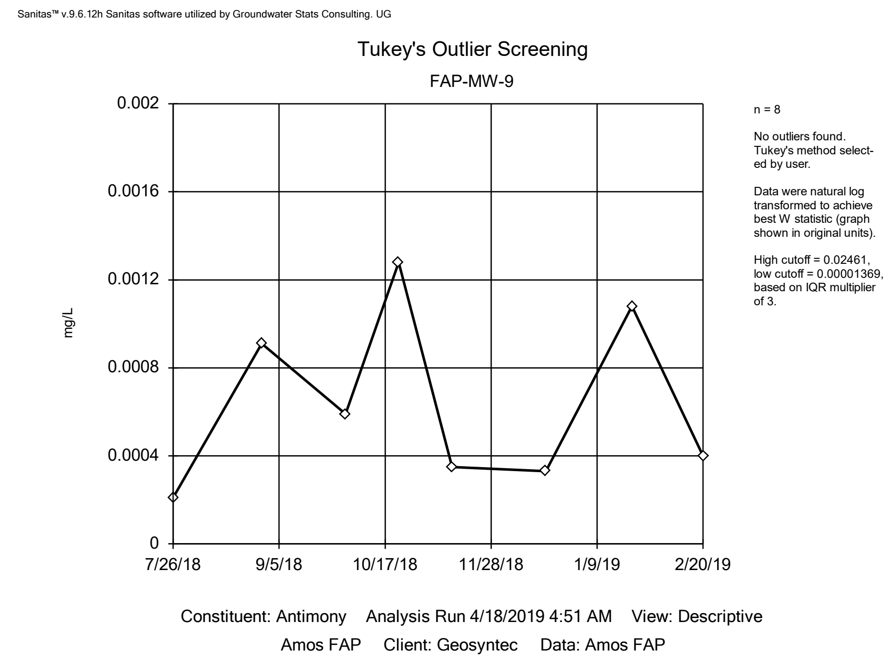
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.009241, low cutoff = 5.2e-7, based on IQR multiplier of 3.

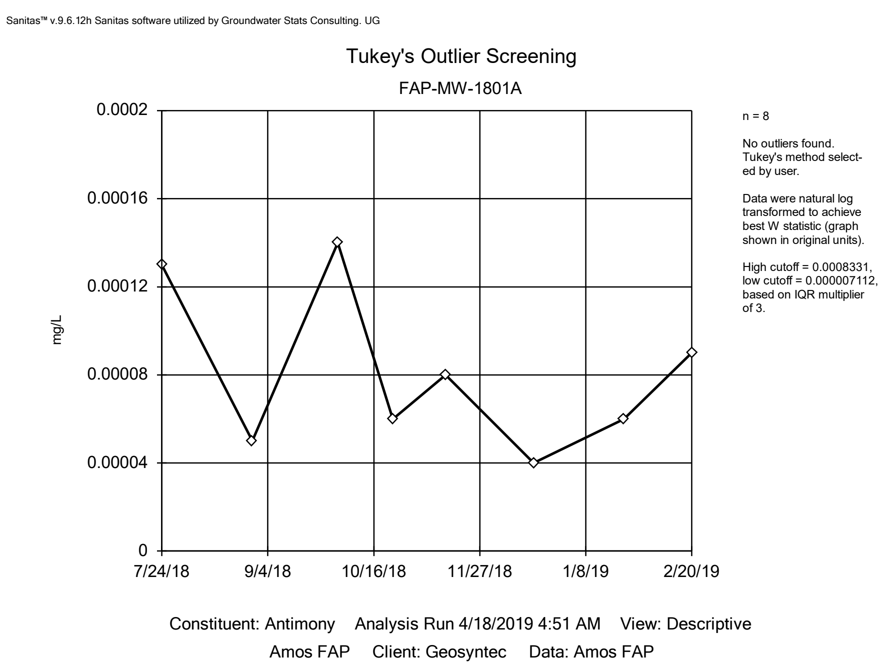
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



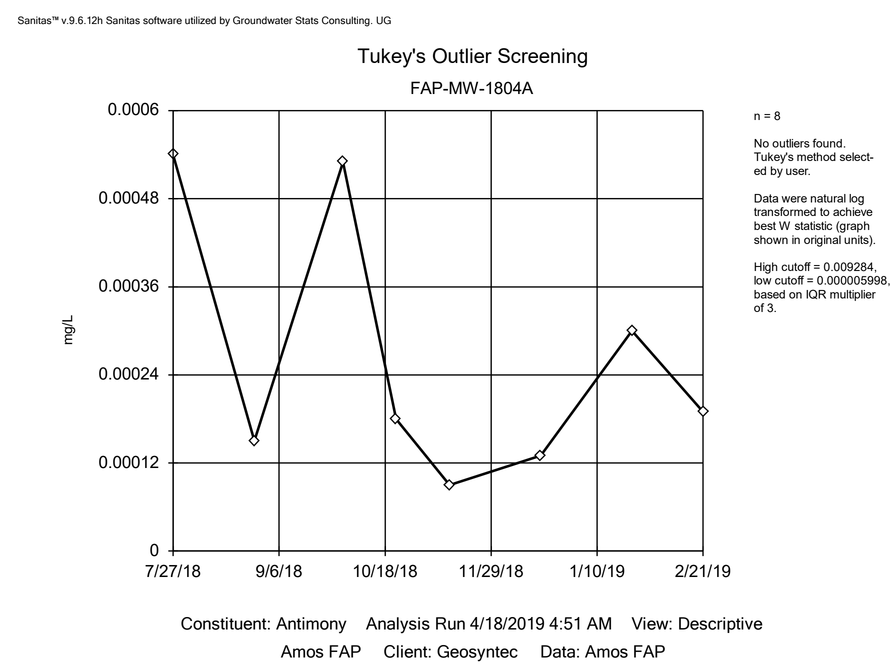
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1807B (bg)
mg/L
0.0005
0.0004
0.0003
0.0002
0.0001
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.001085, low cutoff = -0.000008508, based on IQR multiplier of 3.
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-9
mg/L
0.002
0.0016
0.0012
0.0008
0.0004
0
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.02461, low cutoff = 0.00001369, based on IQR multiplier of 3.
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1801A
mg/L
0.0002
0.00016
0.00012
0.00008
0.00004
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0008331, low cutoff = 0.000007112, based on IQR multiplier of 3.
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

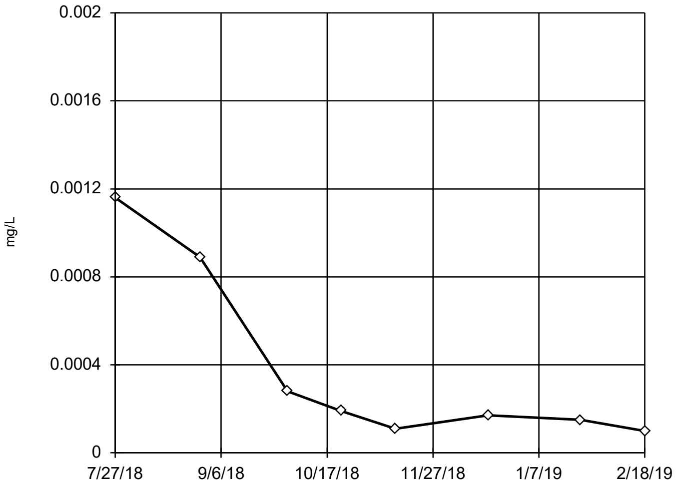


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
mg/L
0.0006
0.00048
0.00036
0.00024
0.00012
0
7/27/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.009284, low cutoff = 0.000005998, based on IQR multiplier of 3.
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1806A



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

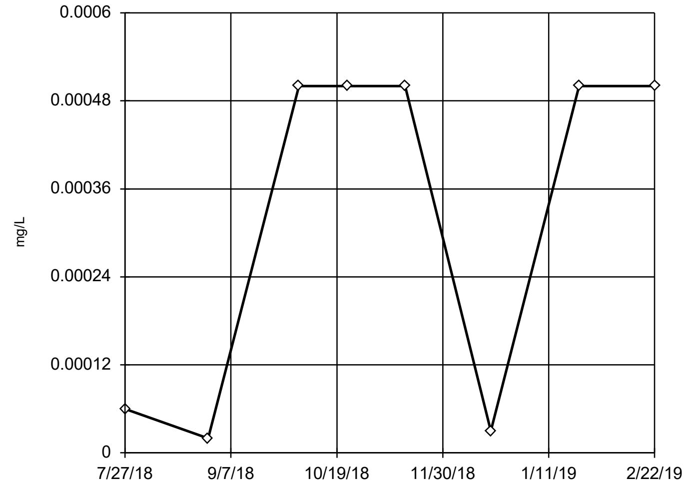
High cutoff = 0.0293, low cutoff = 0.000002188, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

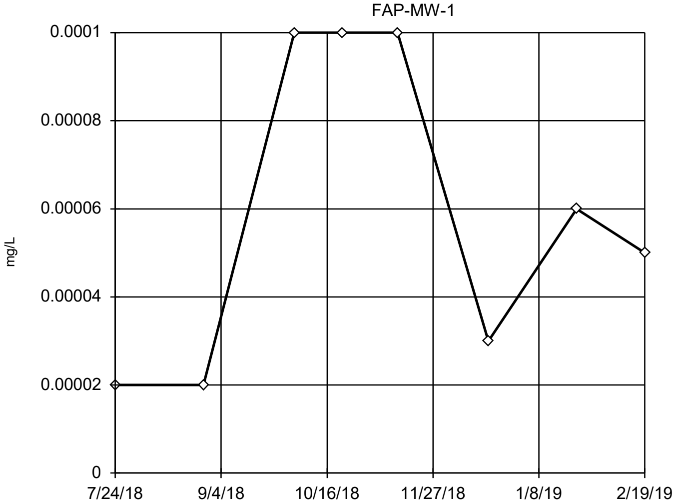
High cutoff = 0.8184, low cutoff = 2.6e-8, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

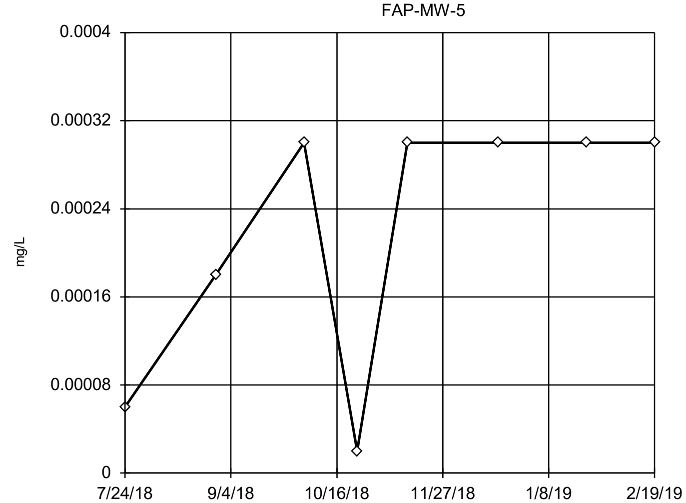
High cutoff = 0.000951, low cutoff = -0.00001188, based on IQR multiplier of 3.

Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

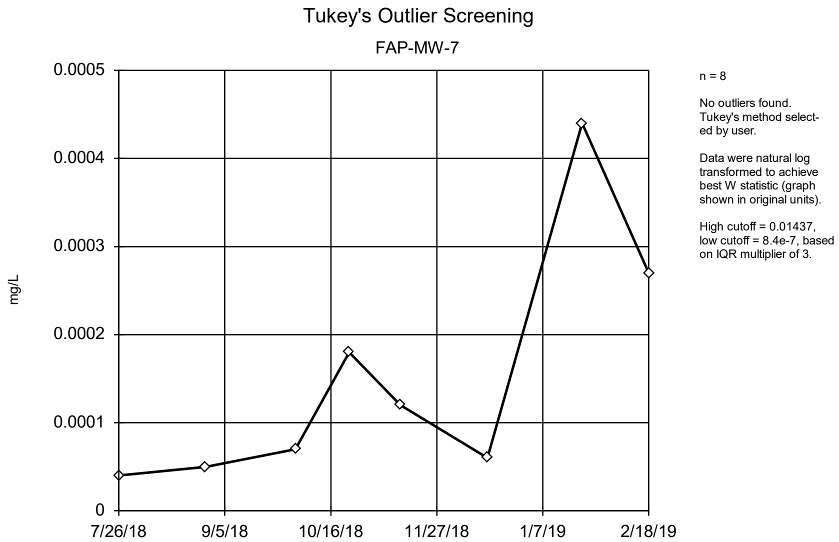
No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.00084, low cutoff = -0.00042, based on IQR multiplier of 3.

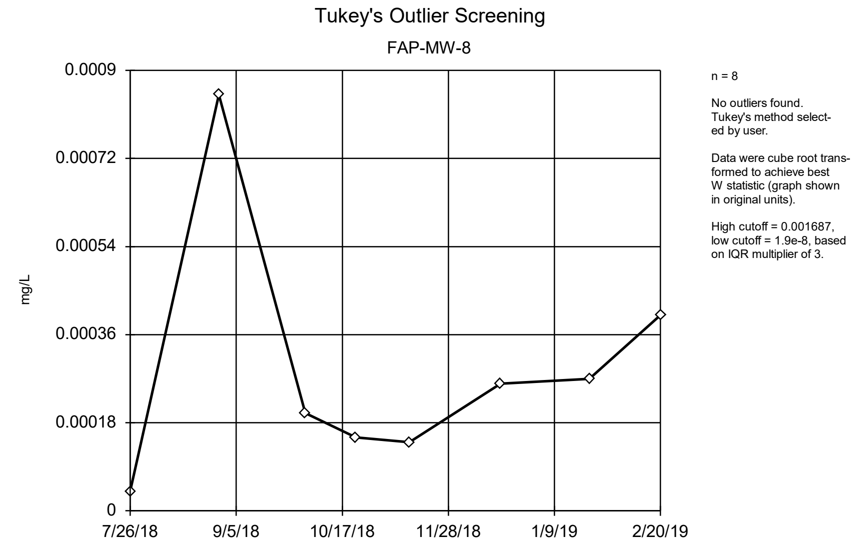
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



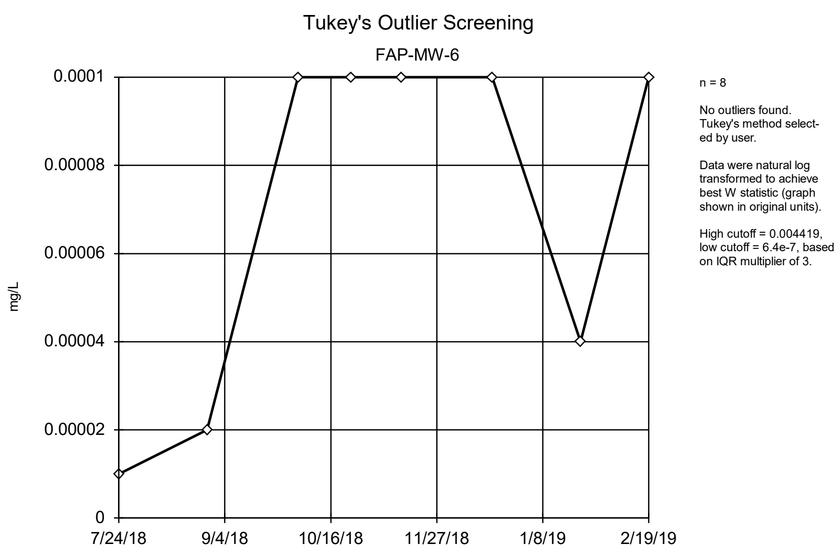
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



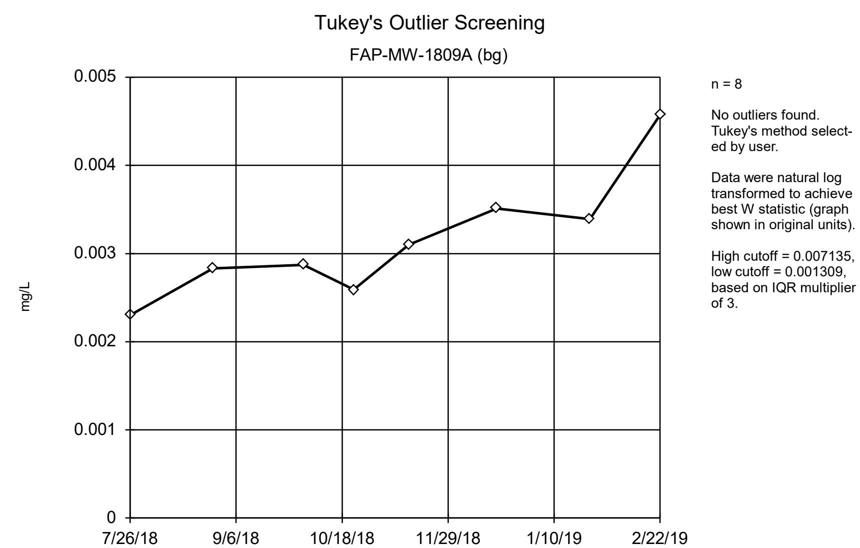
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



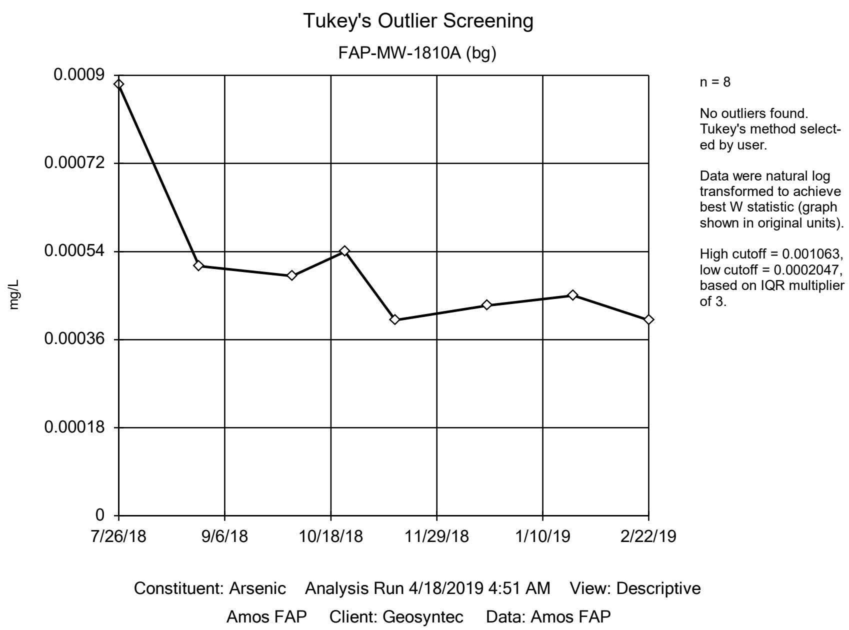
Constituent: Antimony Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

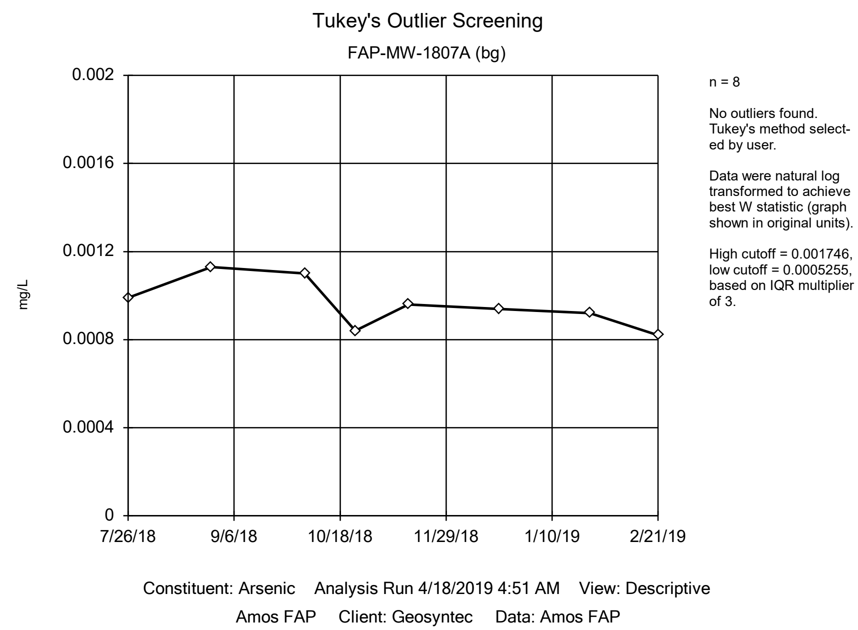


Constituent: Arsenic Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

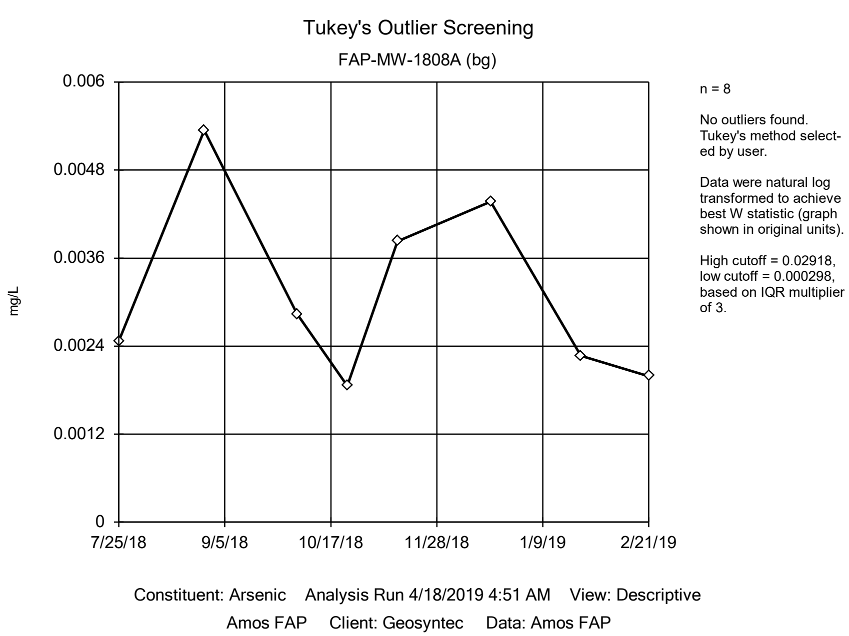
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



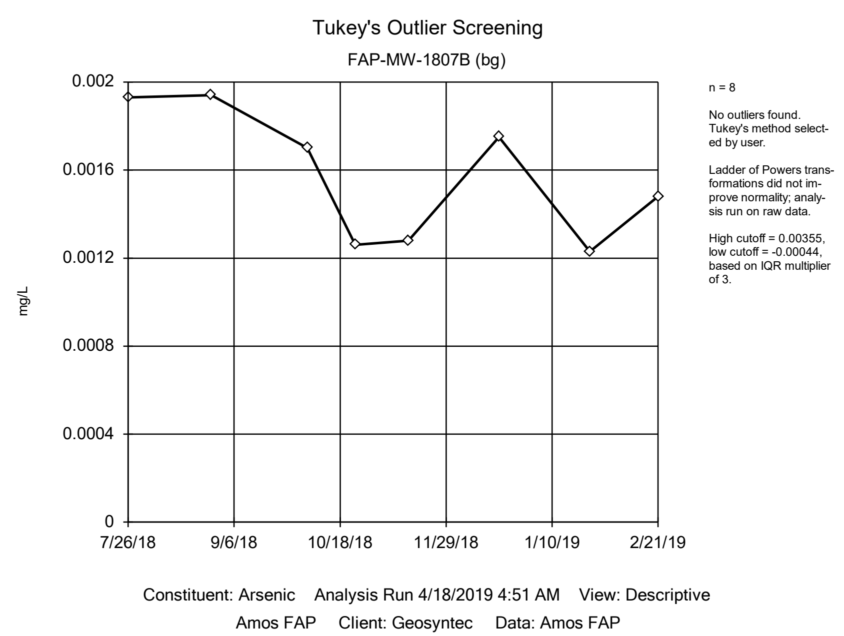
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

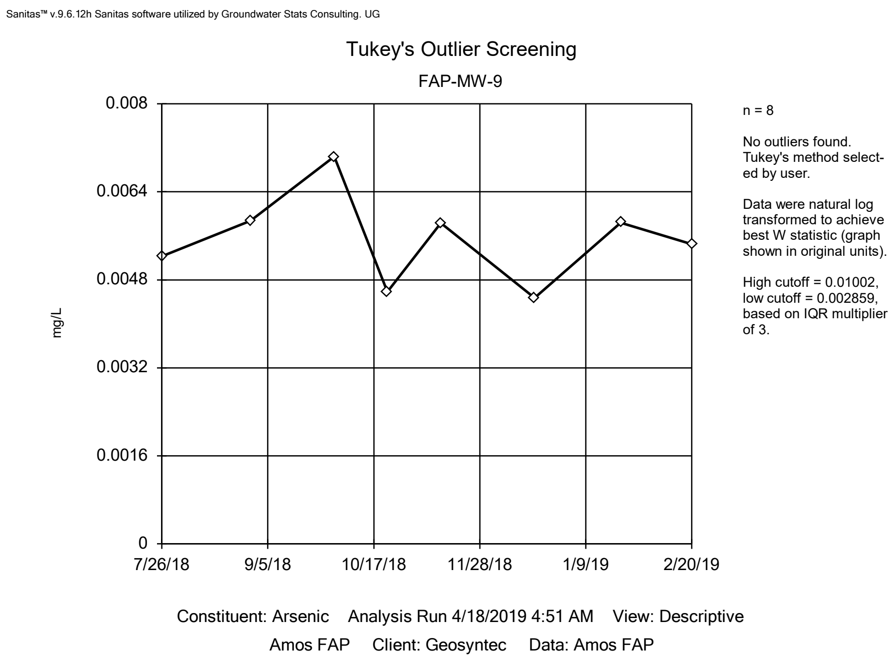


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

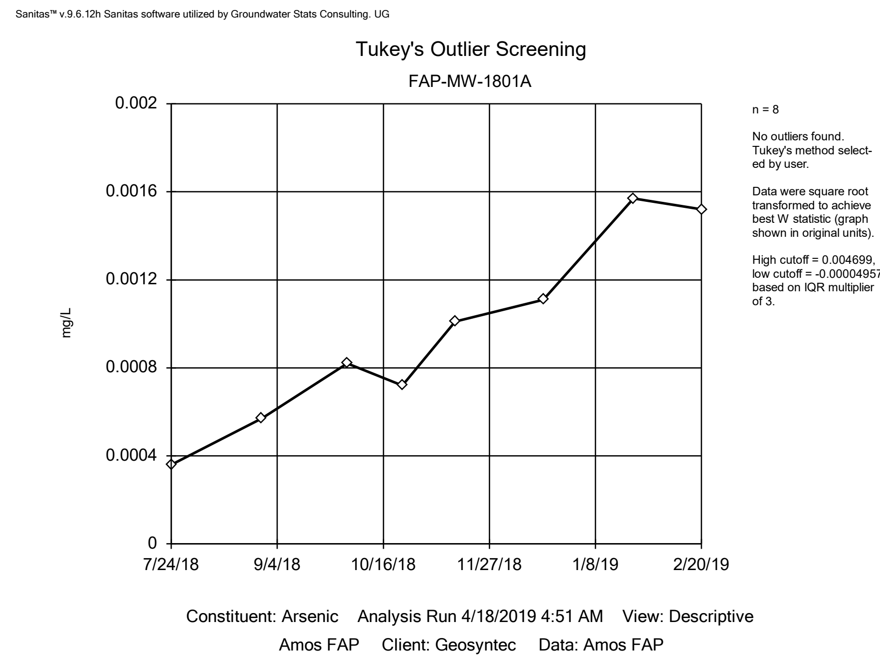


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

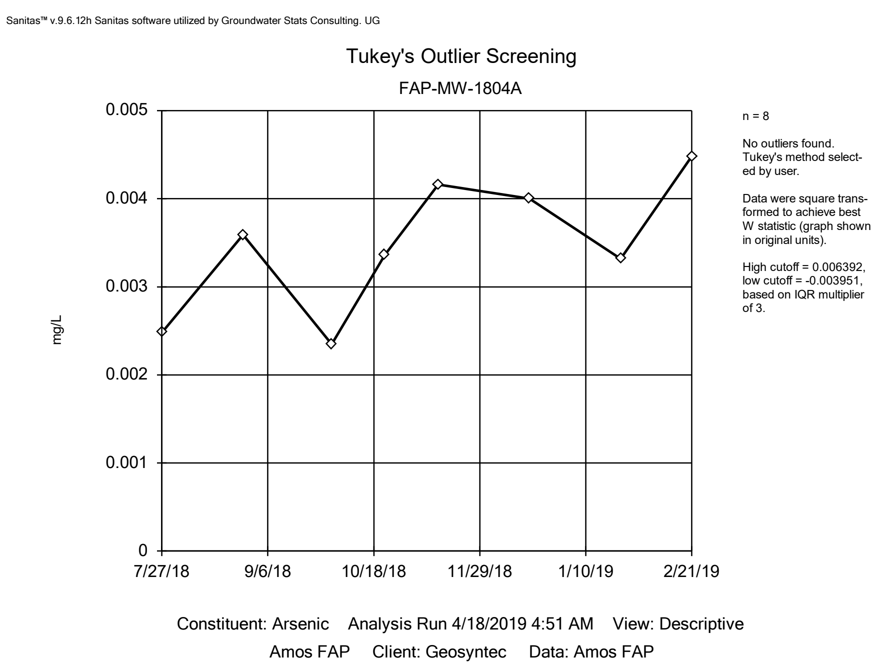




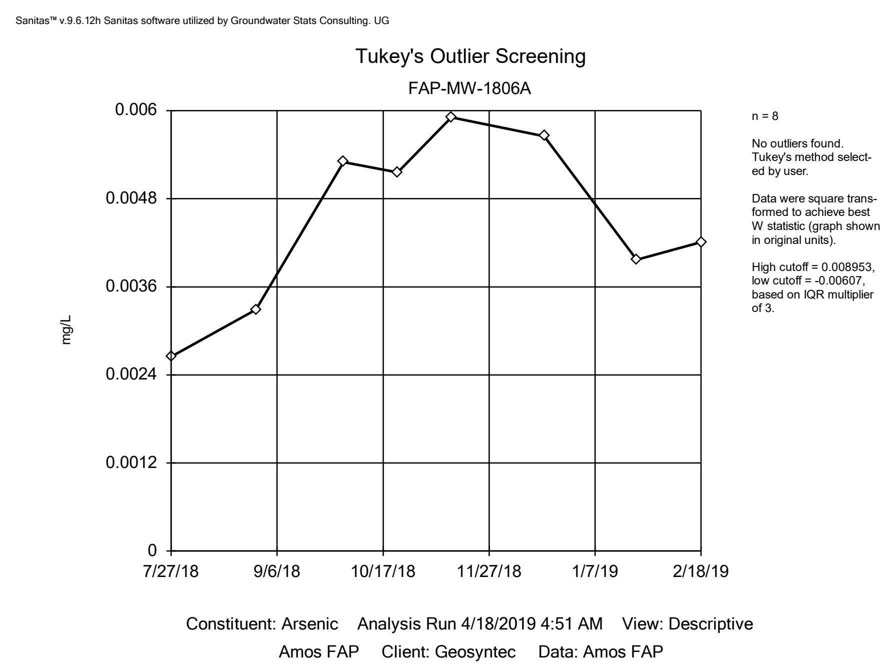
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-9
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.01002, low cutoff = 0.002859, based on IQR multiplier of 3.
mg/L
Constituent: Arsenic Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1801A
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.004699, low cutoff = -0.00004957, based on IQR multiplier of 3.
mg/L
Constituent: Arsenic Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
n = 8
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.006392, low cutoff = -0.003951, based on IQR multiplier of 3.
mg/L
Constituent: Arsenic Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

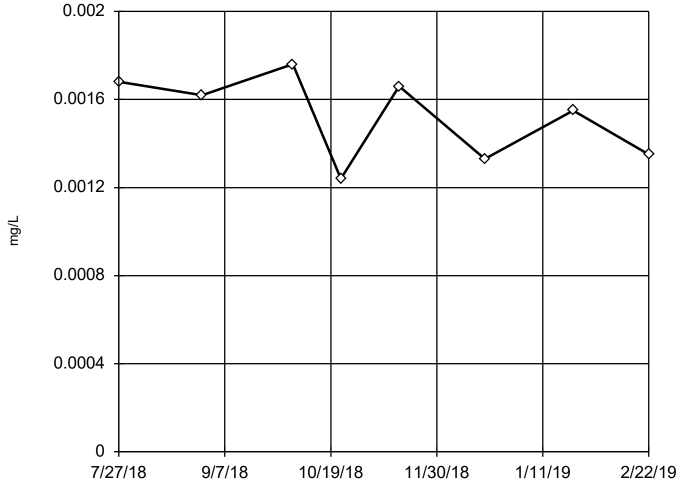


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
n = 8
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.008953, low cutoff = -0.00607, based on IQR multiplier of 3.
mg/L
Constituent: Arsenic Analysis Run 4/18/2019 4:51 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

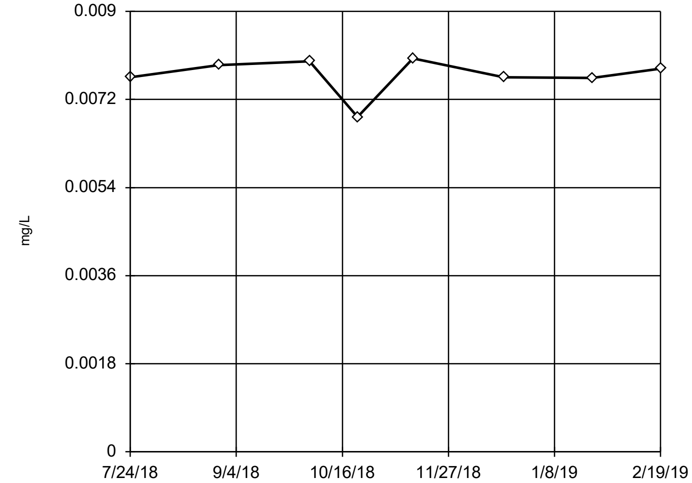
High cutoff = 0.002027, low cutoff = -0.001864, based on IQR multiplier of 3.

Constituent: Arsenic   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

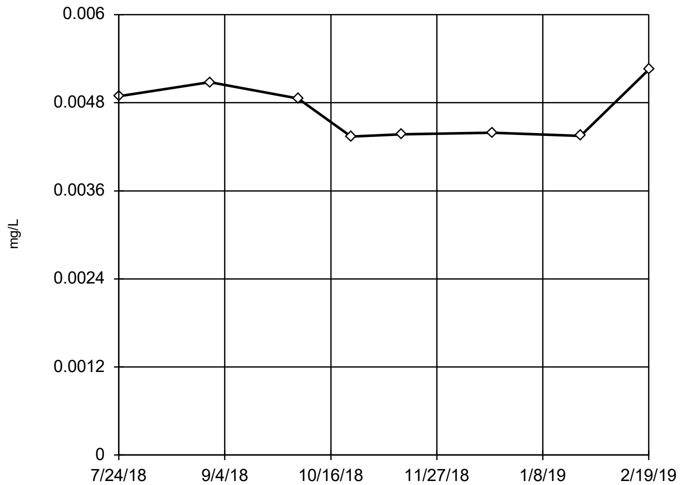
High cutoff = 0.008597, low cutoff = 0.005999, based on IQR multiplier of 3.

Constituent: Arsenic   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

No outliers found. Tukey's method selected by user.

Data were x^5 transformed to achieve best W statistic (graph shown in original units).

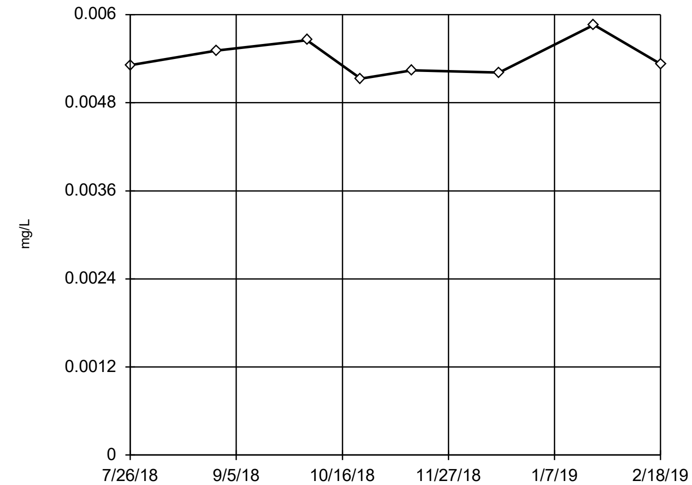
High cutoff = 0.005978, low cutoff = -0.004948, based on IQR multiplier of 3.

Constituent: Arsenic   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

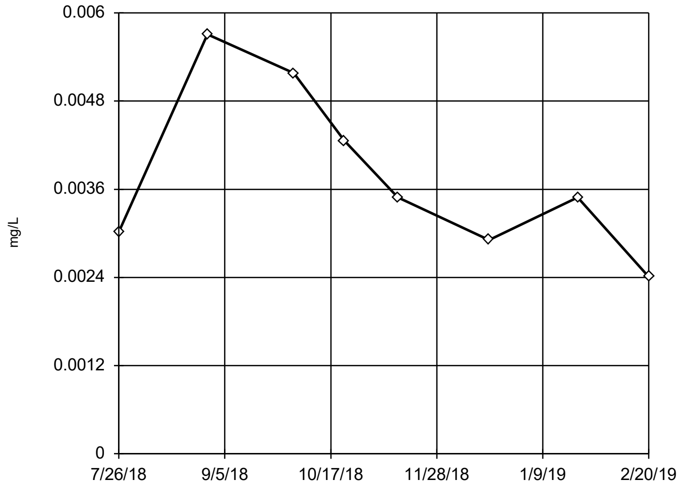
High cutoff = 0.006794, low cutoff = 0.004291, based on IQR multiplier of 3.

Constituent: Arsenic   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

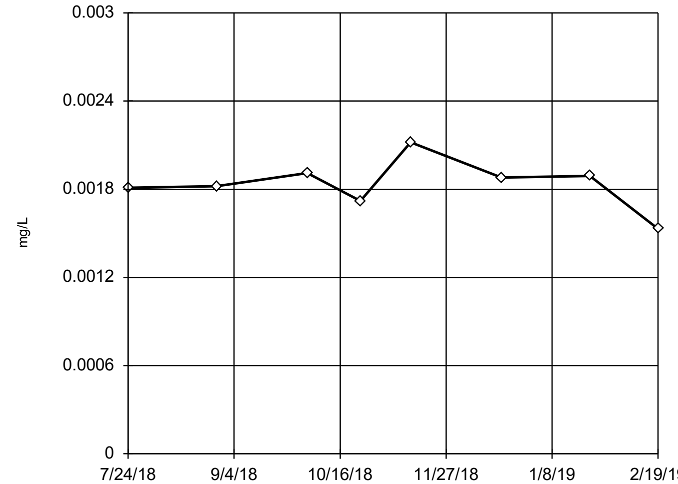
High cutoff = 0.01869, low cutoff = 0.0007451, based on IQR multiplier of 3.

Constituent: Arsenic   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

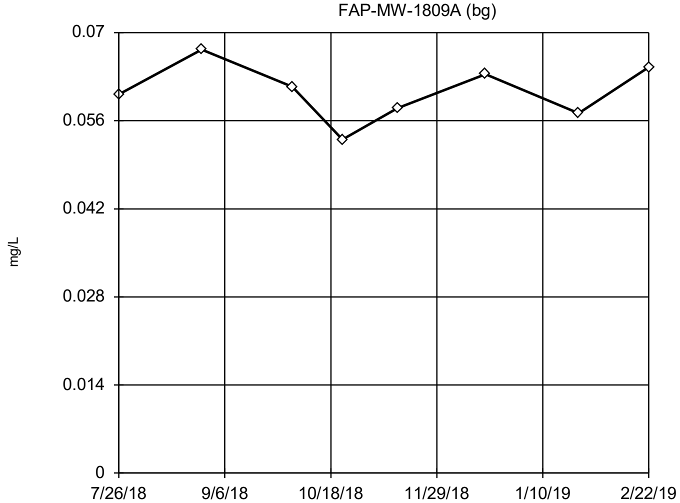
High cutoff = 0.002256, low cutoff = 0.00128, based on IQR multiplier of 3.

Constituent: Arsenic   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1809A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

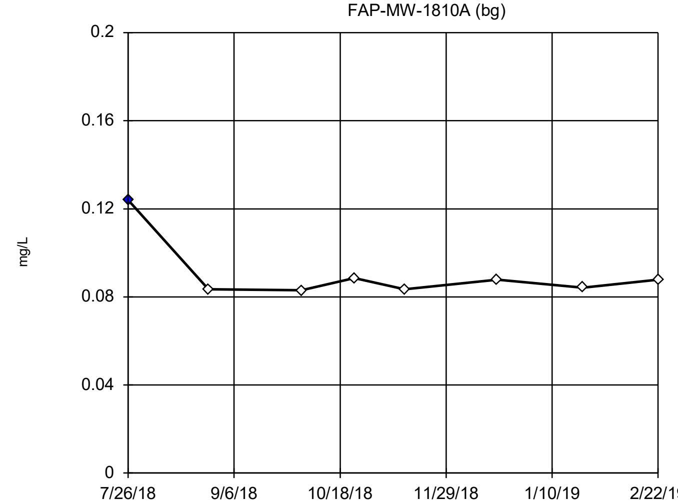
High cutoff = 0.07791, low cutoff = -0.02725, based on IQR multiplier of 3.

Constituent: Barium   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1810A (bg)



n = 8

Outlier is drawn as solid. Tukey's method selected by user.

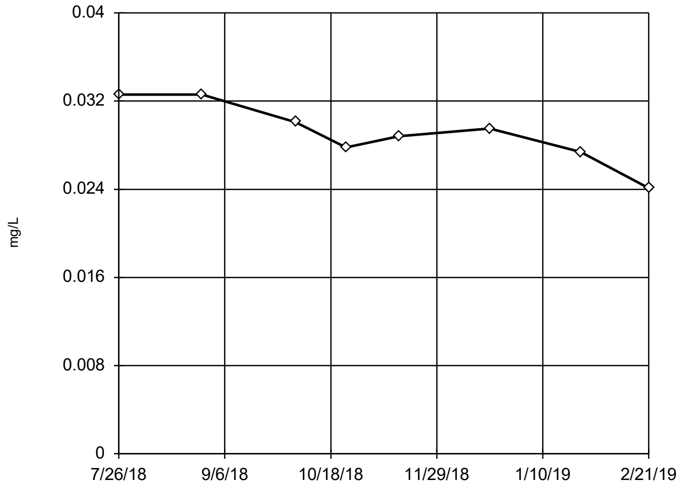
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1041, low cutoff = 0.07068, based on IQR multiplier of 3.

Constituent: Barium   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Tukey's Outlier Screening

FAP-MW-1807A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

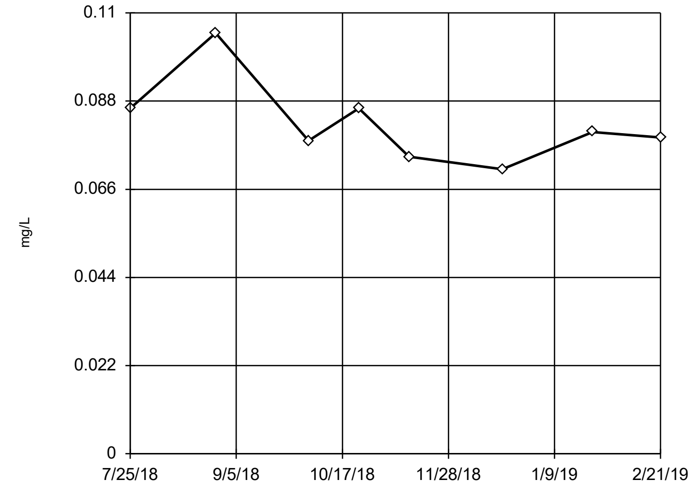
High cutoff = 0.04065, low cutoff = 0.009698, based on IQR multiplier of 3.

Constituent: Barium   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1808A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

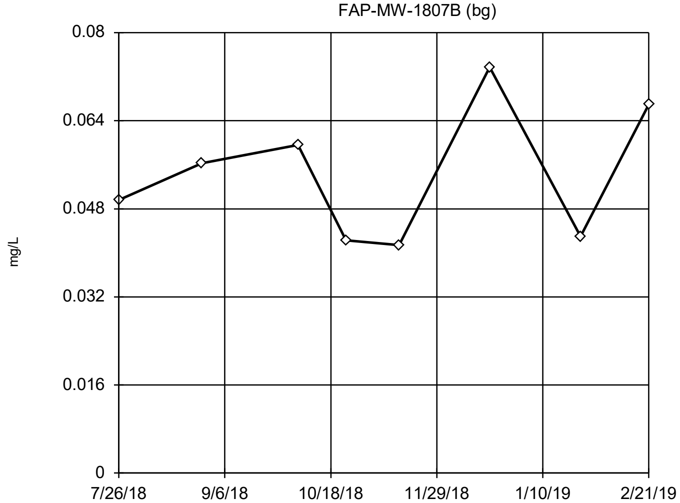
High cutoff = 0.1254, low cutoff = 0.05229, based on IQR multiplier of 3.

Constituent: Barium   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

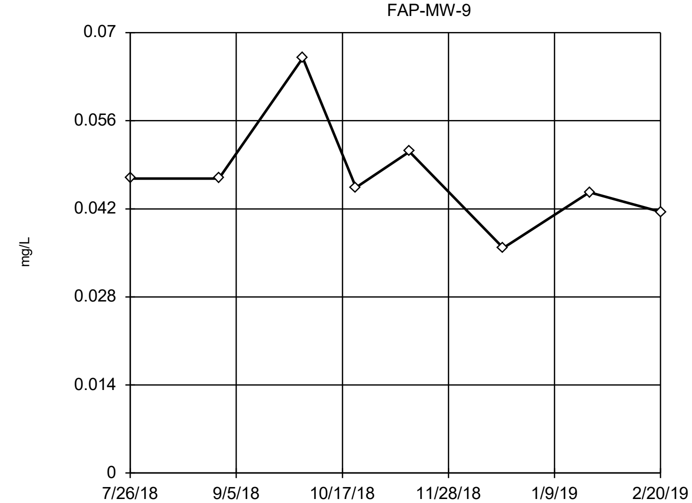
High cutoff = 0.2049, low cutoff = 0.01314, based on IQR multiplier of 3.

Constituent: Barium   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9



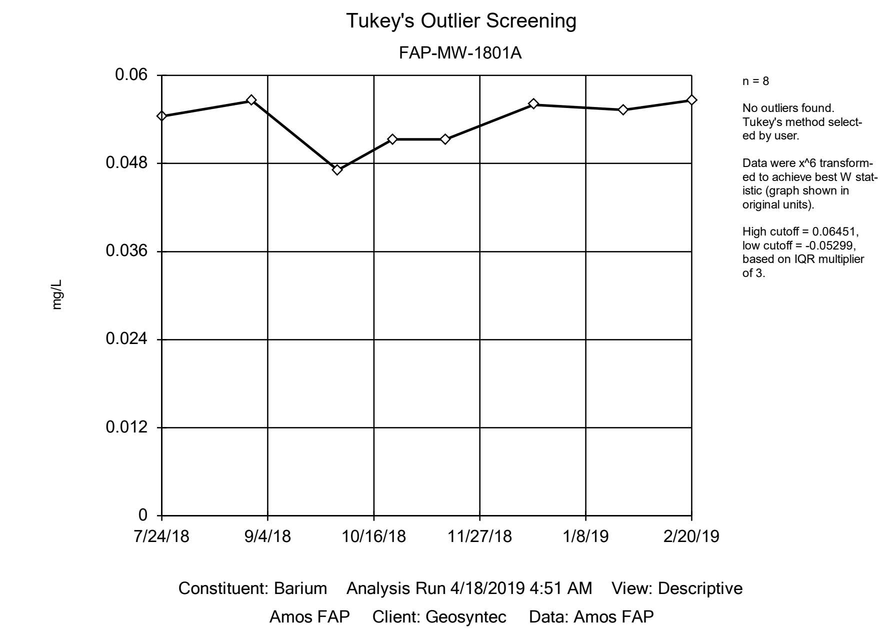
n = 8

No outliers found. Tukey's method selected by user.

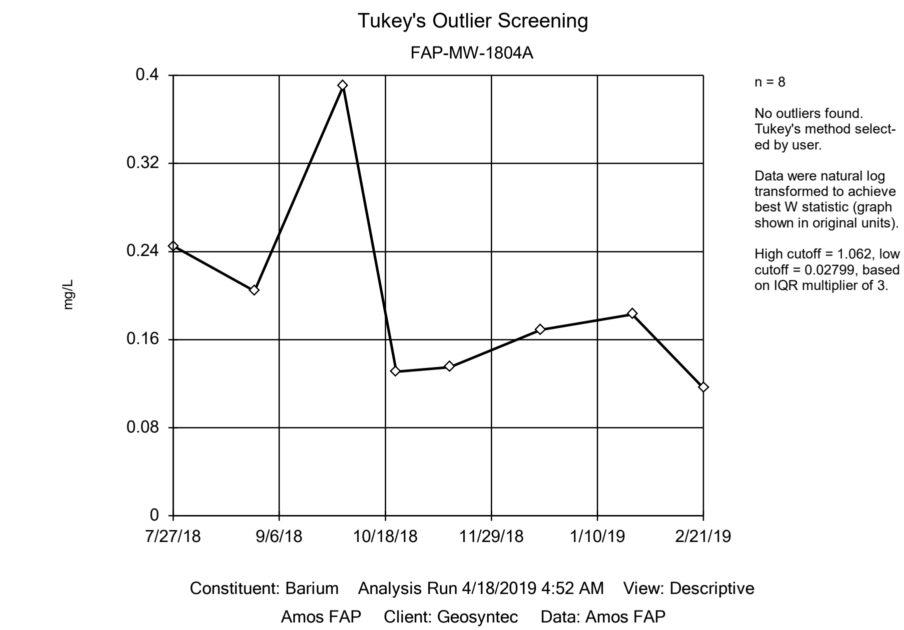
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.07182, low cutoff = 0.02929, based on IQR multiplier of 3.

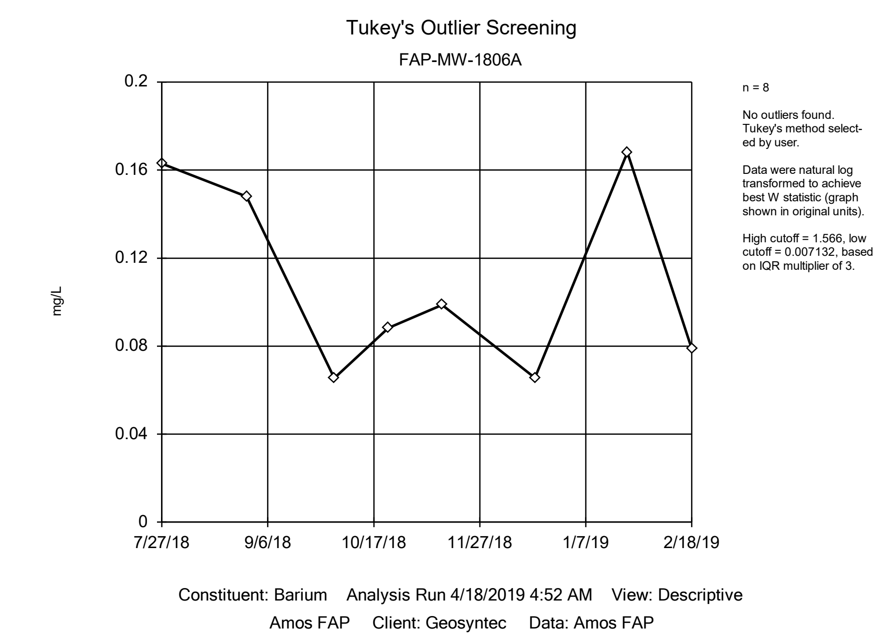
Constituent: Barium   Analysis Run 4/18/2019 4:51 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP



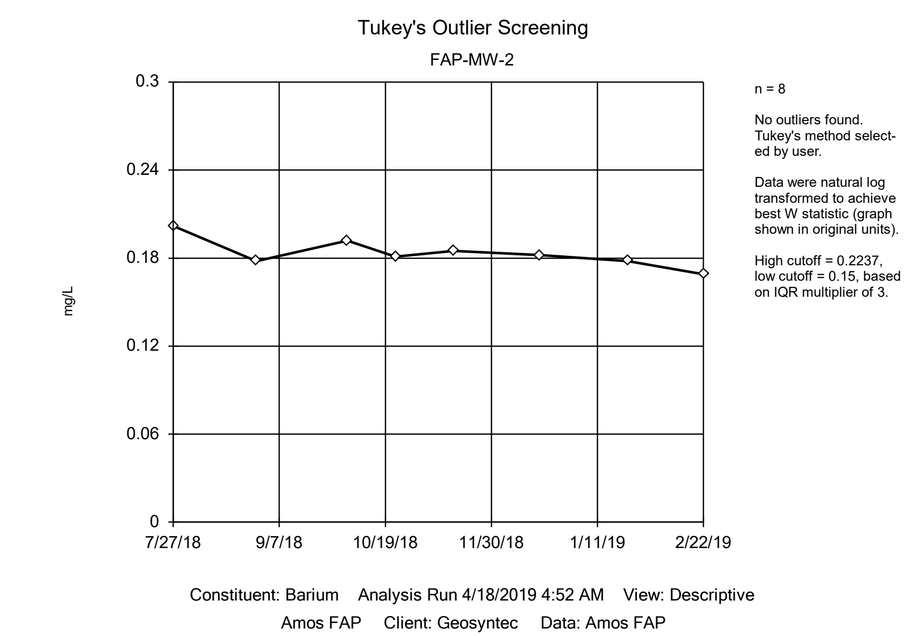
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

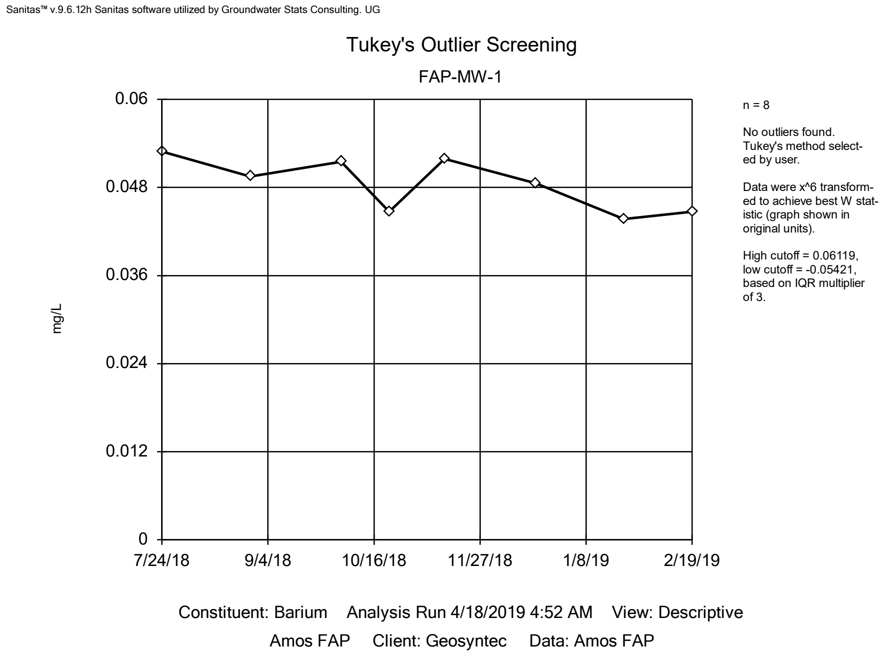


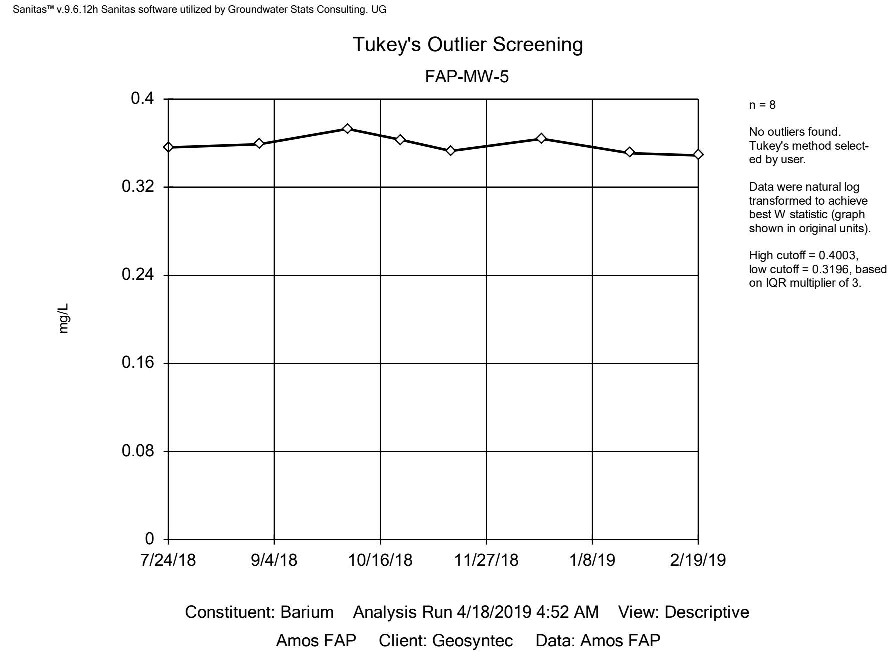
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

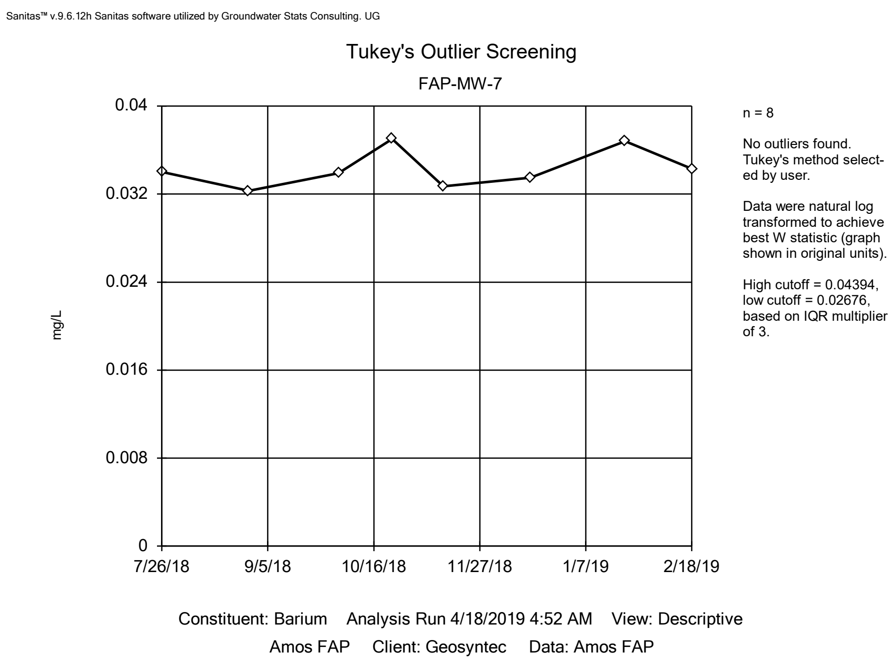


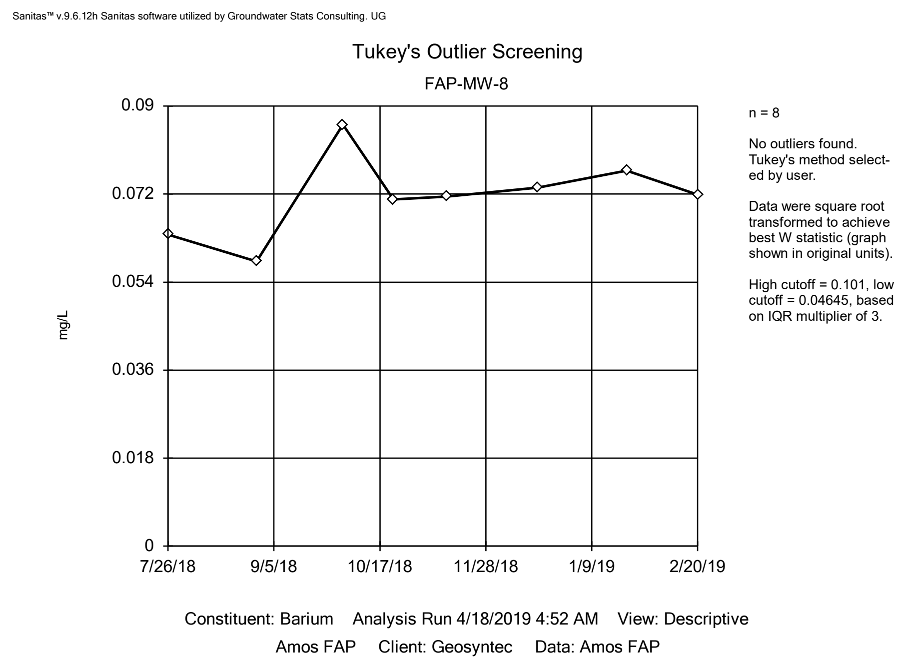
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

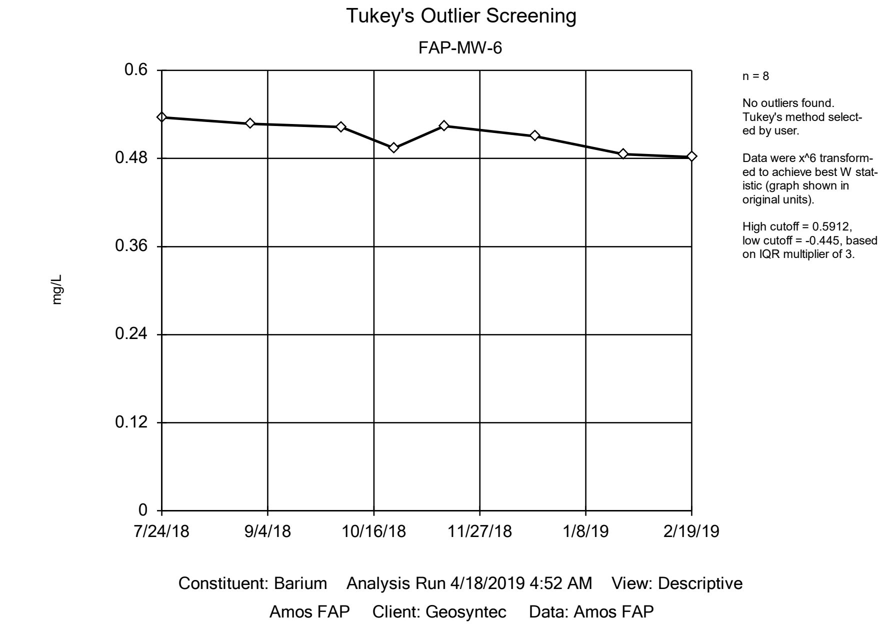



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1
mg/L
0.06
0.048
0.036
0.024
0.012
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.06119, low cutoff = -0.05421, based on IQR multiplier of 3.
Constituent: Barium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

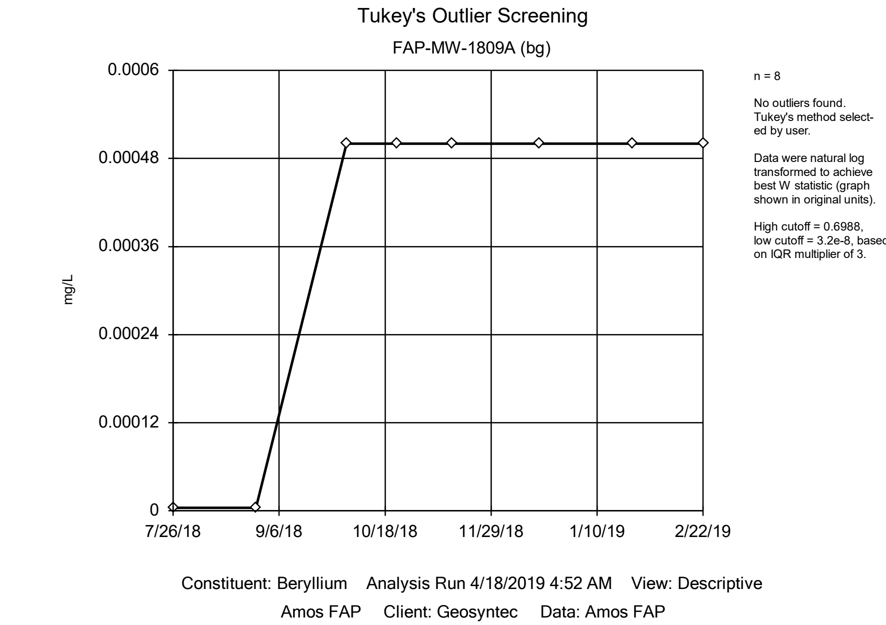

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-5
mg/L
0.4
0.32
0.24
0.16
0.08
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.4003, low cutoff = 0.3196, based on IQR multiplier of 3.
Constituent: Barium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
mg/L
0.04
0.032
0.024
0.016
0.008
0
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.04394, low cutoff = 0.02676, based on IQR multiplier of 3.
Constituent: Barium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

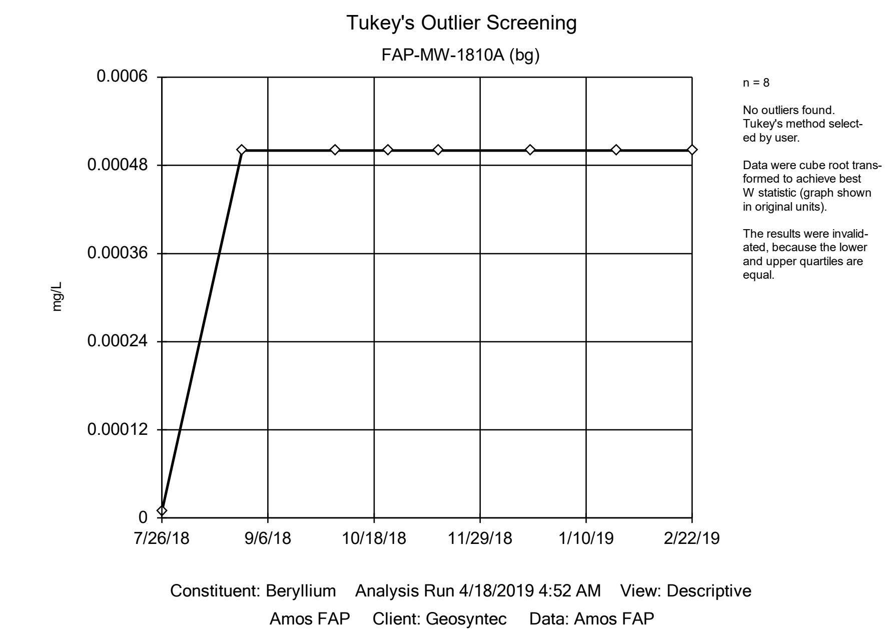

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
mg/L
0.09
0.072
0.054
0.036
0.018
0
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.101, low cutoff = 0.04645, based on IQR multiplier of 3.
Constituent: Barium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



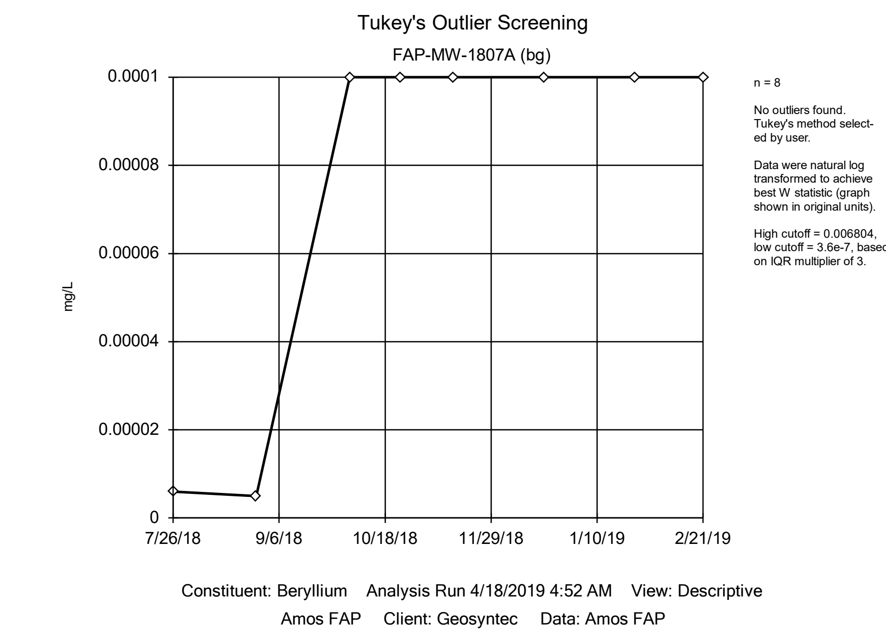
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



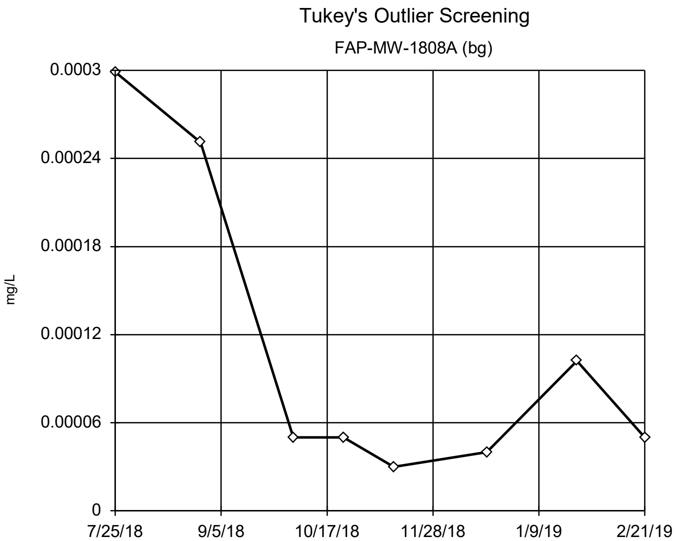
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

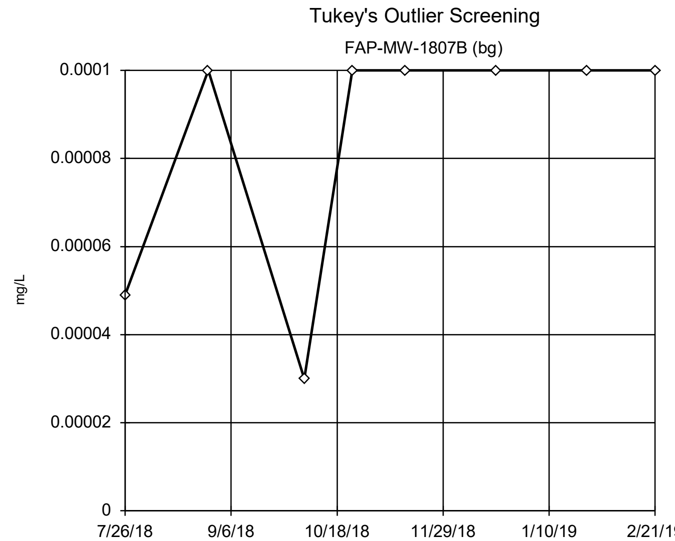
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.007328, low cutoff = 9.8e-7, based on IQR multiplier of 3.

Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

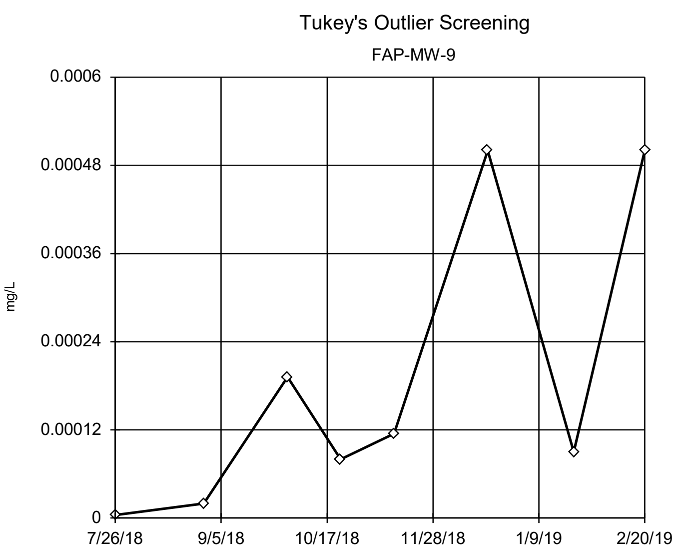
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0002287, low cutoff = 0.00001918, based on IQR multiplier of 3.

Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

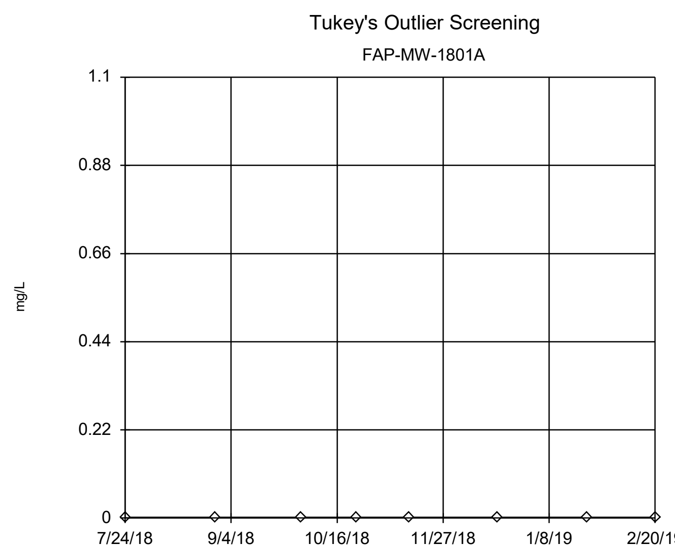
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.004807, low cutoff = -0.0002762, based on IQR multiplier of 3.

Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

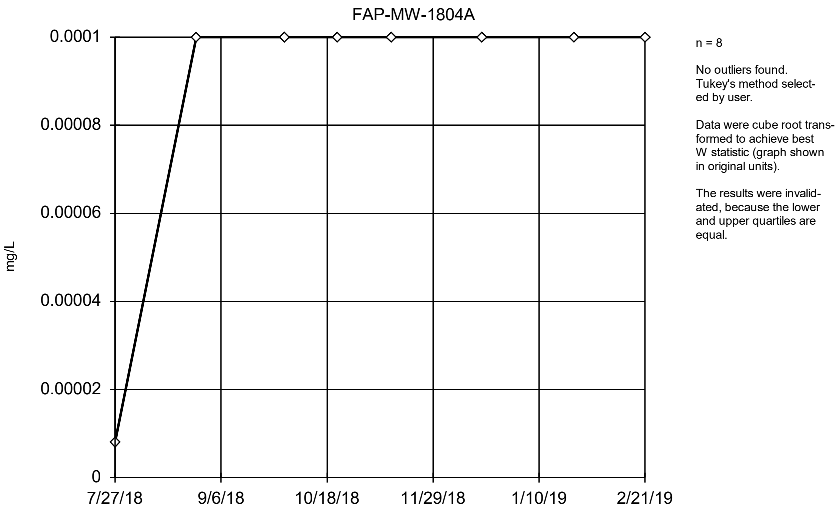
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

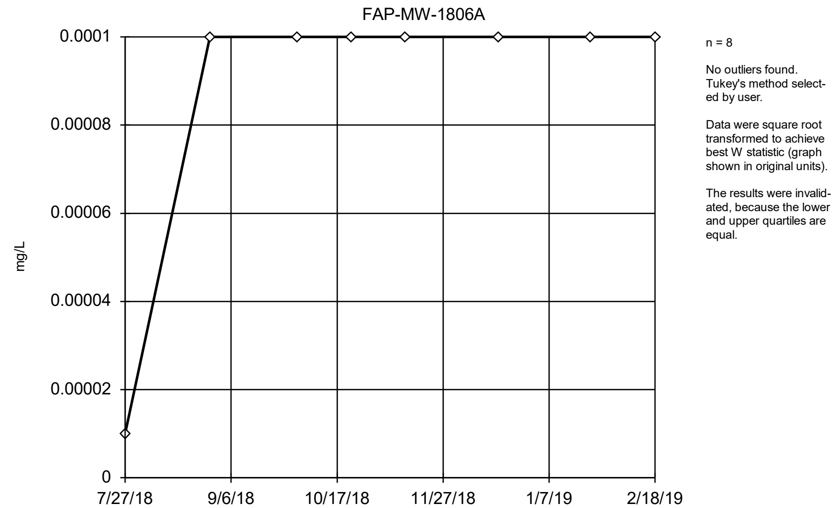
Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening



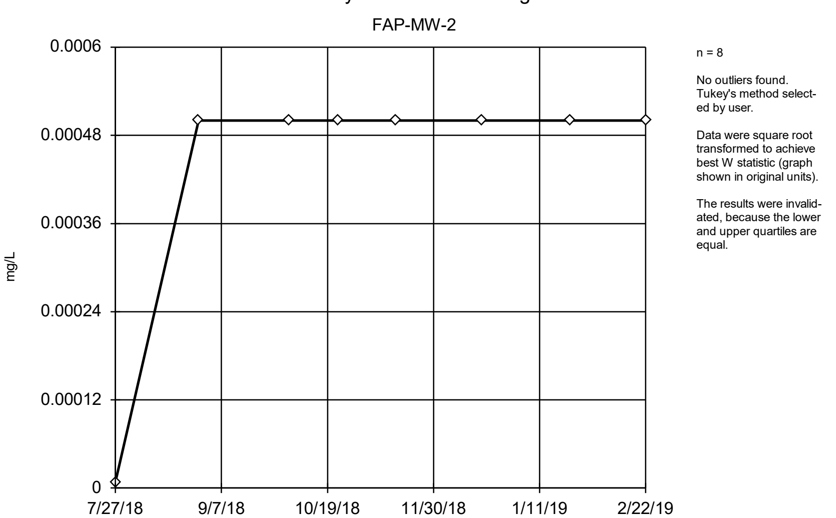
Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening



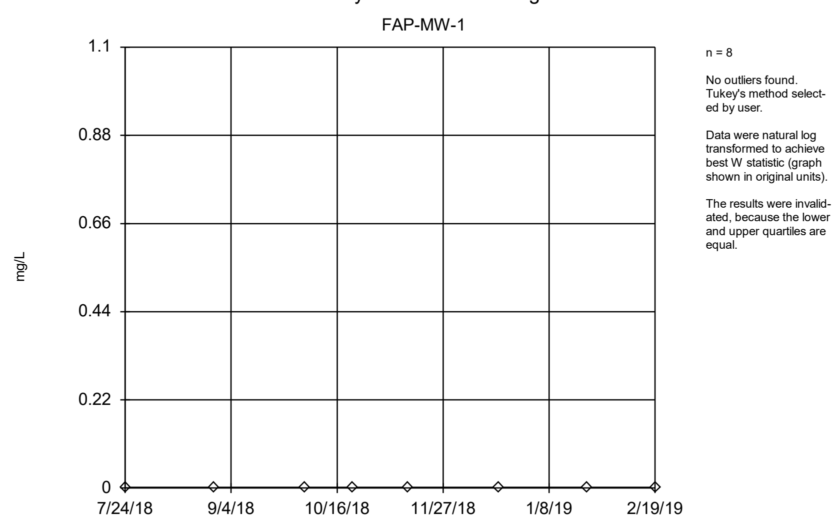
Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening



Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening

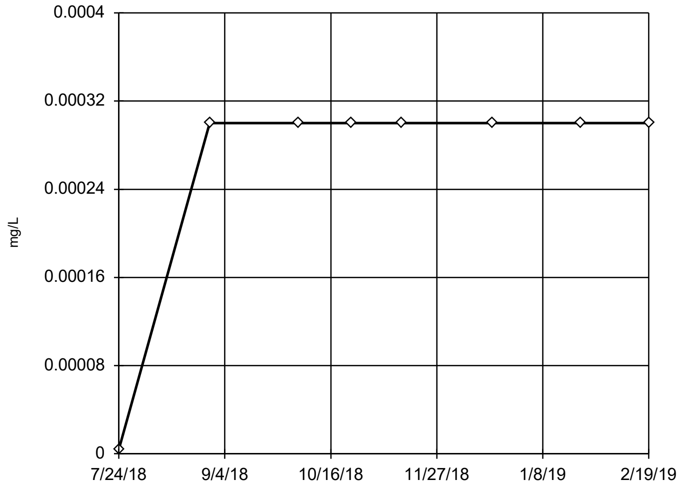


Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

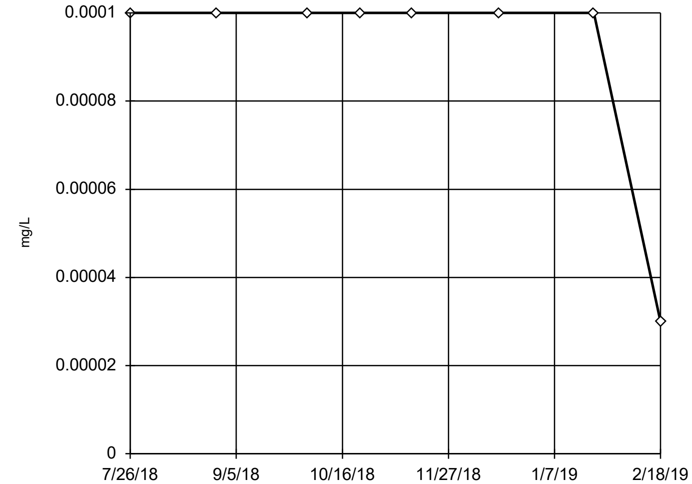
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

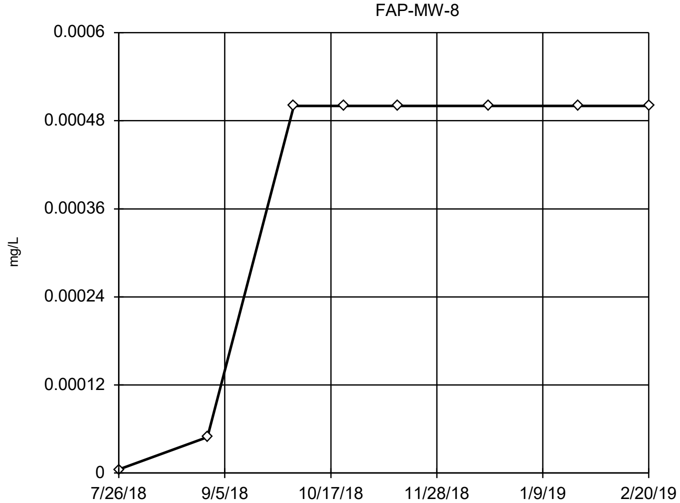
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

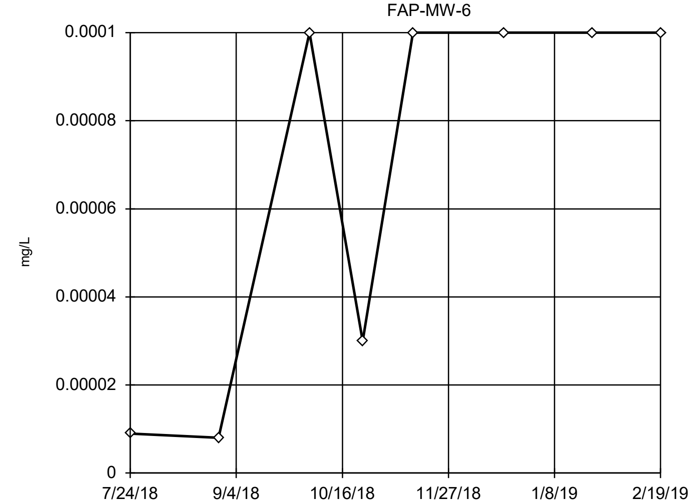
High cutoff = 0.002957, low cutoff = -2.4e-7, based on IQR multiplier of 3.

Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



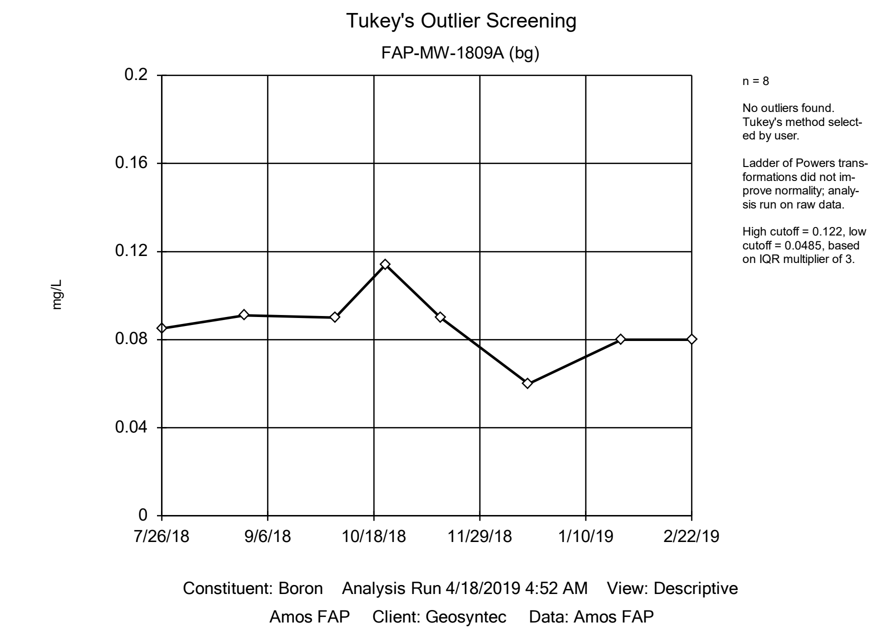
n = 8

No outliers found. Tukey's method selected by user.

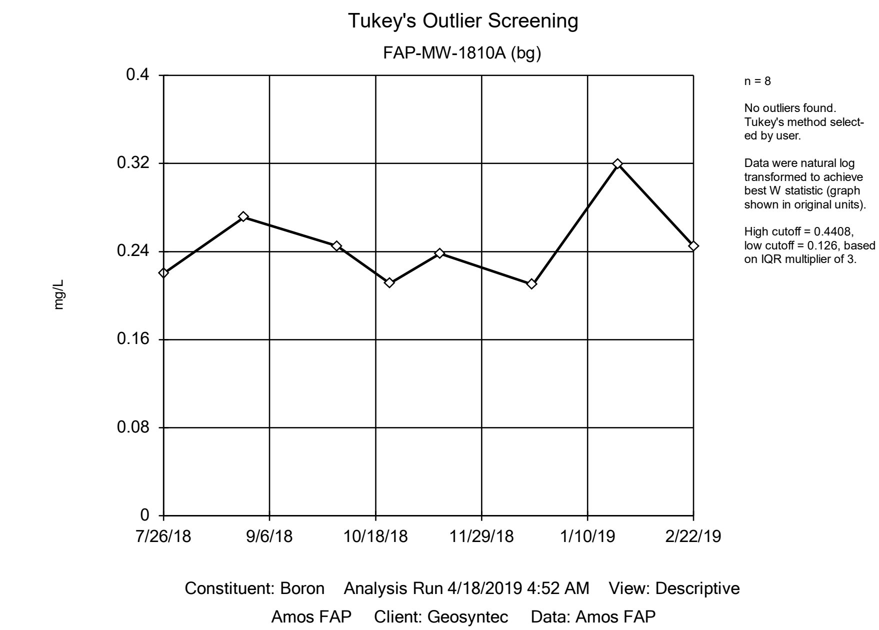
Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.001255, low cutoff = -0.00004474, based on IQR multiplier of 3.

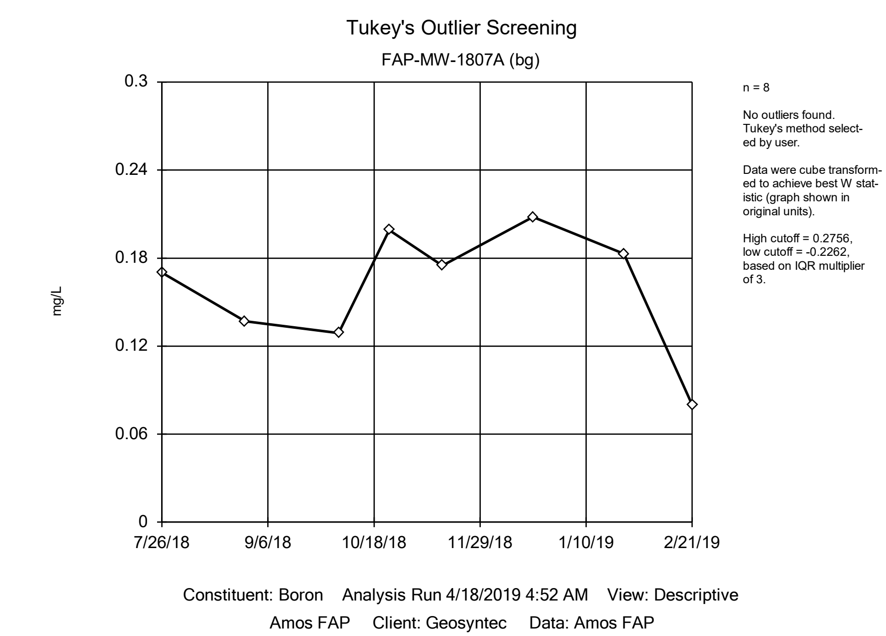
Constituent: Beryllium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



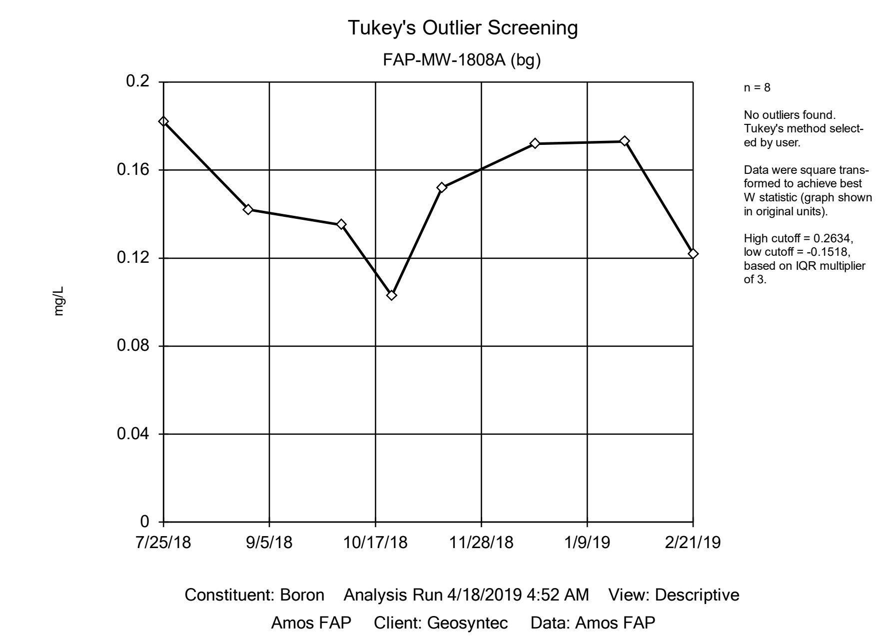
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



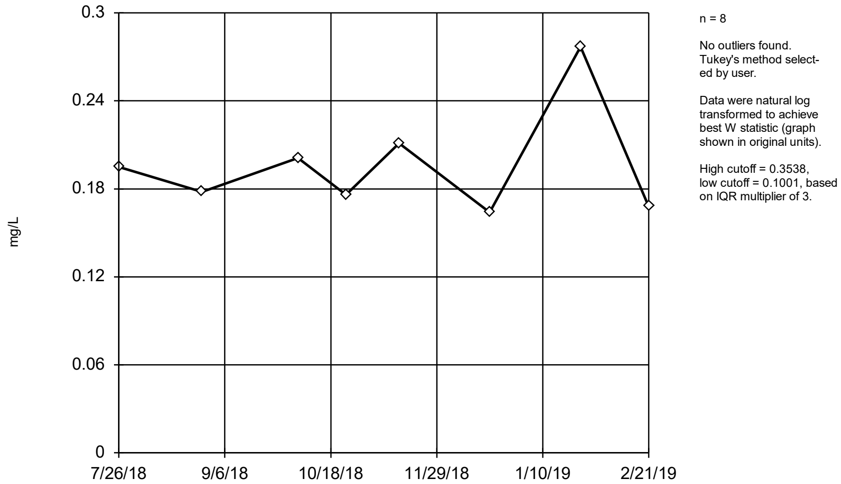
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)

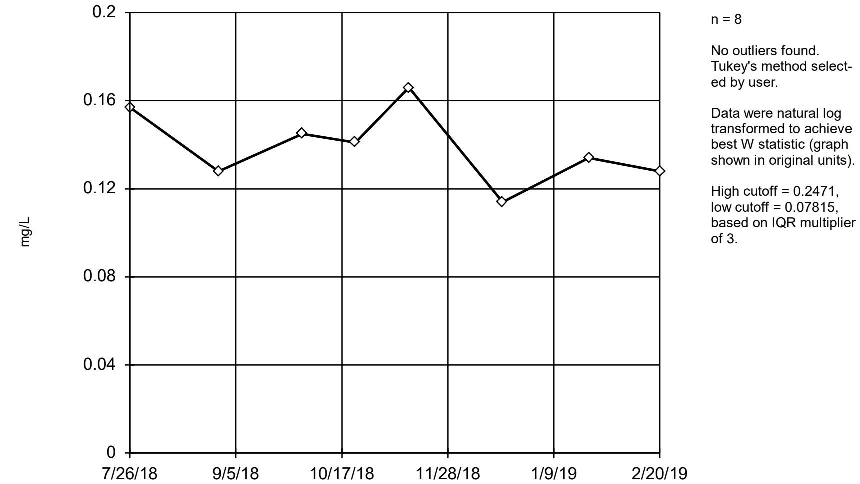


Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9

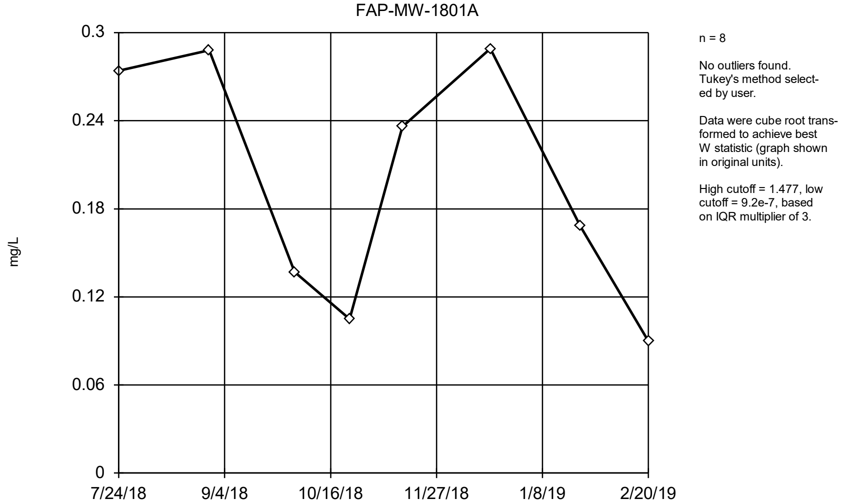


Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1801A

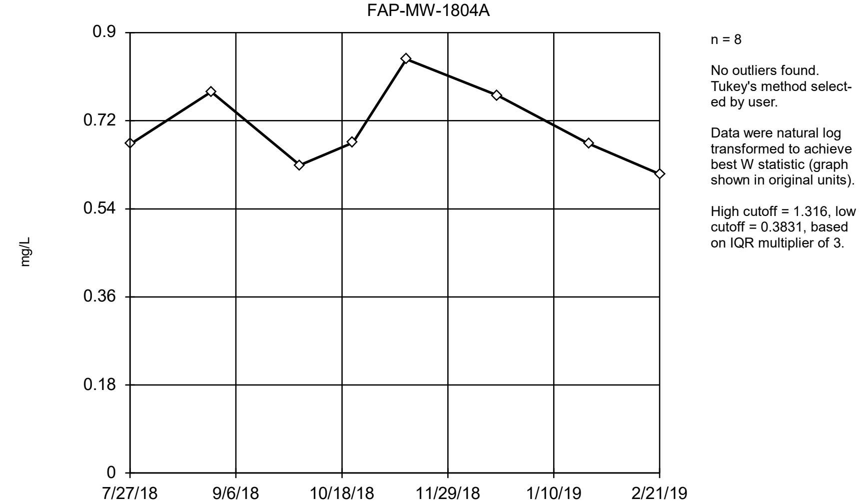


Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

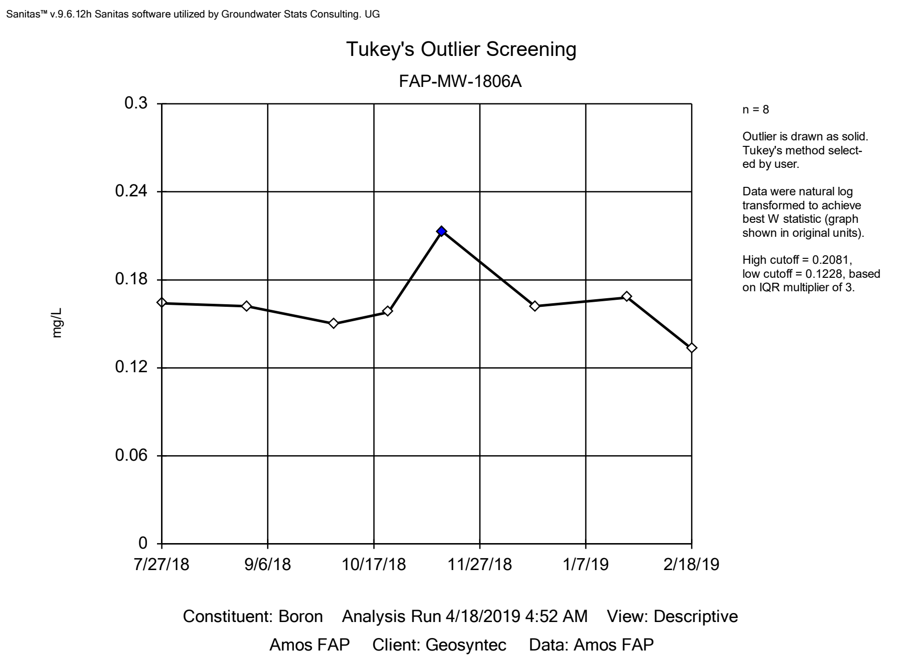
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

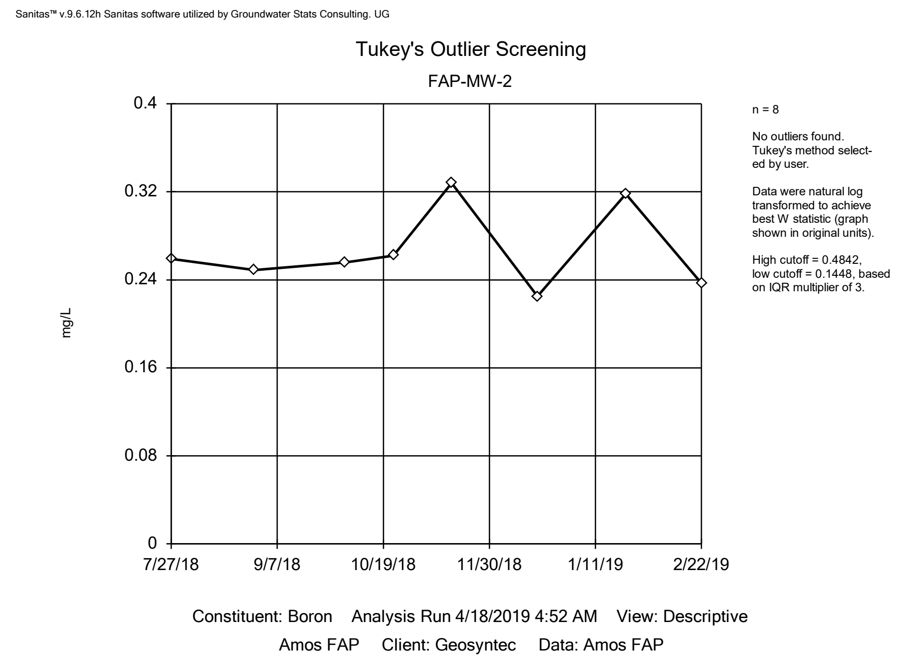
Tukey's Outlier Screening

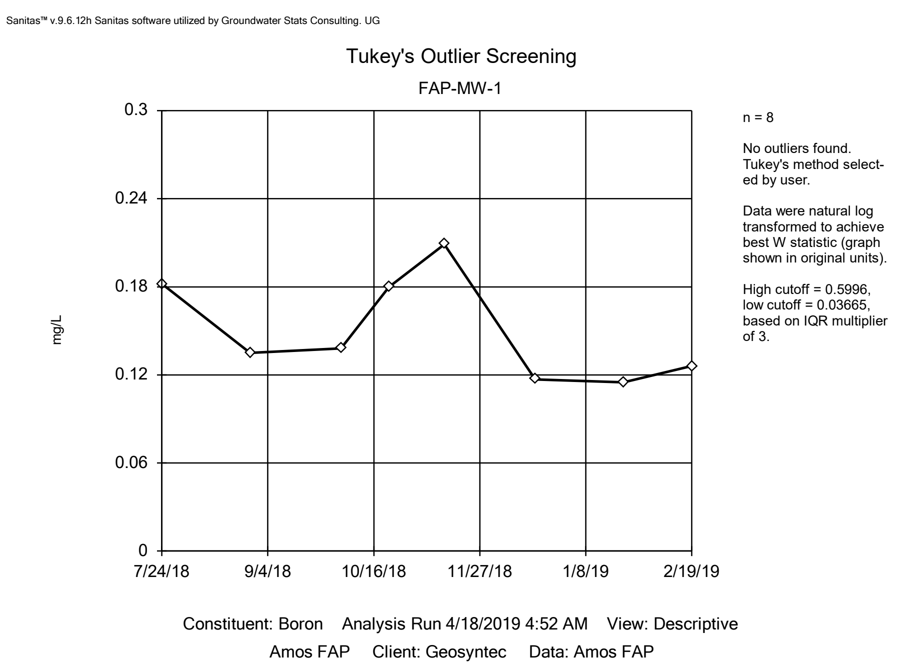
FAP-MW-1804A

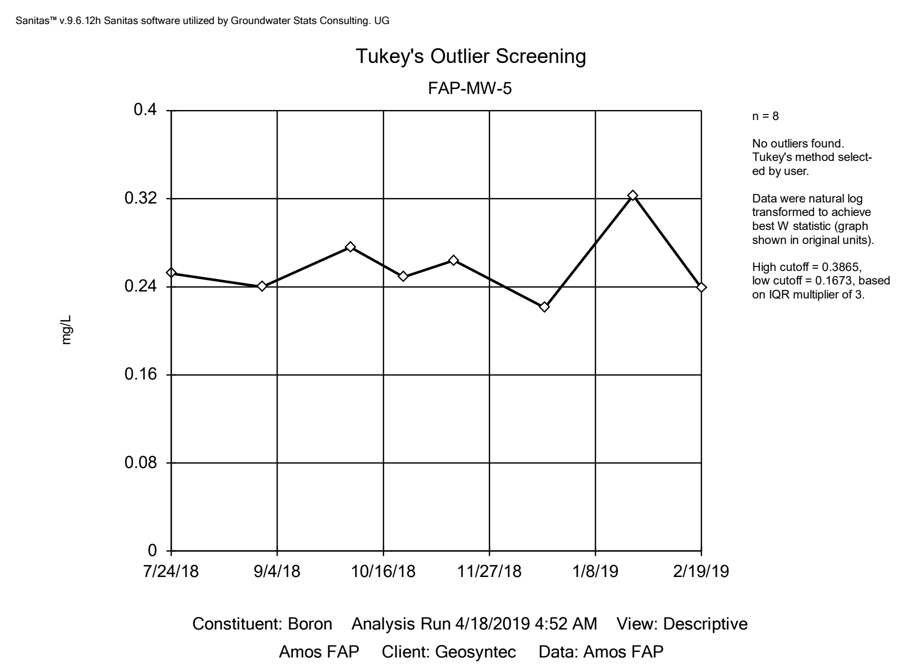


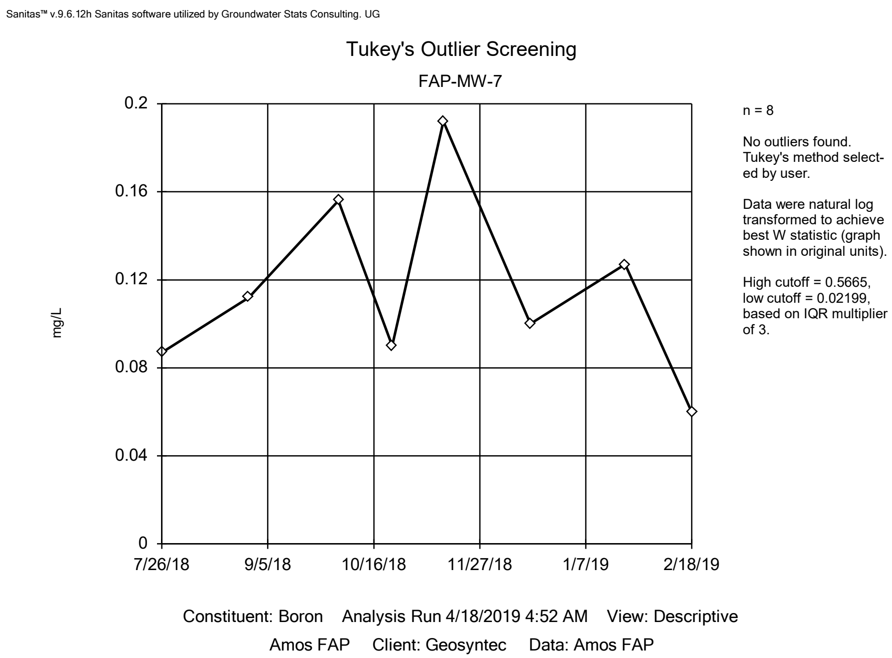
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

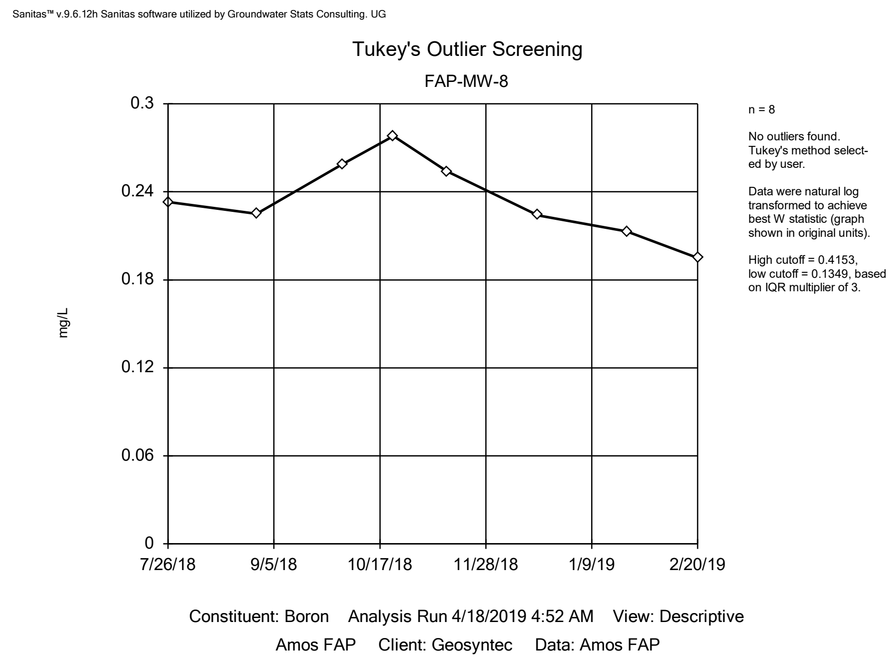

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
mg/L
0.3
0.24
0.18
0.12
0.06
0
7/27/18
9/6/18
10/17/18
11/27/18
1/7/19
2/18/19
n = 8
Outlier is drawn as solid. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.2081, low cutoff = 0.1228, based on IQR multiplier of 3.
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

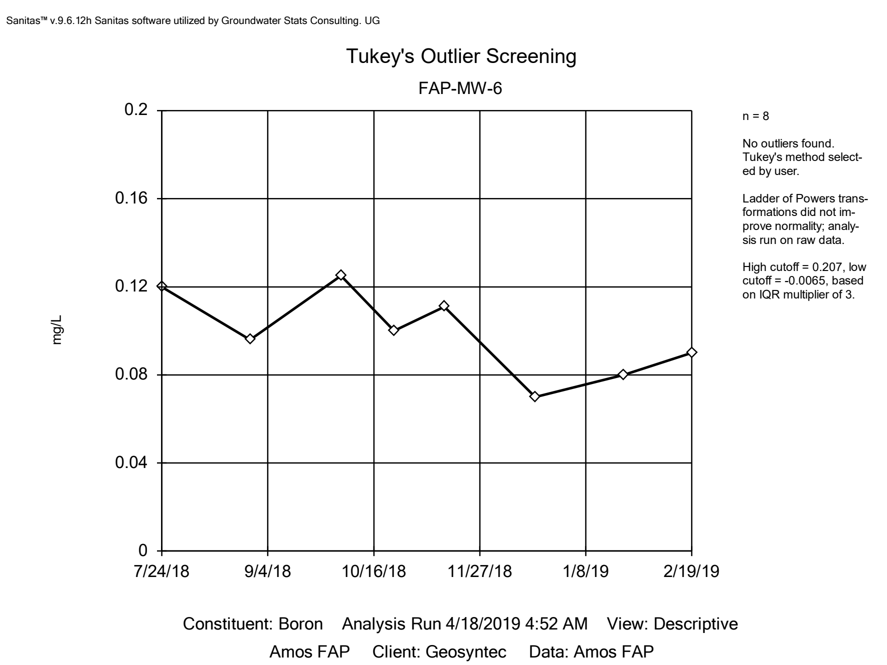

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-2
mg/L
0.4
0.32
0.24
0.16
0.08
0
7/27/18
9/7/18
10/19/18
11/30/18
1/11/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.4842, low cutoff = 0.1448, based on IQR multiplier of 3.
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

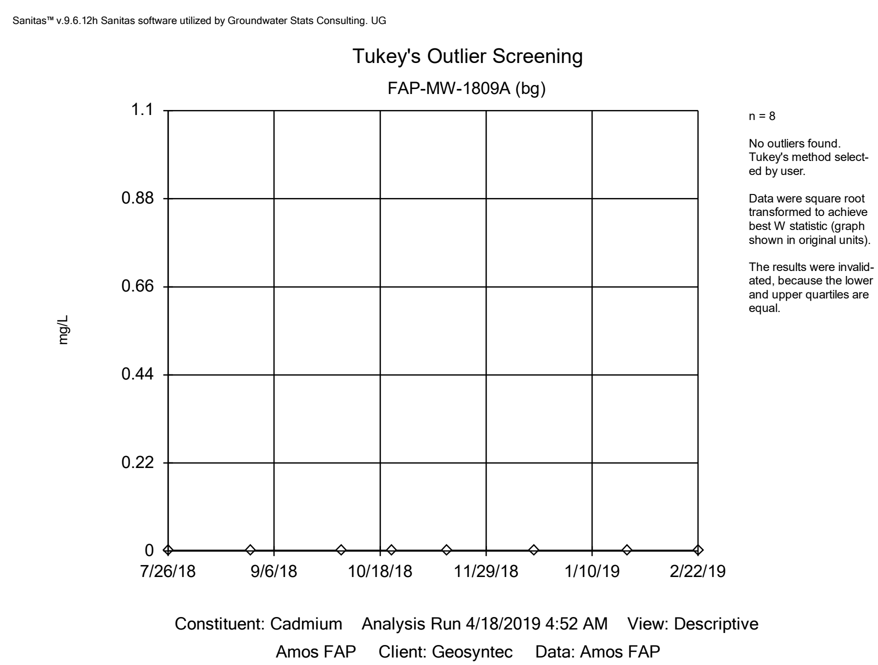

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1
mg/L
0.3
0.24
0.18
0.12
0.06
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.5996, low cutoff = 0.03665, based on IQR multiplier of 3.
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-5
mg/L
0.4
0.32
0.24
0.16
0.08
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.3865, low cutoff = 0.1673, based on IQR multiplier of 3.
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

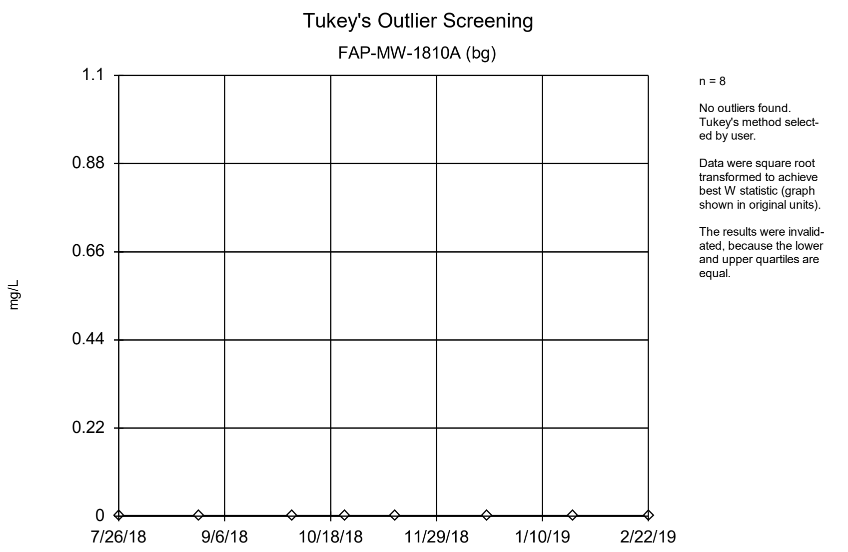

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.5665, low cutoff = 0.02199, based on IQR multiplier of 3.
mg/L
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.4153, low cutoff = 0.1349, based on IQR multiplier of 3.
mg/L
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-6
n = 8
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.207, low cutoff = -0.0065, based on IQR multiplier of 3.
mg/L
Constituent: Boron Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

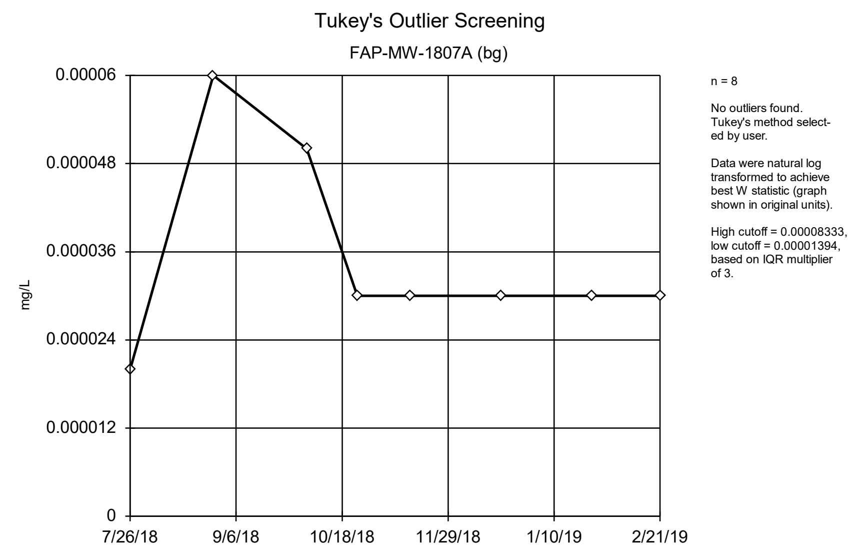

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1809A (bg)
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
mg/L
Constituent: Cadmium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



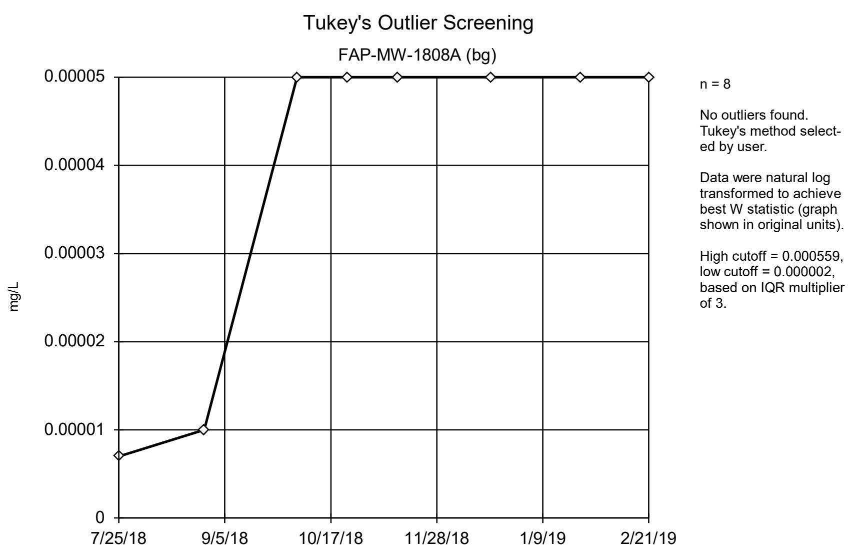
Constituent: Cadmium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



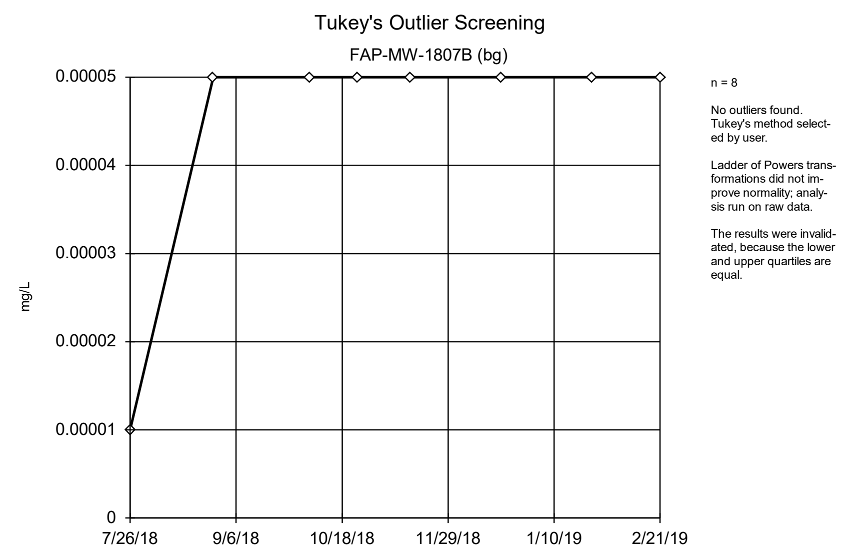
Constituent: Cadmium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Cadmium Analysis Run 4/18/2019 4:52 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

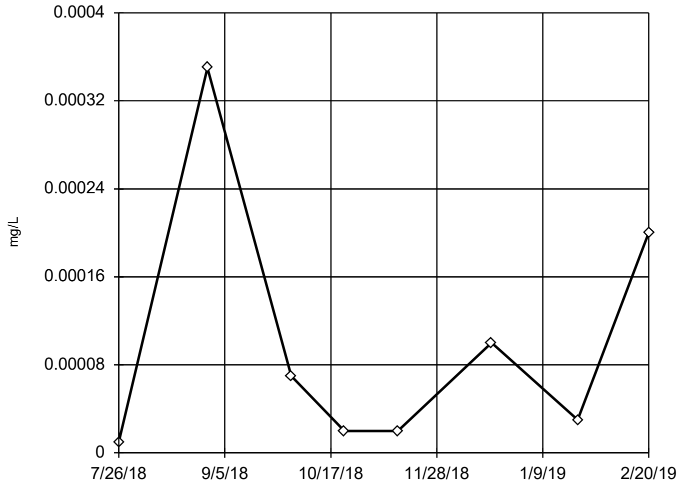
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening

FAP-MW-9



n = 8

No outliers found. Tukey's method selected by user.

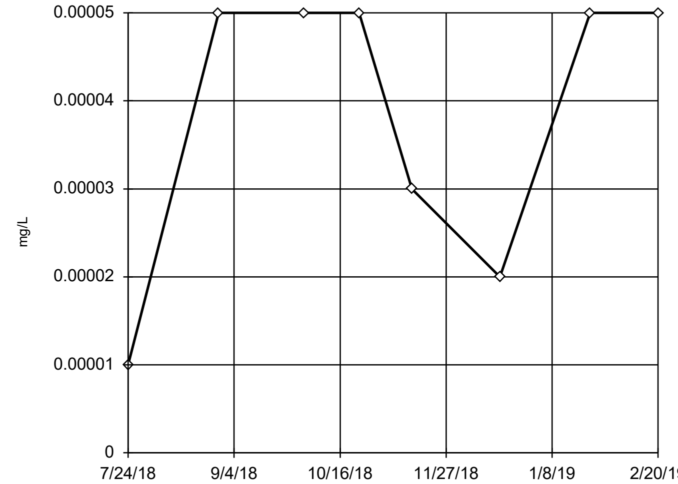
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.05, low cutoff = 5.7e-8, based on IQR multiplier of 3.

Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening

FAP-MW-1801A



n = 8

No outliers found. Tukey's method selected by user.

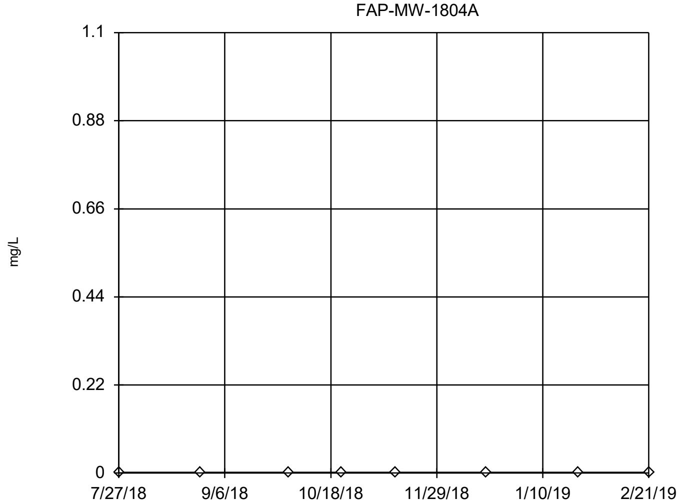
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0001785, low cutoff = -0.000001728, based on IQR multiplier of 3.

Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening

FAP-MW-1804A



n = 8

No outliers found. Tukey's method selected by user.

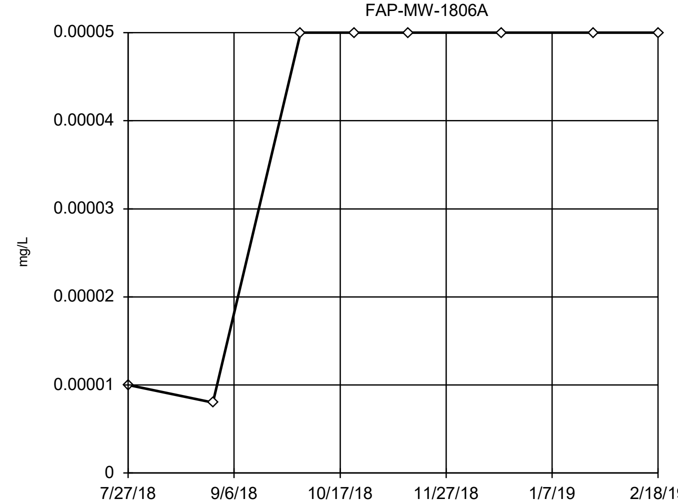
Data were square root transformed to achieve best W statistic (graph shown in original units).

The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening

FAP-MW-1806A



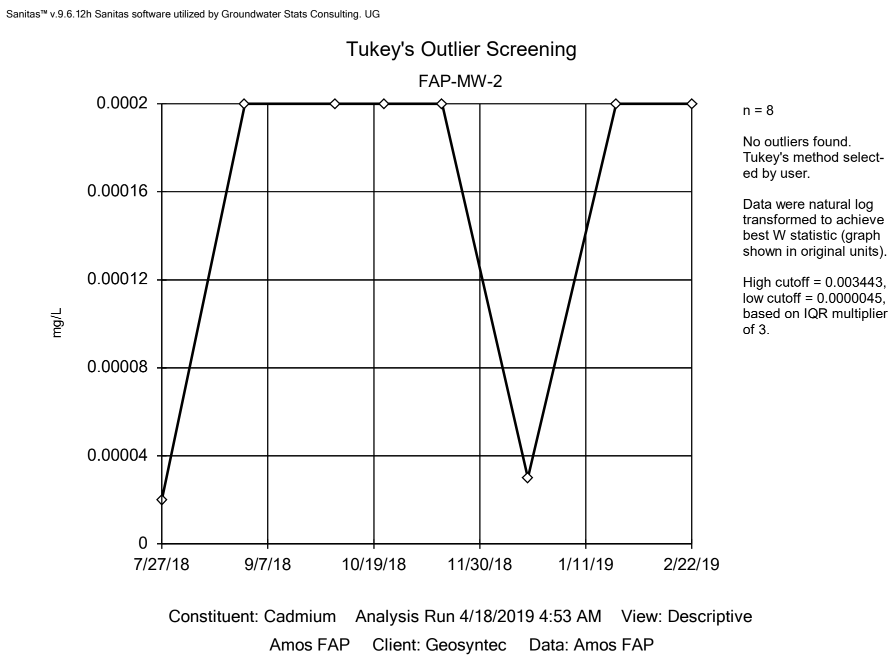
n = 8

No outliers found. Tukey's method selected by user.

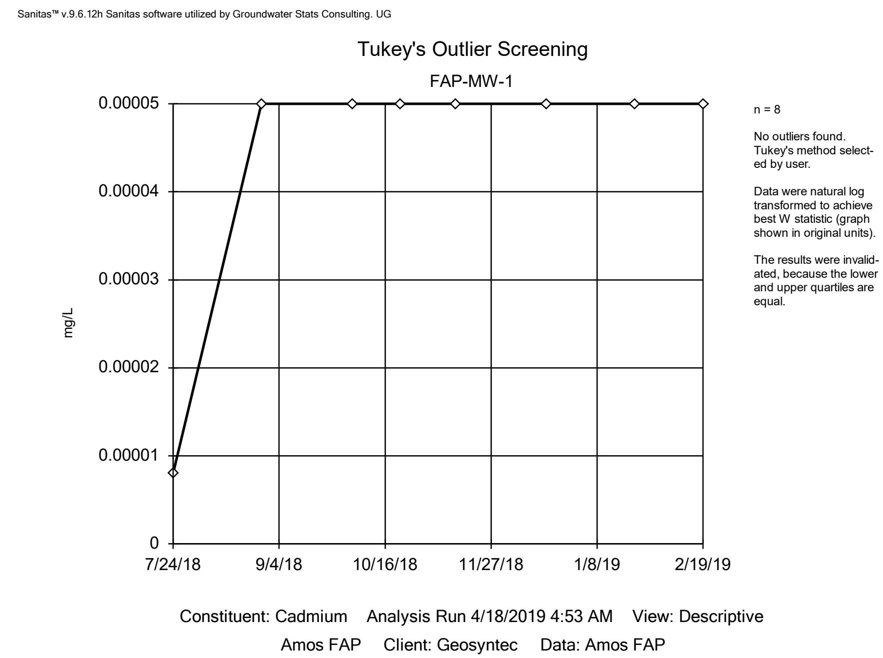
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.000559, low cutoff = 0.000002, based on IQR multiplier of 3.

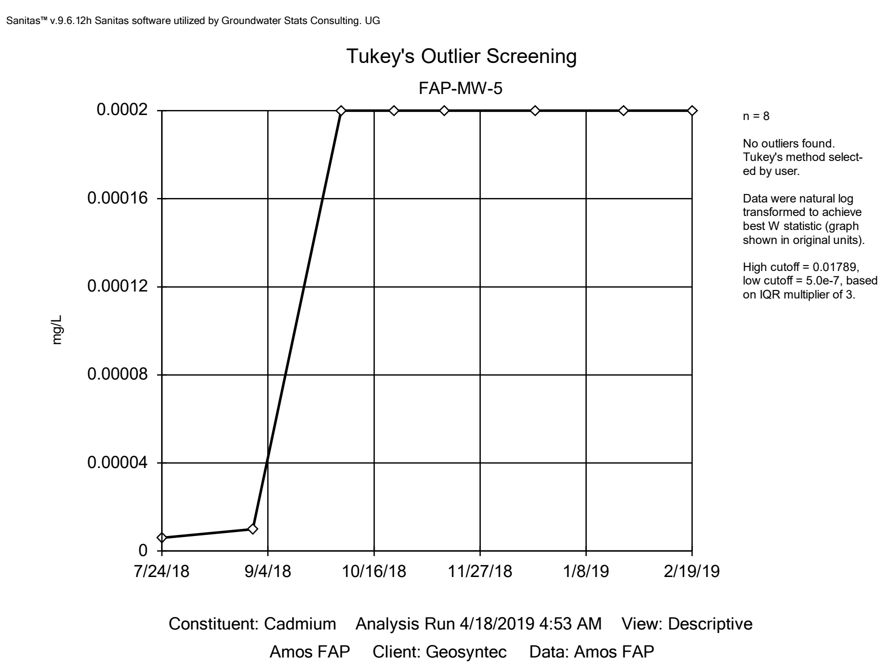
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



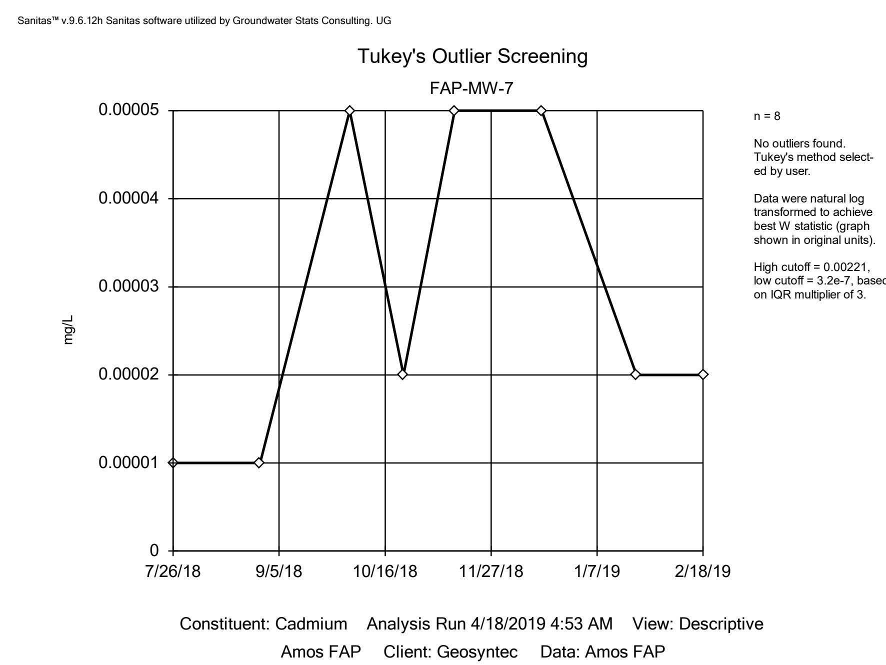
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-2
mg/L
0.0002
0.00016
0.00012
0.00008
0.00004
0
7/27/18
9/7/18
10/19/18
11/30/18
1/11/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.003443, low cutoff = 0.0000045, based on IQR multiplier of 3.
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



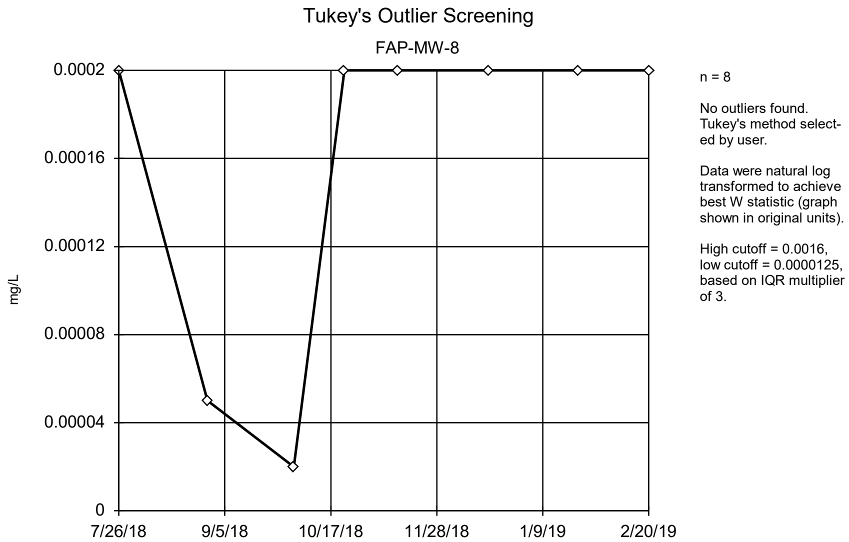
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1
mg/L
0.00005
0.00004
0.00003
0.00002
0.00001
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-5
mg/L
0.0002
0.00016
0.00012
0.00008
0.00004
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.01789, low cutoff = 5.0e-7, based on IQR multiplier of 3.
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

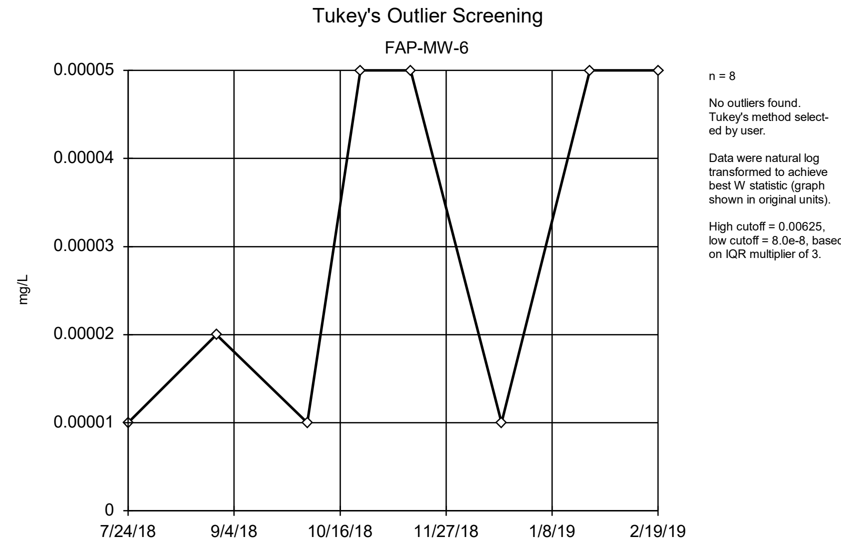


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
mg/L
0.00005
0.00004
0.00003
0.00002
0.00001
0
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.00221, low cutoff = 3.2e-7, based on IQR multiplier of 3.
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



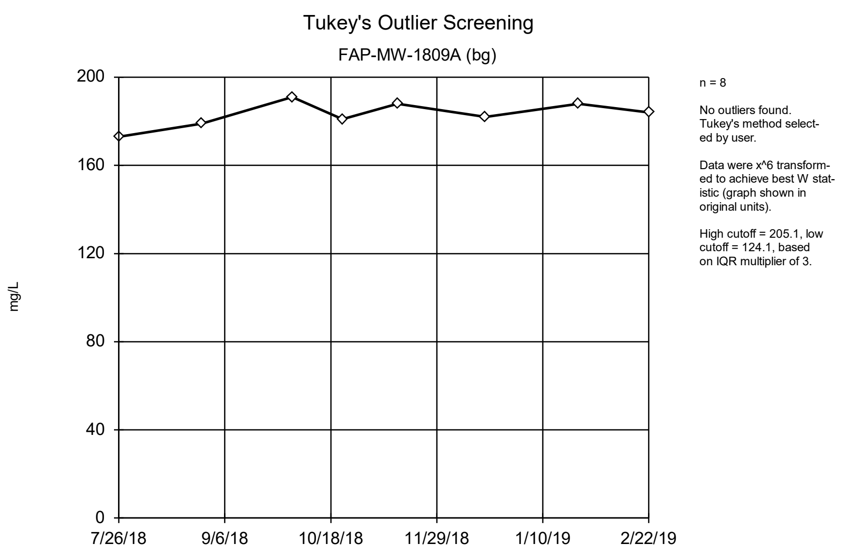
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



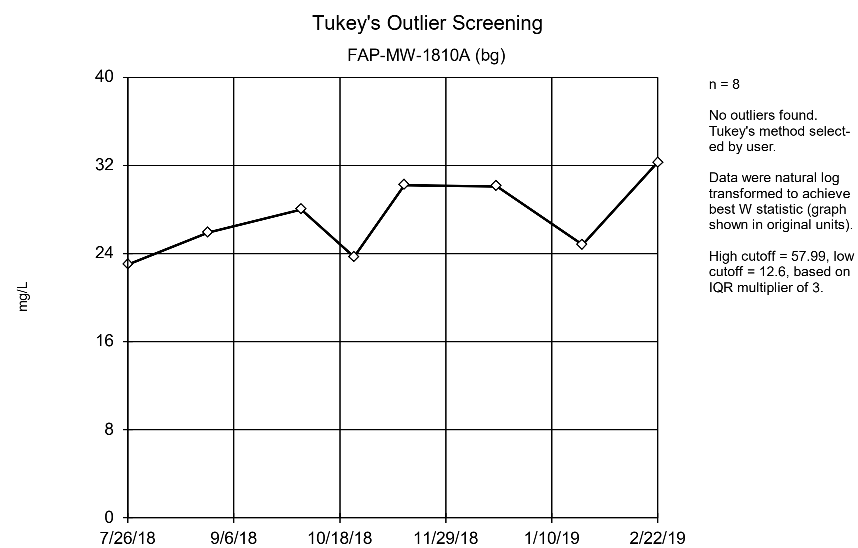
Constituent: Cadmium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



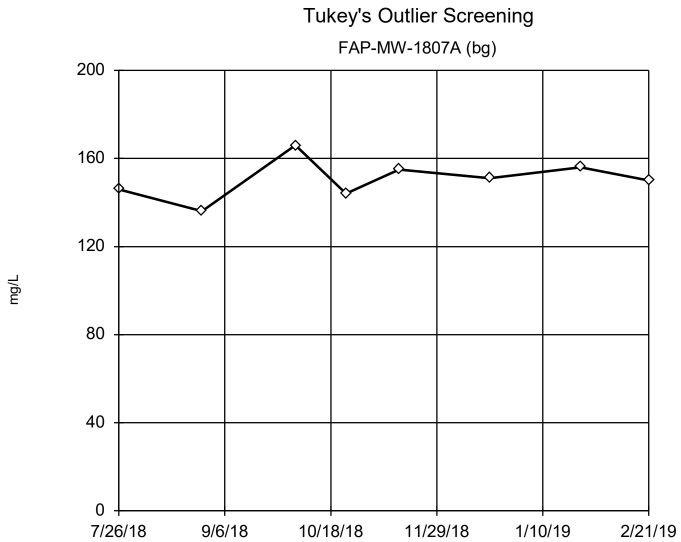
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

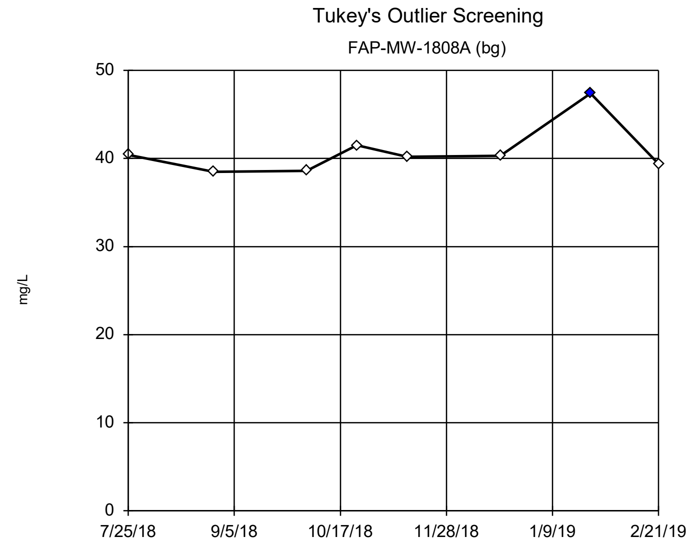
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 191.8, low cutoff = 117.6, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

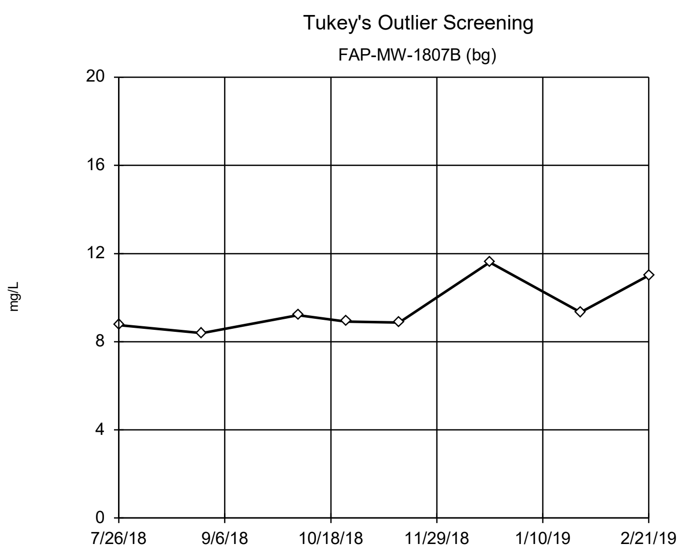
Outlier is drawn as solid. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 47.4, low cutoff = 33.69, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



n = 8

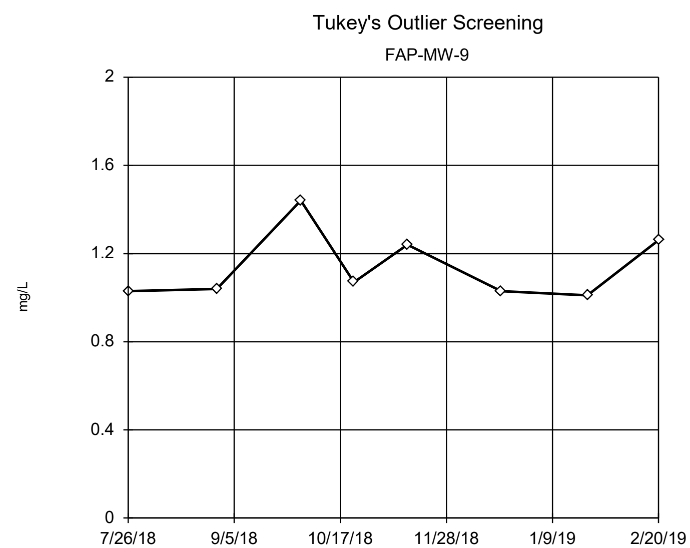
No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 15.38, low cutoff = 5.807, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



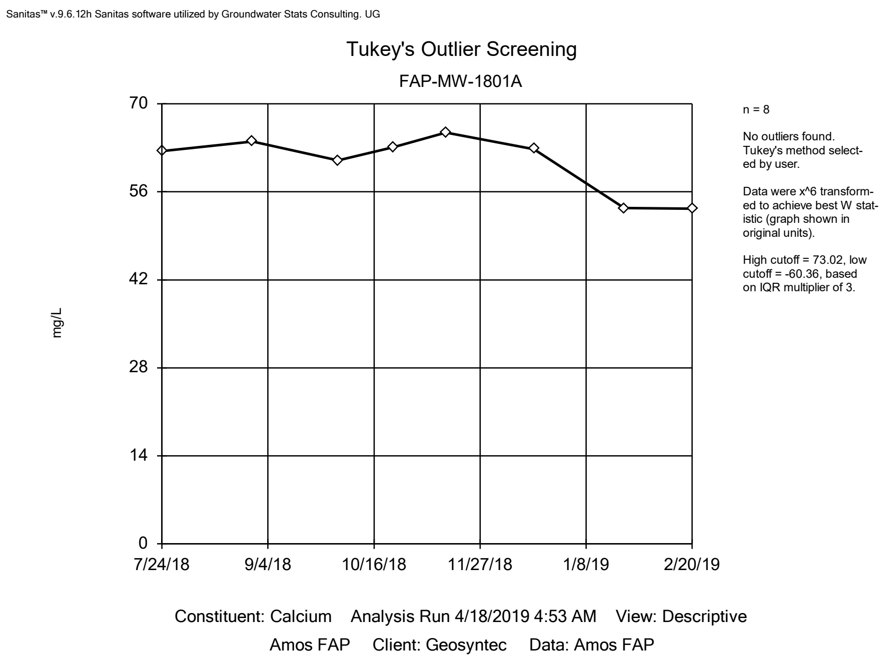
n = 8

No outliers found. Tukey's method selected by user.

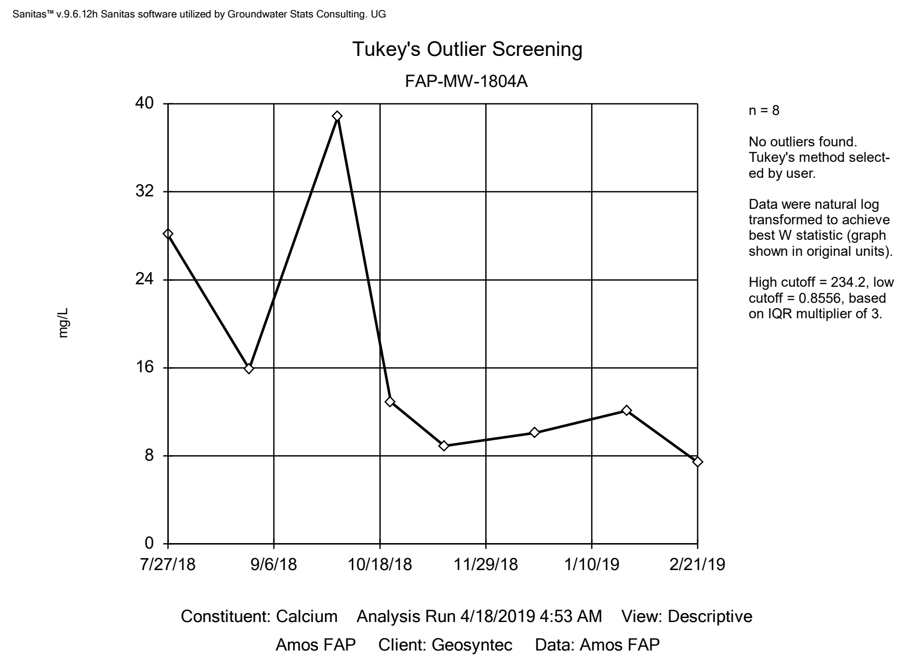
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 2.234, low cutoff = 0.5763, based on IQR multiplier of 3.

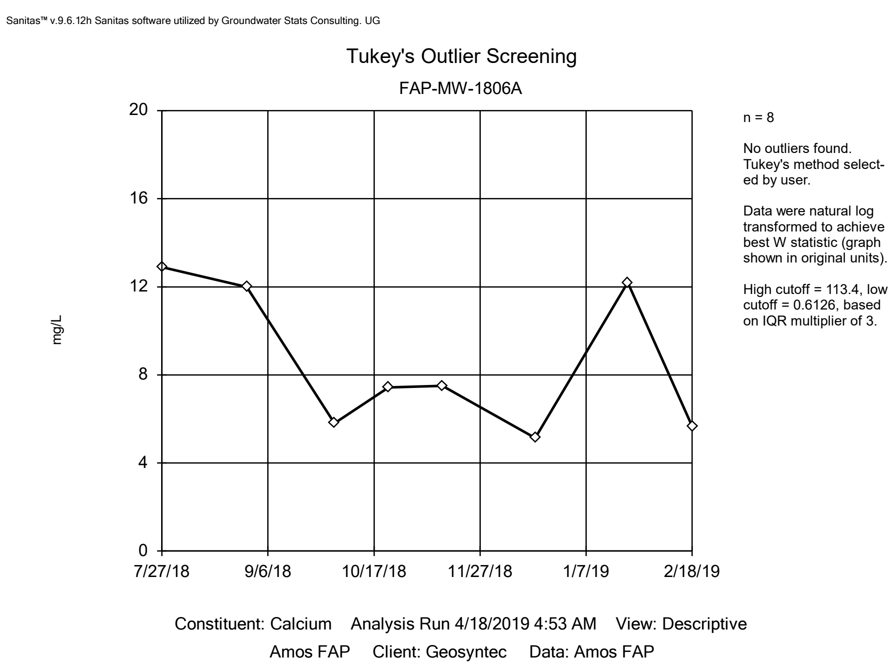
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



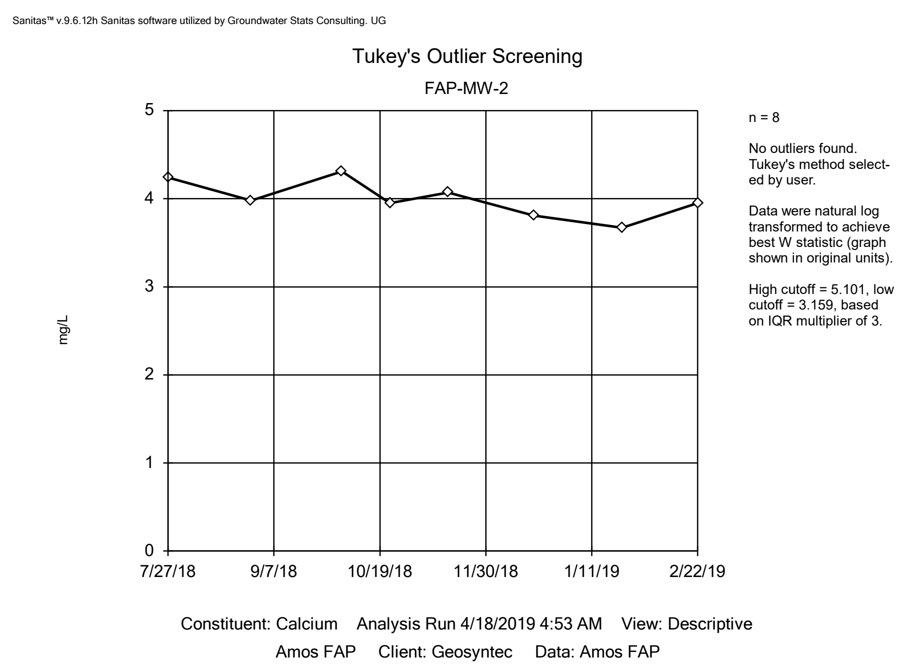
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1801A
mg/L
70
56
42
28
14
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 73.02, low cutoff = -60.36, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
mg/L
40
32
24
16
8
0
7/27/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 234.2, low cutoff = 0.8556, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

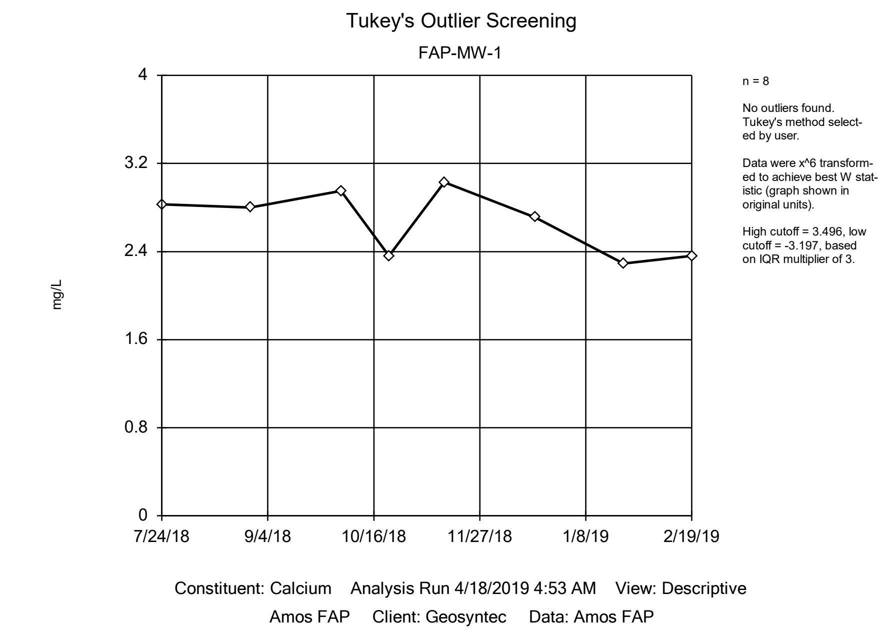


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
mg/L
20
16
12
8
4
0
7/27/18
9/6/18
10/17/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 113.4, low cutoff = 0.6126, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

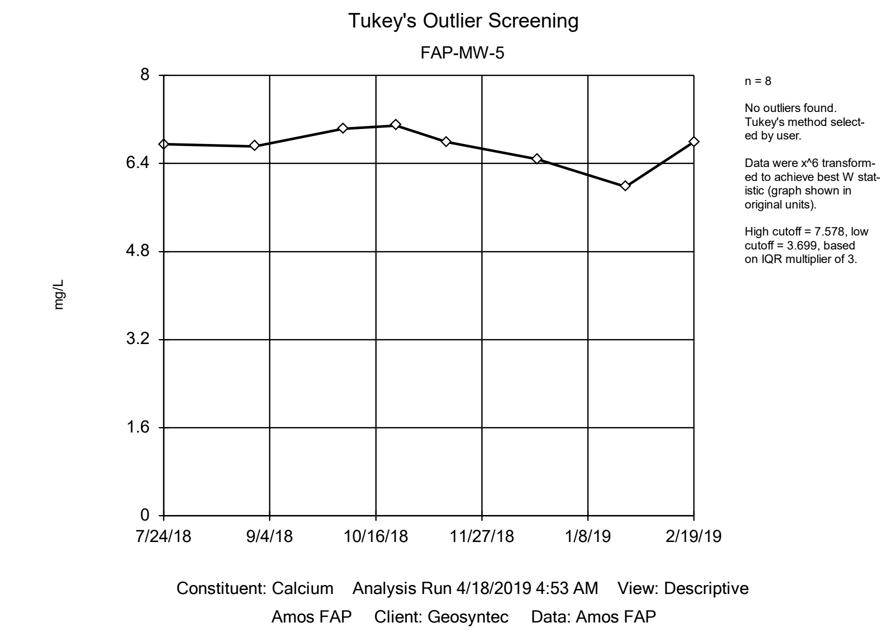


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-2
mg/L
5
4
3
2
1
0
7/27/18
9/7/18
10/19/18
11/30/18
1/11/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 5.101, low cutoff = 3.159, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

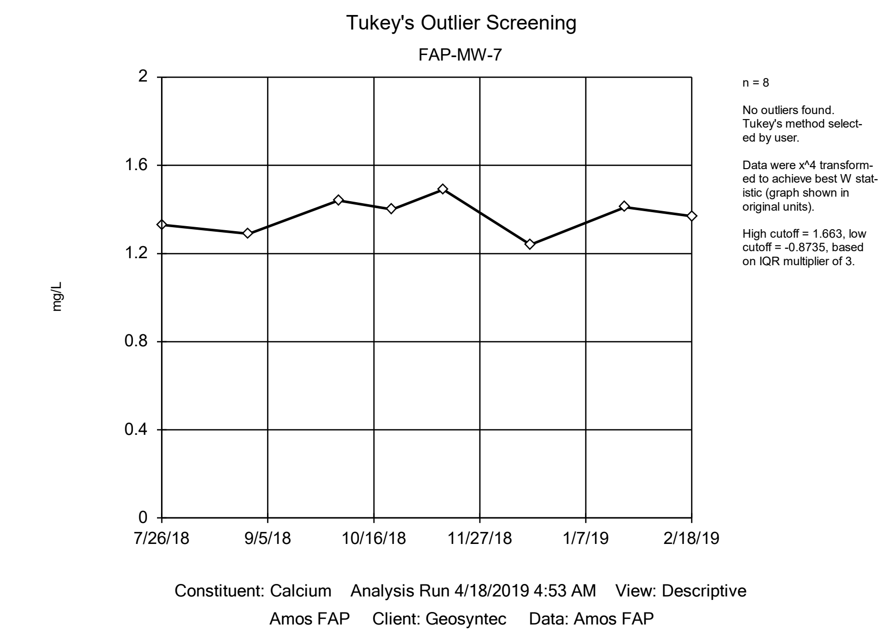
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



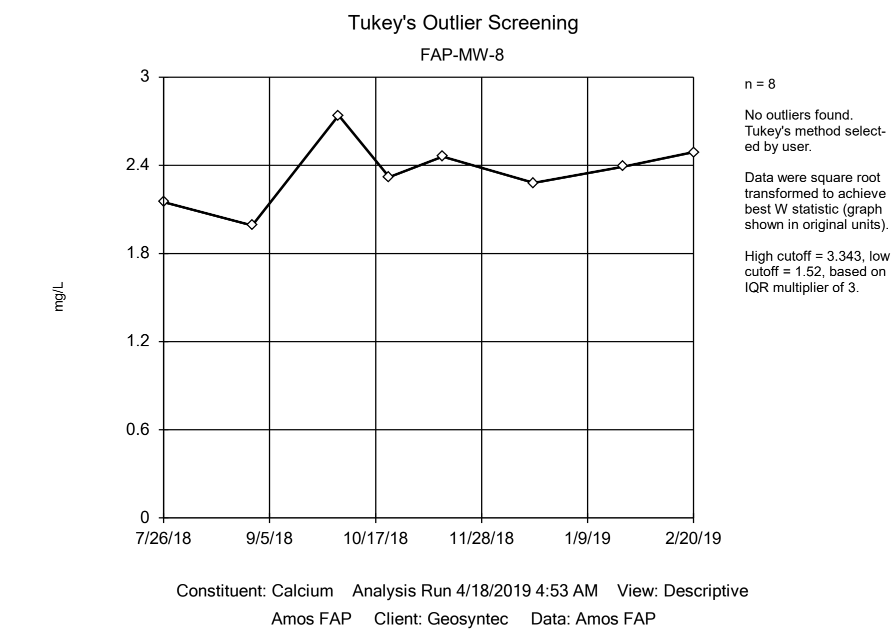
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

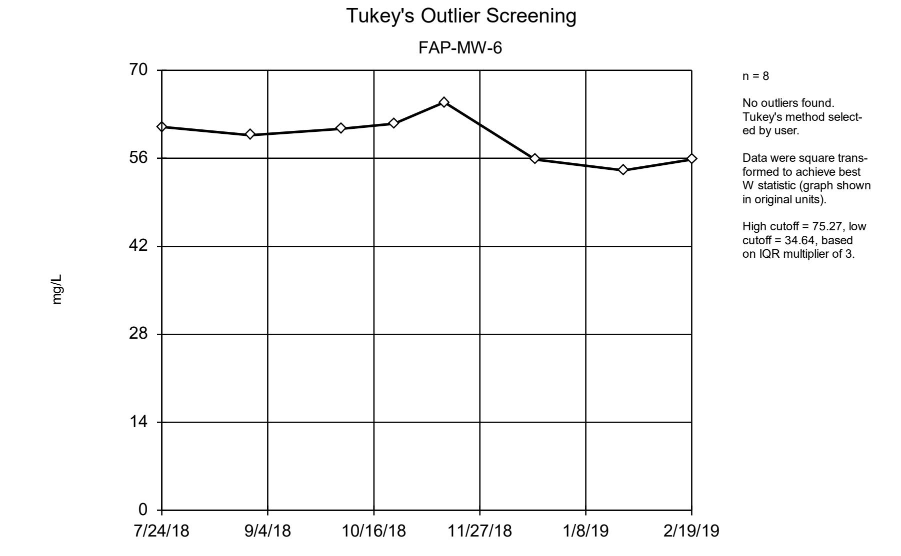


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



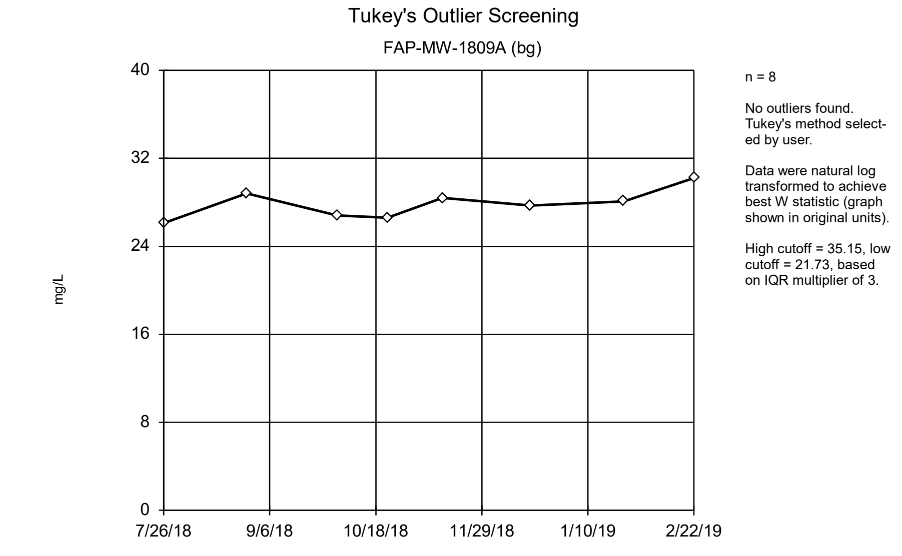
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG





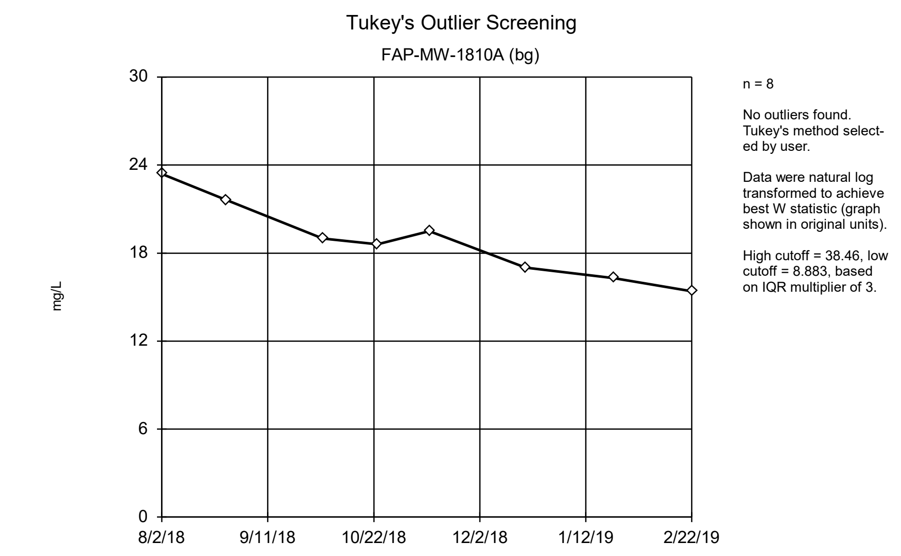
Constituent: Calcium Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



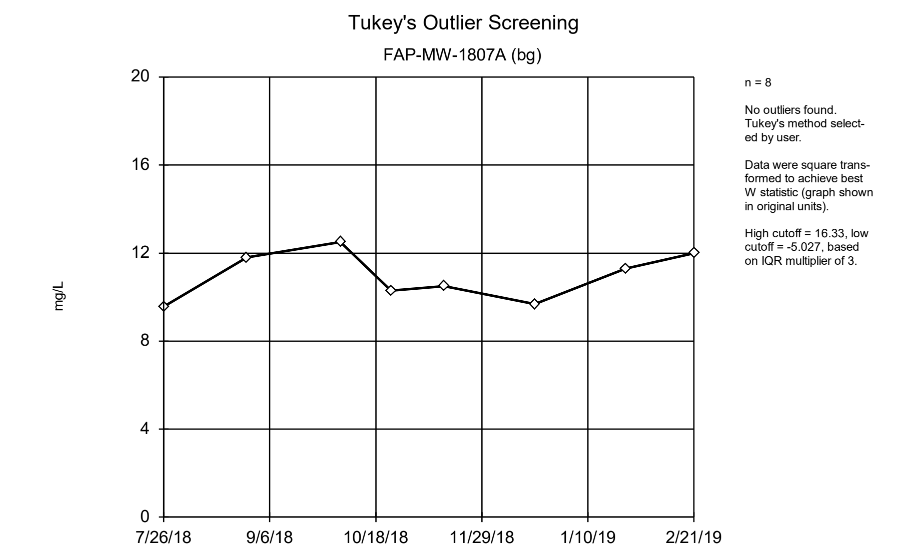
Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

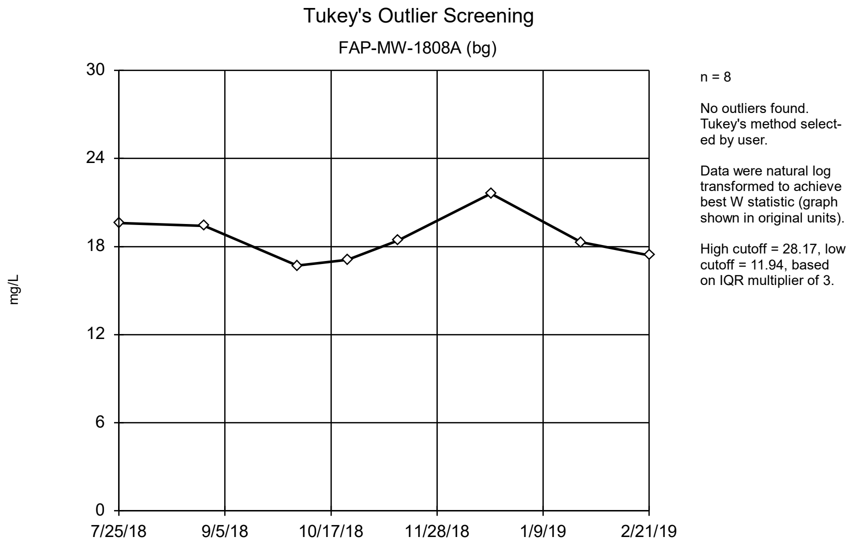


Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

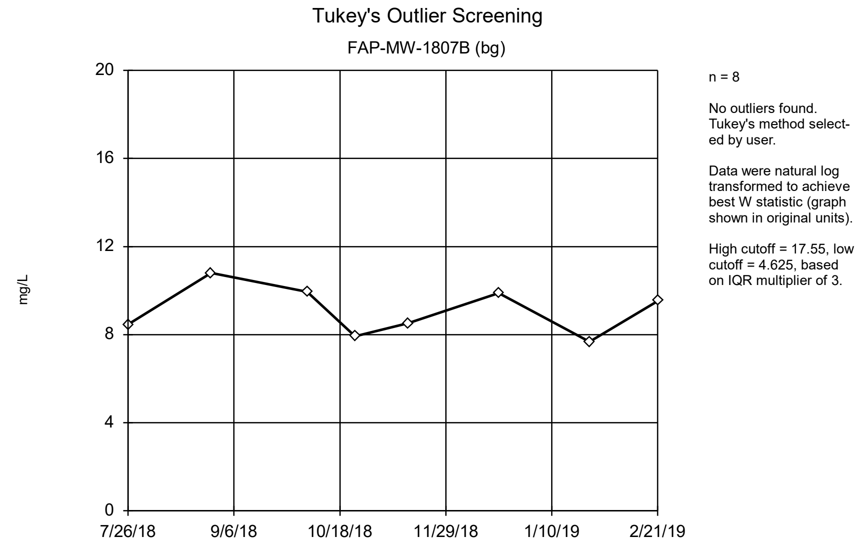


Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



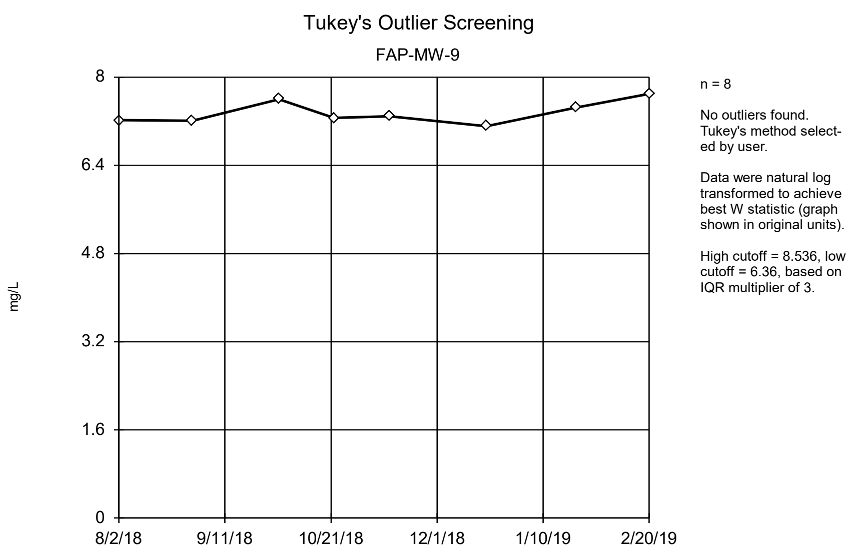
Constituent: Chloride   Analysis Run 4/18/2019 4:53 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



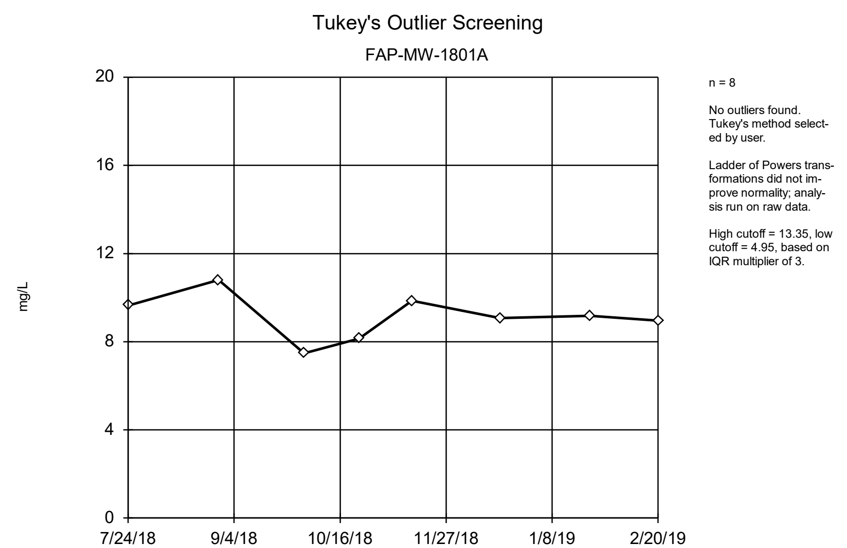
Constituent: Chloride   Analysis Run 4/18/2019 4:53 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

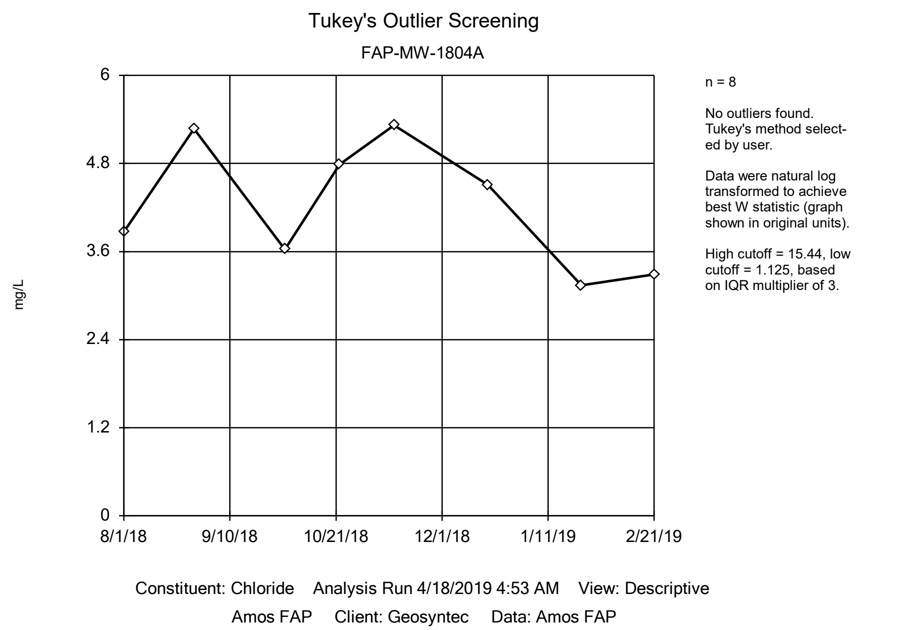


Constituent: Chloride   Analysis Run 4/18/2019 4:53 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

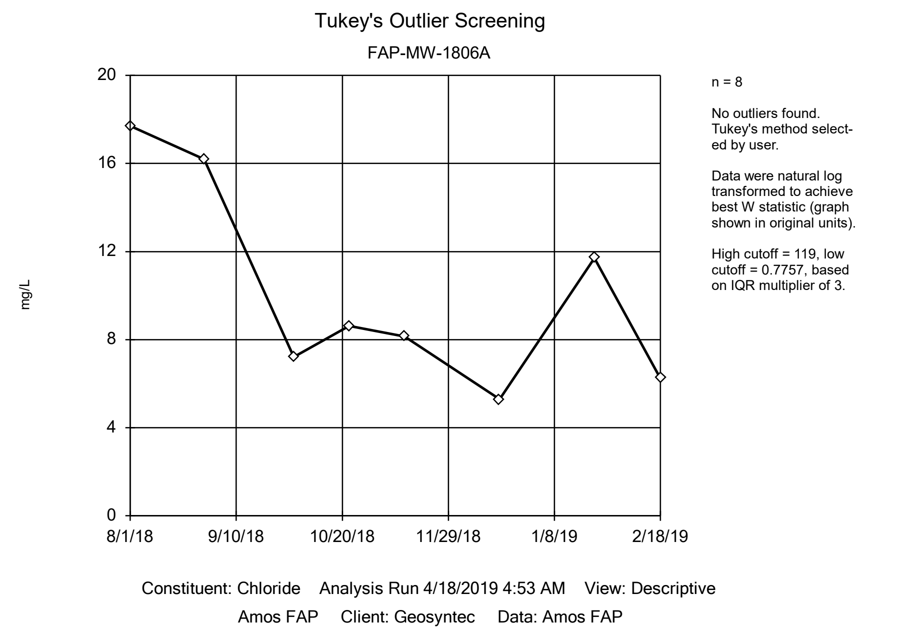
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



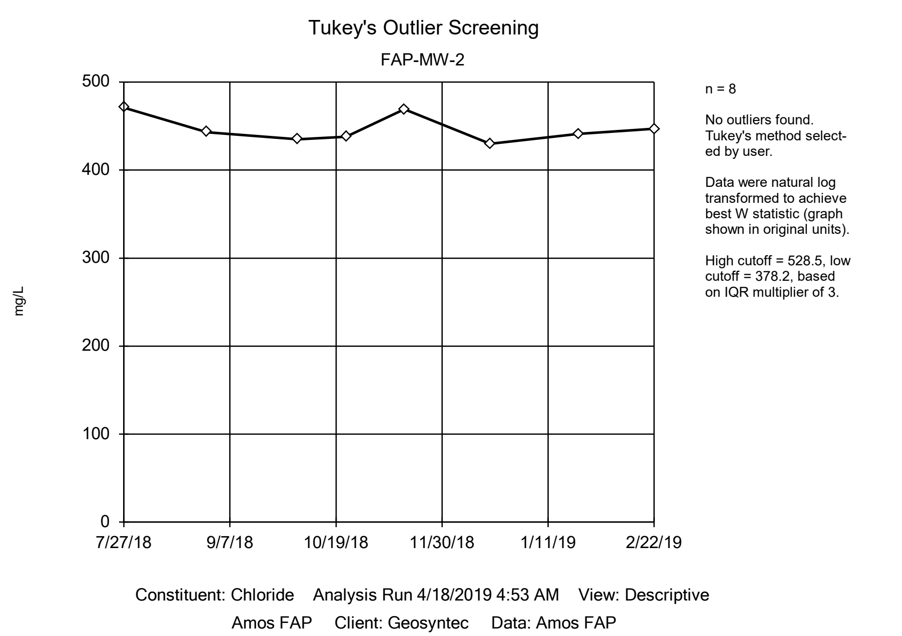
Constituent: Chloride   Analysis Run 4/18/2019 4:53 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP



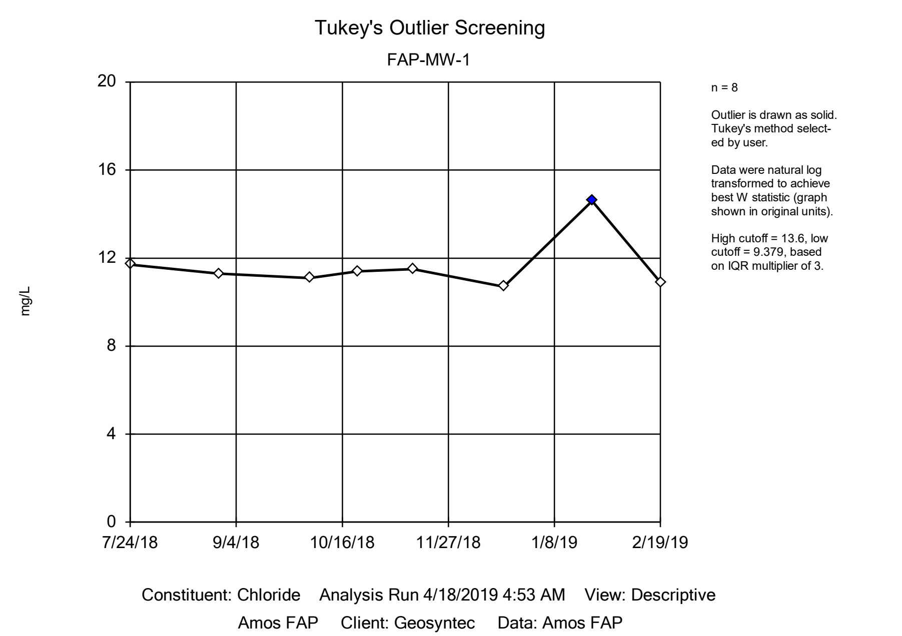
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



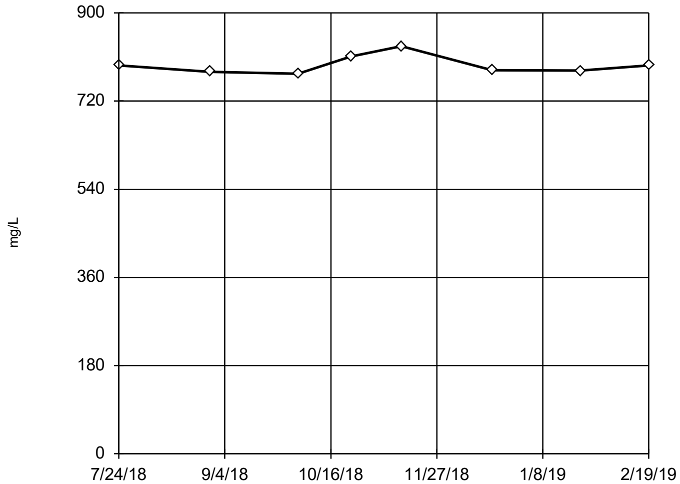
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

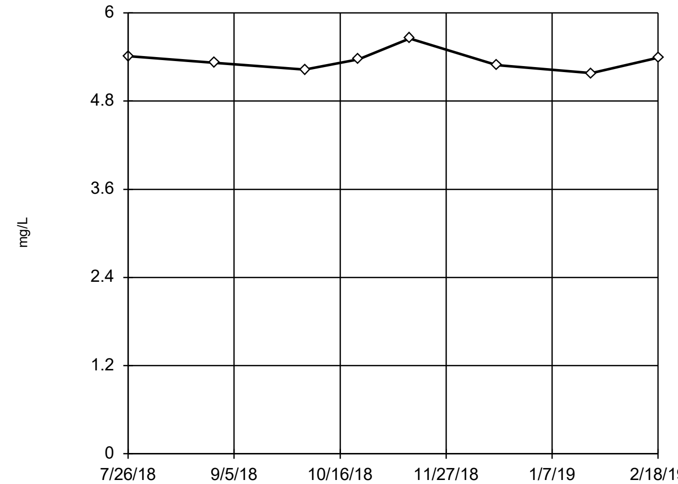
High cutoff = 868.2, low cutoff = 721.4, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

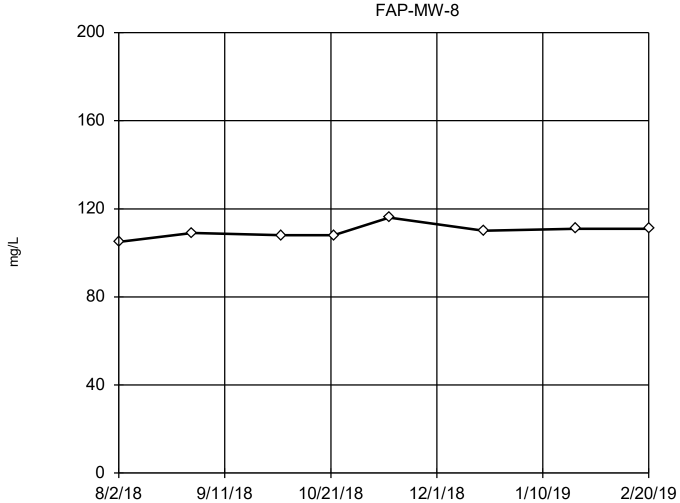
High cutoff = 5.843, low cutoff = 4.861, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

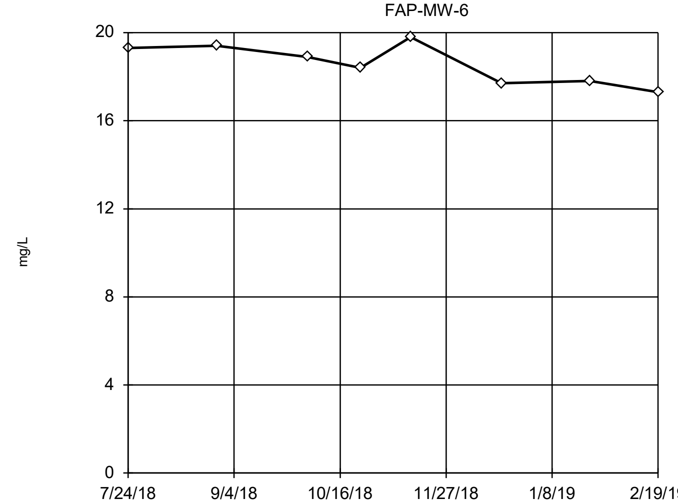
High cutoff = 120.5, low cutoff = 99.48, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



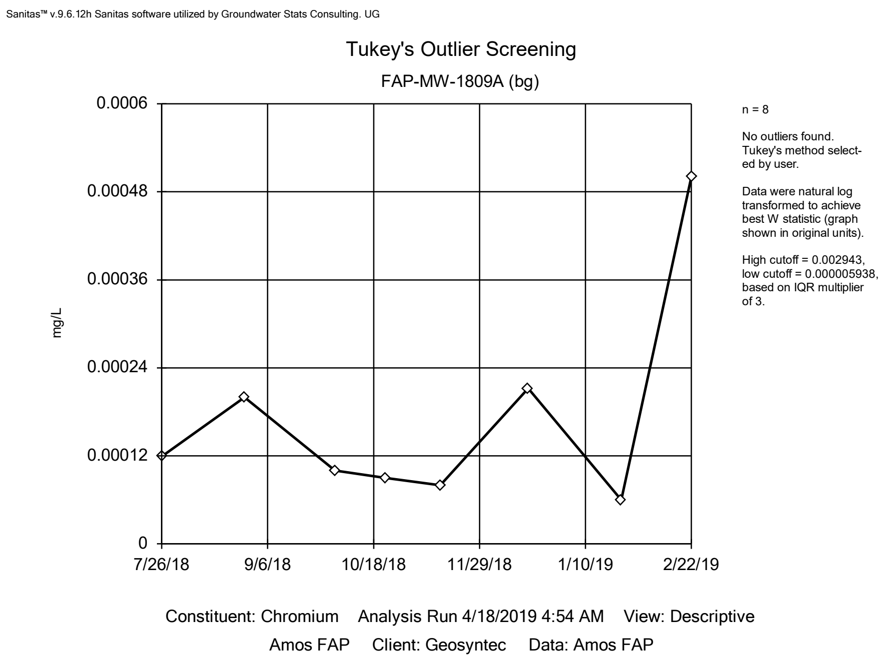
n = 8

No outliers found. Tukey's method selected by user.

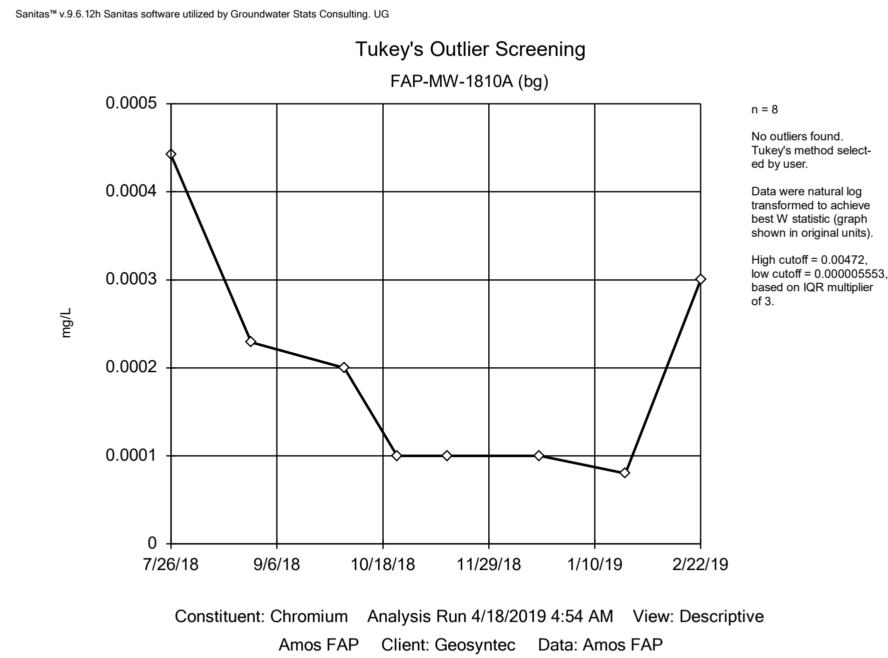
Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 22.65, low cutoff = -12.38, based on IQR multiplier of 3.

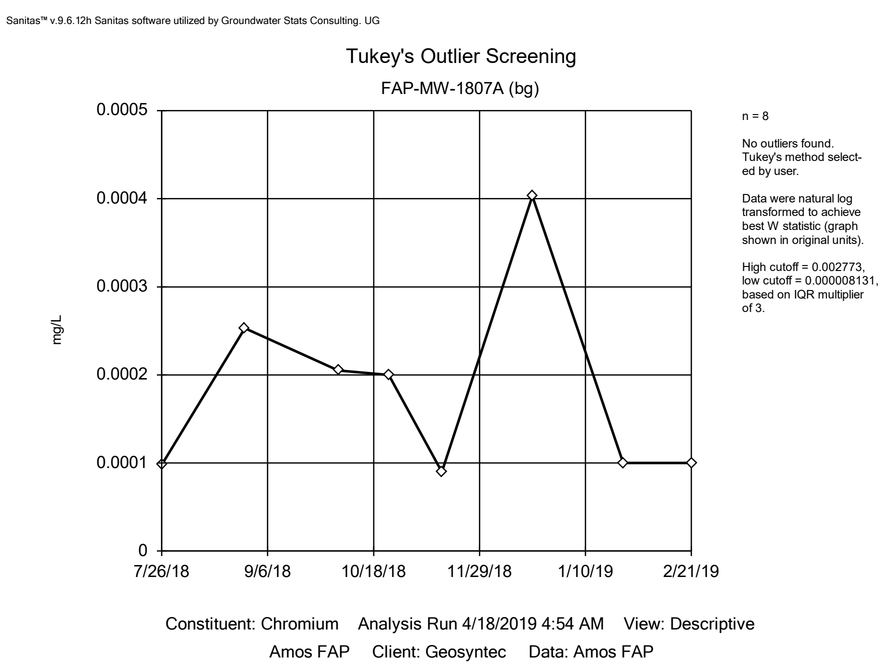
Constituent: Chloride Analysis Run 4/18/2019 4:53 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



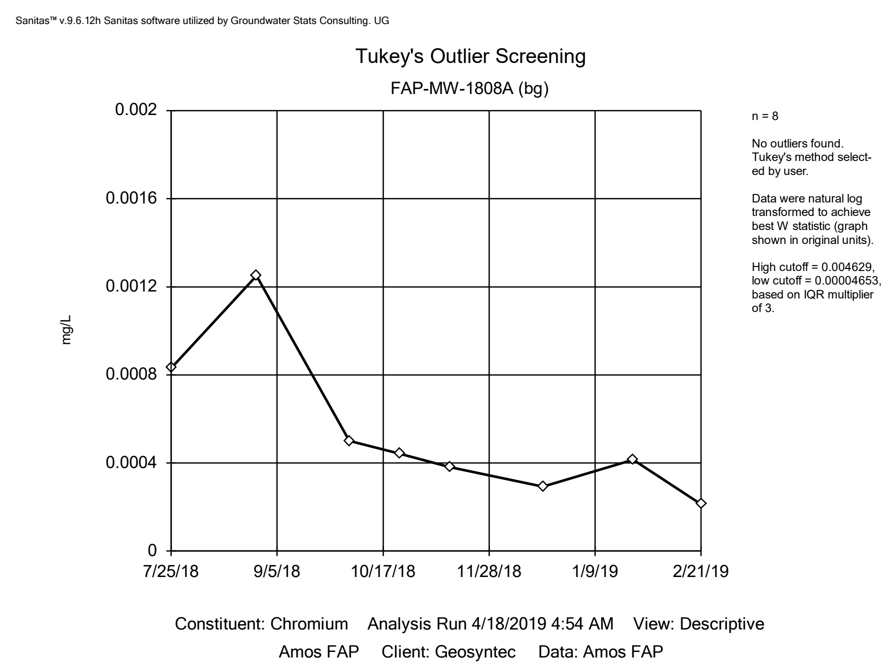
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1809A (bg)
0.0006
0.00048
0.00036
0.00024
0.00012
0
mg/L
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.002943, low cutoff = 0.000005938, based on IQR multiplier of 3.
Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1810A (bg)
0.0005
0.0004
0.0003
0.0002
0.0001
0
mg/L
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.00472, low cutoff = 0.000005553, based on IQR multiplier of 3.
Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1807A (bg)
0.0005
0.0004
0.0003
0.0002
0.0001
0
mg/L
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.002773, low cutoff = 0.000008131, based on IQR multiplier of 3.
Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

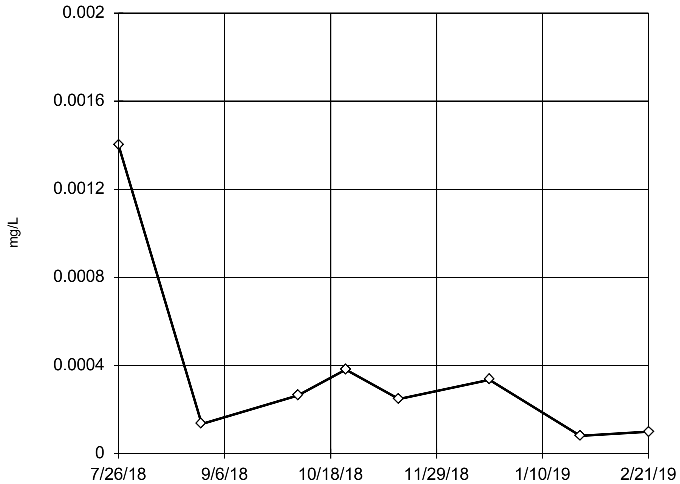


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1808A (bg)
0.002
0.0016
0.0012
0.0008
0.0004
0
mg/L
7/25/18
9/5/18
10/17/18
11/28/18
1/9/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.004629, low cutoff = 0.00004653, based on IQR multiplier of 3.
Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

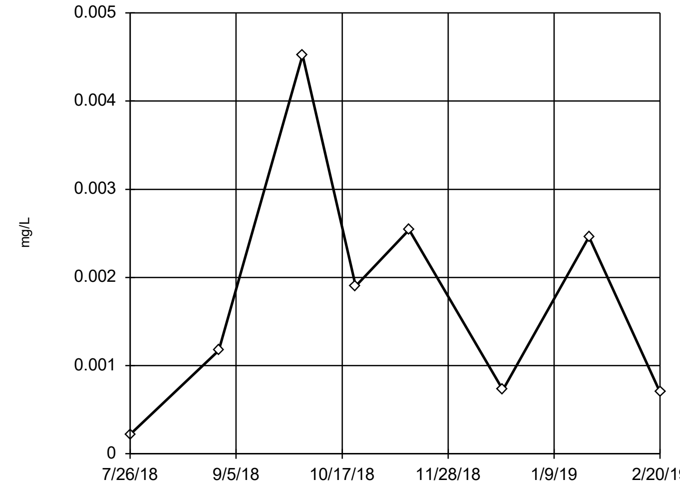
High cutoff = 0.0105, low cutoff = 0.000003938, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

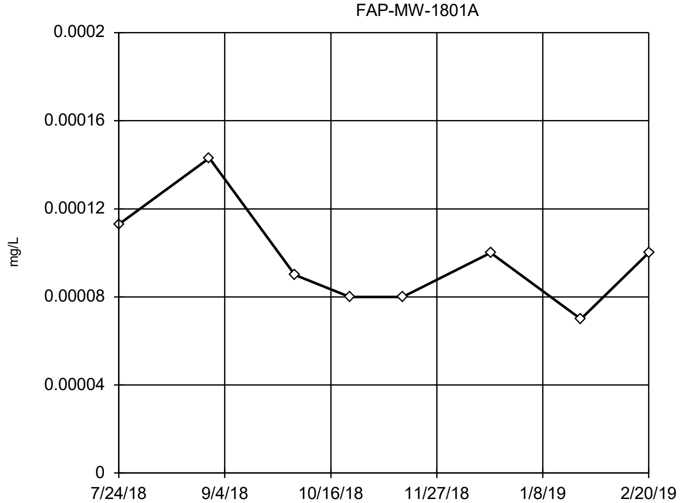
High cutoff = 0.02078, low cutoff = -0.0001243, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1801A



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

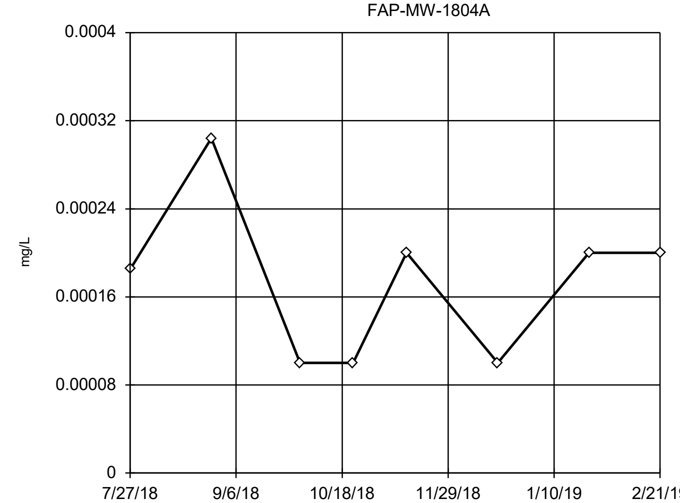
High cutoff = 0.0002494, low cutoff = 0.0000341, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1804A



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

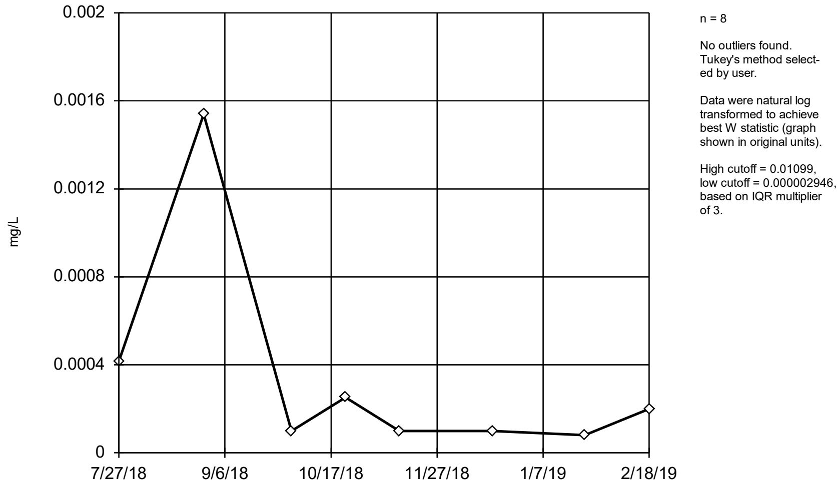
High cutoff = 0.0005, low cutoff = -0.0002, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1806A

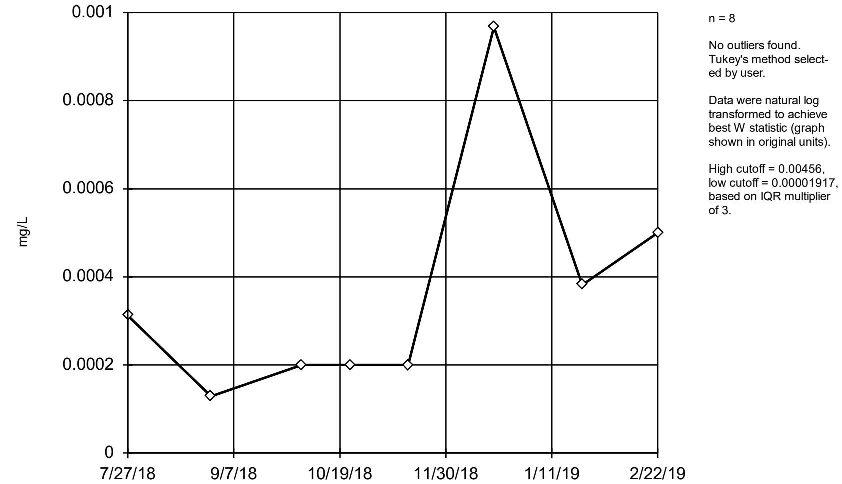


Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2

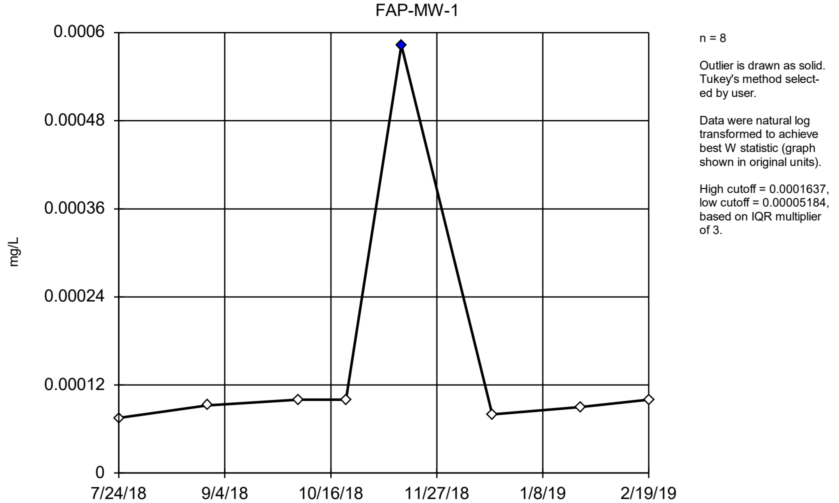


Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1

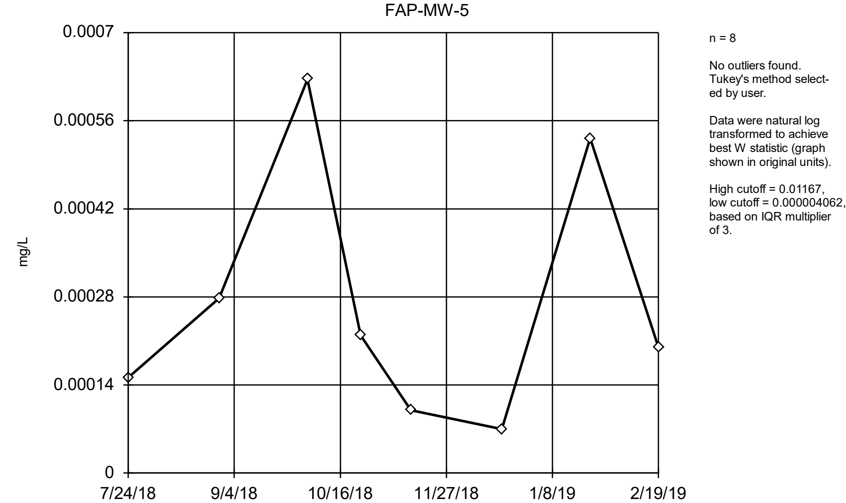


Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5

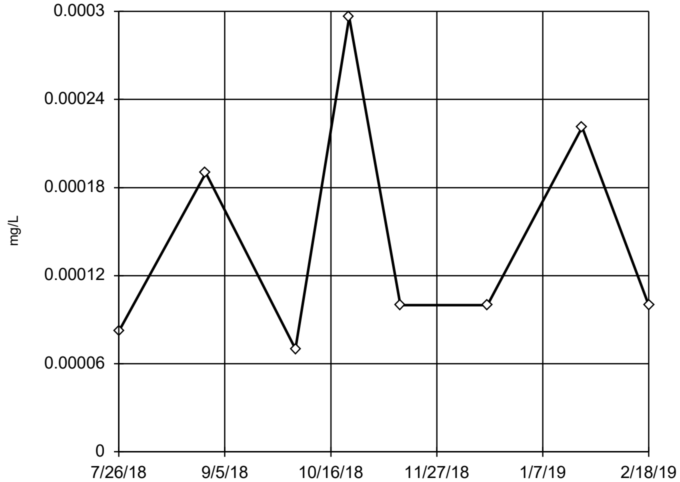


Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

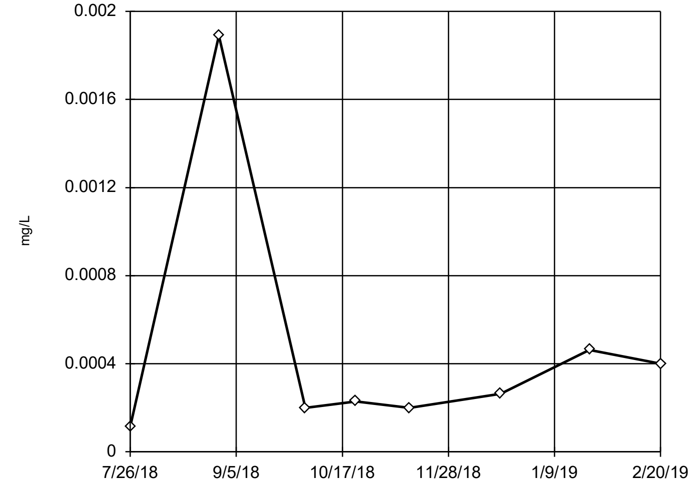
High cutoff = 0.002374, low cutoff = 0.000007815, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

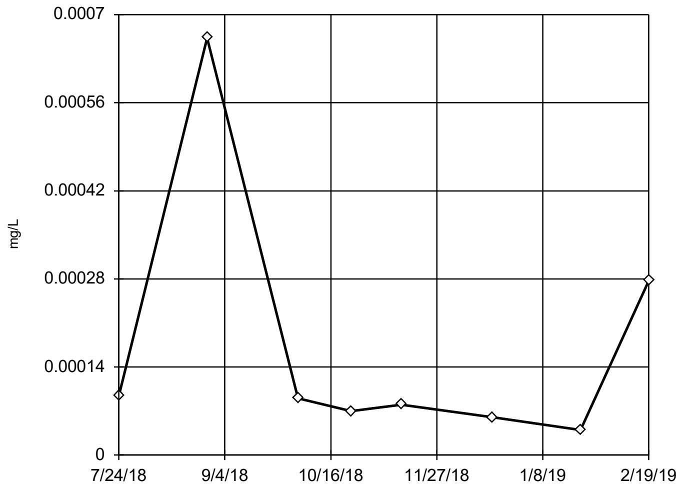
High cutoff = 0.004287, low cutoff = 0.00002008, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

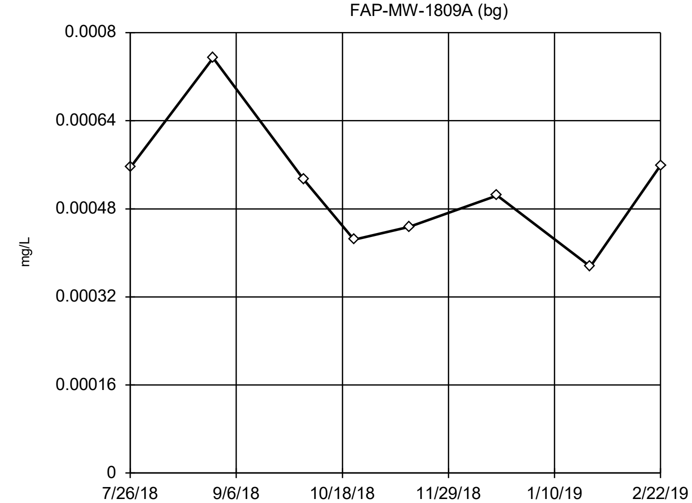
High cutoff = 0.002491, low cutoff = 0.000004198, based on IQR multiplier of 3.

Constituent: Chromium Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1809A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

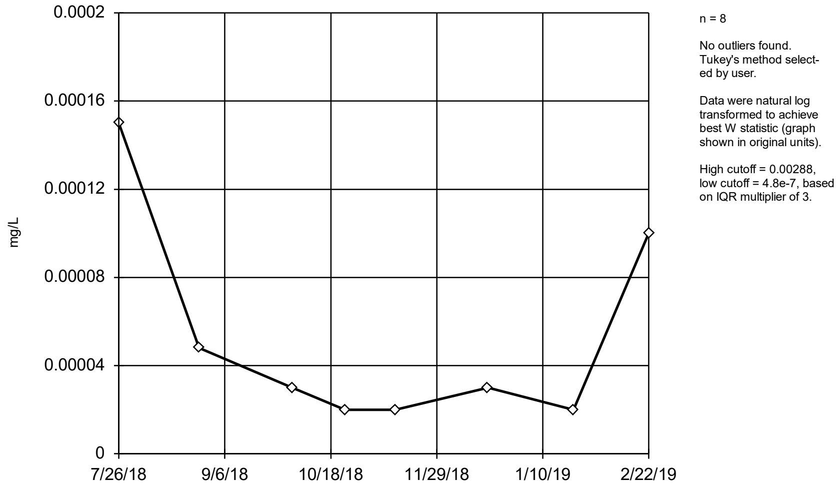
High cutoff = 0.001167, low cutoff = 0.0002079, based on IQR multiplier of 3.

Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1810A (bg)

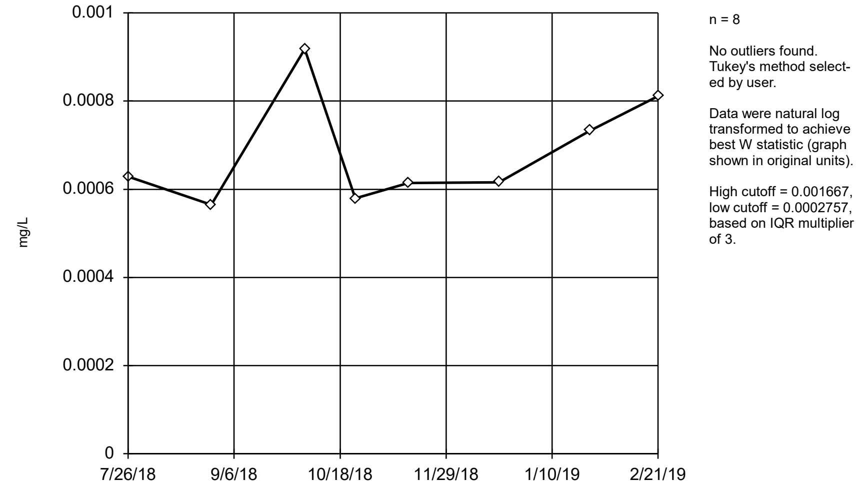


Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807A (bg)

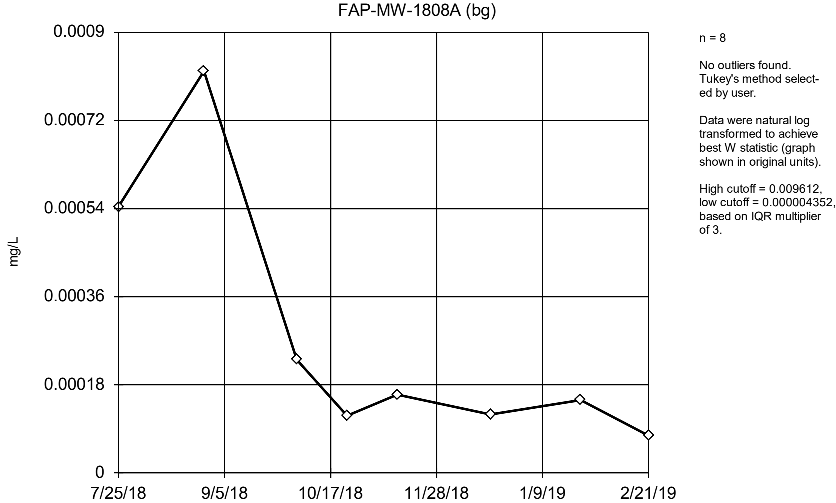


Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1808A (bg)

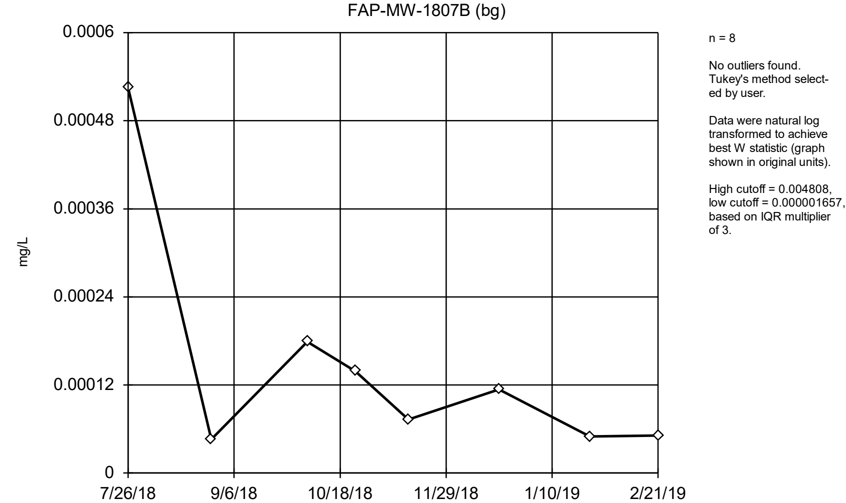


Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

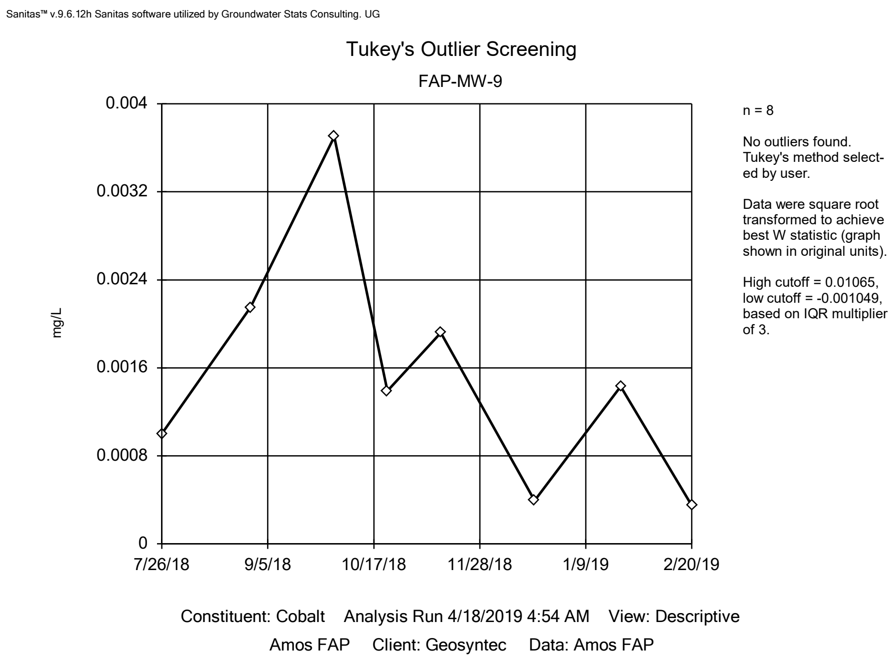
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

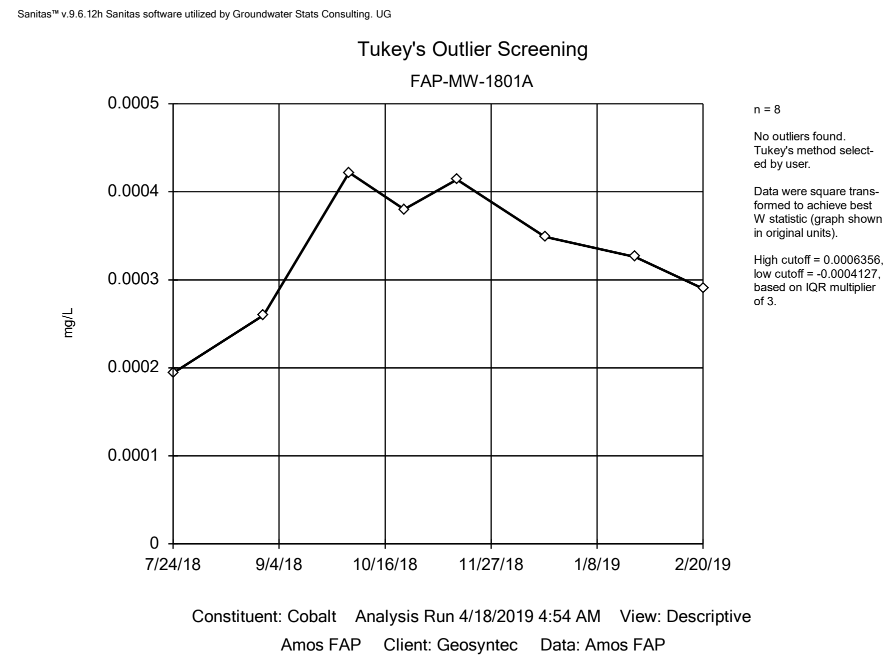
Tukey's Outlier Screening

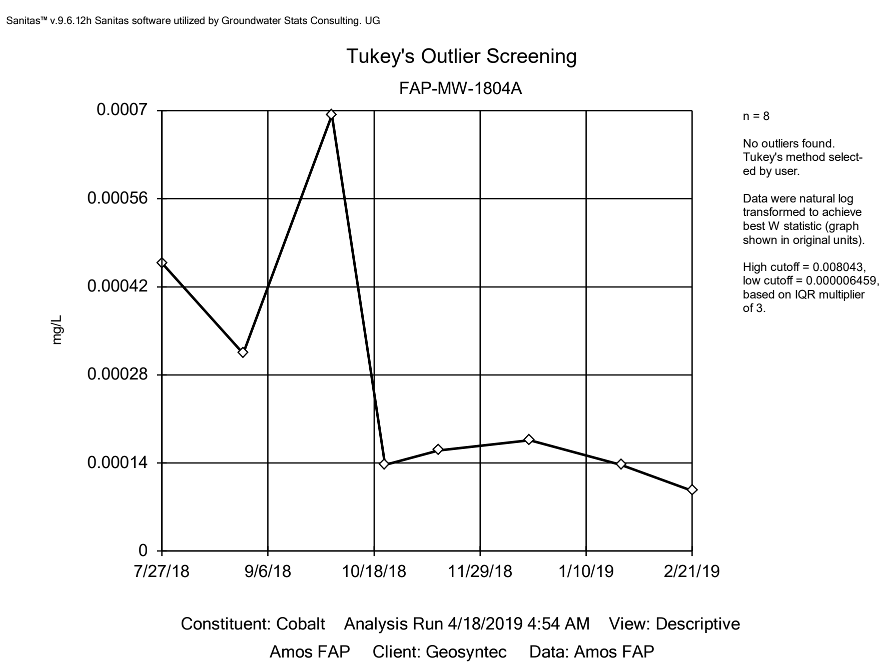
FAP-MW-1807B (bg)

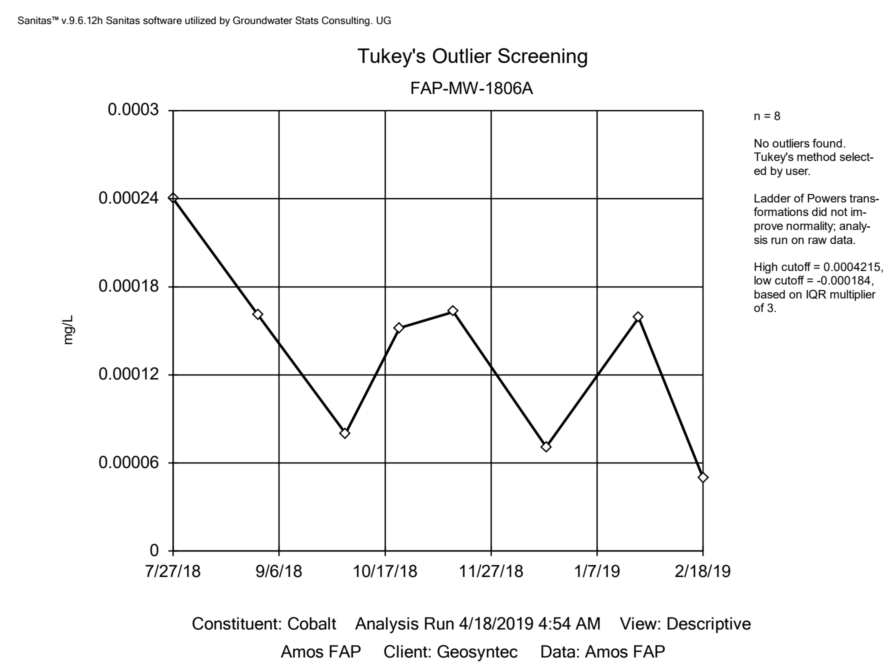


Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

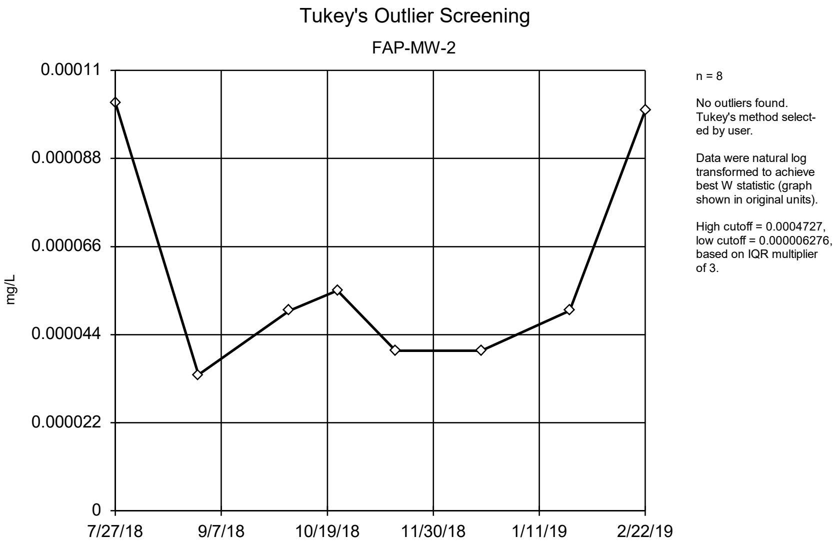

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-9
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.01065, low cutoff = -0.001049, based on IQR multiplier of 3.
mg/L
0.004
0.0032
0.0024
0.0016
0.0008
0
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1801A
n = 8
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0006356, low cutoff = -0.0004127, based on IQR multiplier of 3.
mg/L
0.0005
0.0004
0.0003
0.0002
0.0001
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.008043, low cutoff = 0.000006459, based on IQR multiplier of 3.
mg/L
0.0007
0.00056
0.00042
0.00028
0.00014
0
7/27/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

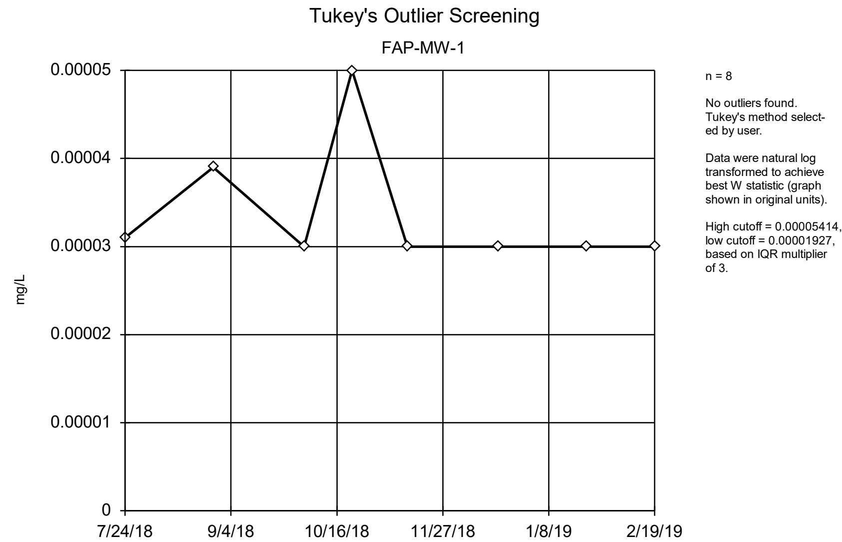

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
n = 8
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.0004215, low cutoff = -0.000184, based on IQR multiplier of 3.
mg/L
0.0003
0.00024
0.00018
0.00012
0.00006
0
7/27/18
9/6/18
10/17/18
11/27/18
1/7/19
2/18/19
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



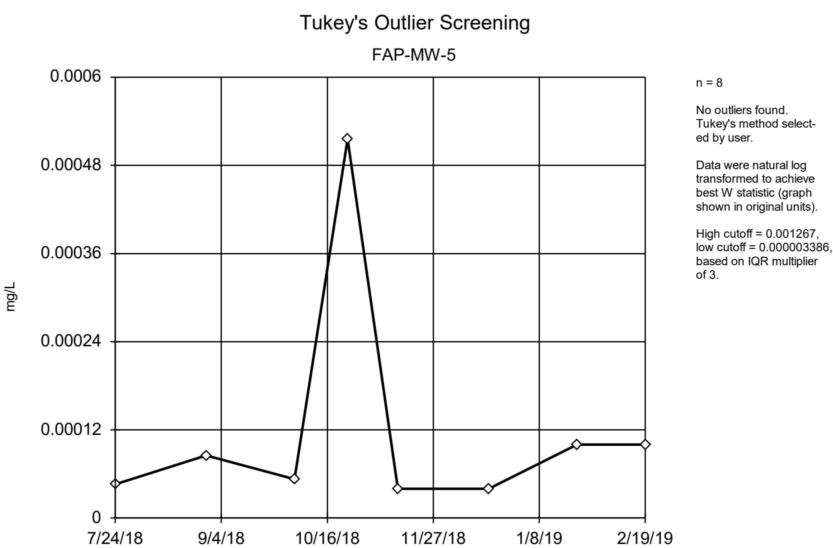
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



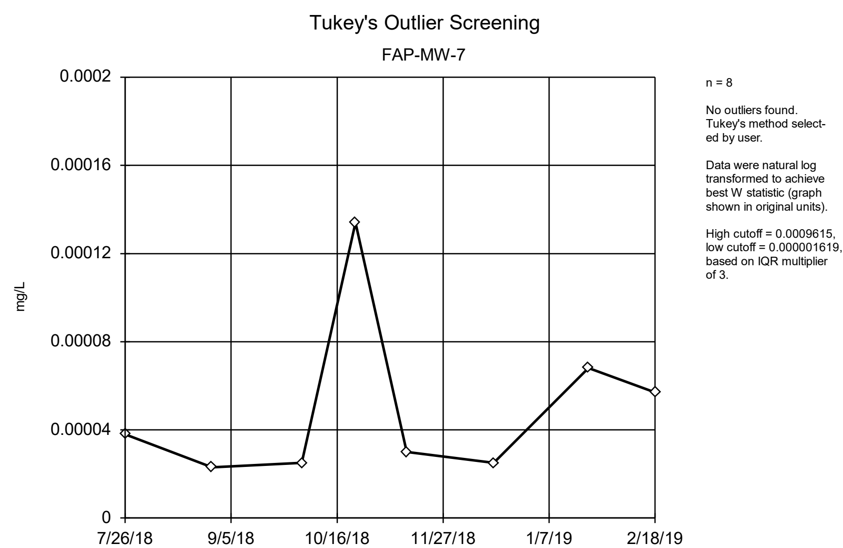
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



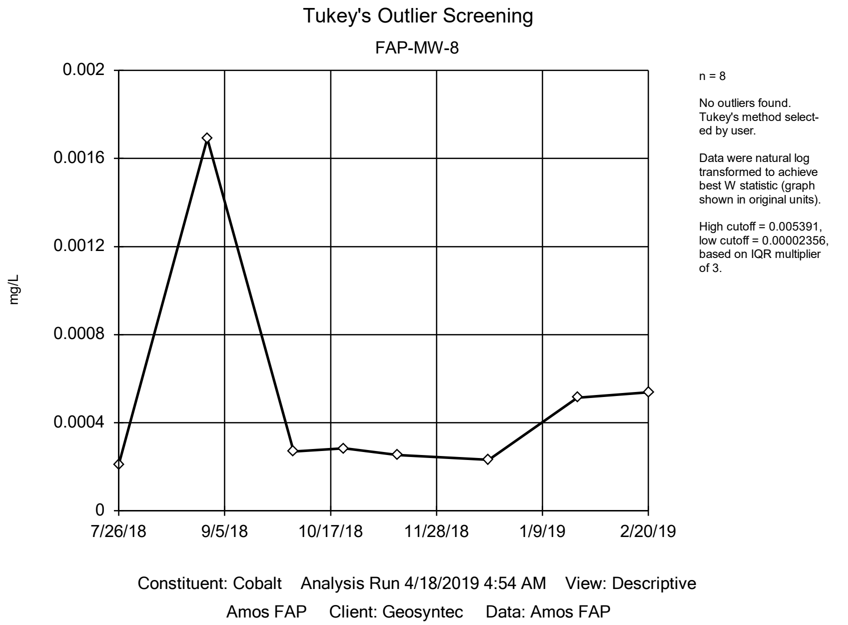
Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

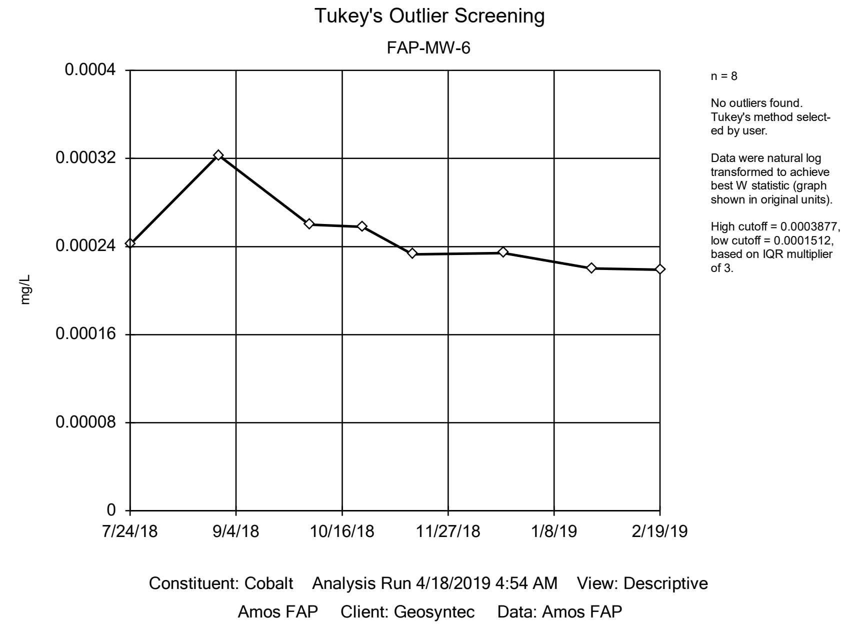


Constituent: Cobalt Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

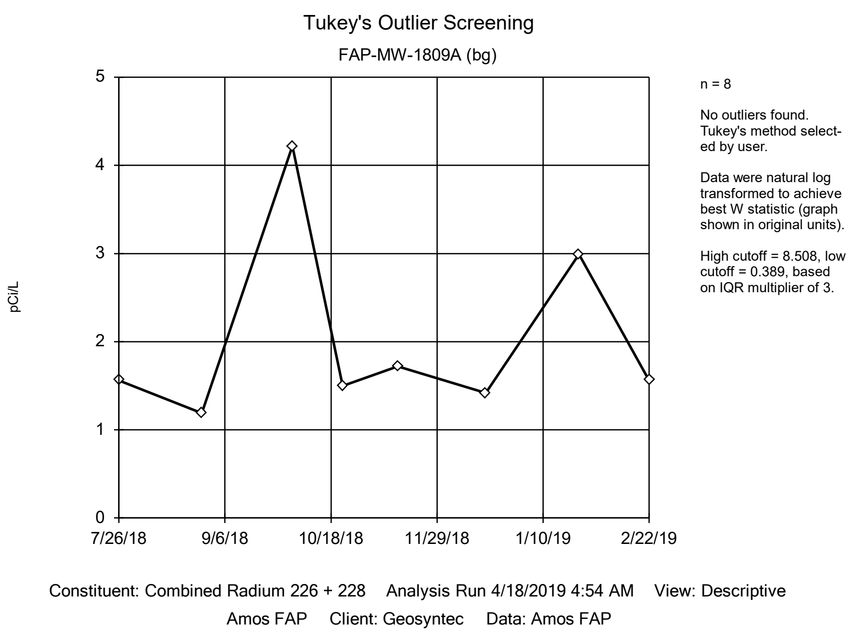
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



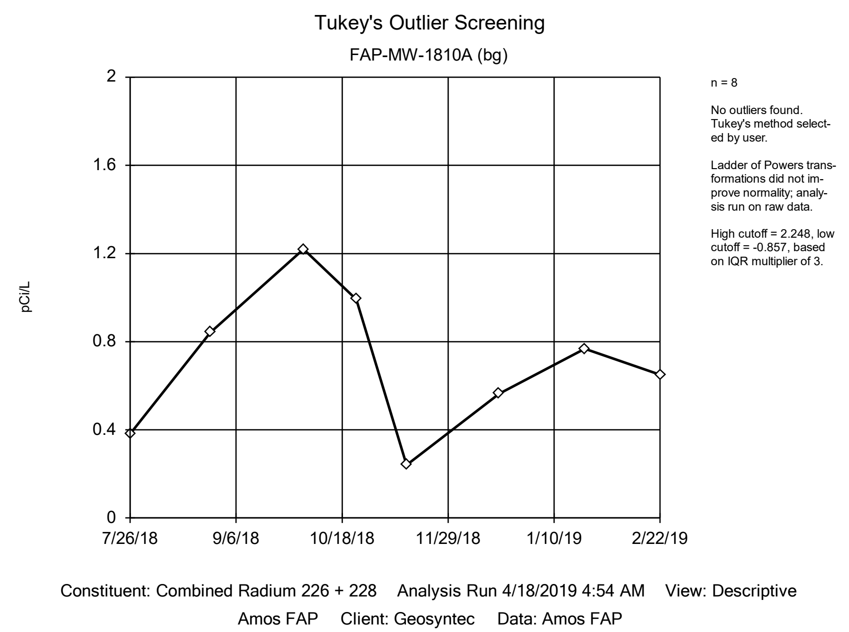
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

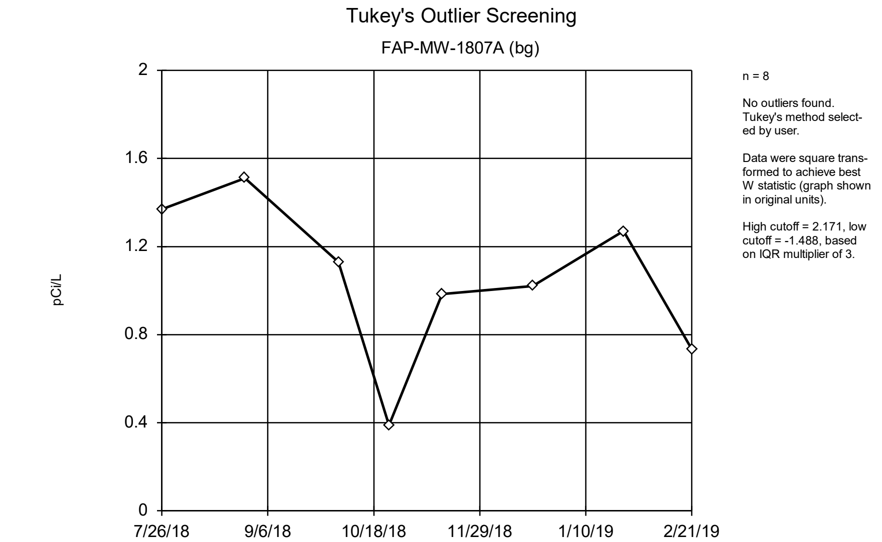


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

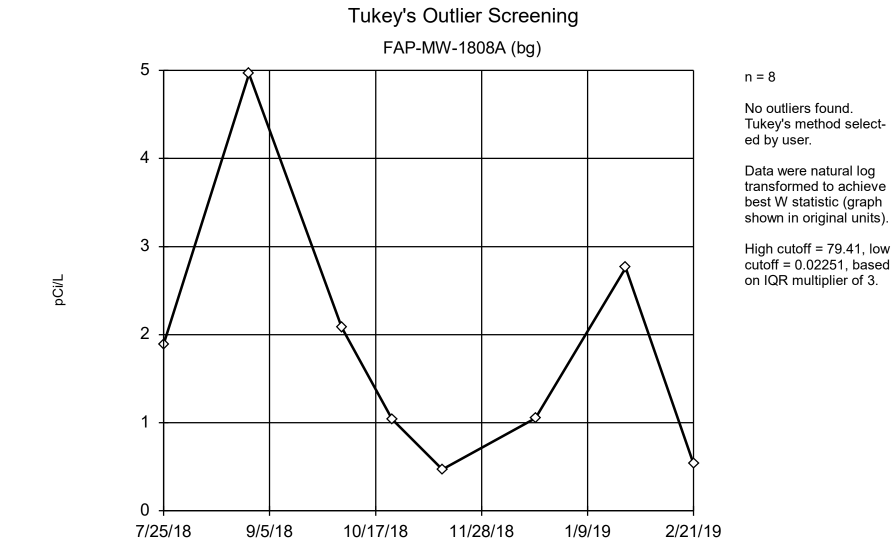


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

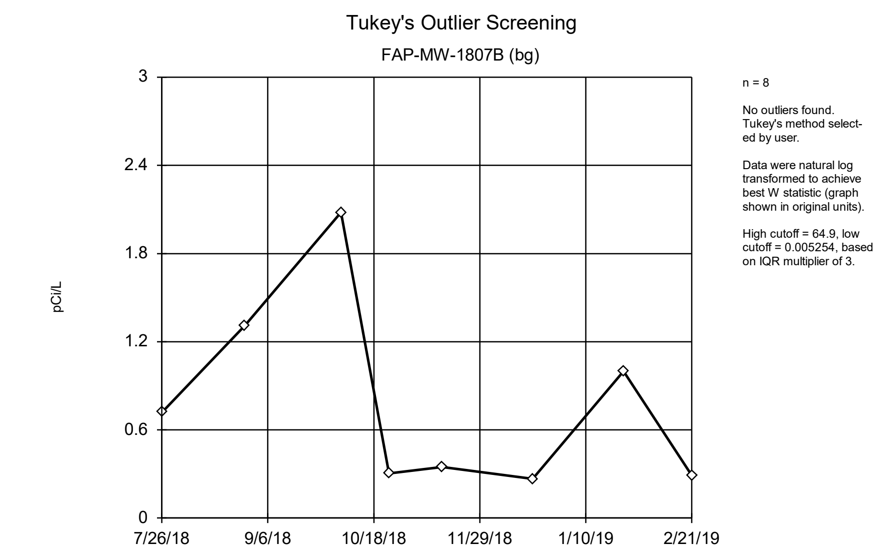




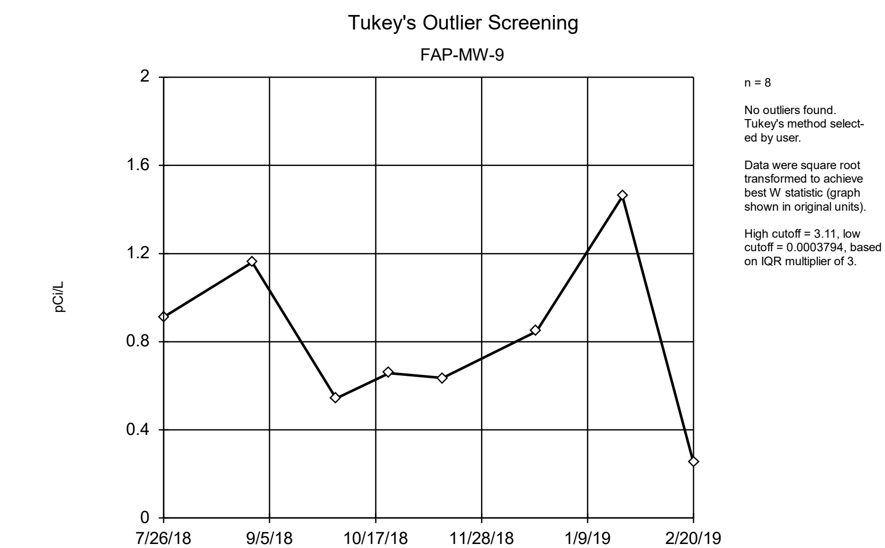
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



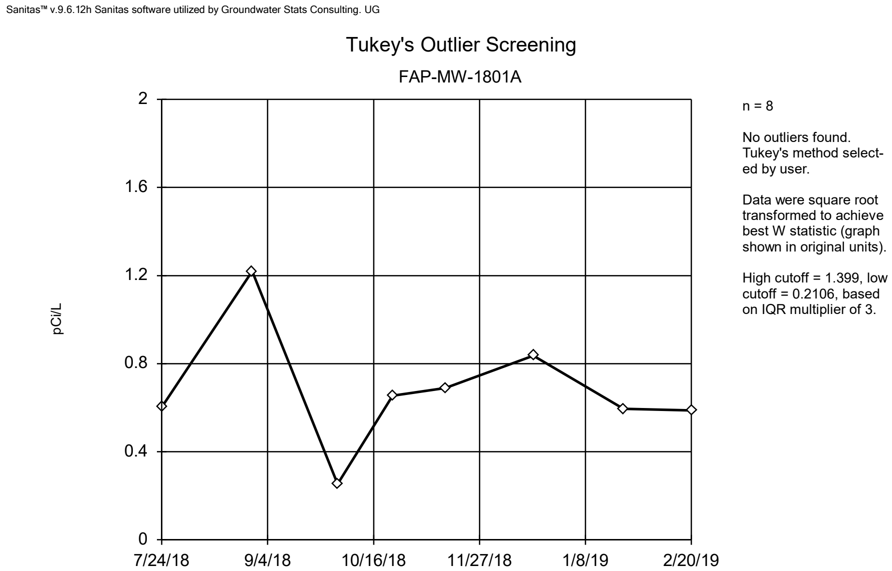
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



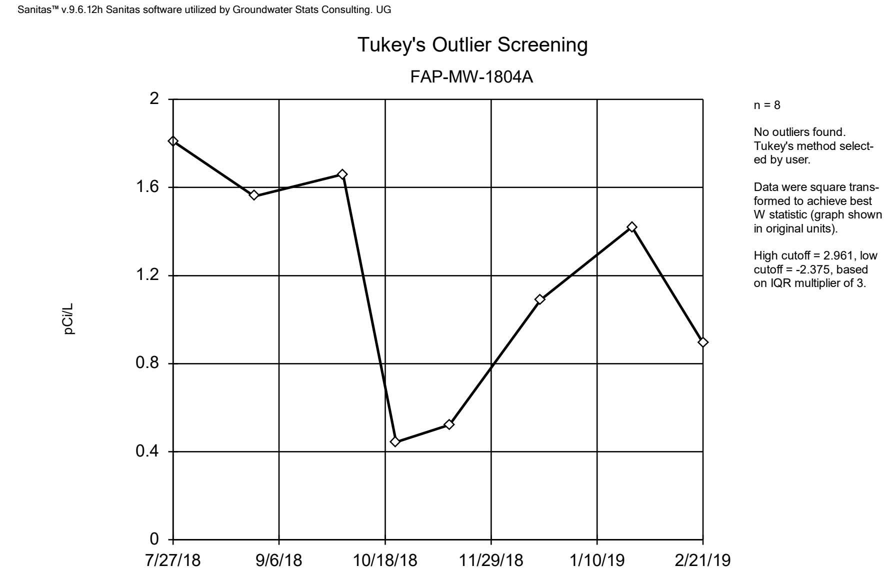
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



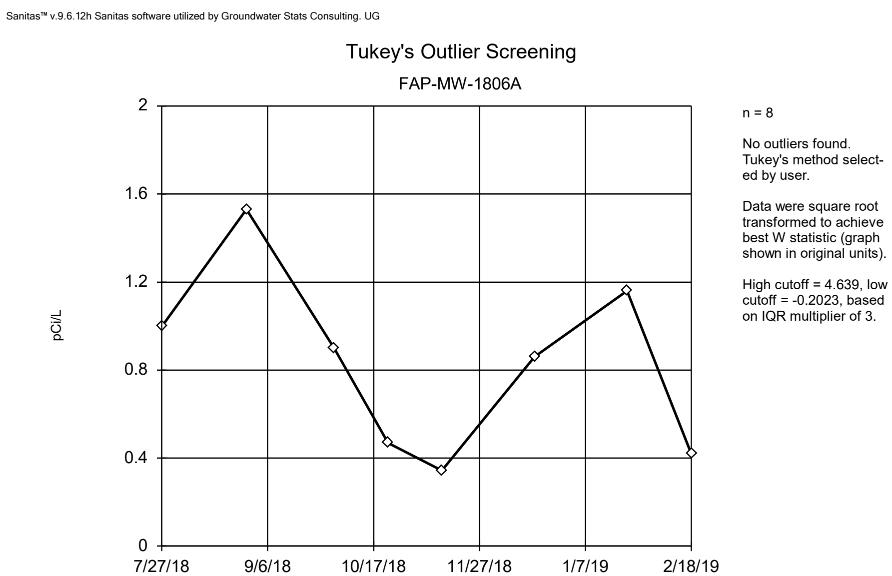
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



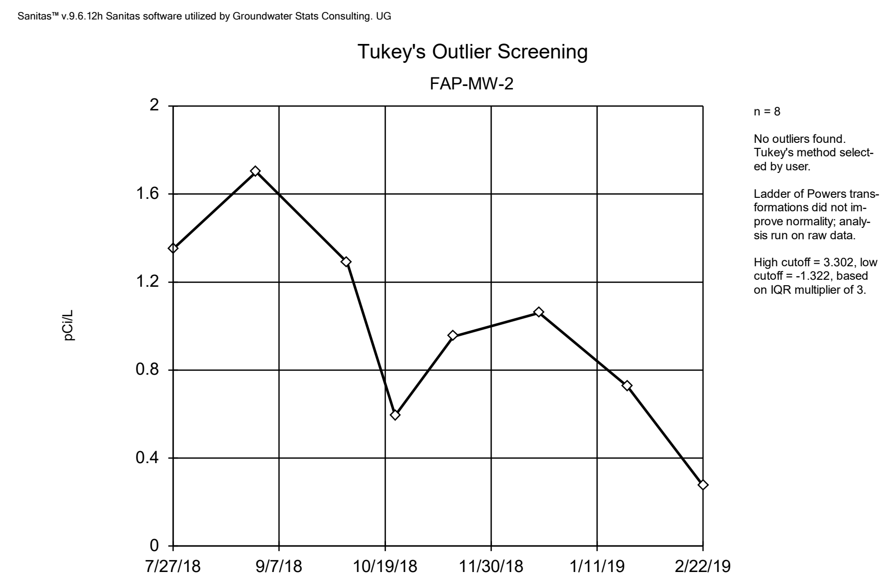
Constituent: Combined Radium 226 + 228   Analysis Run 4/18/2019 4:54 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP



Constituent: Combined Radium 226 + 228   Analysis Run 4/18/2019 4:54 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

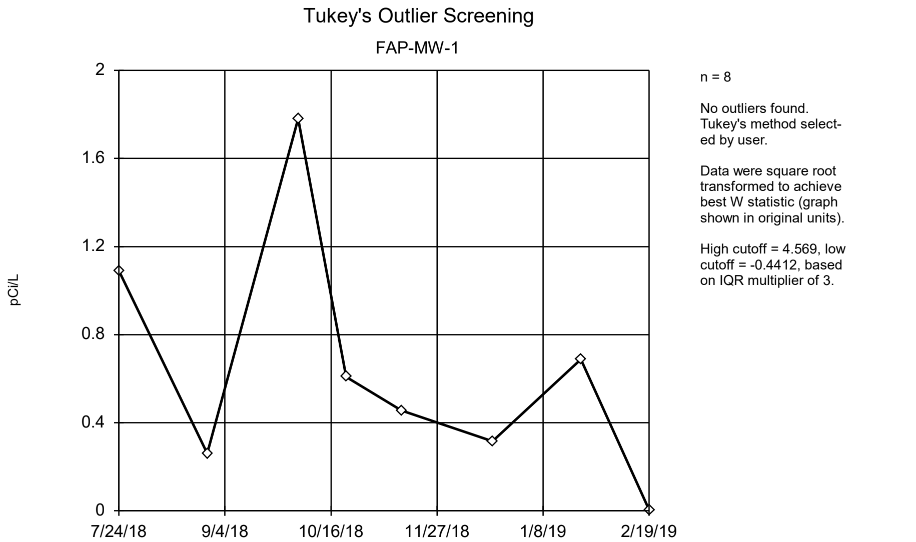


Constituent: Combined Radium 226 + 228   Analysis Run 4/18/2019 4:54 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP



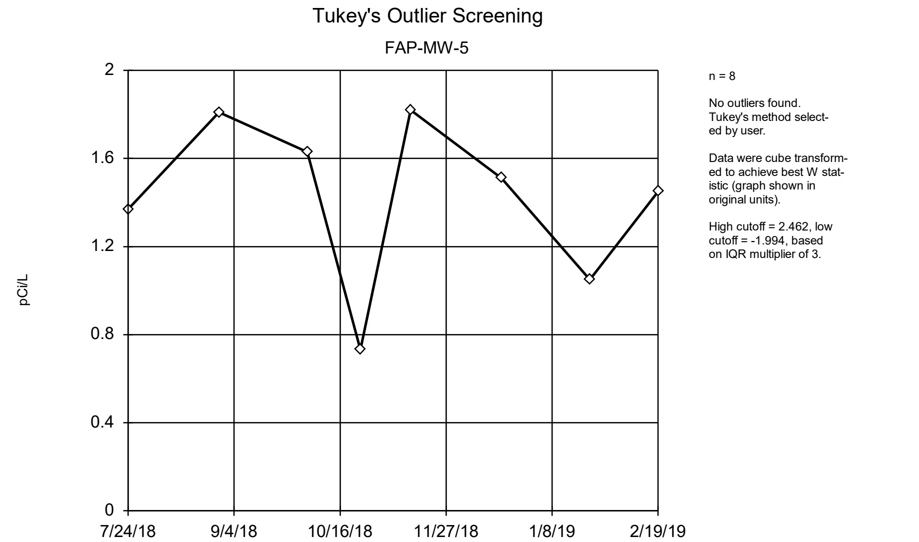
Constituent: Combined Radium 226 + 228   Analysis Run 4/18/2019 4:54 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



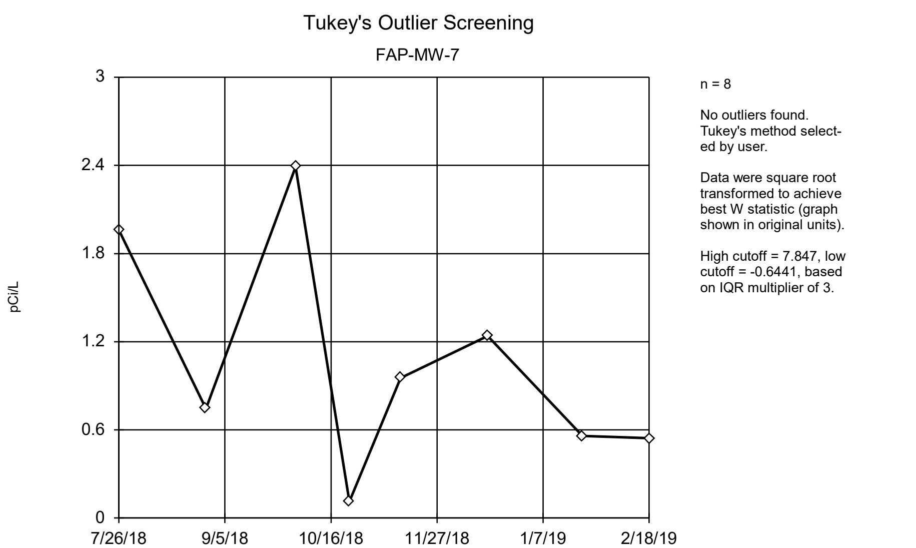
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:54 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



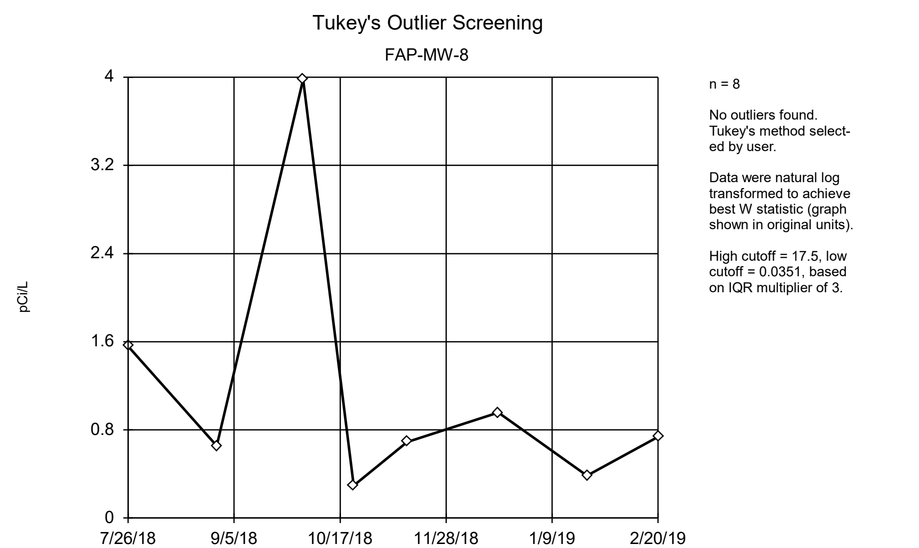
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



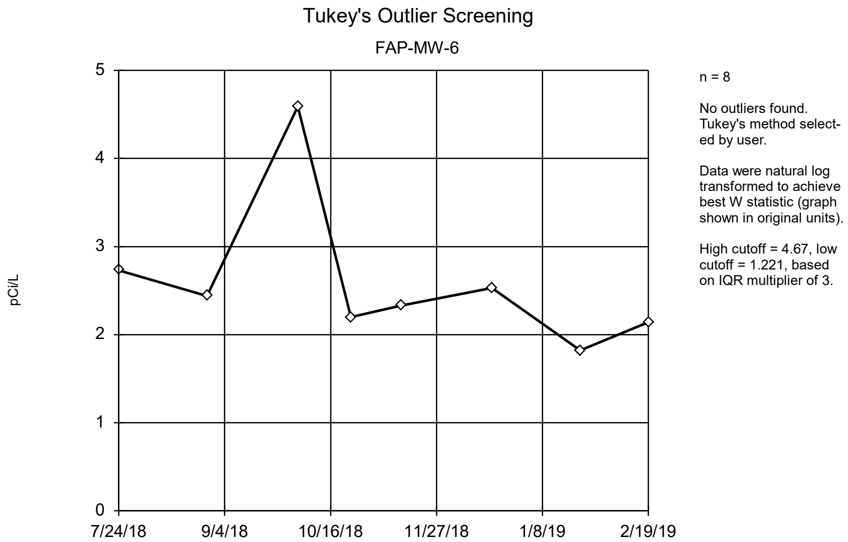
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



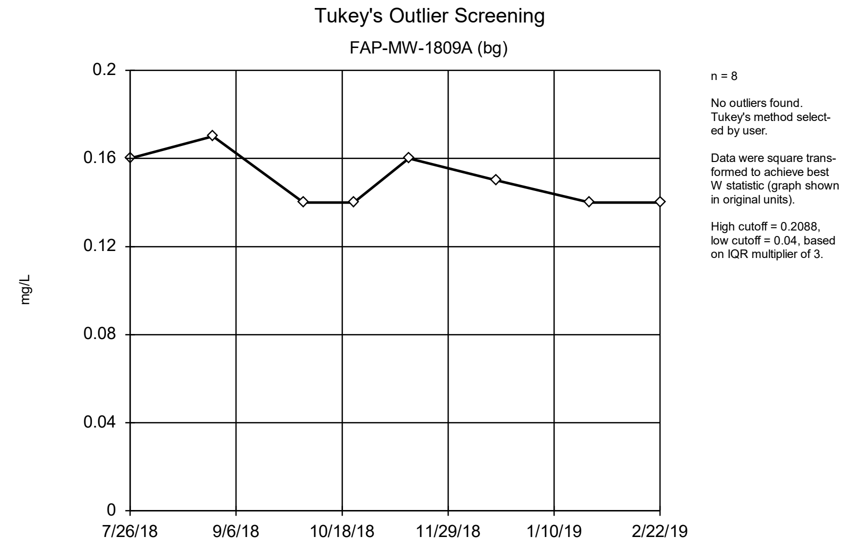
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



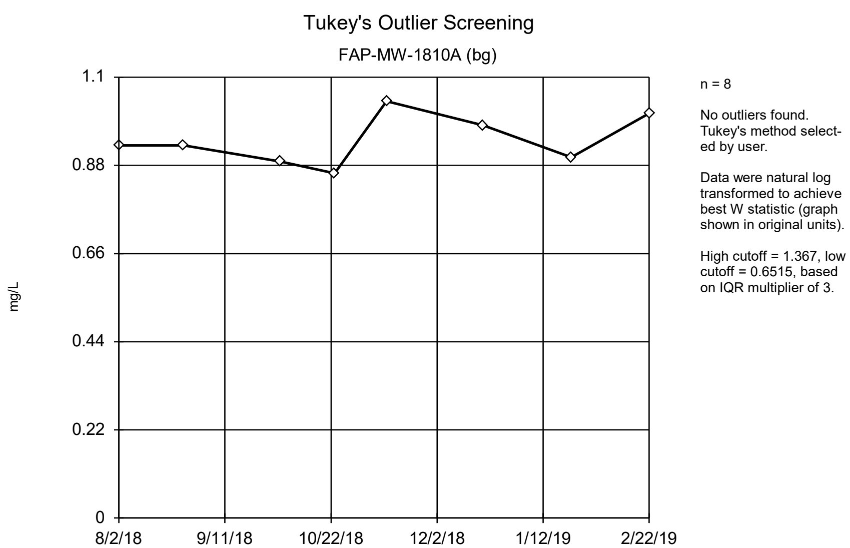
Constituent: Combined Radium 226 + 228 Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



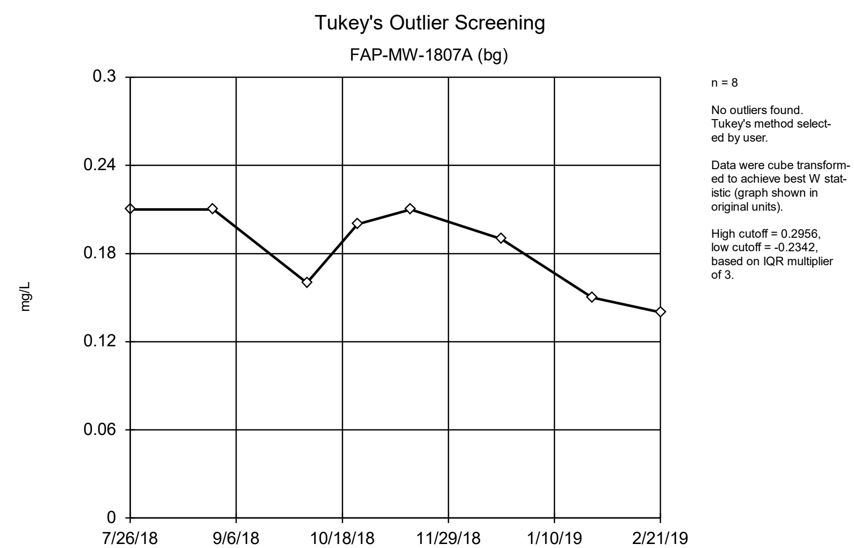
Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

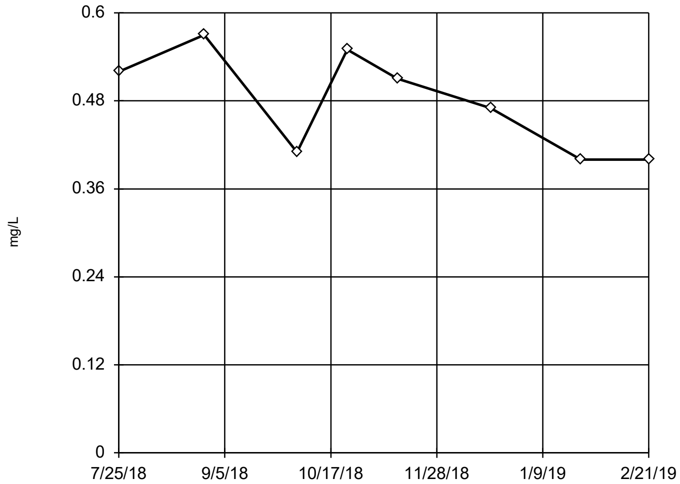
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Tukey's Outlier Screening

FAP-MW-1808A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

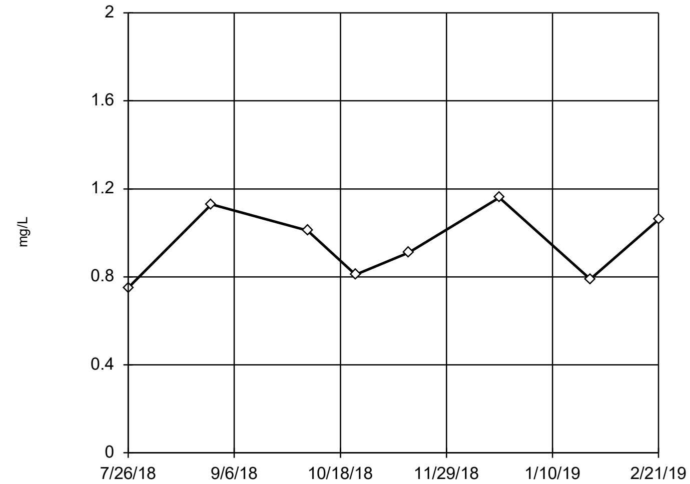
High cutoff = 0.706, low cutoff = -0.6108, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

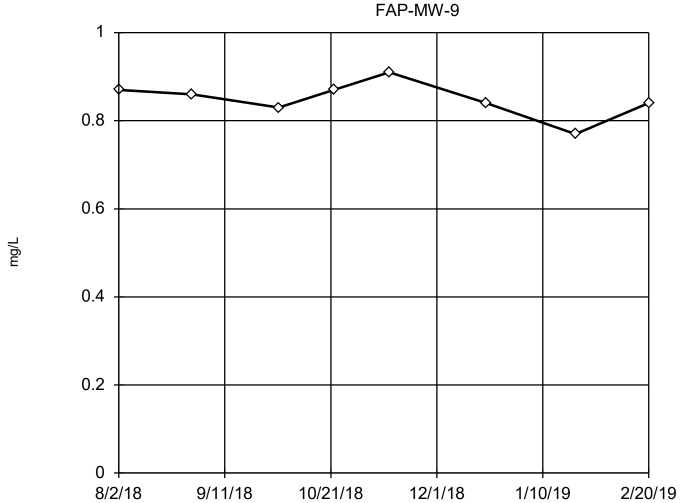
High cutoff = 1.98, low cutoff = -0.085, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

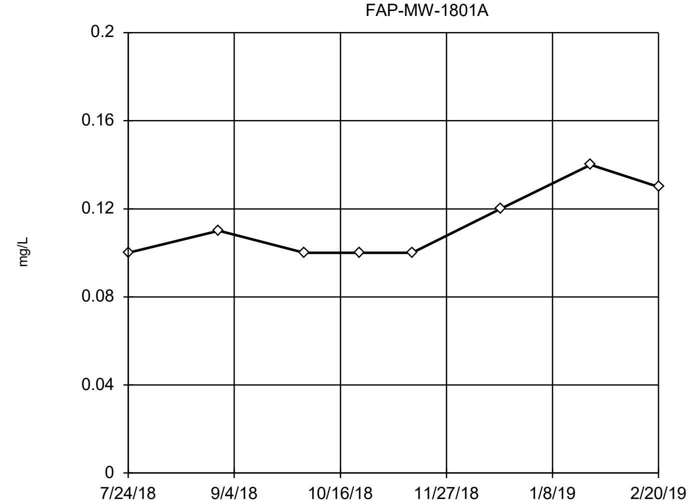
High cutoff = 0.9461, low cutoff = 0.6178, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1801A



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

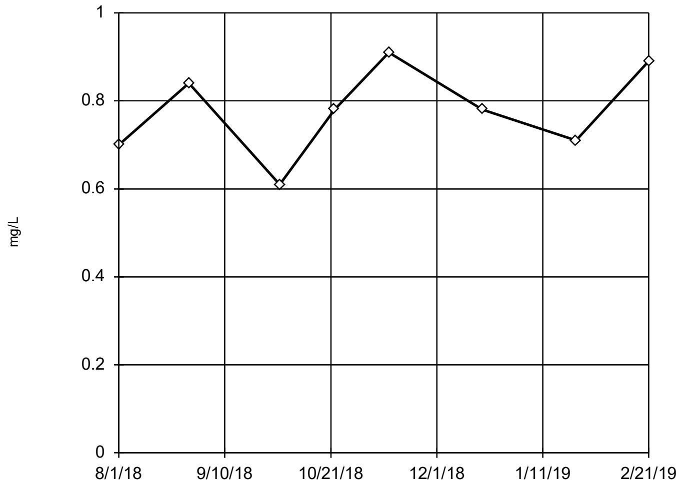
High cutoff = 0.2434, low cutoff = 0.05132, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1804A



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.226, low cutoff = -0.5083, based on IQR multiplier of 3.

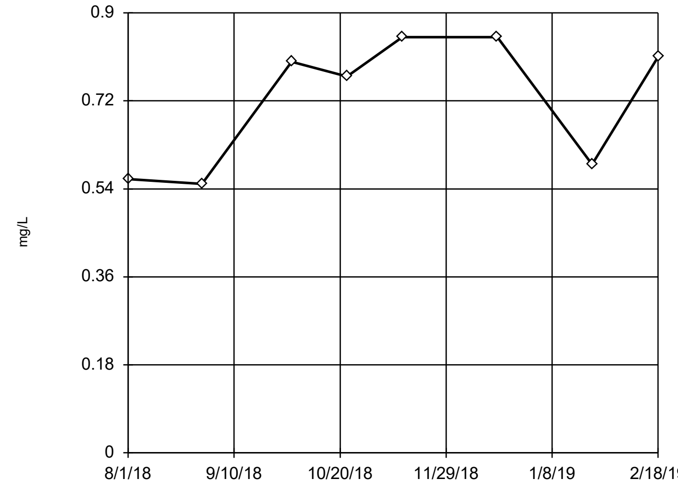
Constituent: Fluoride   Analysis Run 4/18/2019 4:55 AM   View: Descriptive

Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1806A



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1.032, low cutoff = -0.972, based on IQR multiplier of 3.

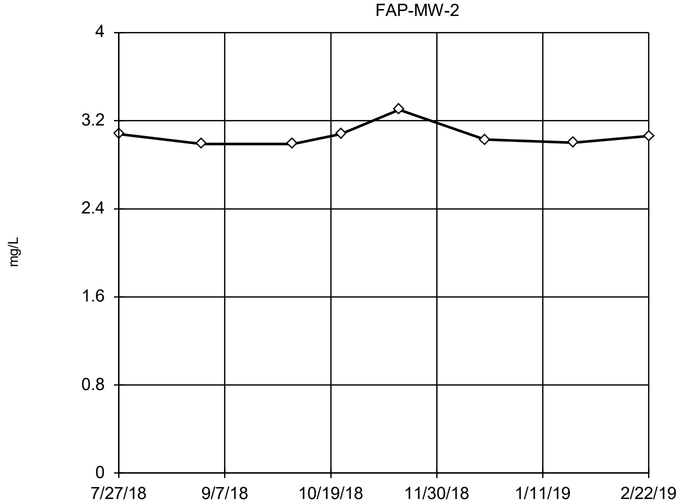
Constituent: Fluoride   Analysis Run 4/18/2019 4:55 AM   View: Descriptive

Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 3.35, low cutoff = 2.754, based on IQR multiplier of 3.

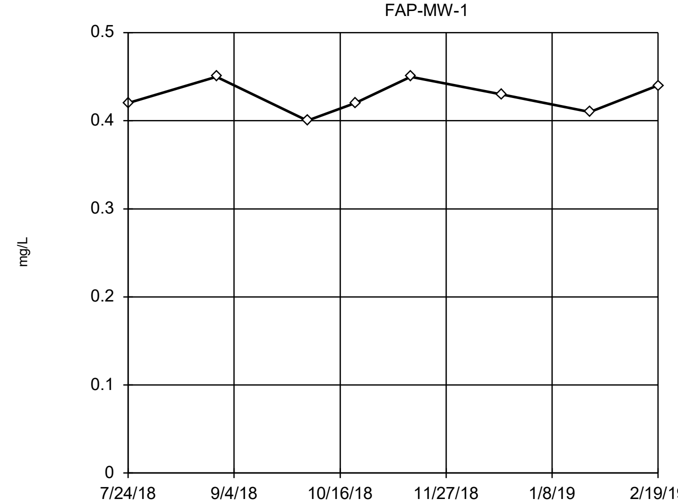
Constituent: Fluoride   Analysis Run 4/18/2019 4:55 AM   View: Descriptive

Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.5486, low cutoff = 0.3366, based on IQR multiplier of 3.

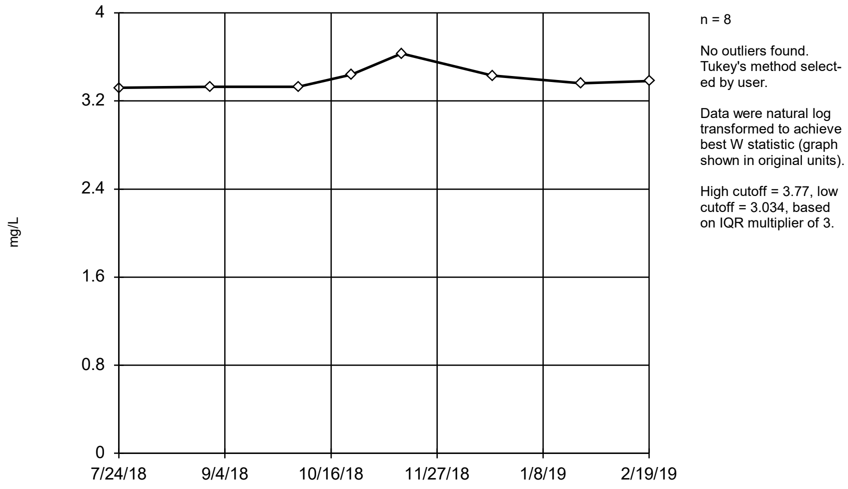
Constituent: Fluoride   Analysis Run 4/18/2019 4:55 AM   View: Descriptive

Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



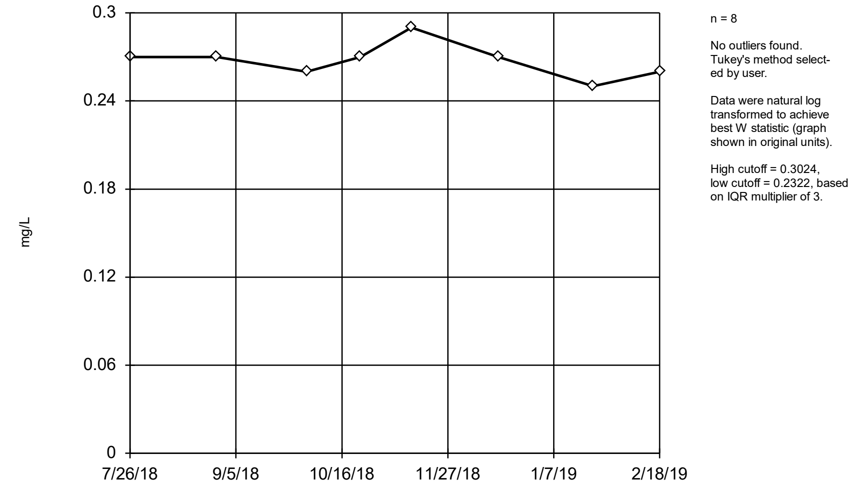
Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



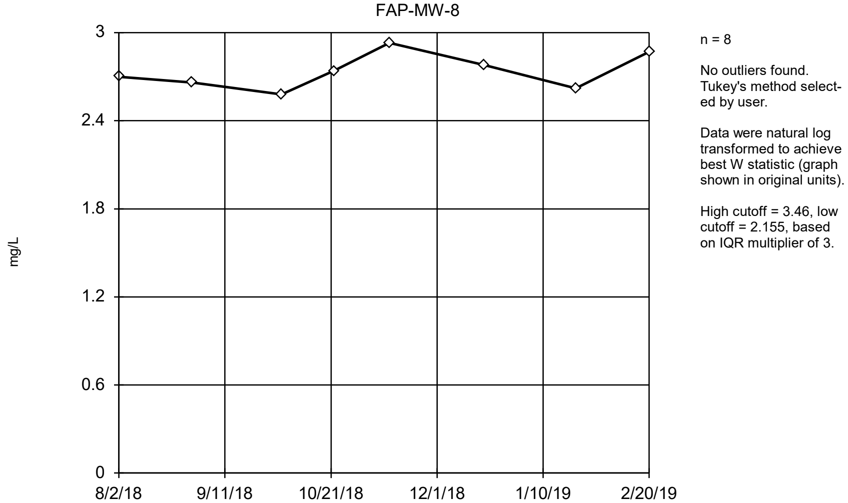
Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



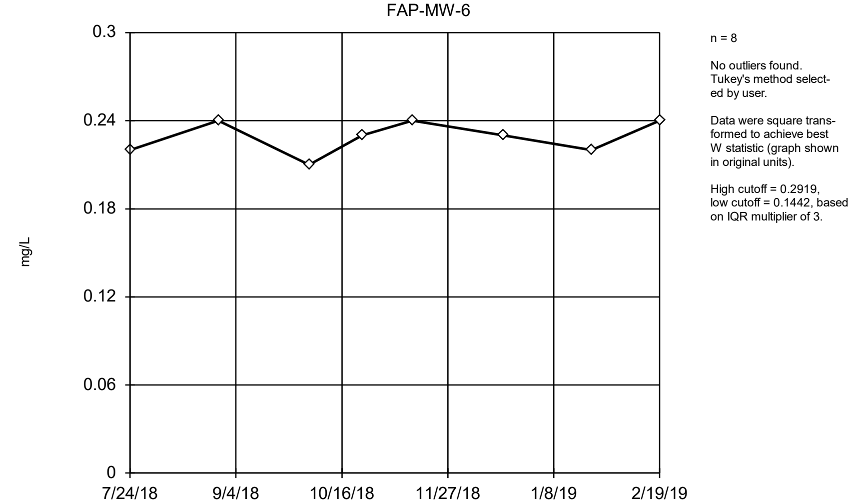
Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

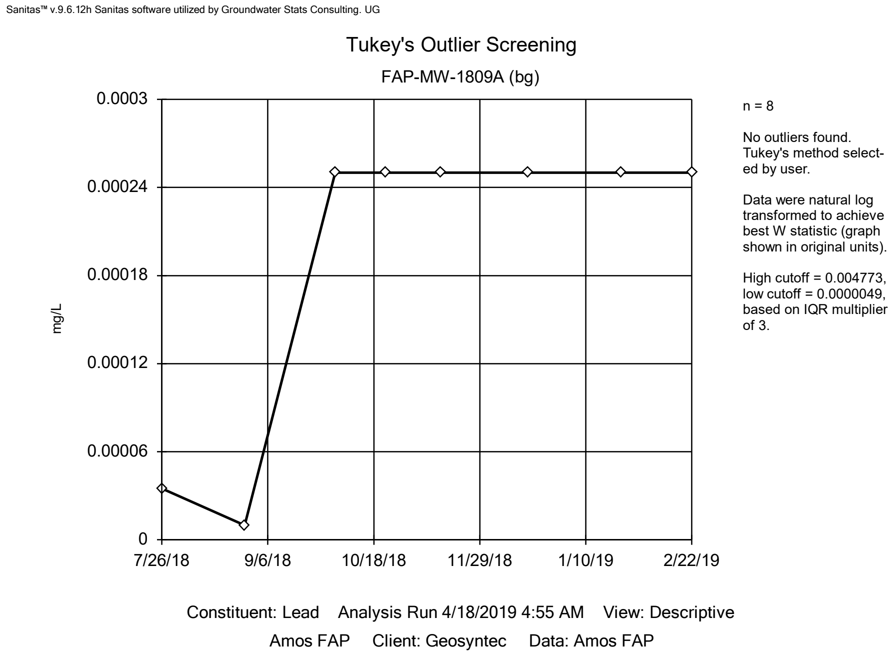
Tukey's Outlier Screening

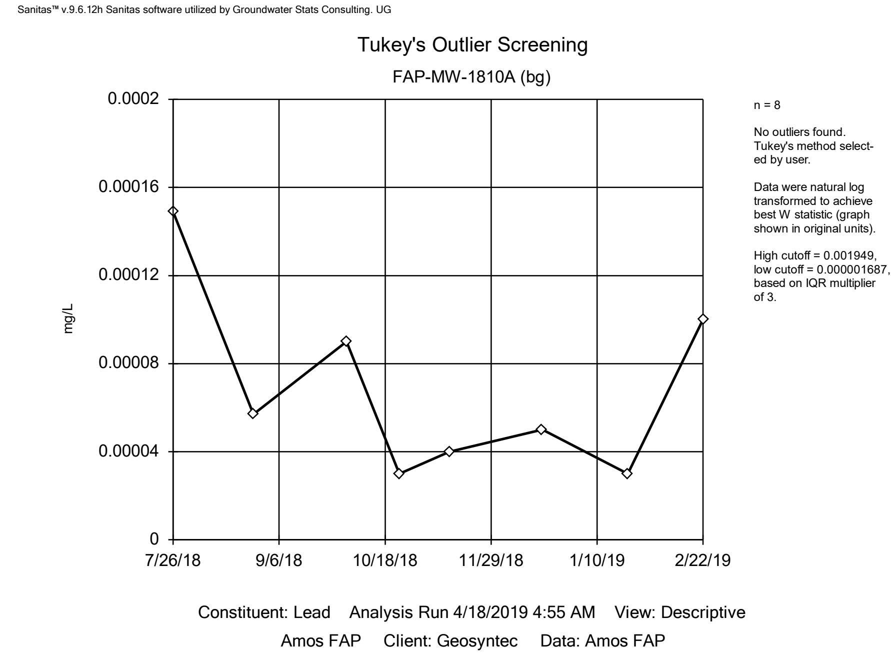
FAP-MW-6

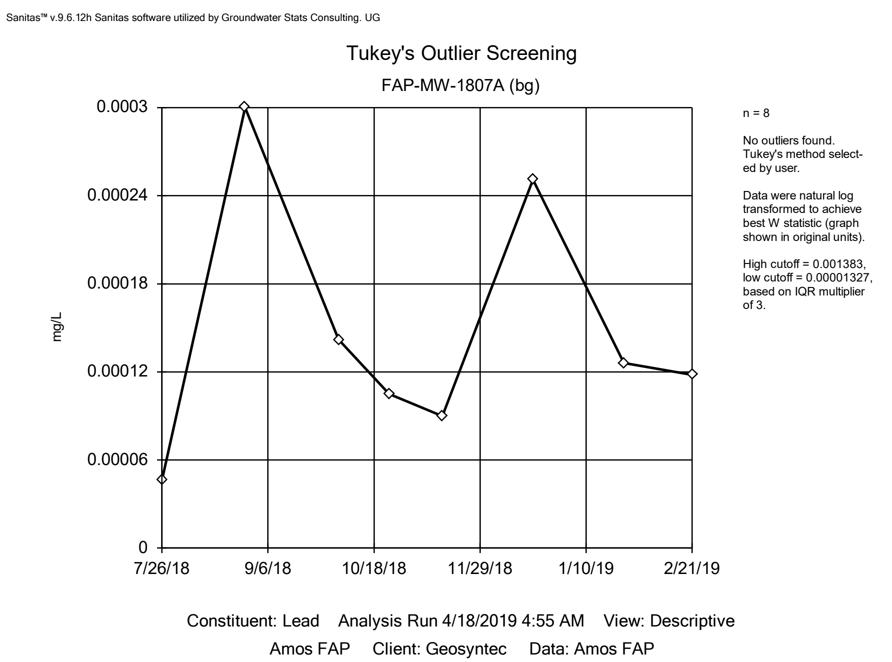


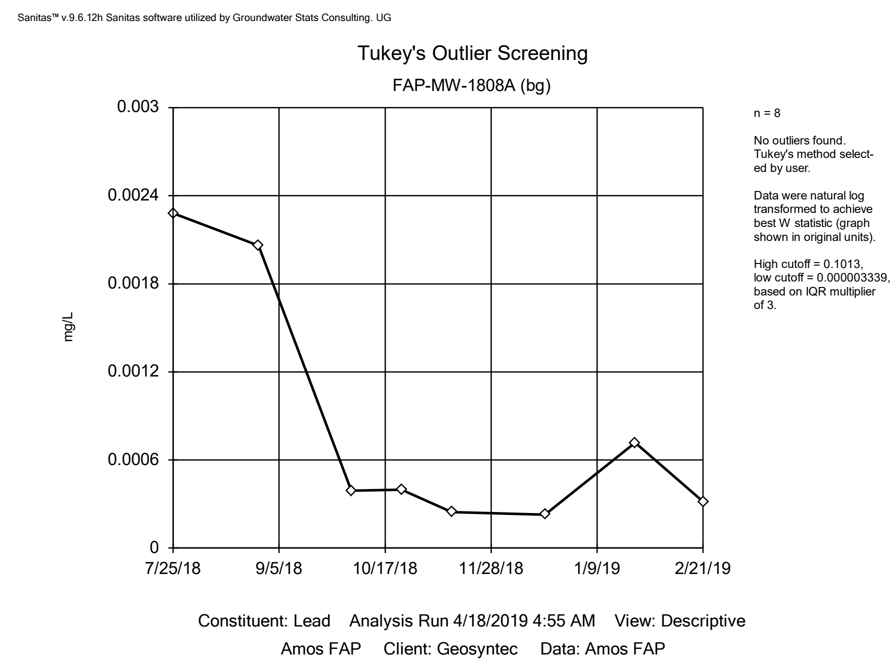
Constituent: Fluoride Analysis Run 4/18/2019 4:55 AM View: Descriptive

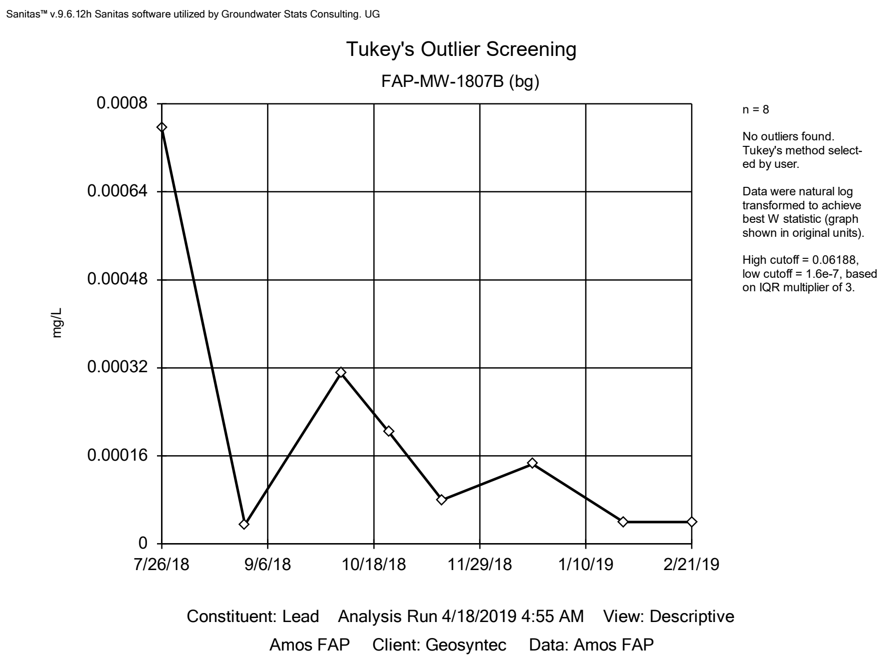
Amos FAP Client: Geosyntec Data: Amos FAP

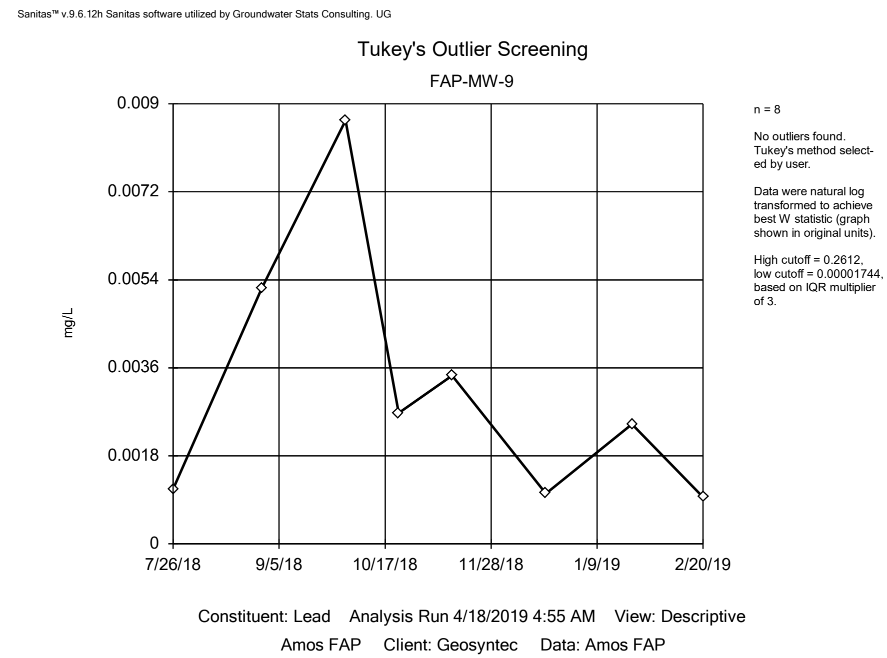

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1809A (bg)
mg/L
0.0003
0.00024
0.00018
0.00012
0.00006
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.004773, low cutoff = 0.0000049, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

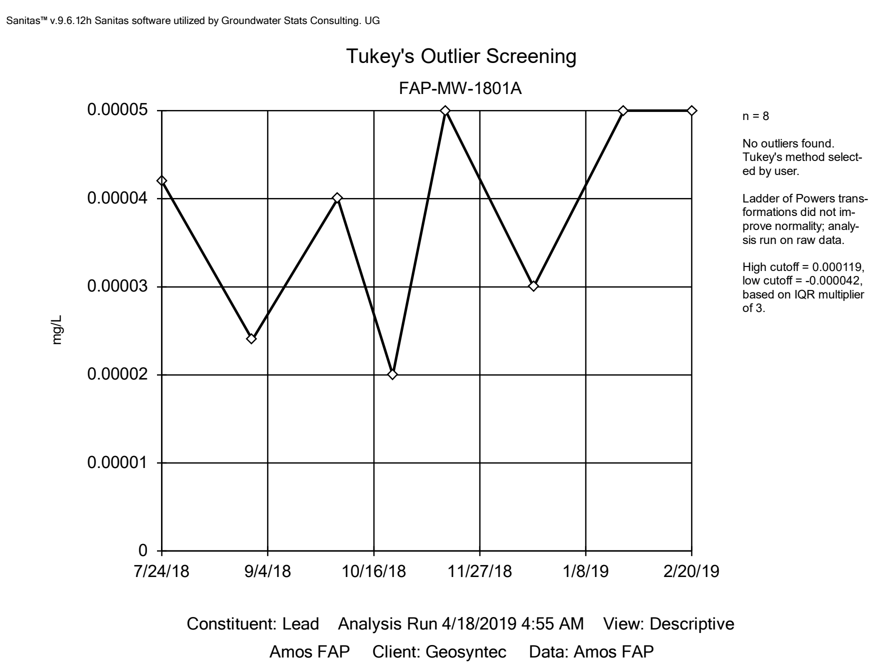

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1810A (bg)
mg/L
0.0002
0.00016
0.00012
0.00008
0.00004
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.001949, low cutoff = 0.000001687, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

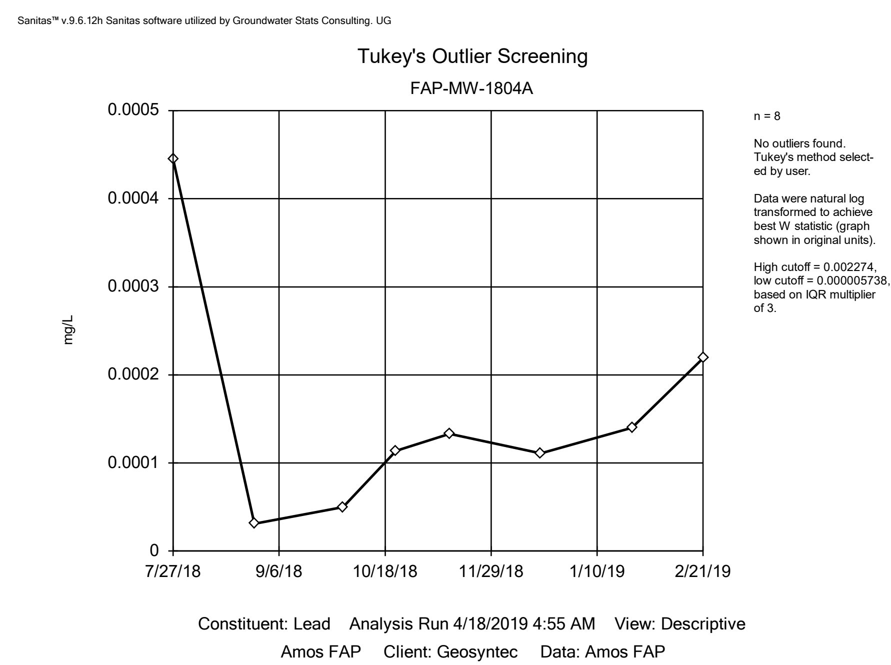

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1807A (bg)
mg/L
0.0003
0.00024
0.00018
0.00012
0.00006
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.001383, low cutoff = 0.00001327, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1808A (bg)
mg/L
0.003
0.0024
0.0018
0.0012
0.0006
0
7/25/18
9/5/18
10/17/18
11/28/18
1/9/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.1013, low cutoff = 0.000003339, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

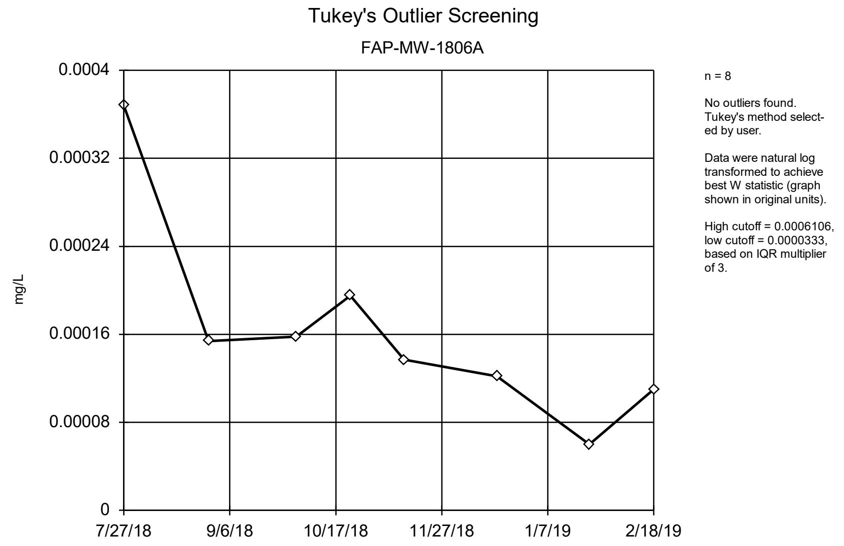

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1807B (bg)
mg/L
0.0008
0.00064
0.00048
0.00032
0.00016
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.06188, low cutoff = 1.6e-7, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-9
mg/L
0.009
0.0072
0.0054
0.0036
0.0018
0
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.2612, low cutoff = 0.00001744, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1801A
mg/L
0.00005
0.00004
0.00003
0.00002
0.00001
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.000119, low cutoff = -0.000042, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

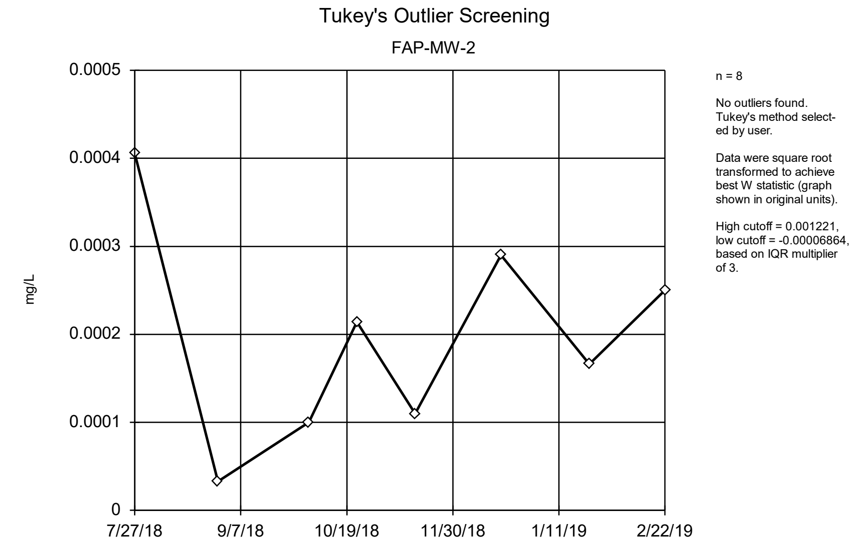

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
mg/L
0.0005
0.0004
0.0003
0.0002
0.0001
0
7/27/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.002274, low cutoff = 0.000005738, based on IQR multiplier of 3.
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



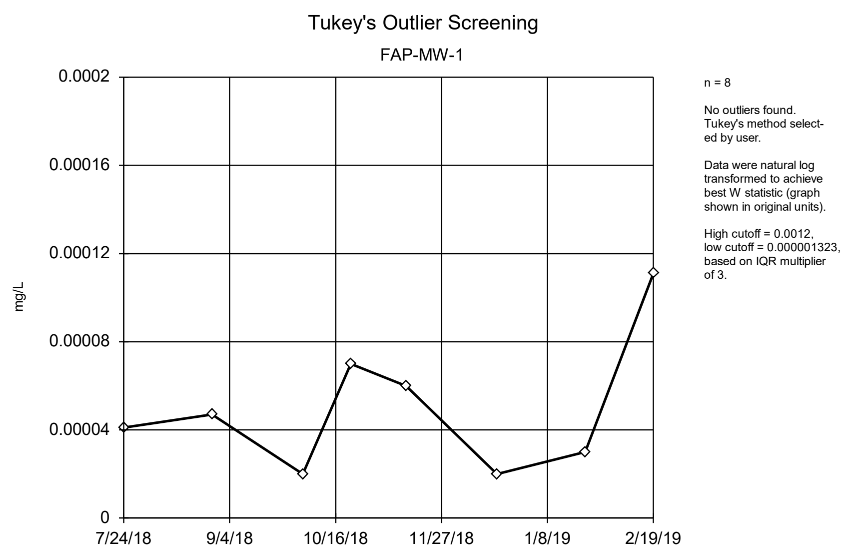
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



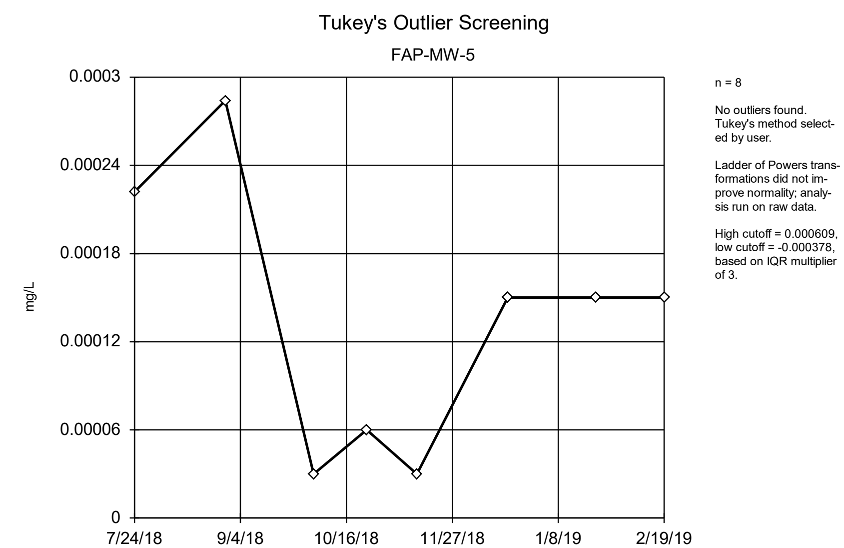
Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

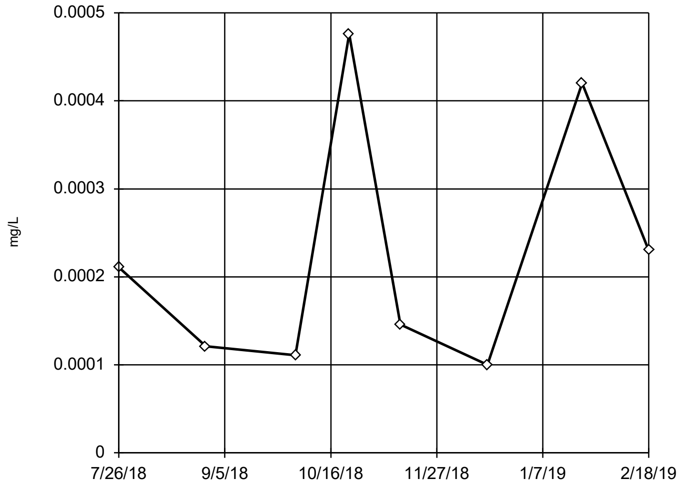


Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

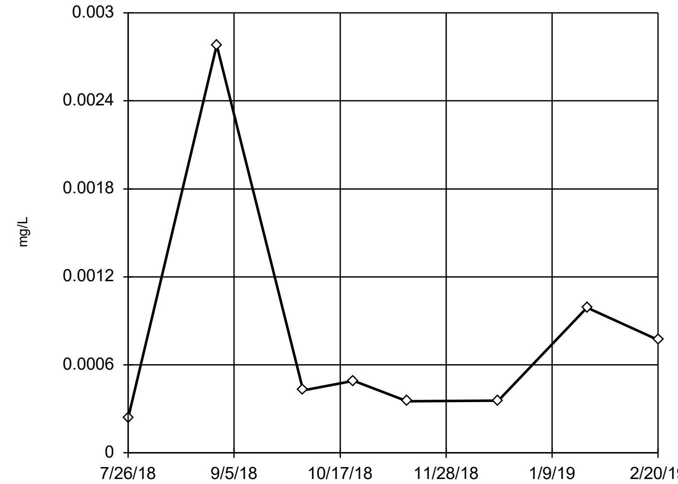
High cutoff = 0.005995, low cutoff = 0.000006008, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

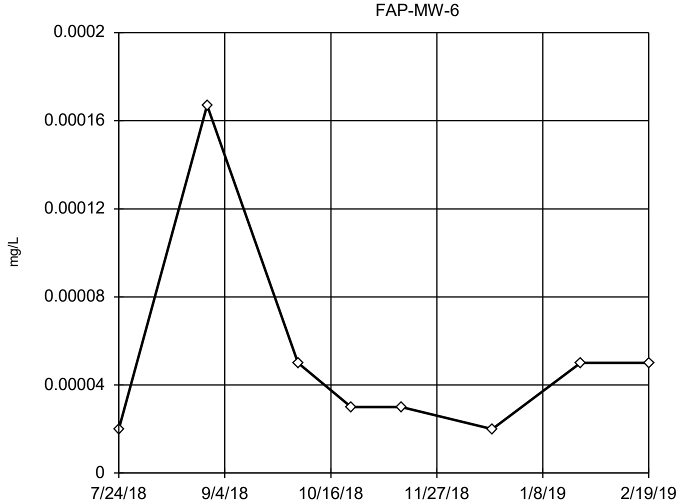
High cutoff = 0.01304, low cutoff = 0.00002373, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

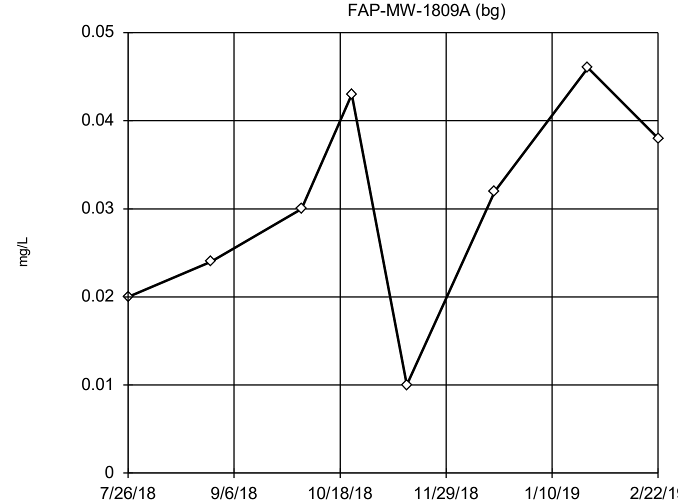
High cutoff = 0.0004253, low cutoff = 0.00000288, based on IQR multiplier of 3.

Constituent: Lead Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1809A (bg)



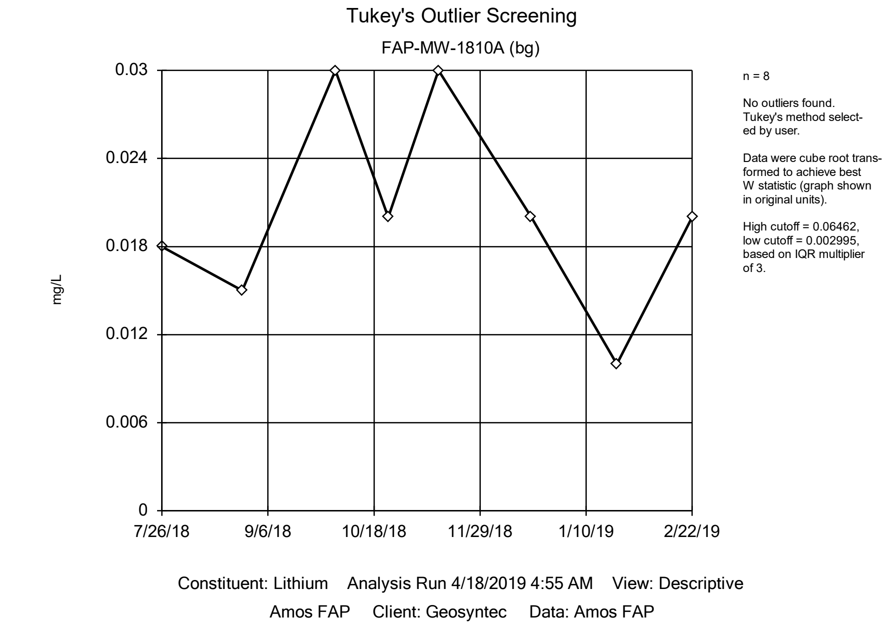
n = 8

No outliers found. Tukey's method selected by user.

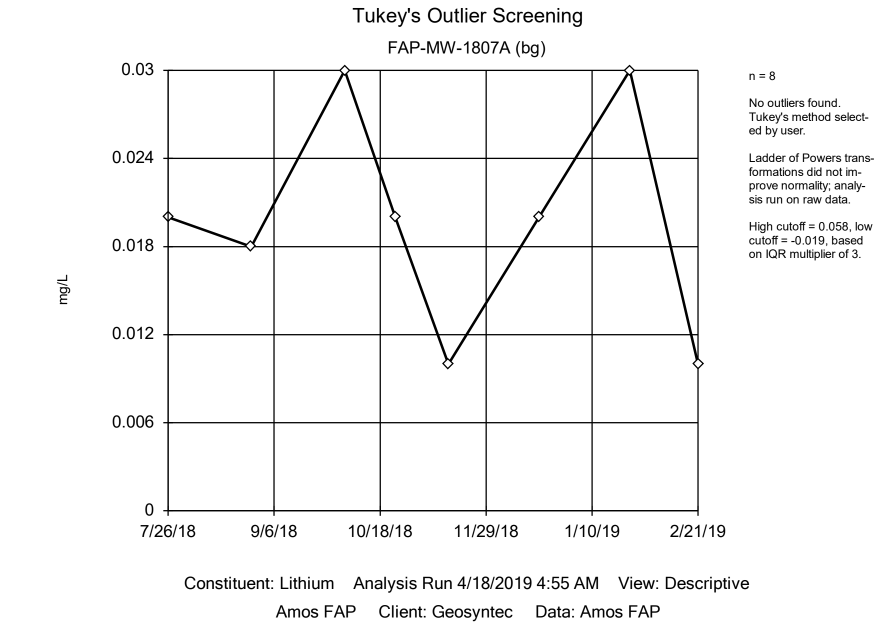
Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 0.096, low cutoff = -0.0335, based on IQR multiplier of 3.

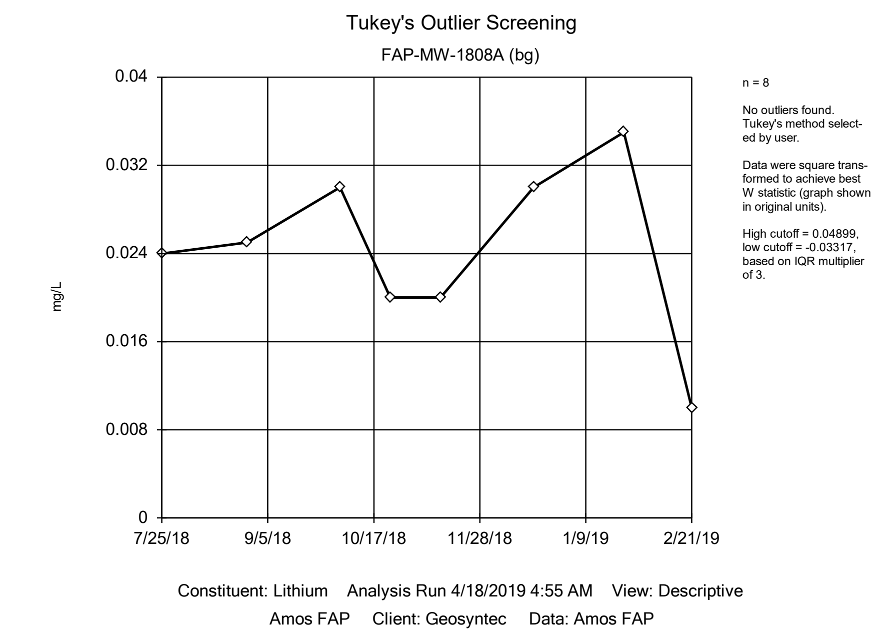
Constituent: Lithium Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



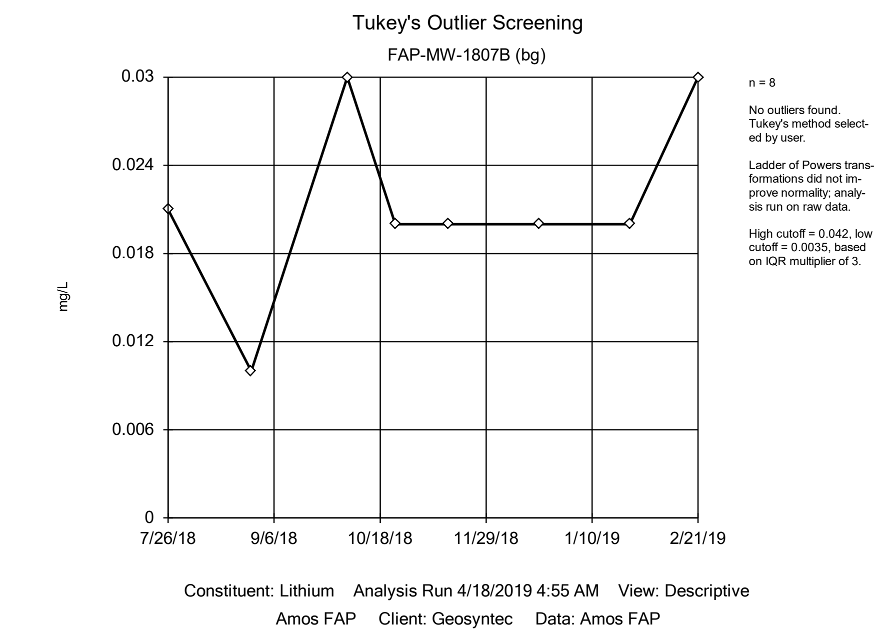
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



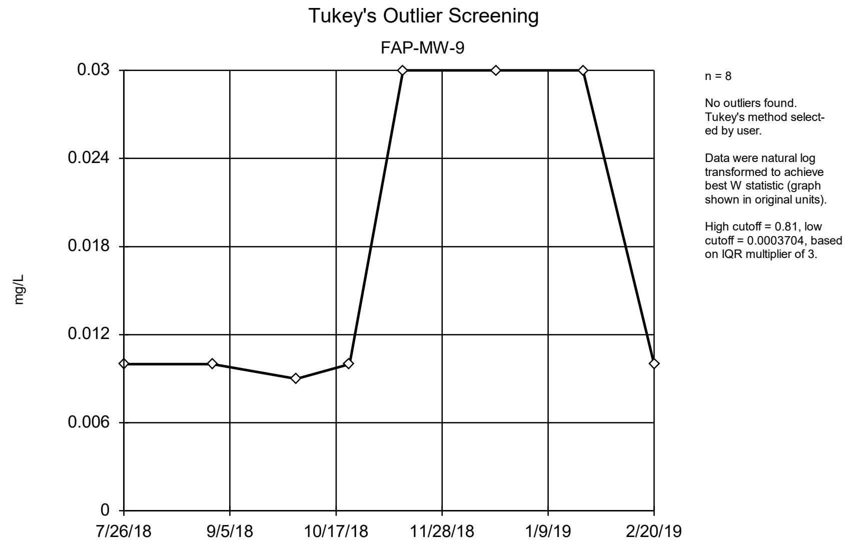
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

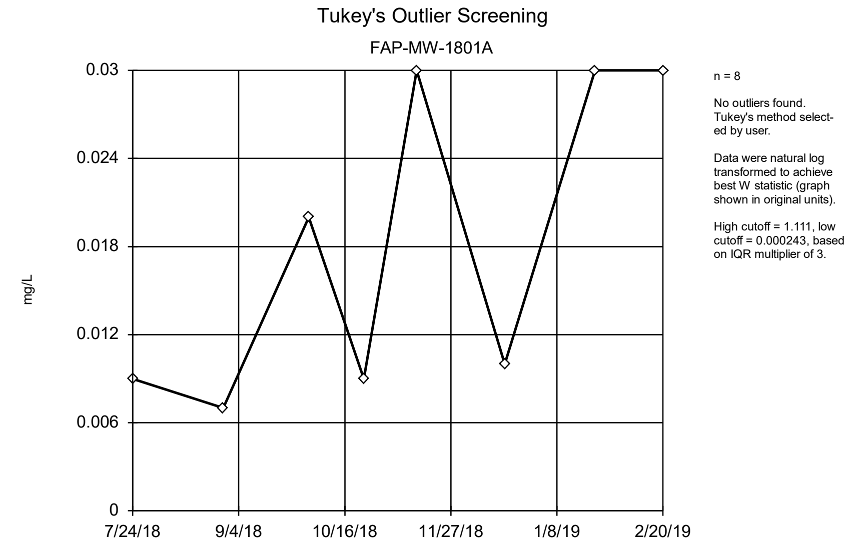


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



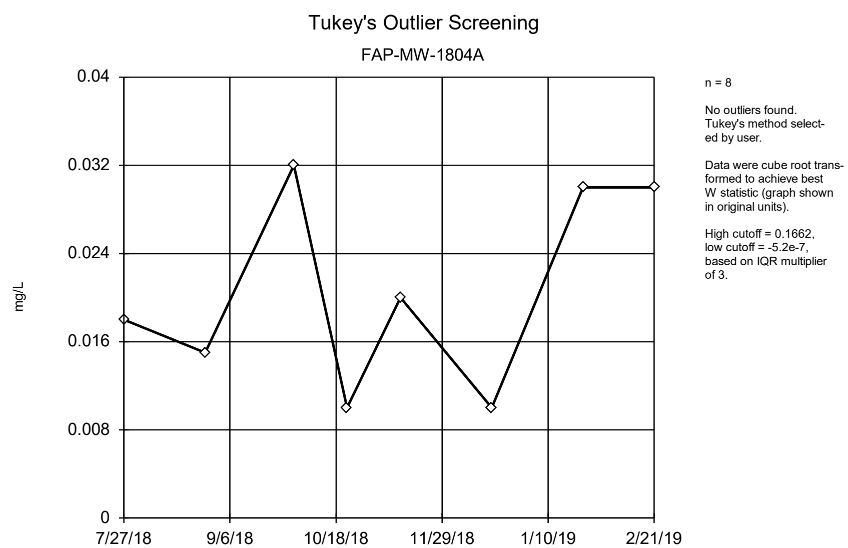
Constituent: Lithium Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



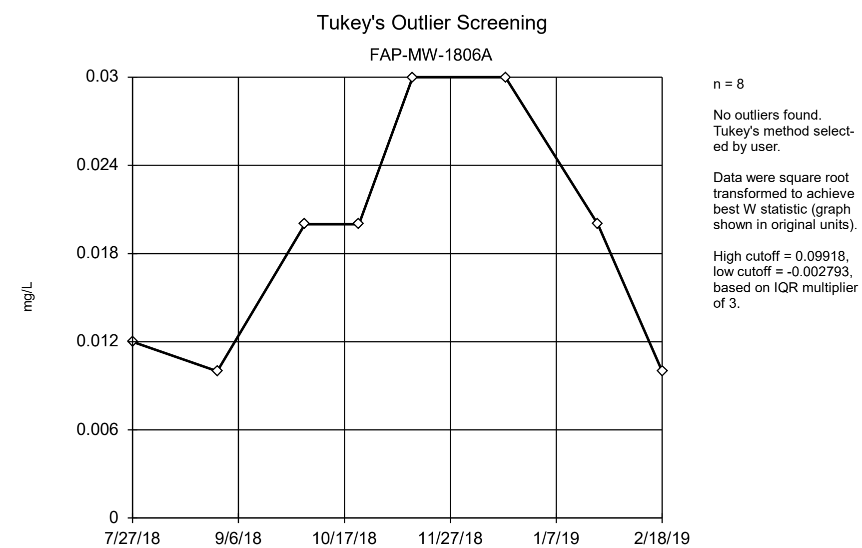
Constituent: Lithium Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Lithium Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

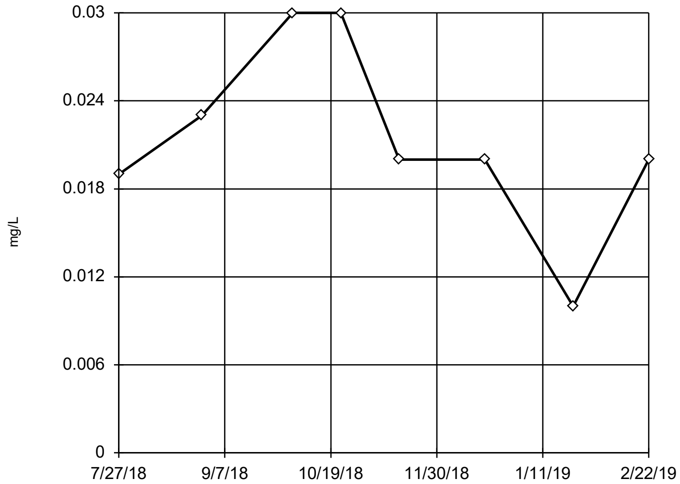


Constituent: Lithium Analysis Run 4/18/2019 4:55 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

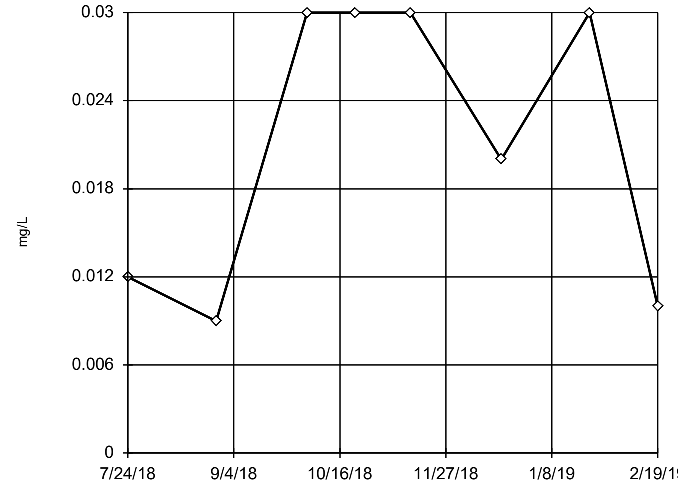
High cutoff = 0.0475, low cutoff = -0.0015, based on IQR multiplier of 3.

Constituent: Lithium   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

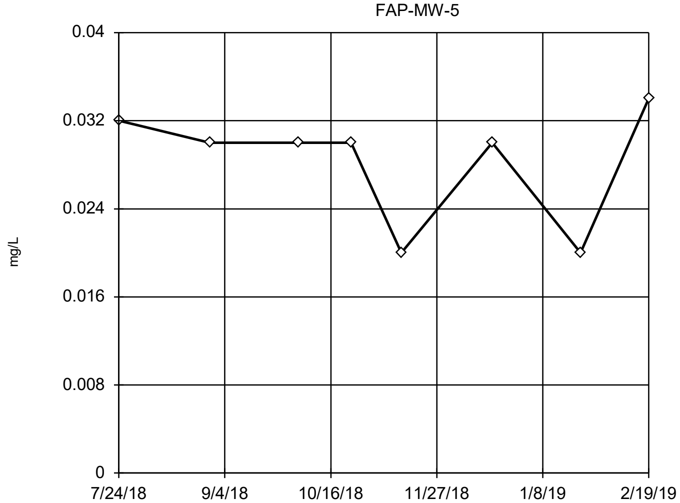
High cutoff = 0.6162, low cutoff = 0.0005333, based on IQR multiplier of 3.

Constituent: Lithium   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

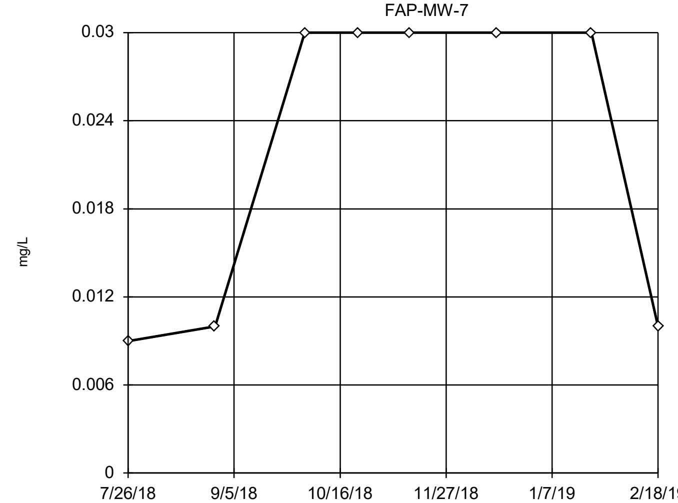
High cutoff = 0.03663, low cutoff = -0.03222, based on IQR multiplier of 3.

Constituent: Lithium   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

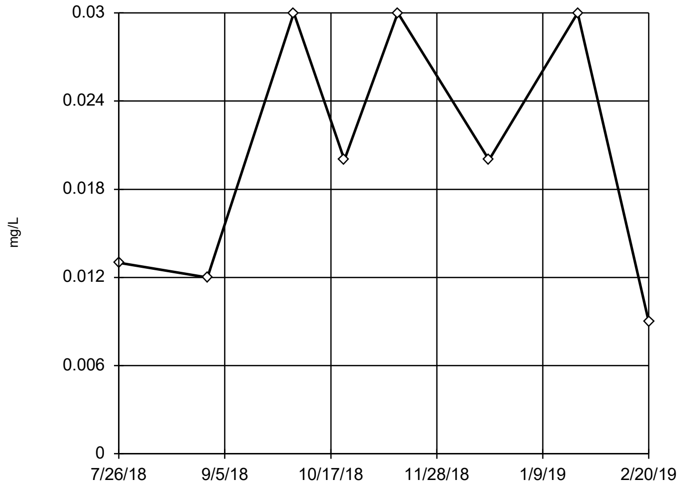
High cutoff = 0.81, low cutoff = 0.0003704, based on IQR multiplier of 3.

Constituent: Lithium   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

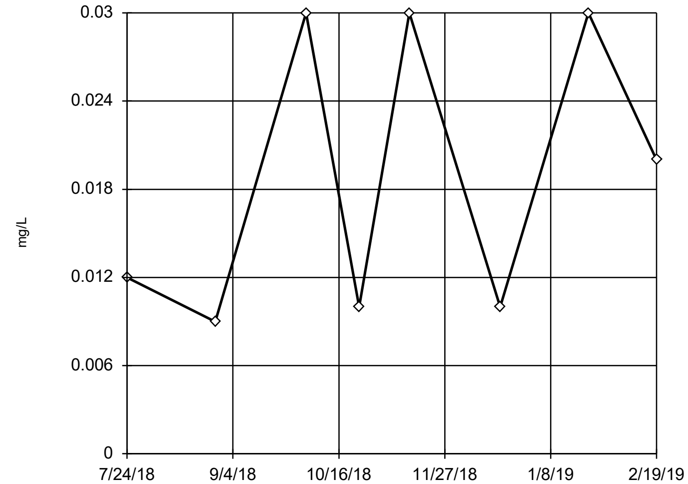
High cutoff = 0.4157, low cutoff = 0.0009013, based on IQR multiplier of 3.

Constituent: Lithium Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

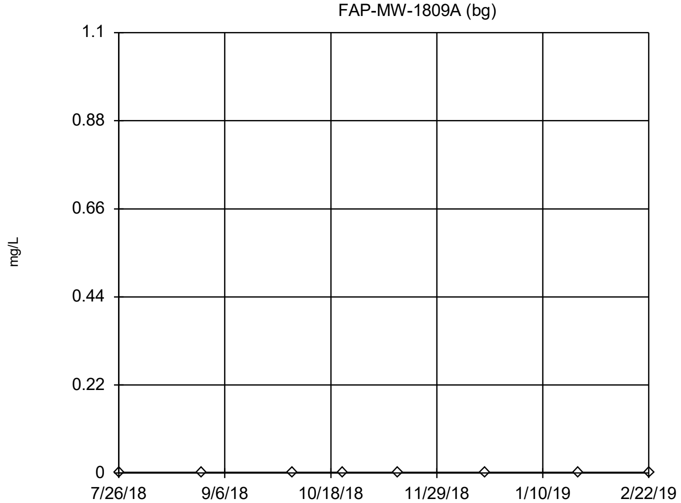
High cutoff = 0.81, low cutoff = 0.0003704, based on IQR multiplier of 3.

Constituent: Lithium Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1809A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

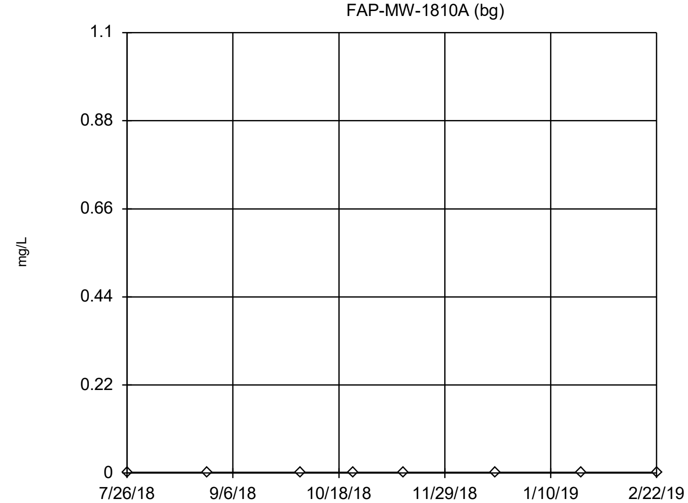
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1810A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

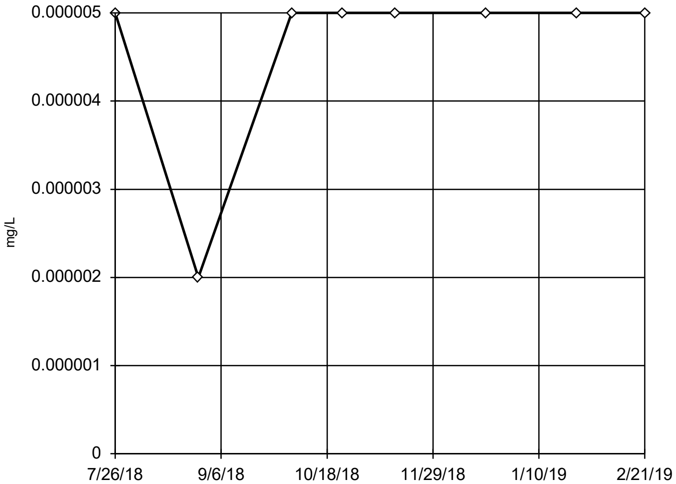
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

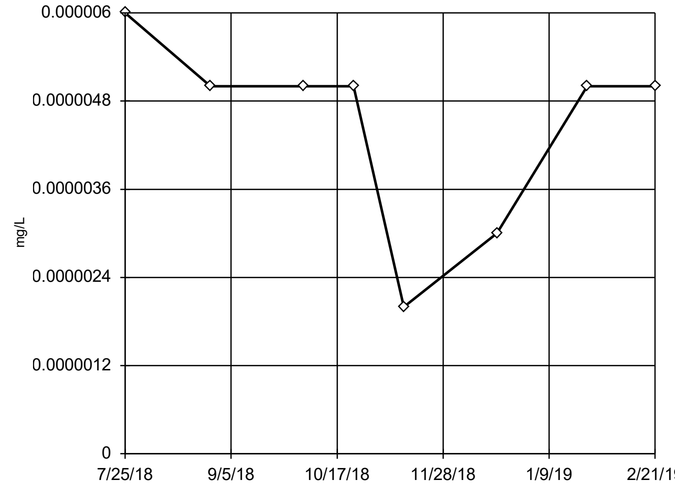
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1808A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were cube transformed to achieve best W statistic (graph shown in original units).

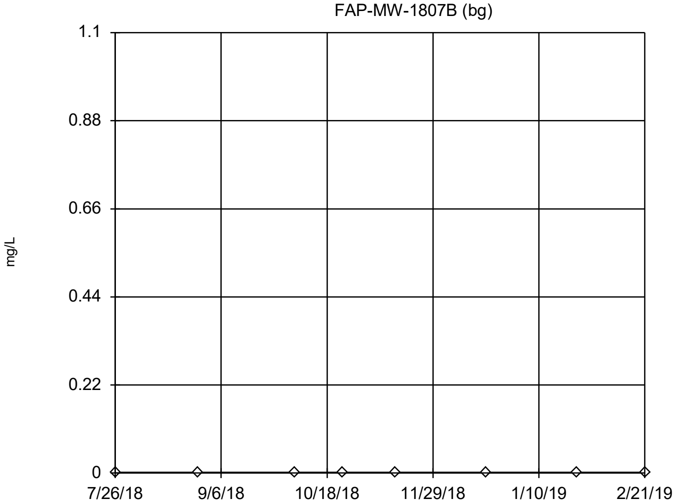
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

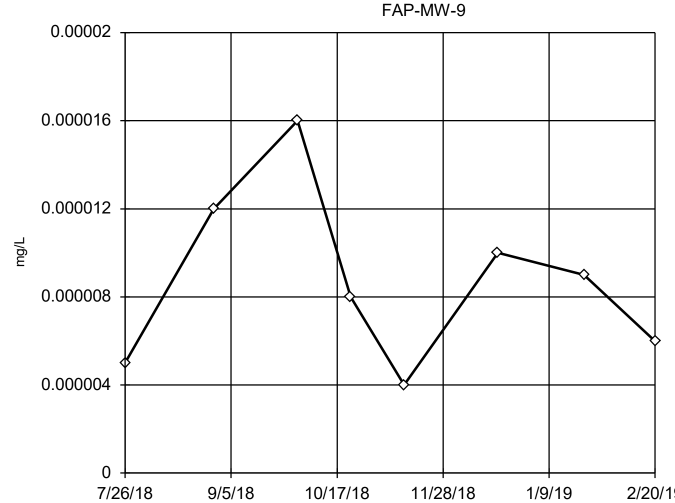
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

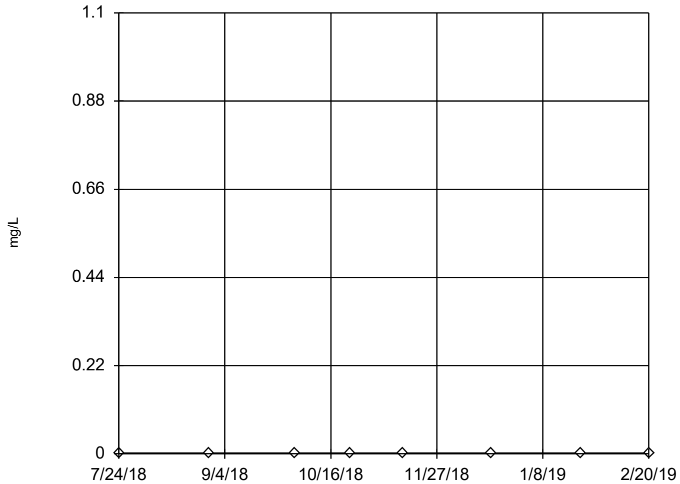
High cutoff = 0.00008764, low cutoff = 6.8e-7, based on IQR multiplier of 3.

Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1801A



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

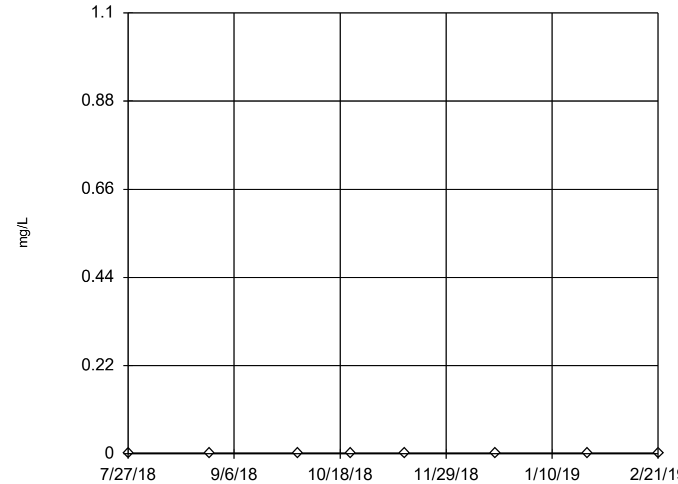
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1804A



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

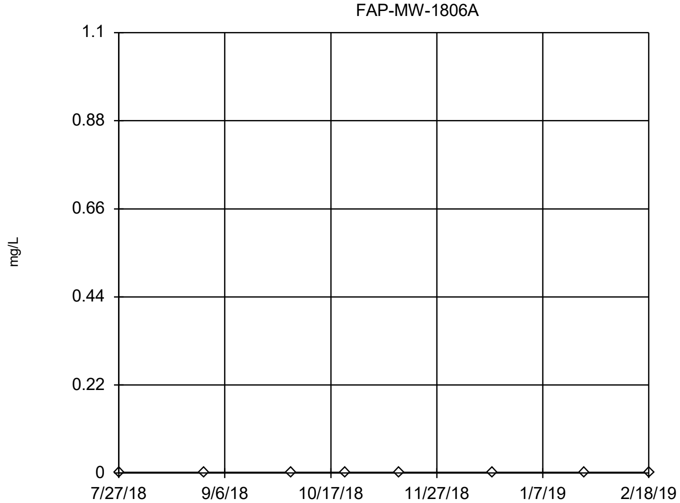
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1806A



n = 8

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

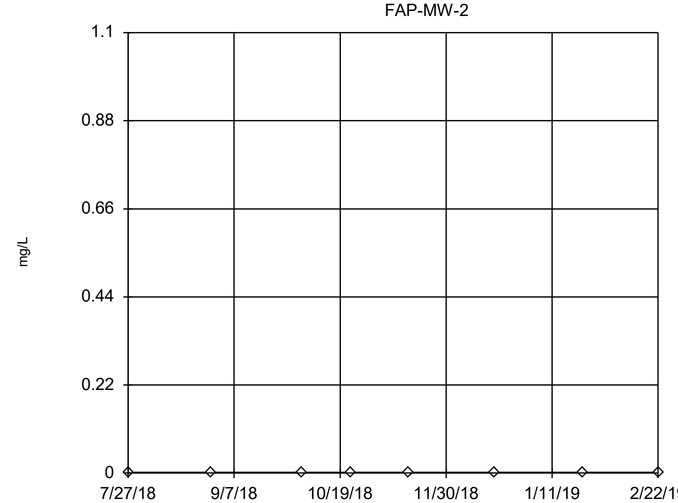
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Mercury   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2



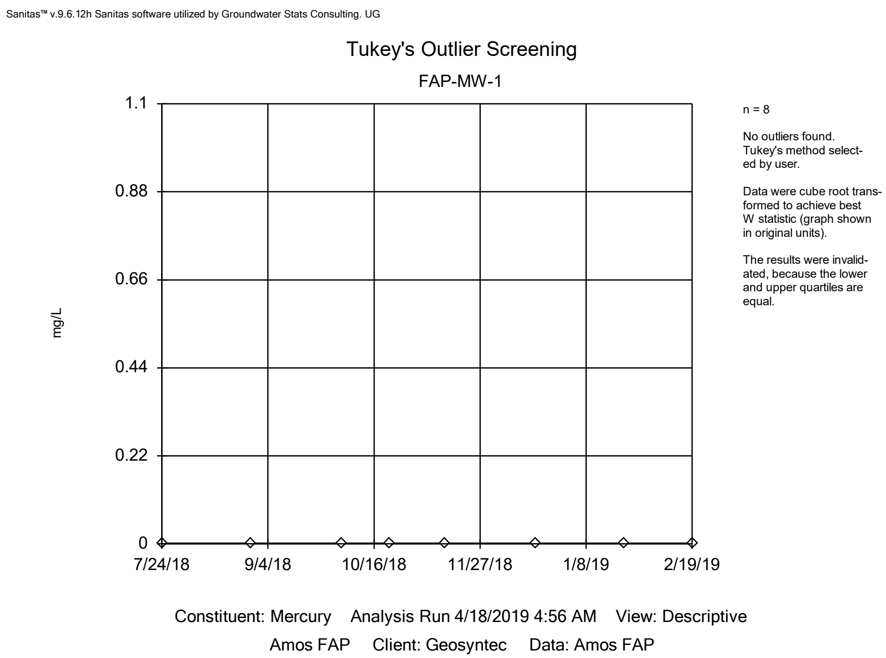
n = 8

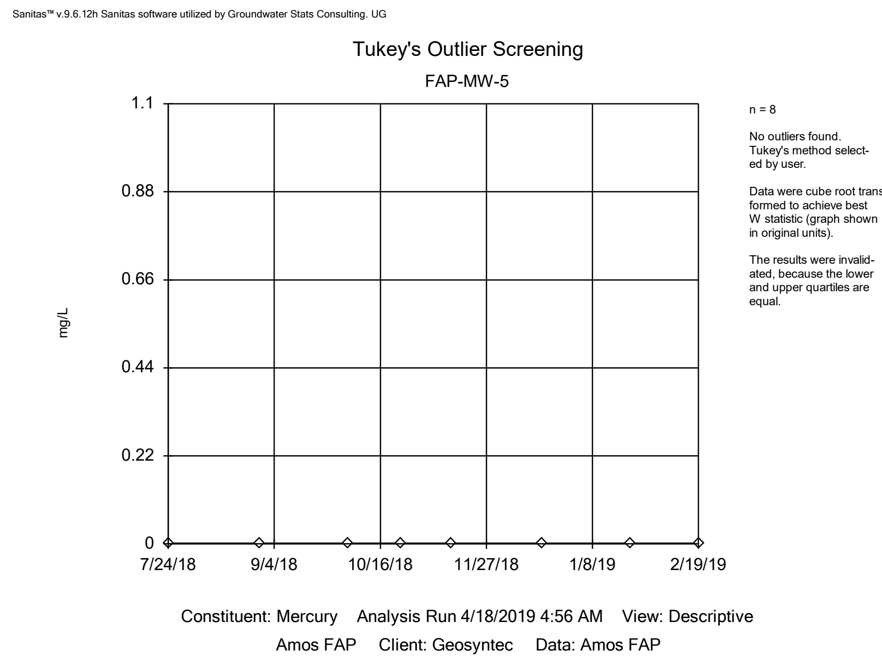
No outliers found. Tukey's method selected by user.

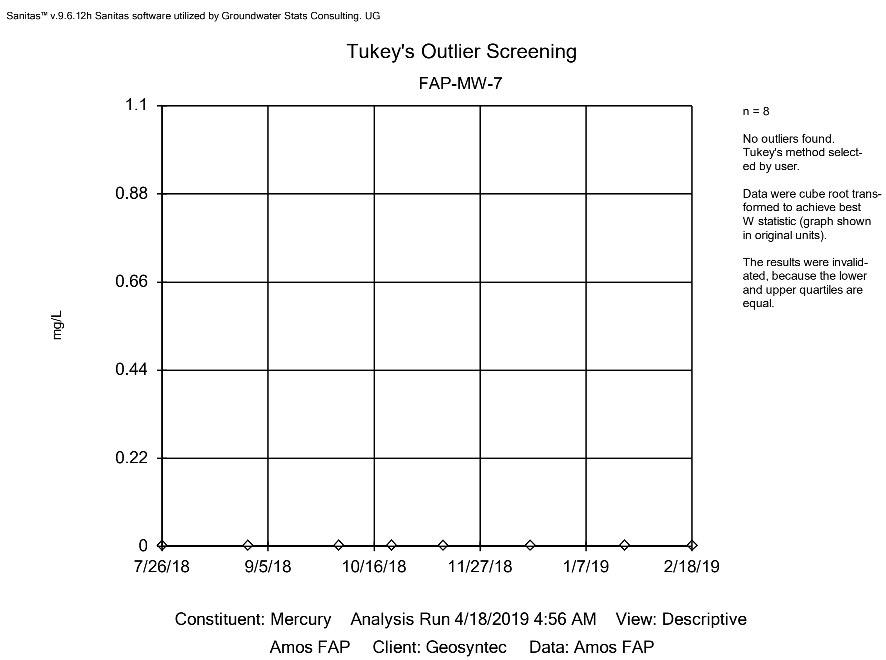
Data were cube root transformed to achieve best W statistic (graph shown in original units).

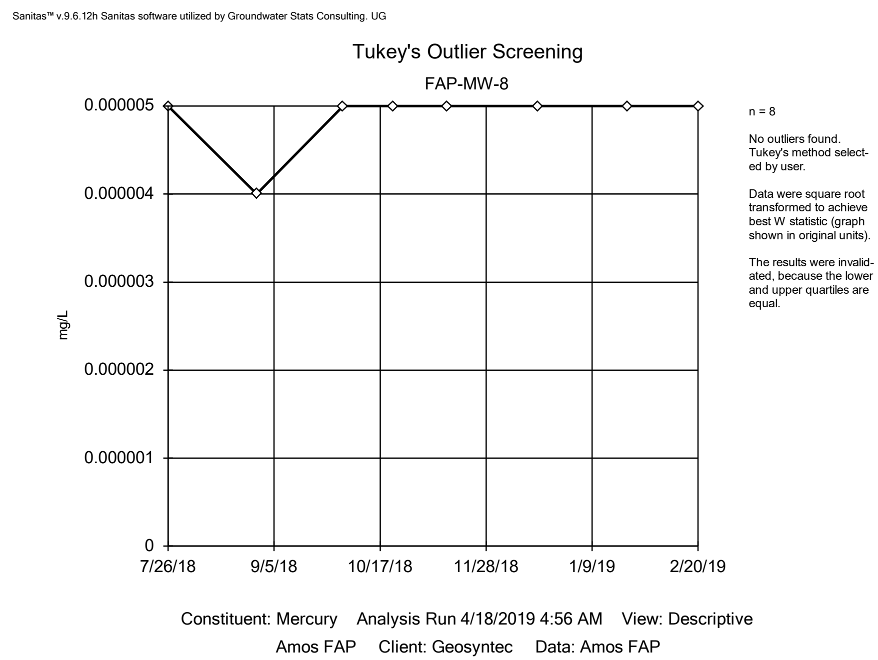
The results were invalidated, because the lower and upper quartiles are equal.

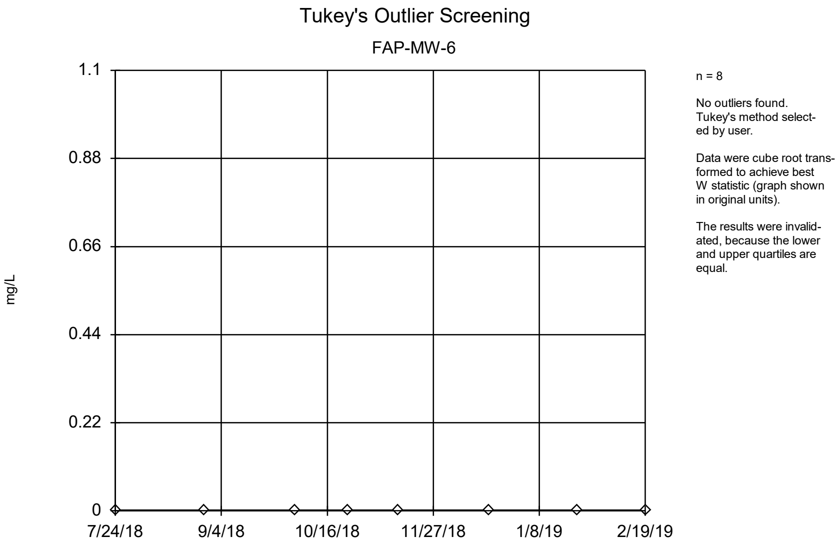
Constituent: Mercury   Analysis Run 4/18/2019 4:56 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1
mg/L
1.1
0.88
0.66
0.44
0.22
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-5
mg/L
1.1
0.88
0.66
0.44
0.22
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

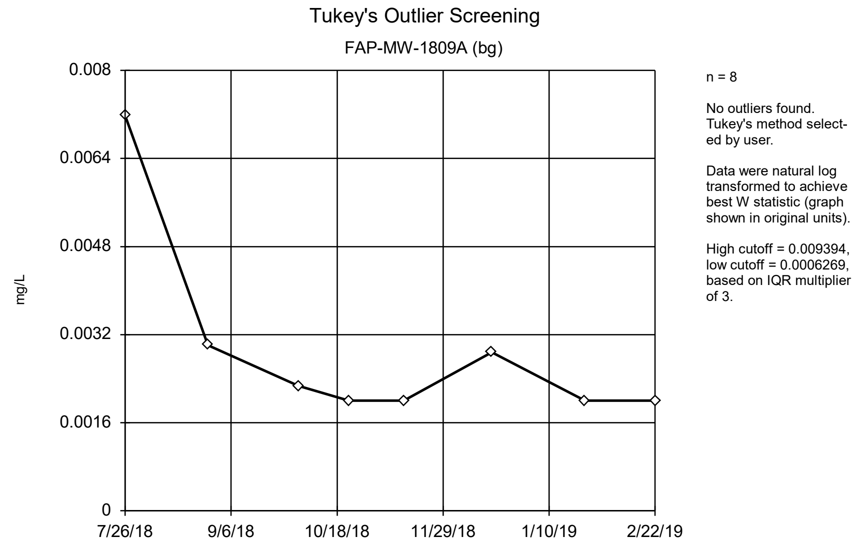

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
mg/L
1.1
0.88
0.66
0.44
0.22
0
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
mg/L
0.000005
0.000004
0.000003
0.000002
0.000001
0
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



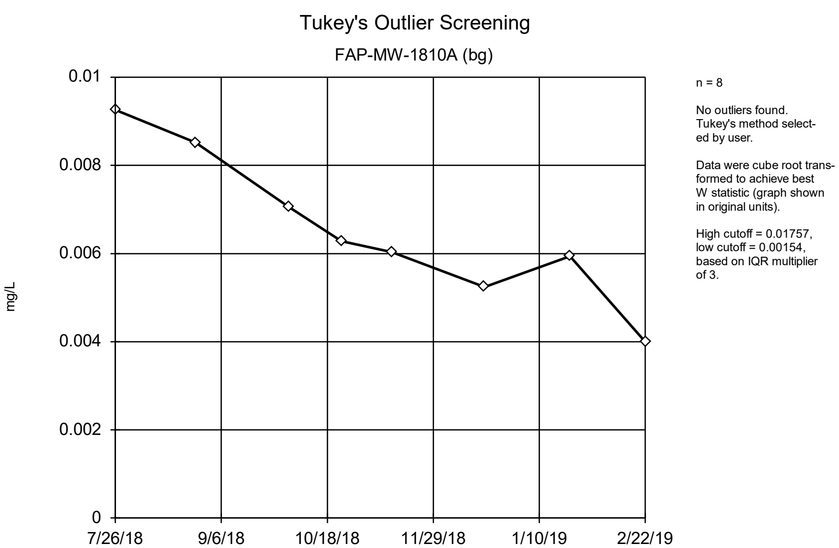
Constituent: Mercury Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



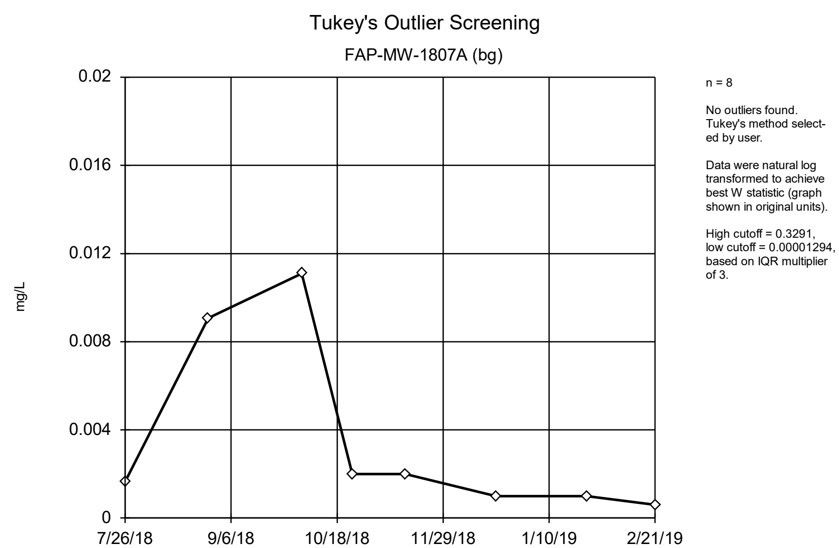
Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

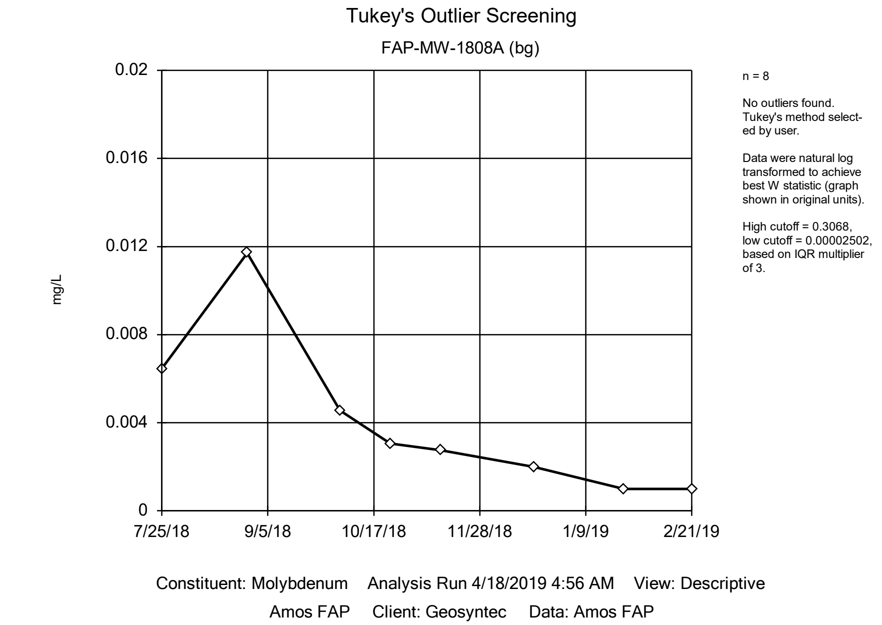


Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

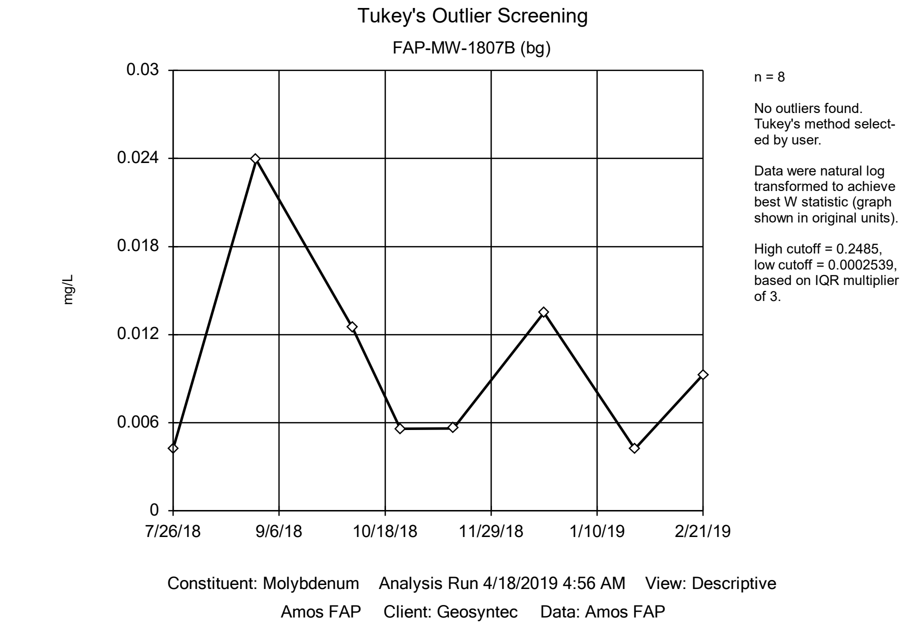
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



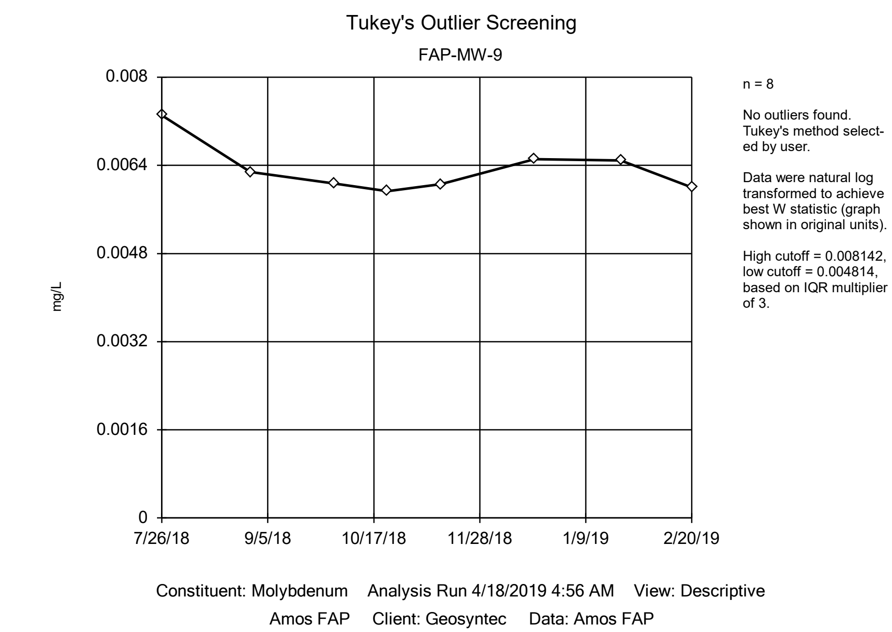
Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



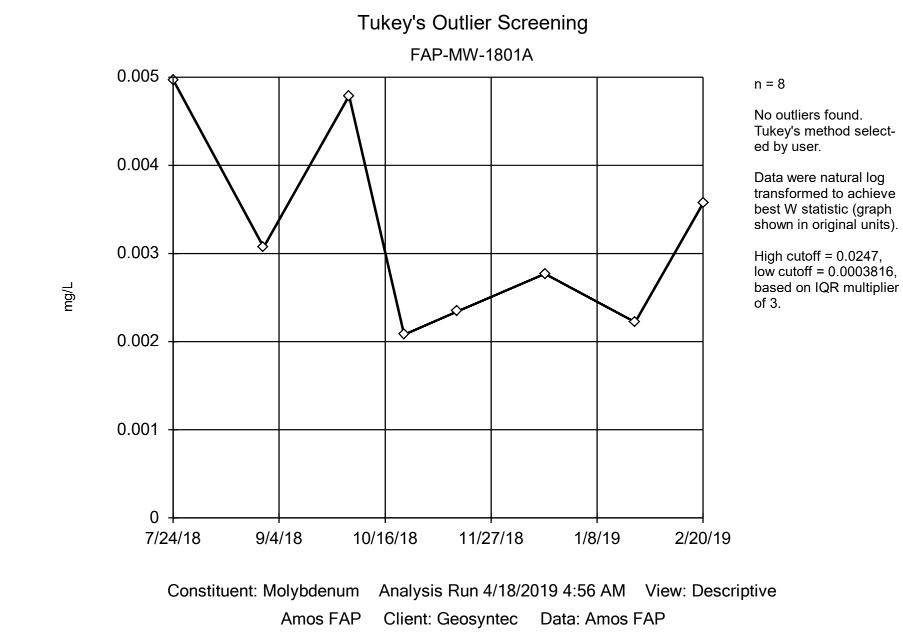
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



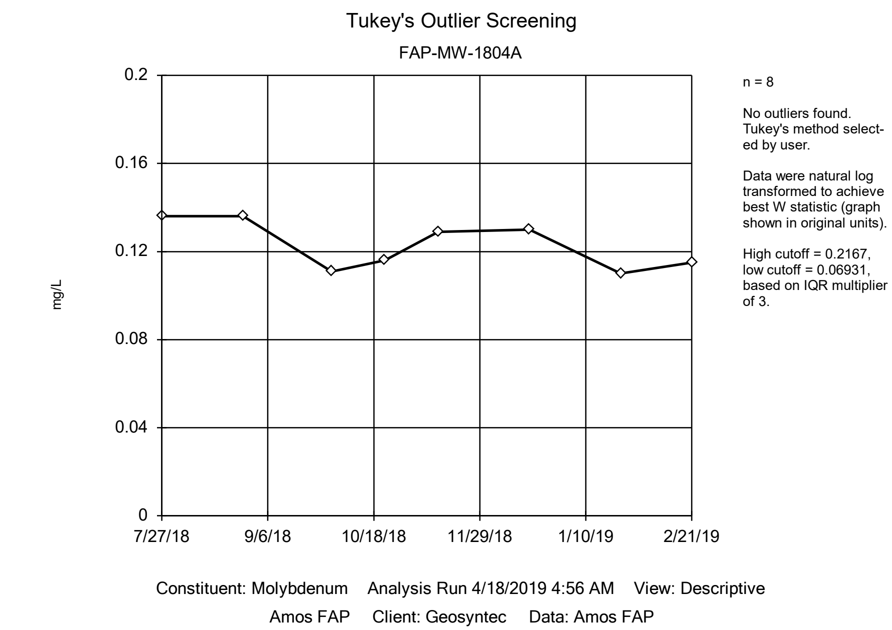
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



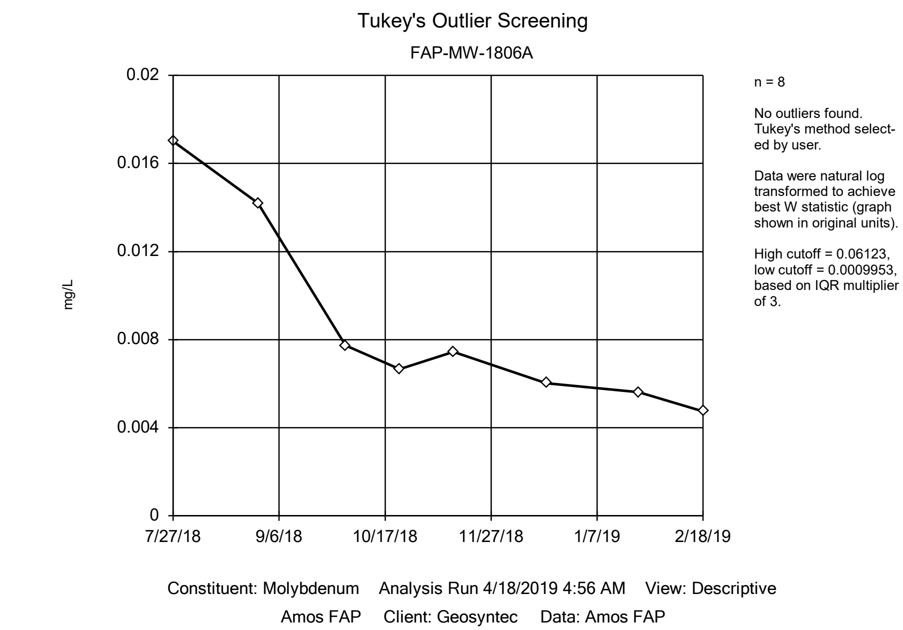
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



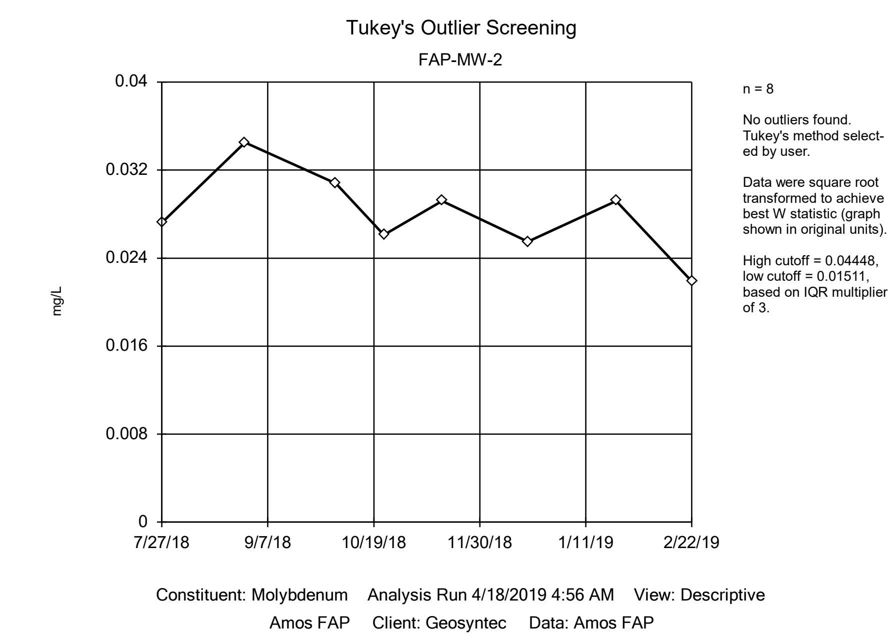
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



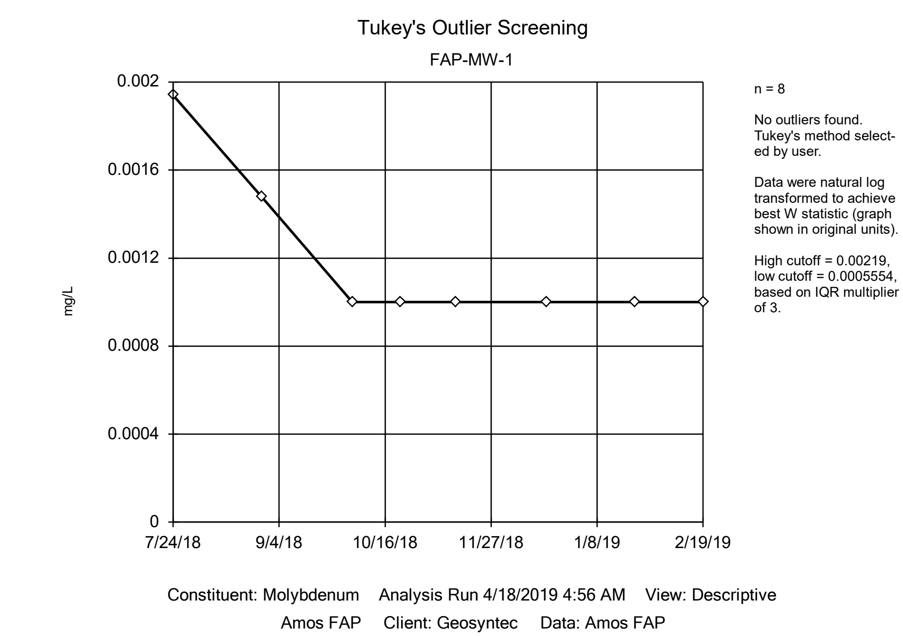
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



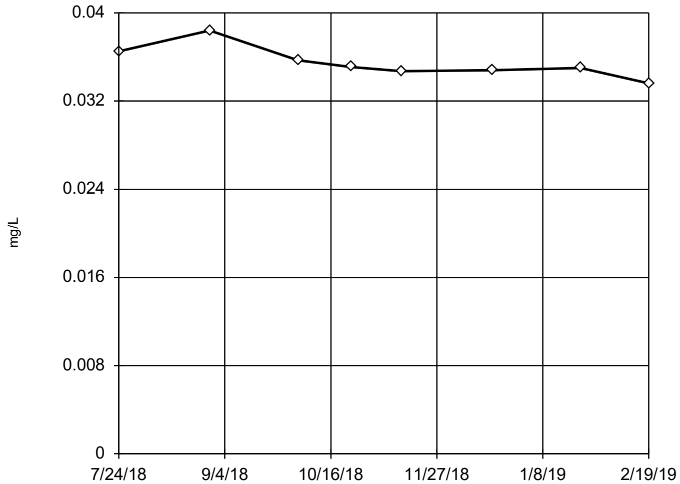
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

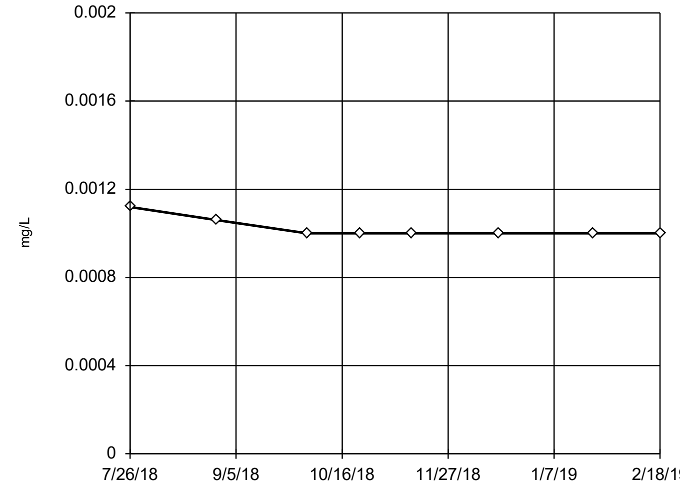
High cutoff = 0.04046, low cutoff = 0.031, based on IQR multiplier of 3.

Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

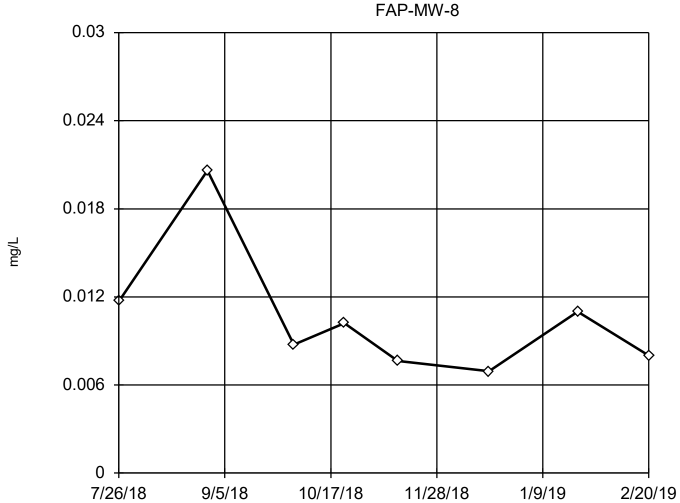
High cutoff = 0.001124, low cutoff = 0.0009163, based on IQR multiplier of 3.

Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-8



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

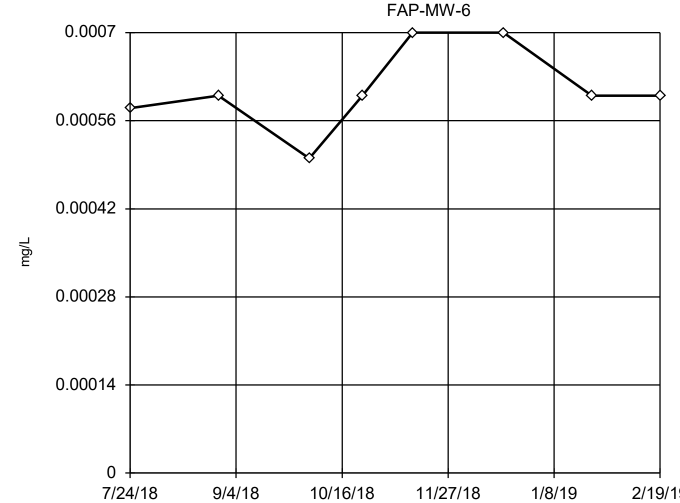
High cutoff = 0.03466, low cutoff = 0.002559, based on IQR multiplier of 3.

Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-6



n = 8

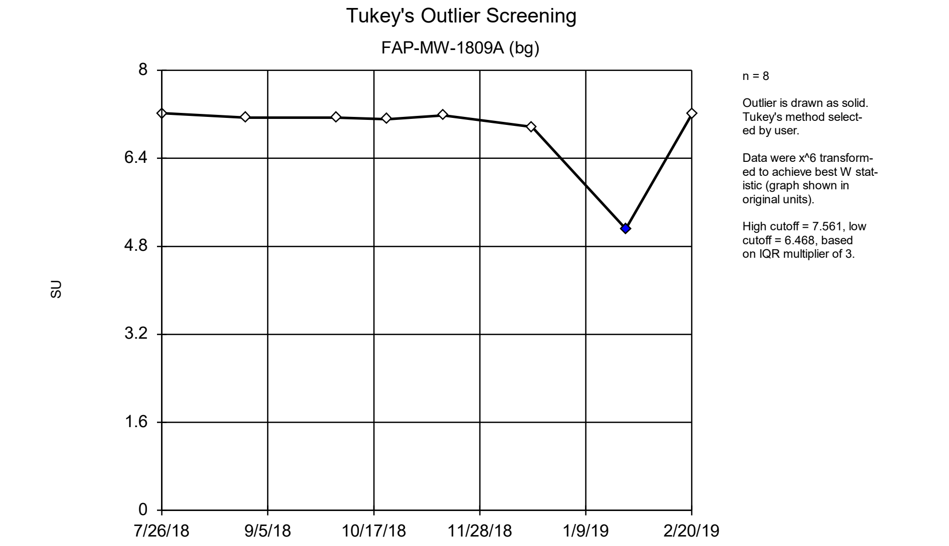
No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.0008482, low cutoff = 0.0004351, based on IQR multiplier of 3.

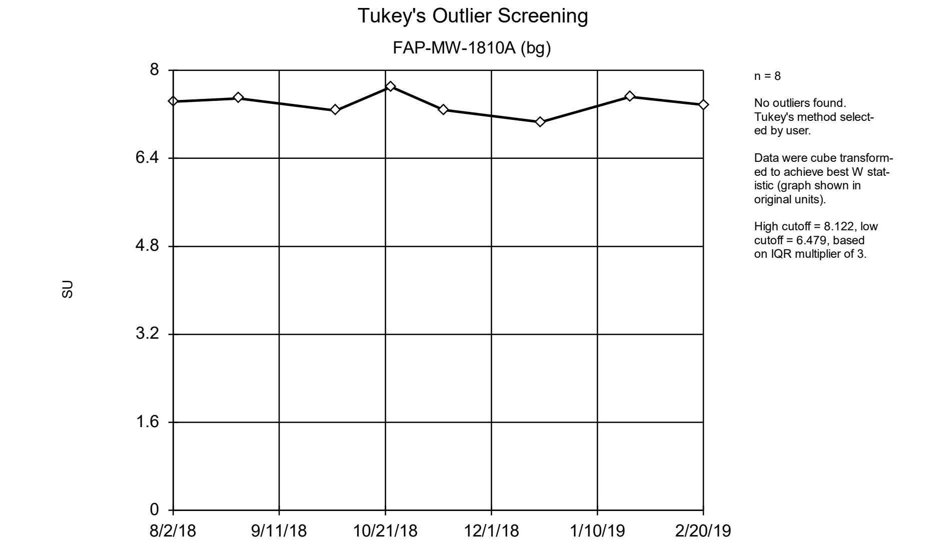
Constituent: Molybdenum Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



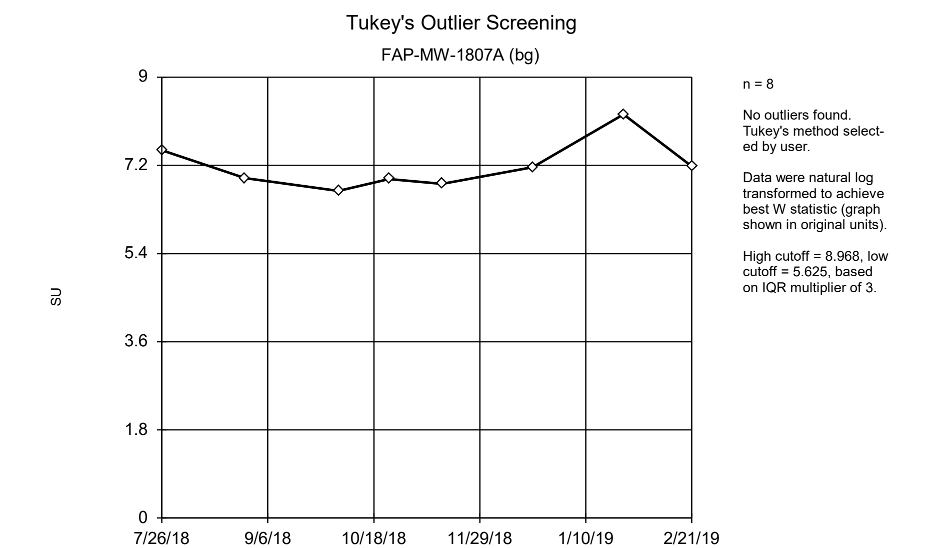
Constituent: pH Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



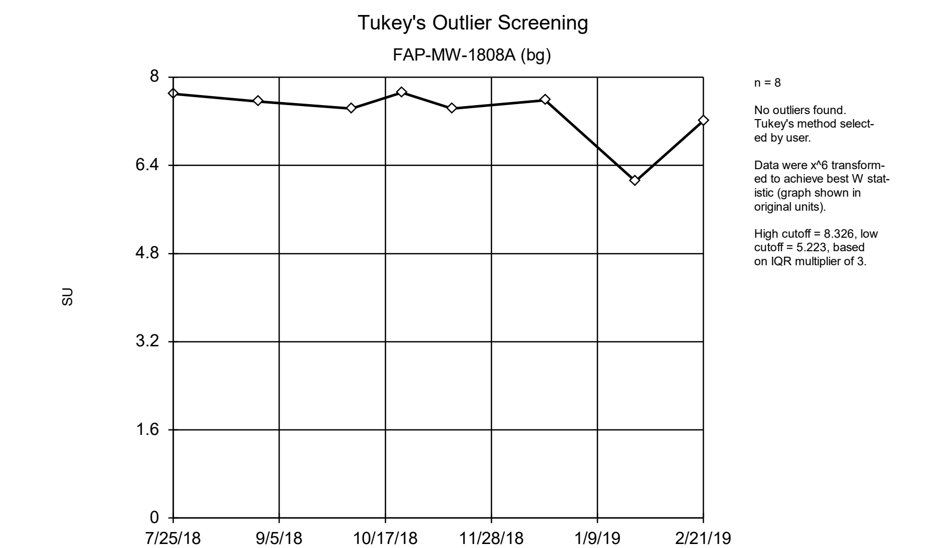
Constituent: pH Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: pH Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

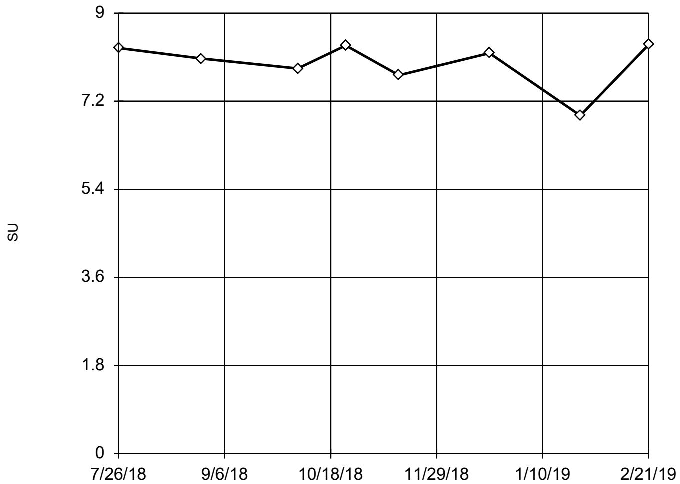


Constituent: pH Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

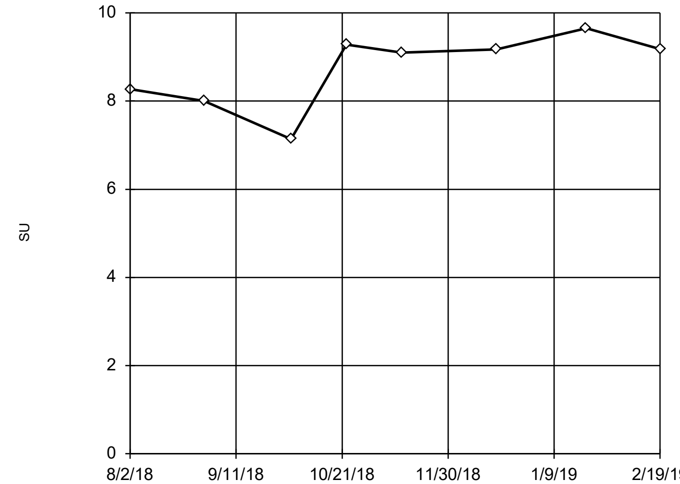
High cutoff = 9.297, low cutoff = -6.691, based on IQR multiplier of 3.

Constituent: pH Analysis Run 4/18/2019 4:56 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

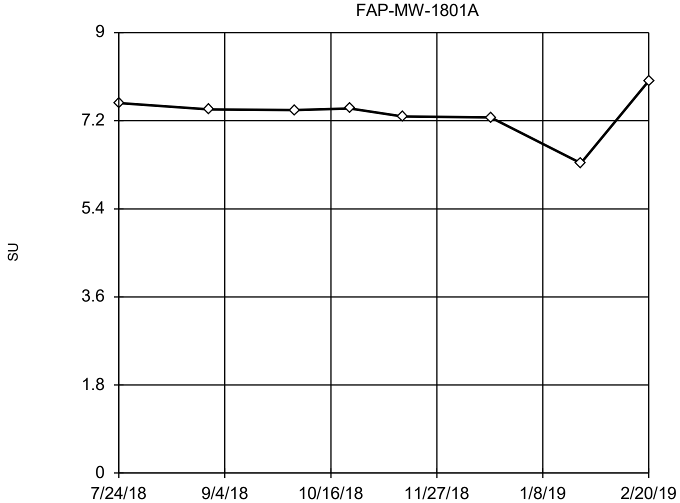
High cutoff = 10.82, low cutoff = -9.404, based on IQR multiplier of 3.

Constituent: pH Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1801A



n = 8

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

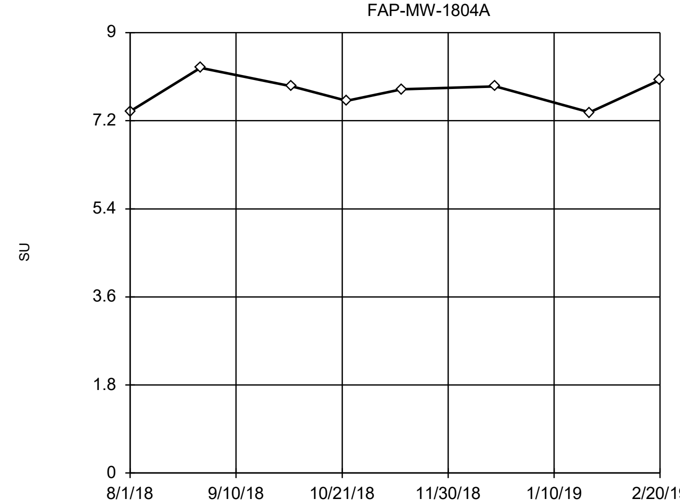
High cutoff = 8.033, low cutoff = 6.239, based on IQR multiplier of 3.

Constituent: pH Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1804A



n = 8

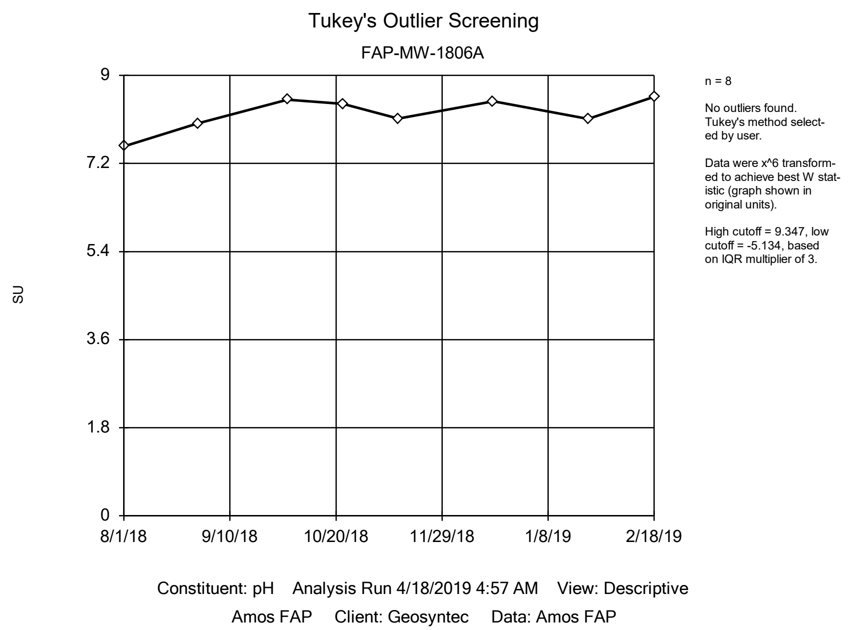
No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

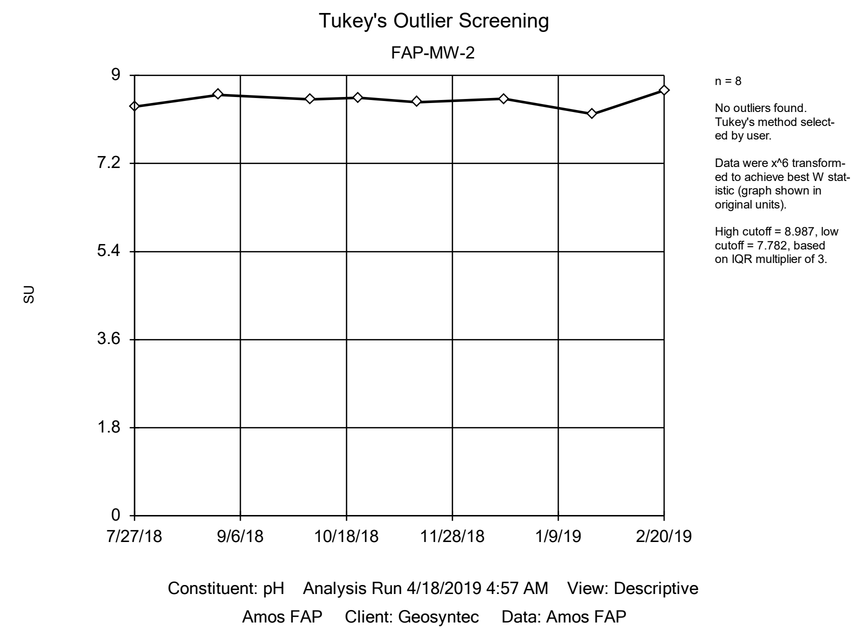
High cutoff = 9.014, low cutoff = 4.936, based on IQR multiplier of 3.

Constituent: pH Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

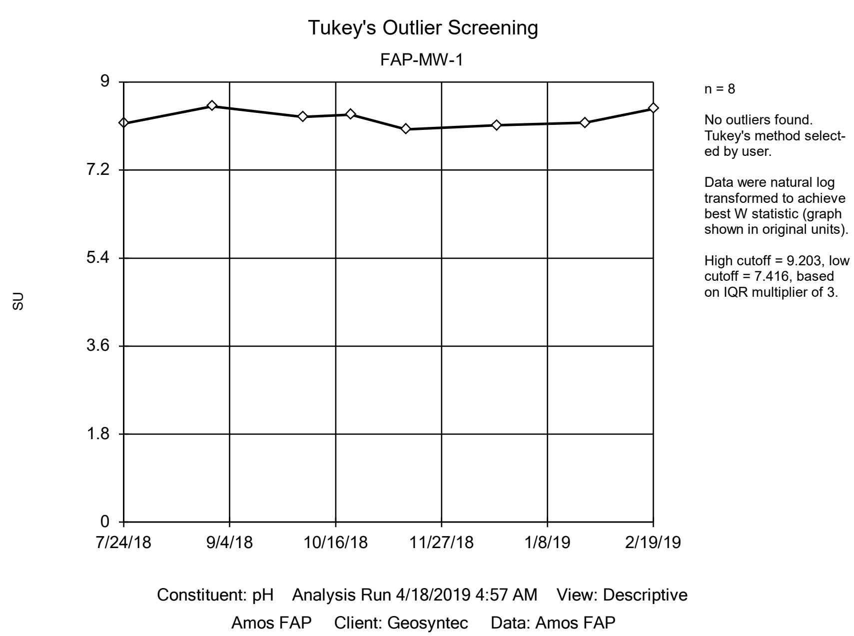
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



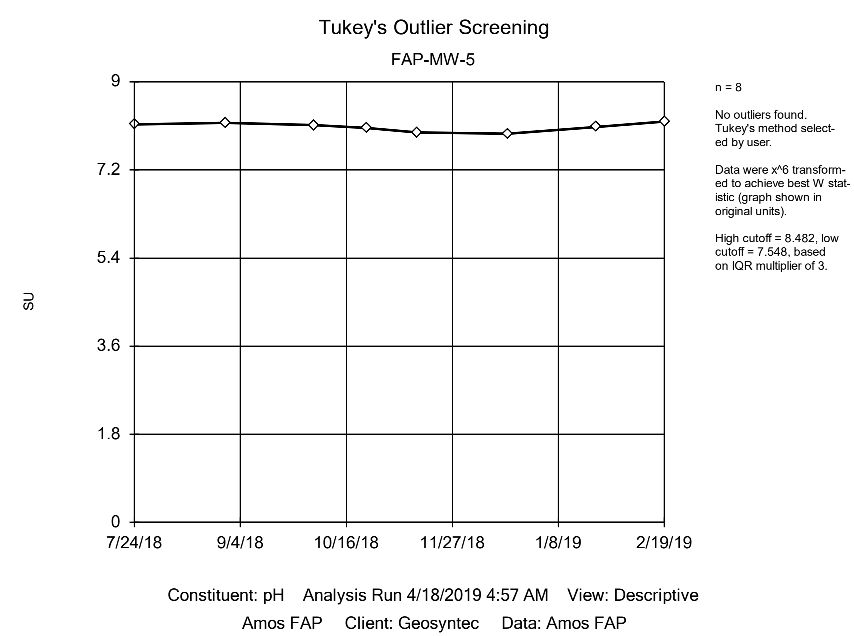
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

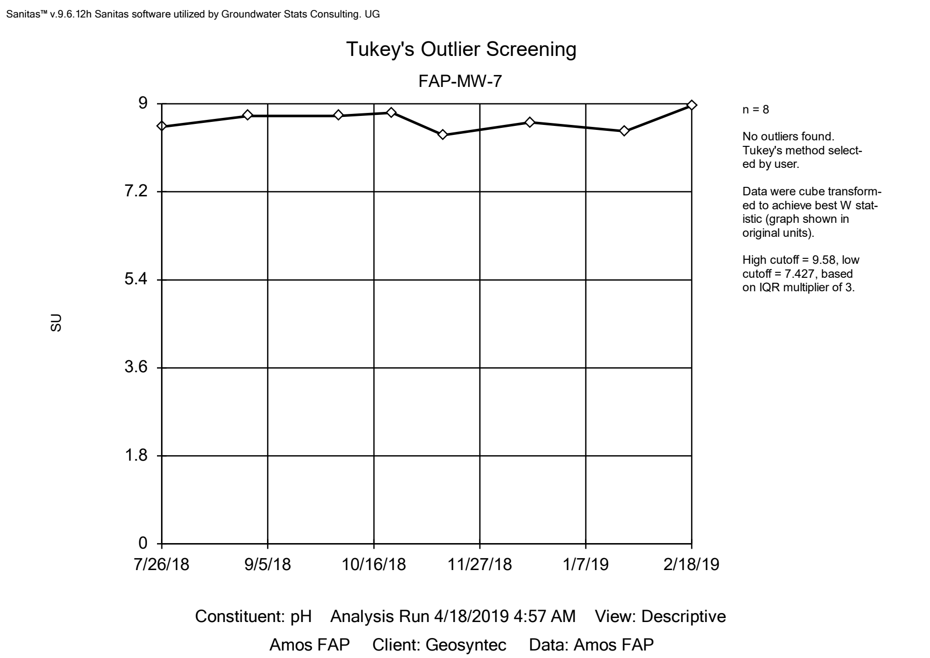


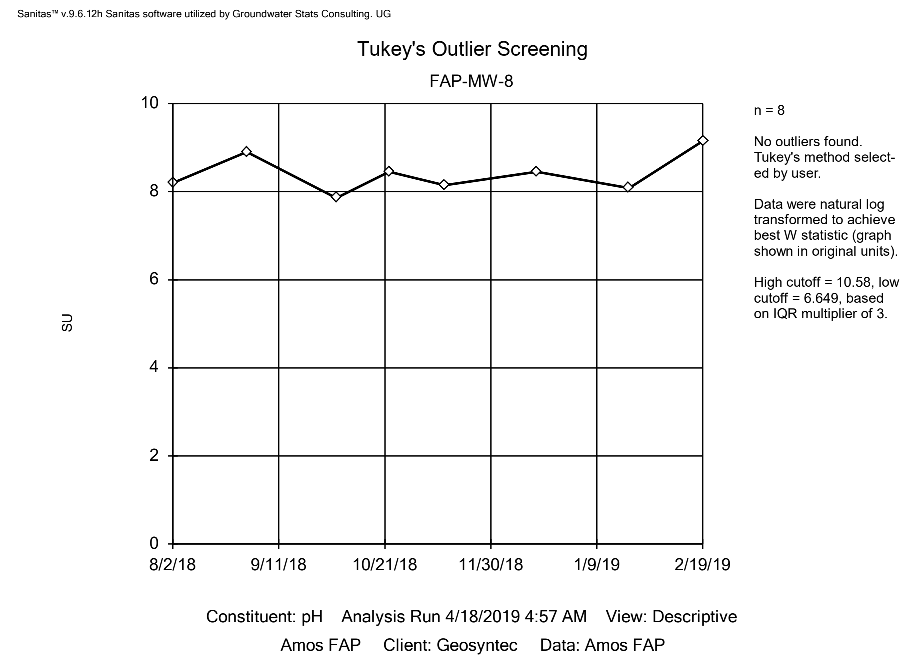
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

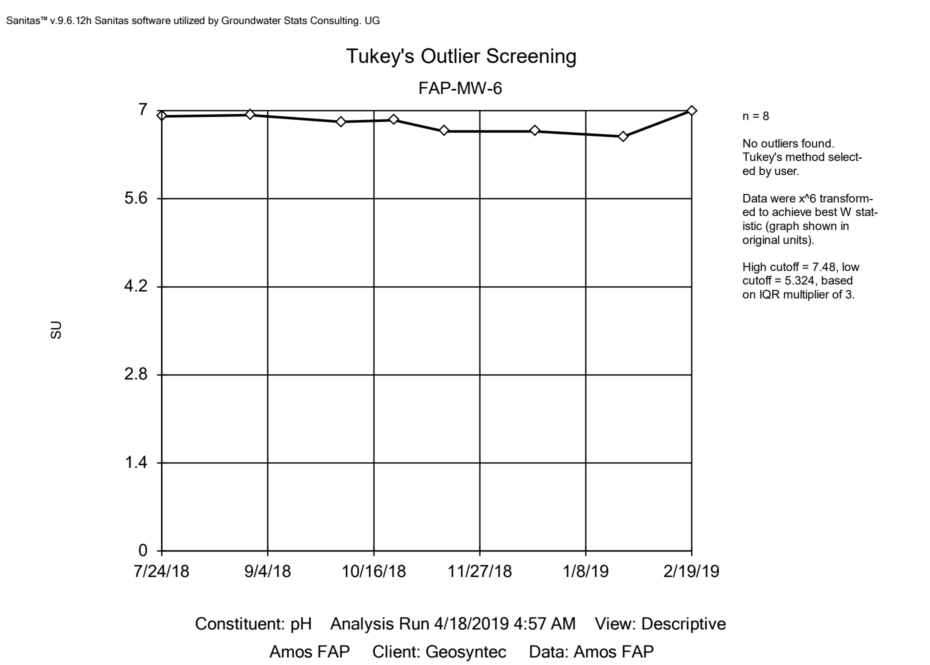


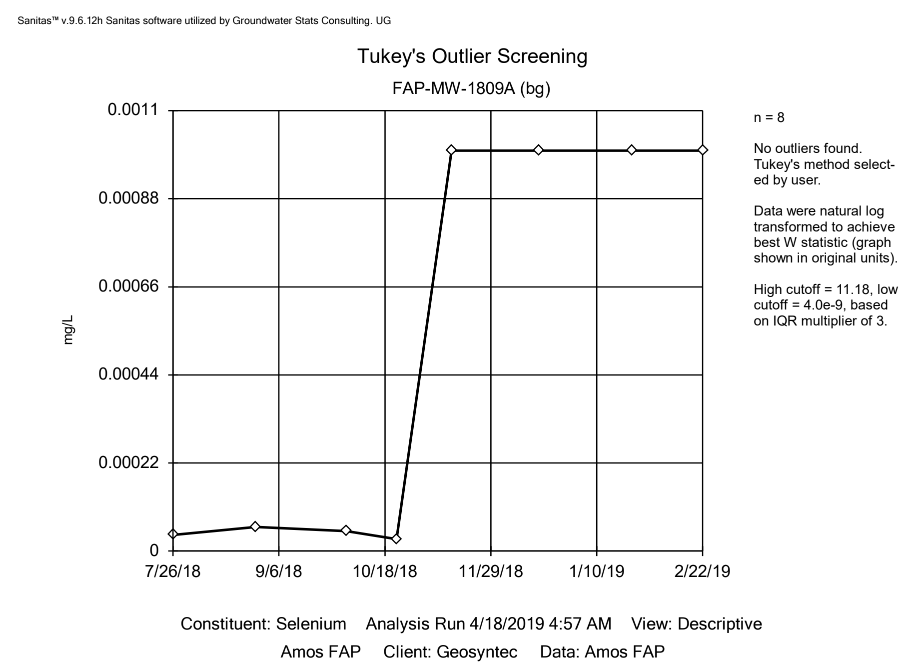
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

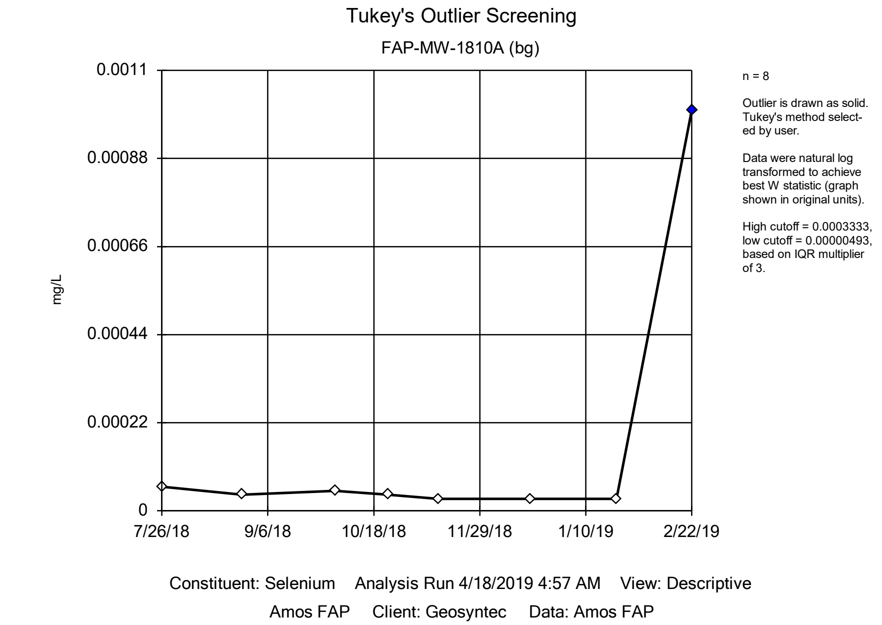



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
SU
9
7.2
5.4
3.6
1.8
0
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were cube transformed to achieve best W statistic (graph shown in original units).
High cutoff = 9.58, low cutoff = 7.427, based on IQR multiplier of 3.
Constituent: pH Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

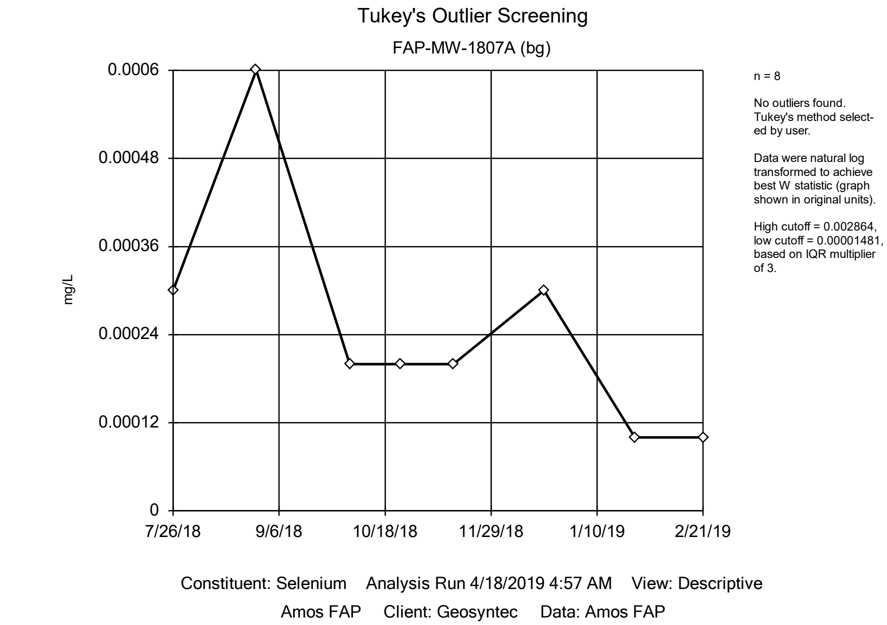

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
SU
10
8
6
4
2
0
8/2/18
9/11/18
10/21/18
11/30/18
1/9/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 10.58, low cutoff = 6.649, based on IQR multiplier of 3.
Constituent: pH Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-6
SU
7
5.6
4.2
2.8
1.4
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 7.48, low cutoff = 5.324, based on IQR multiplier of 3.
Constituent: pH Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

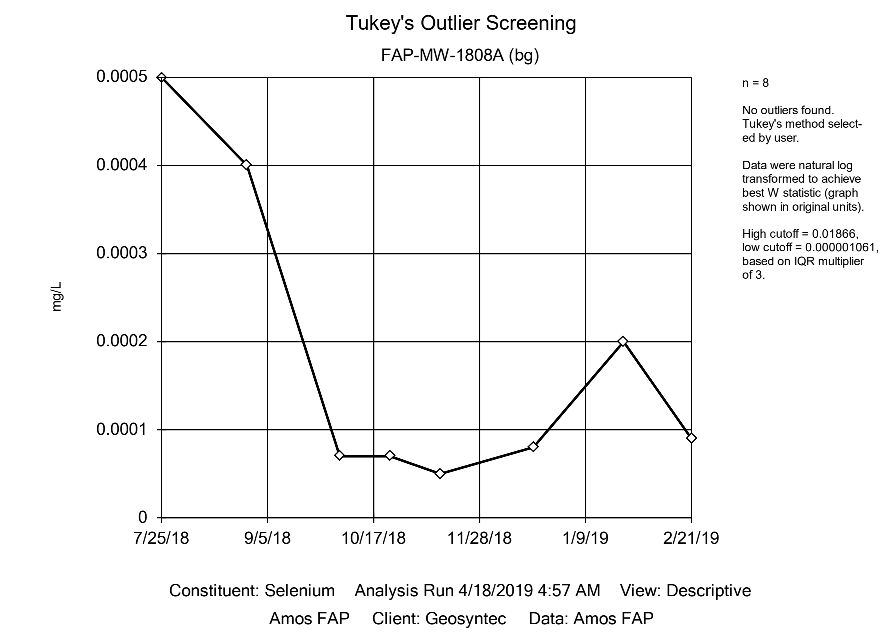

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1809A (bg)
mg/L
0.0011
0.00088
0.00066
0.00044
0.00022
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 11.18, low cutoff = 4.0e-9, based on IQR multiplier of 3.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



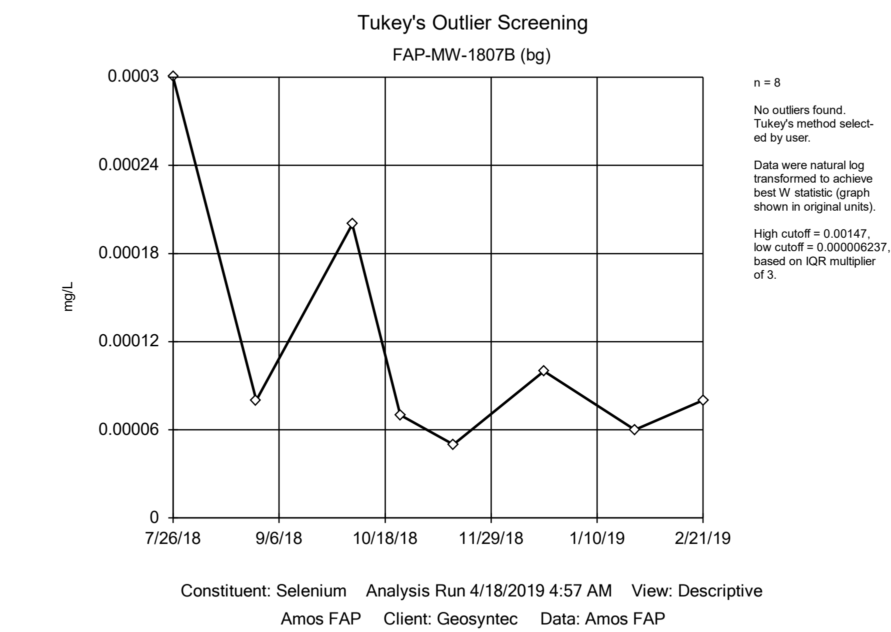
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

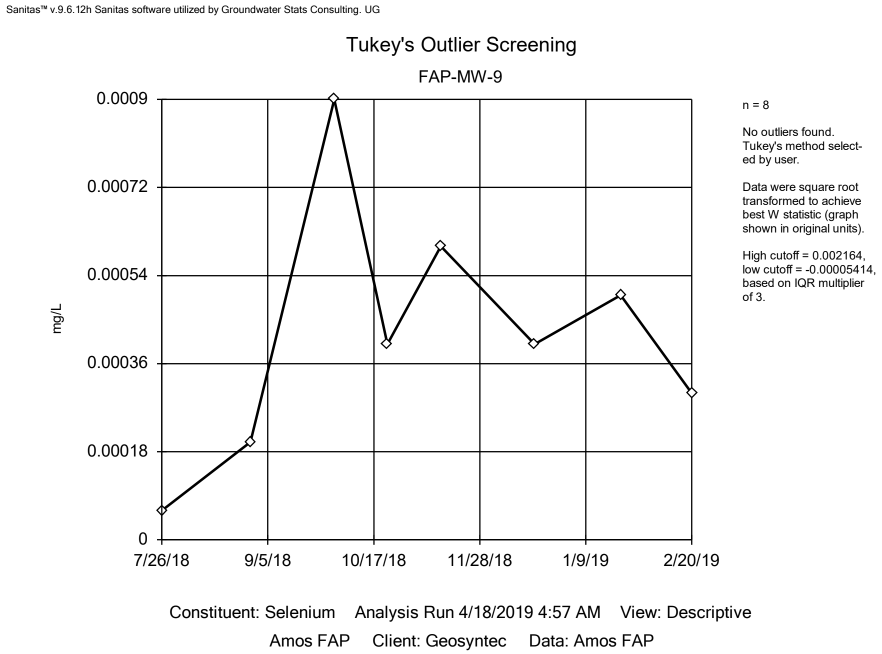


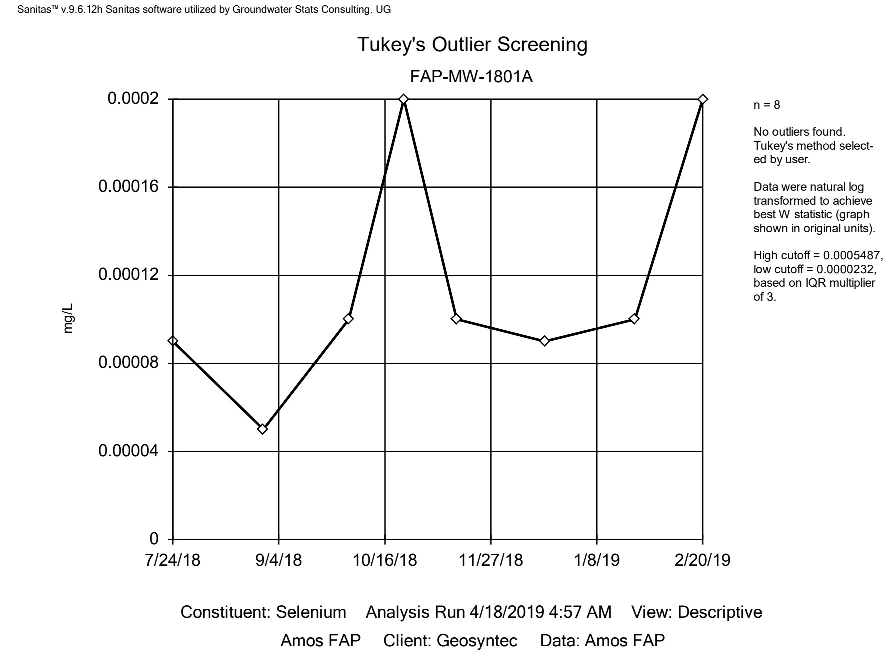
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

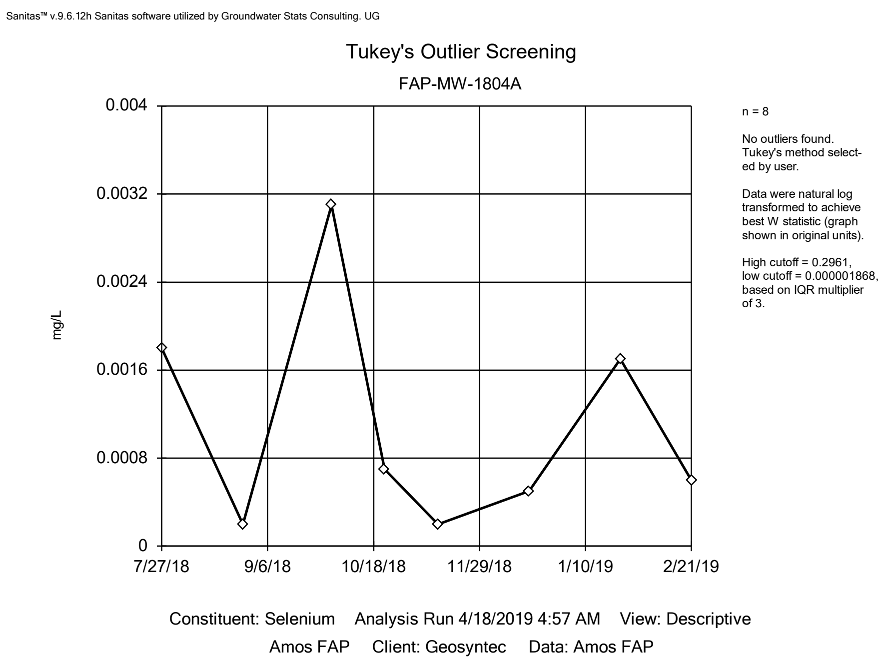


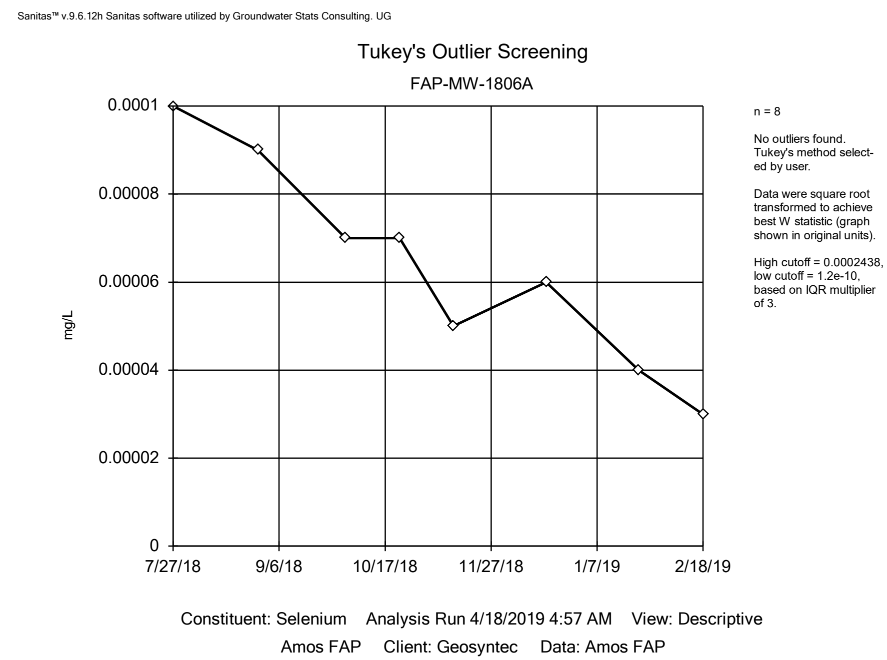
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG




Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-9
0.0009
0.00072
0.00054
0.00036
0.00018
0
mg/L
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.002164, low cutoff = -0.00005414, based on IQR multiplier of 3.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1801A
0.0002
0.00016
0.00012
0.00008
0.00004
0
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0005487, low cutoff = 0.0000232, based on IQR multiplier of 3.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

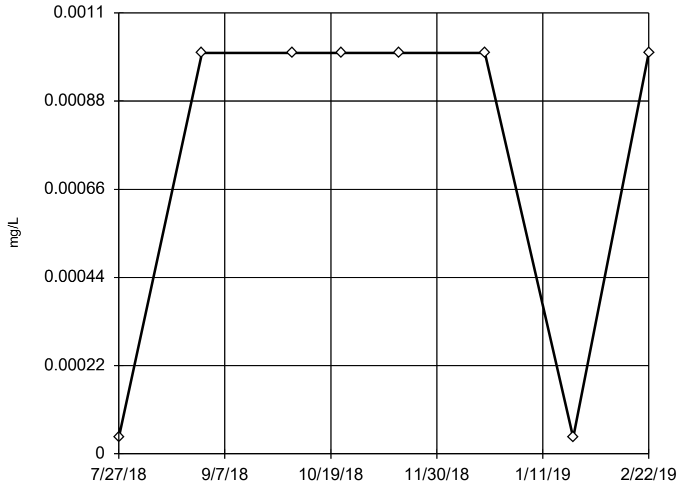

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
0.004
0.0032
0.0024
0.0016
0.0008
0
mg/L
7/27/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.2961, low cutoff = 0.000001868, based on IQR multiplier of 3.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
0.0001
0.00008
0.00006
0.00004
0.00002
0
mg/L
7/27/18
9/6/18
10/17/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0002438, low cutoff = 1.2e-10, based on IQR multiplier of 3.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-2



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

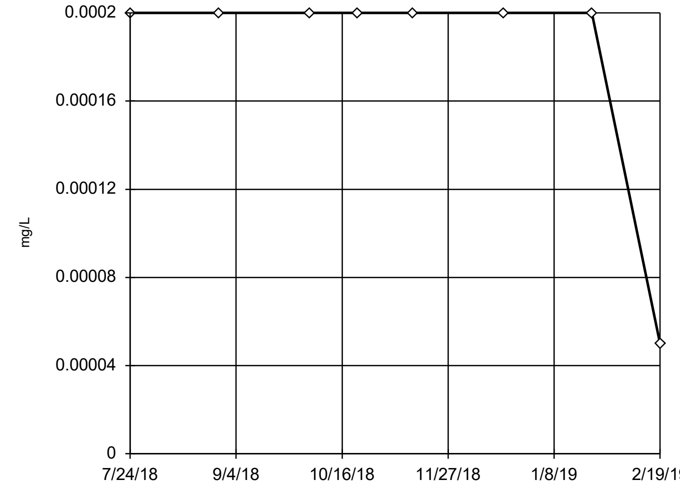
High cutoff = 0.00158, low cutoff = -0.0009984, based on IQR multiplier of 3.

Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1



n = 8

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

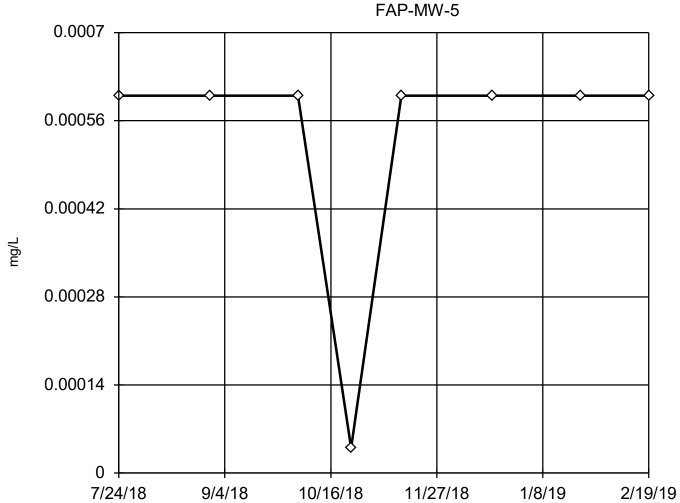
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-5



n = 8

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

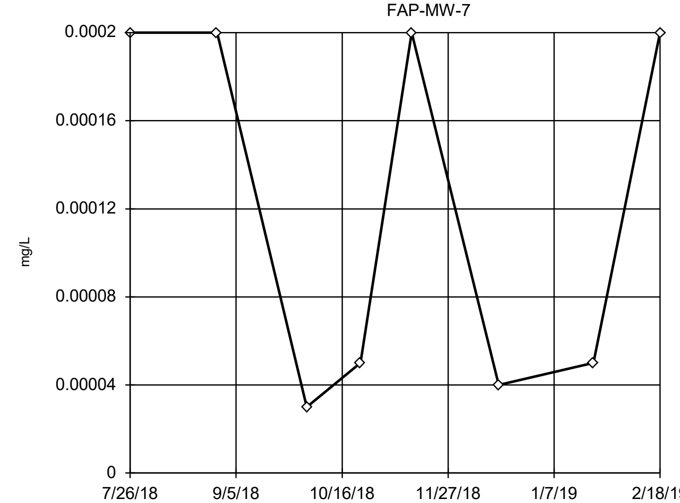
The results were invalidated, because the lower and upper quartiles are equal.

Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-7



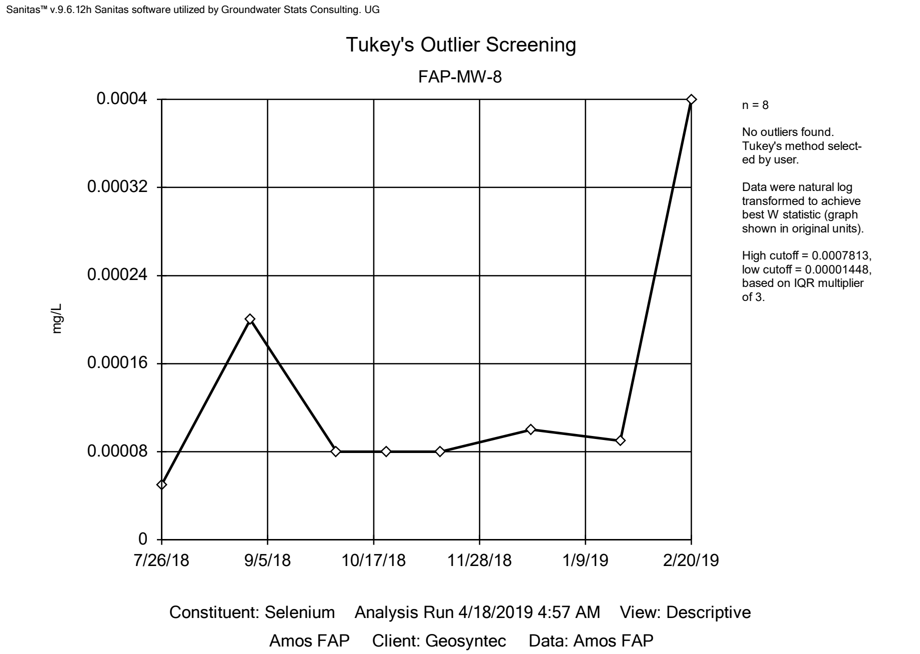
n = 8

No outliers found. Tukey's method selected by user.

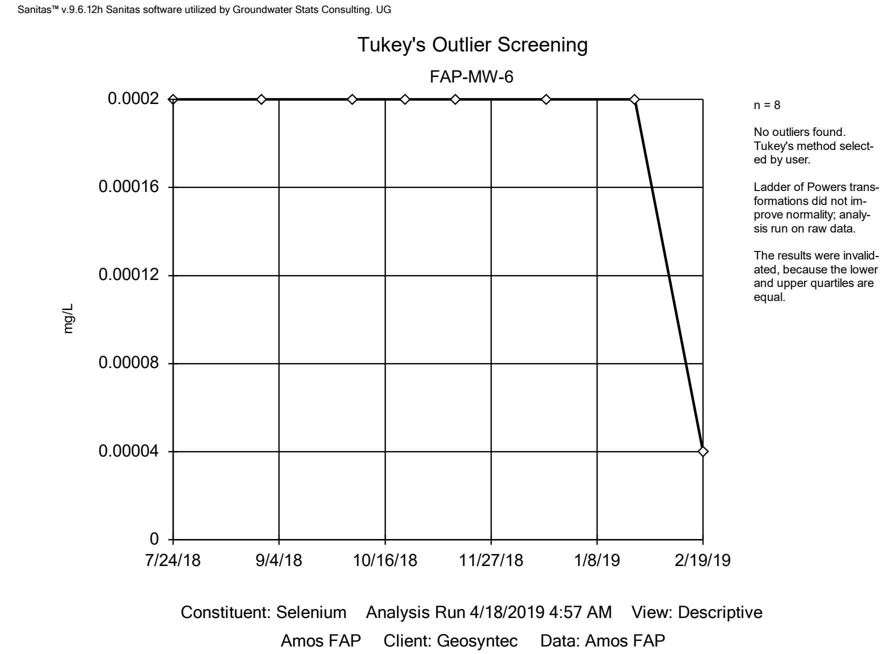
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.01789, low cutoff = 5.0e-7, based on IQR multiplier of 3.

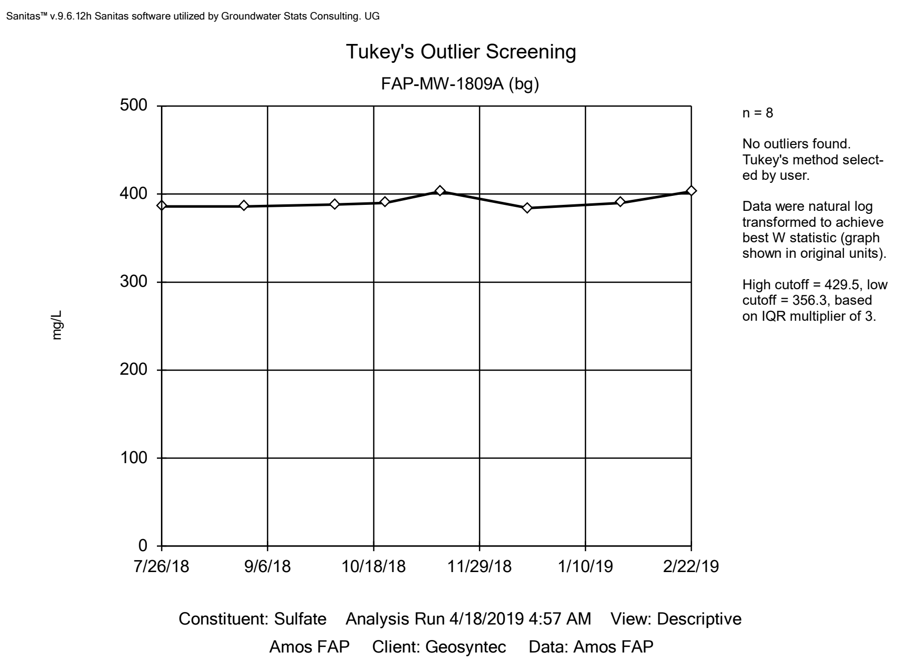
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



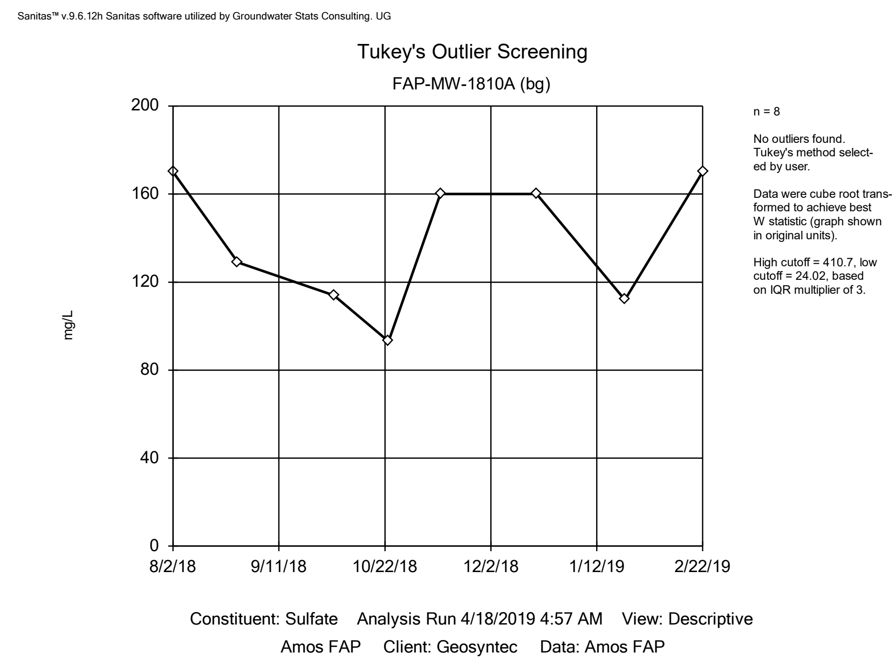
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
mg/L
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0007813, low cutoff = 0.00001448, based on IQR multiplier of 3.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



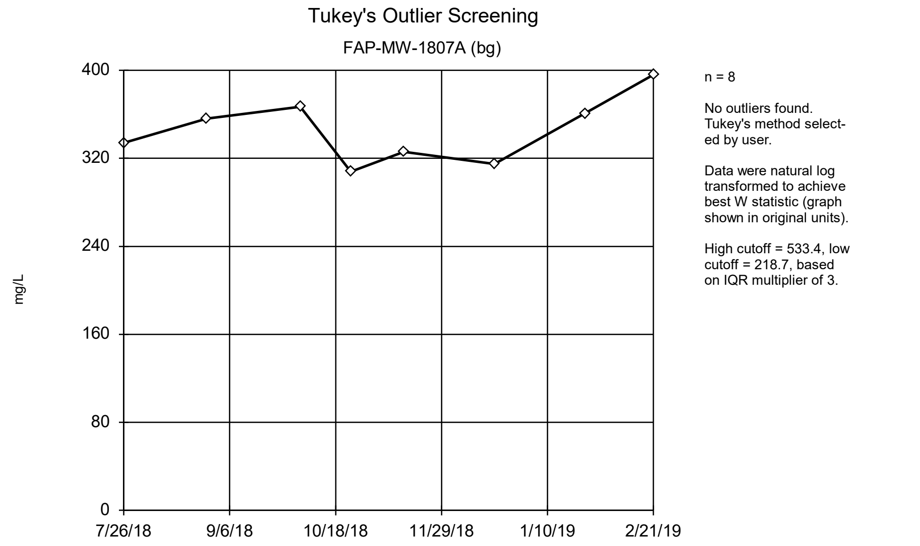
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-6
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
The results were invalidated, because the lower and upper quartiles are equal.
Constituent: Selenium Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



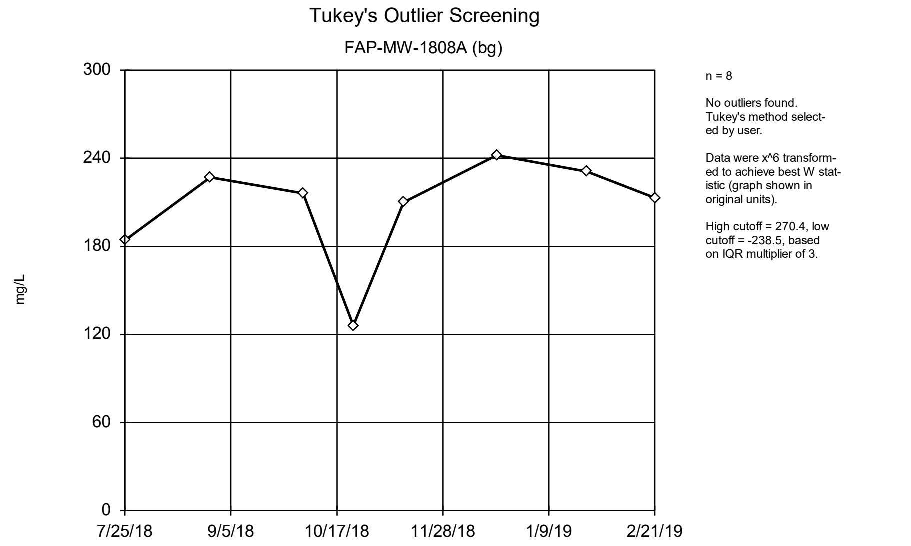
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1809A (bg)
mg/L
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 429.5, low cutoff = 356.3, based on IQR multiplier of 3.
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



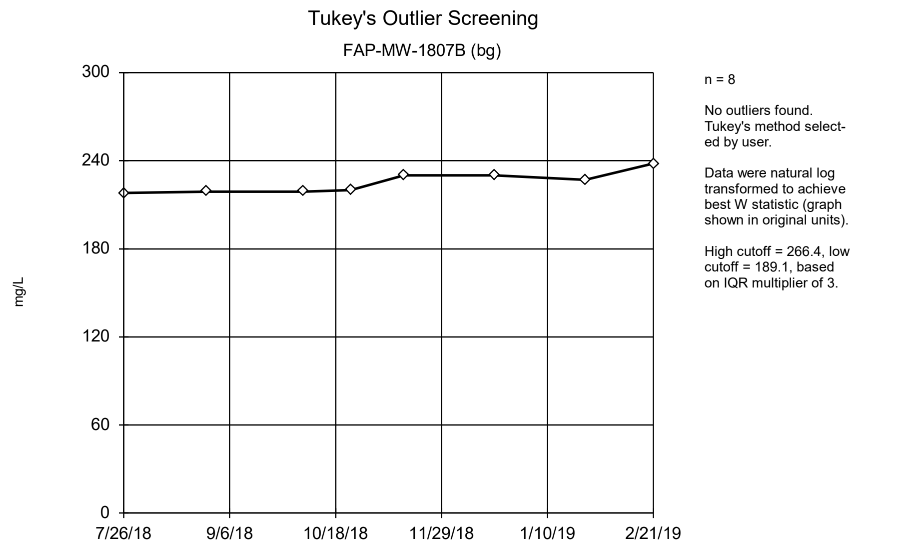
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1810A (bg)
mg/L
8/2/18
9/11/18
10/22/18
12/2/18
1/12/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 410.7, low cutoff = 24.02, based on IQR multiplier of 3.
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



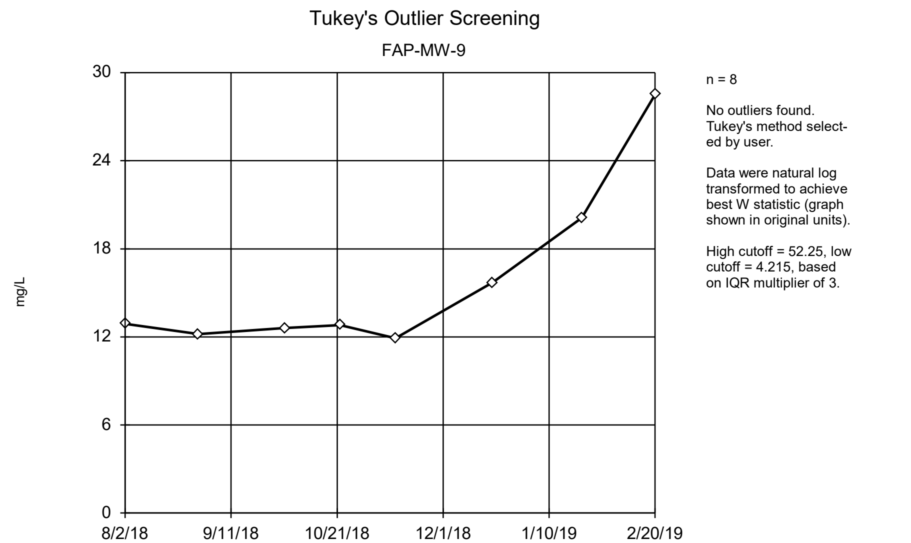
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

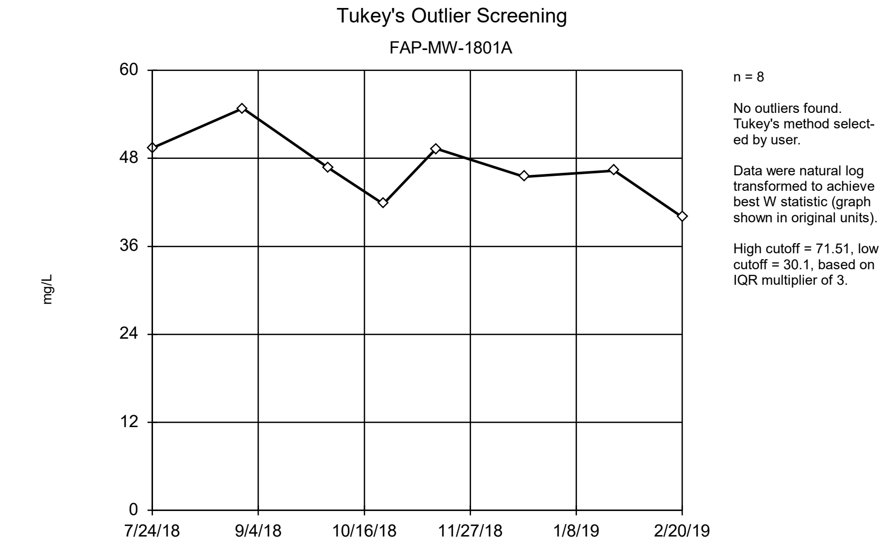


Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



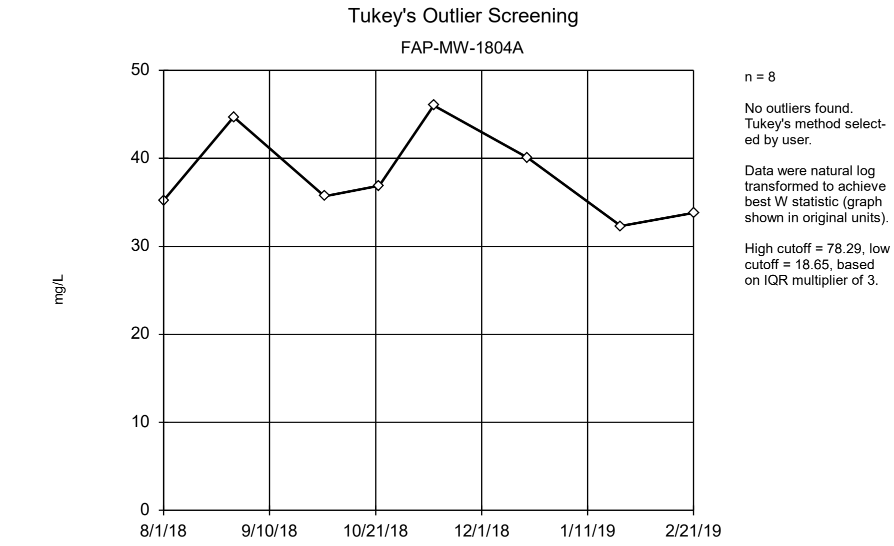
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



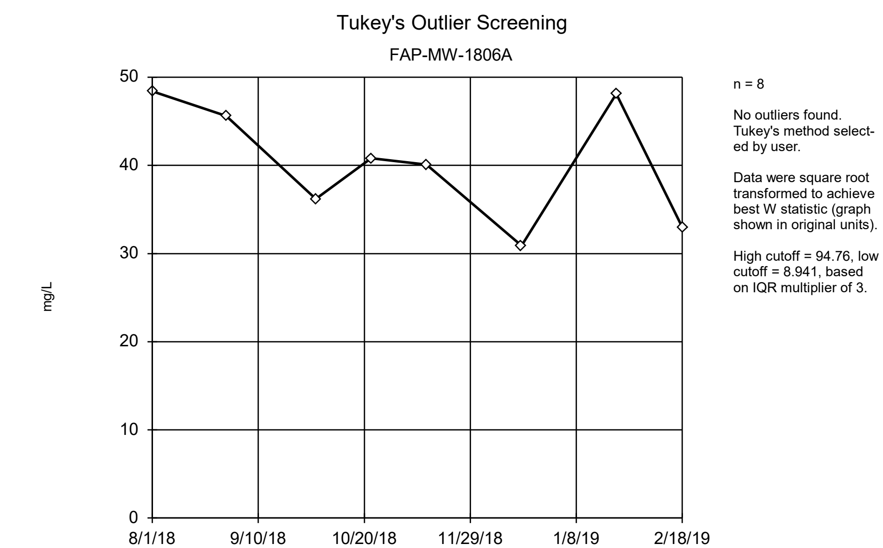
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



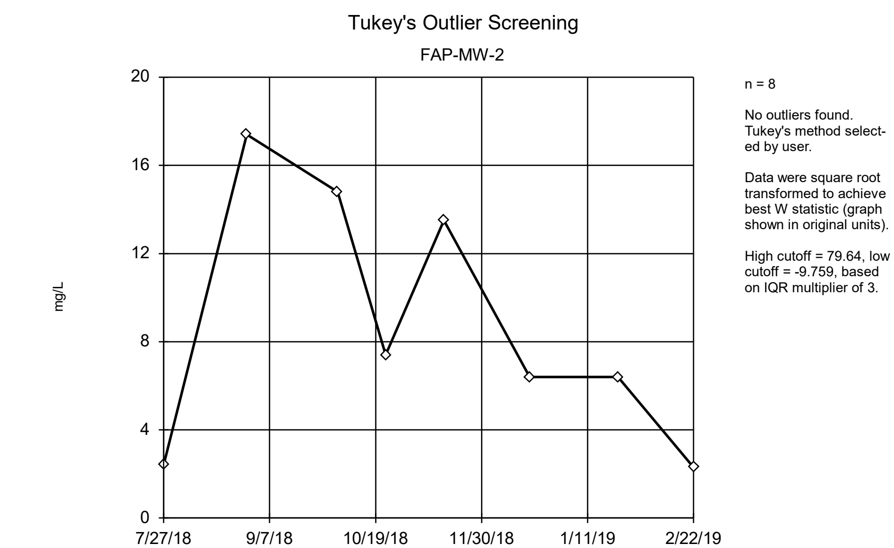
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

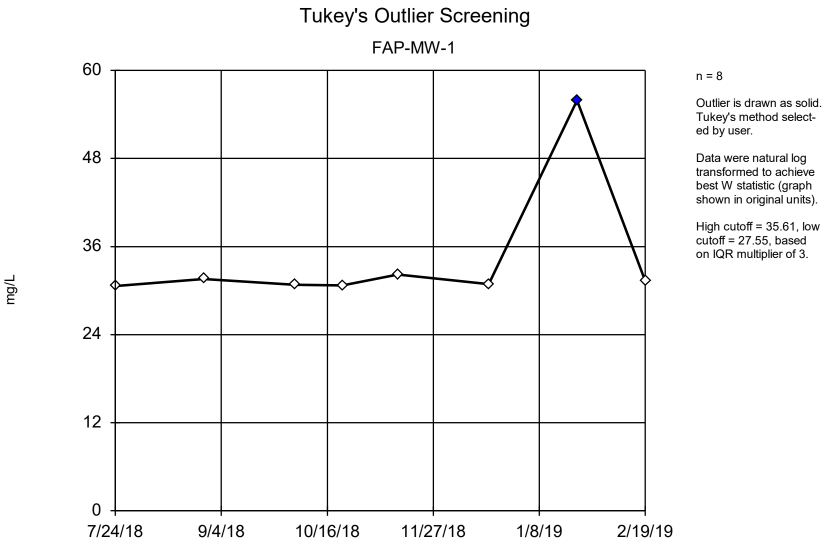


Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

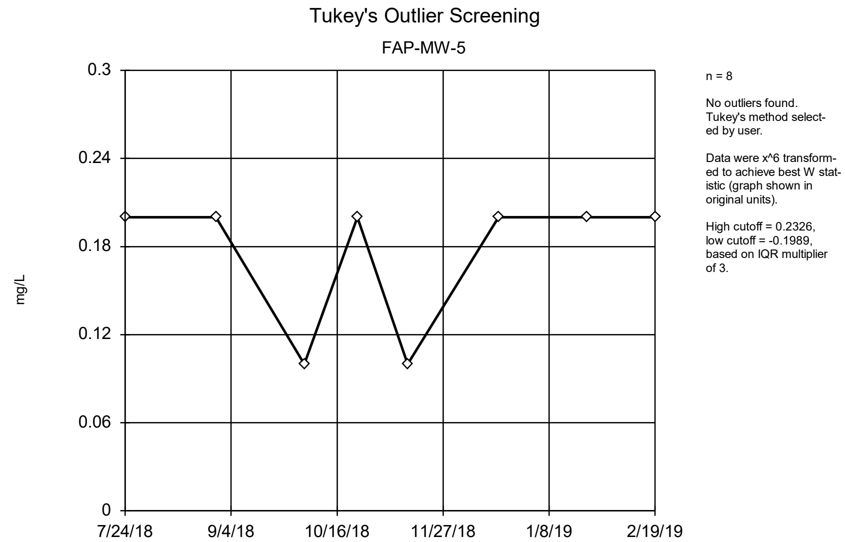


Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



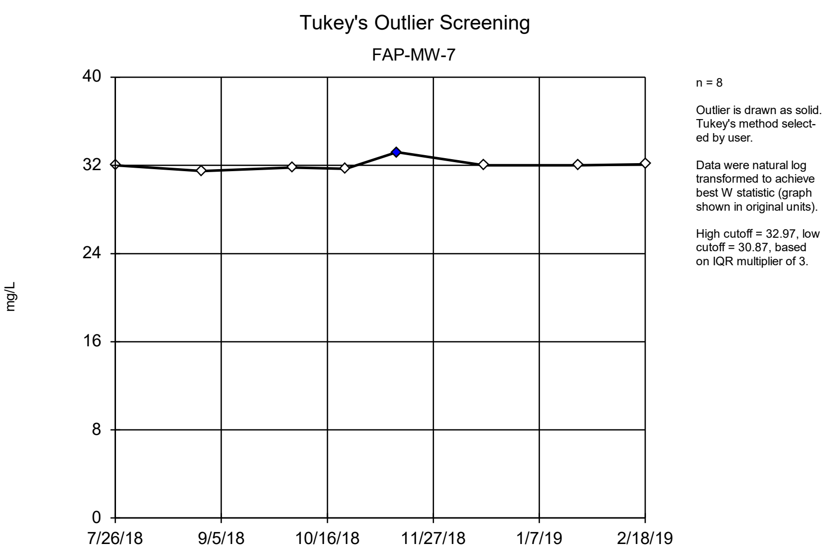
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



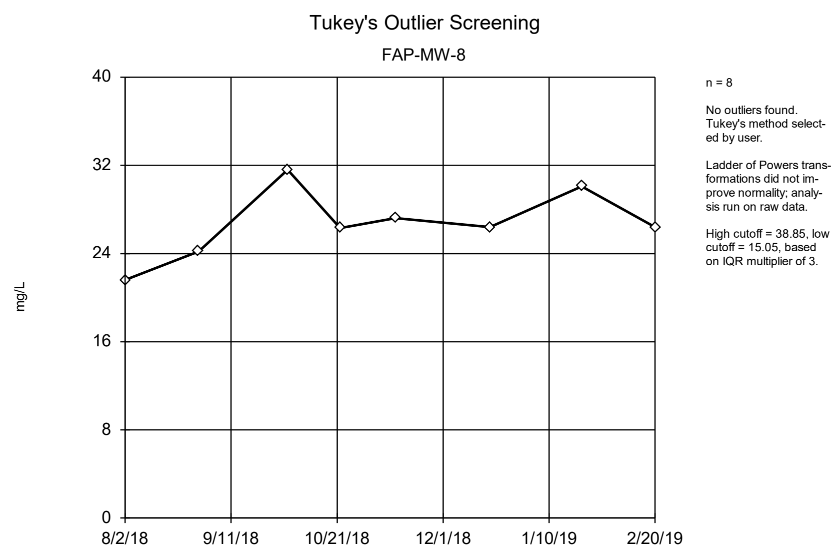
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



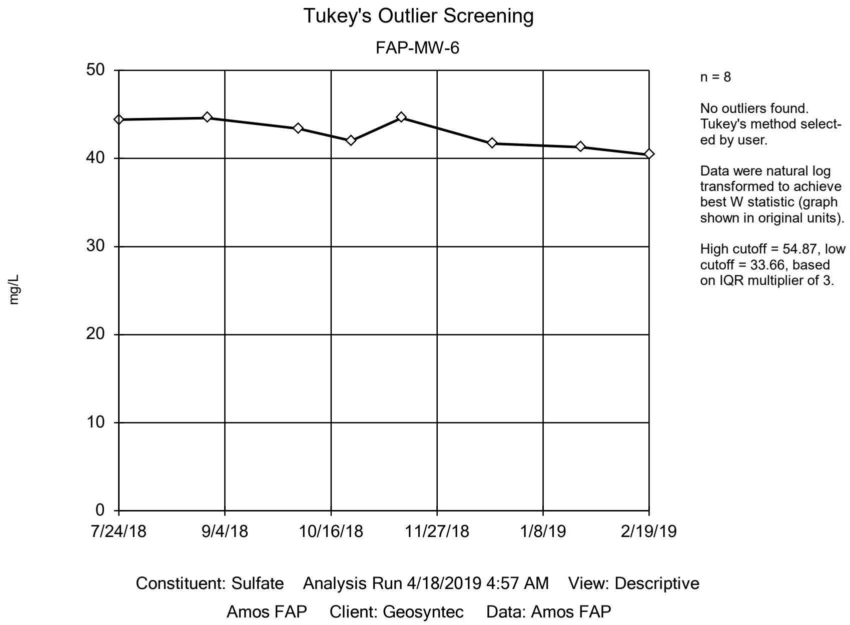
Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

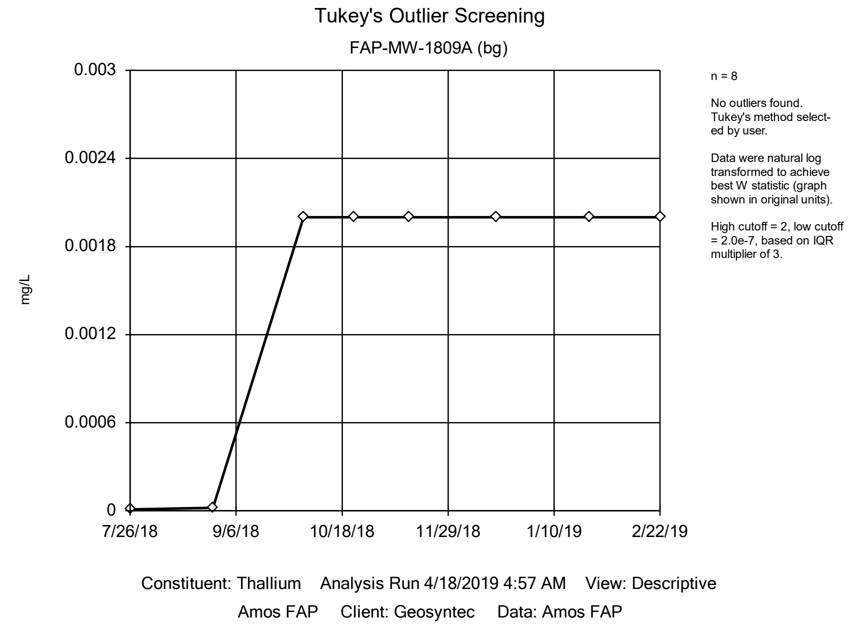


Constituent: Sulfate Analysis Run 4/18/2019 4:57 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

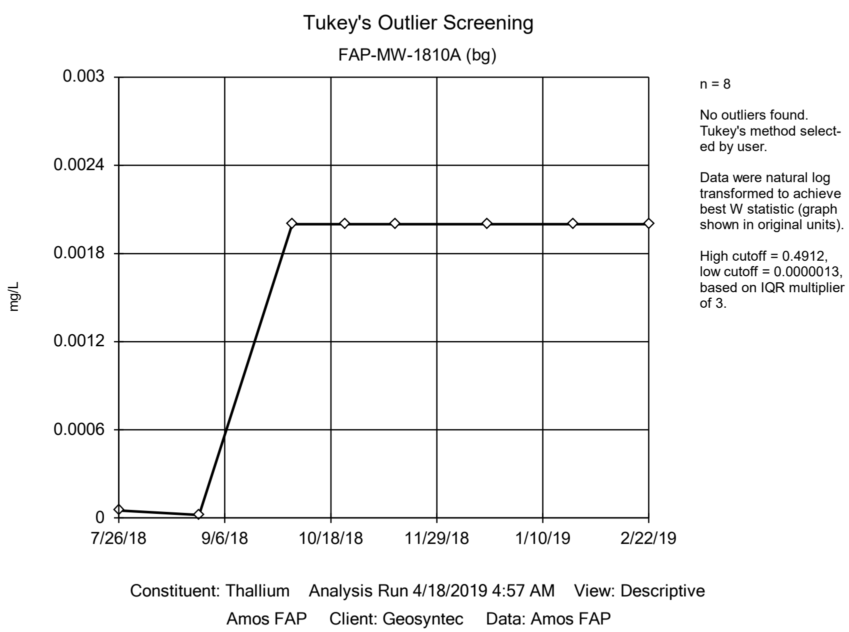
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



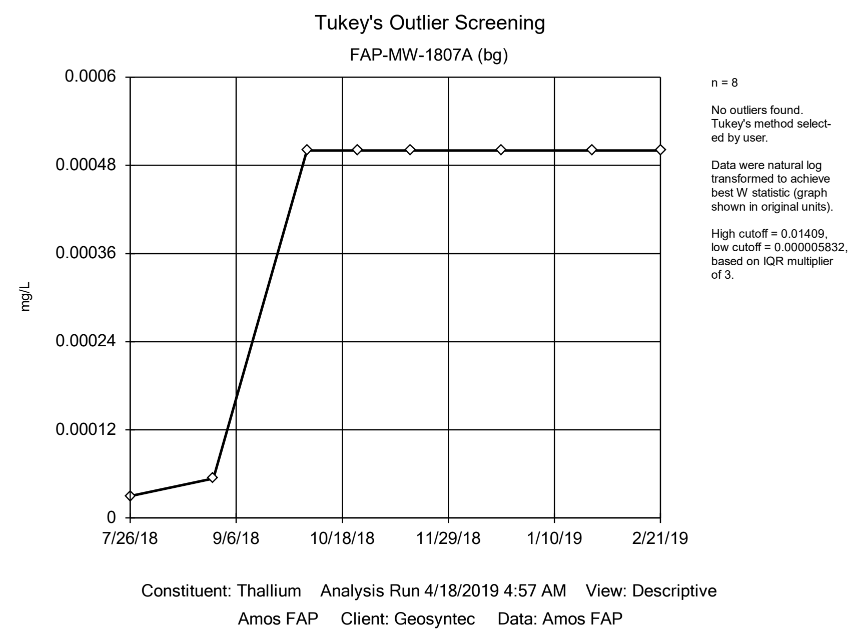
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



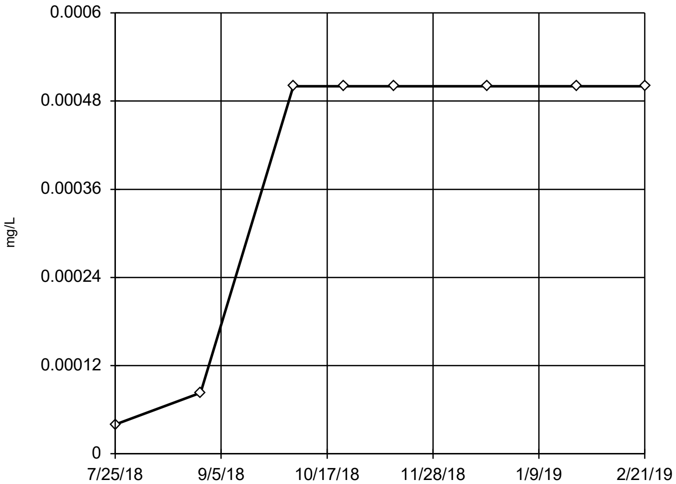
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1808A (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

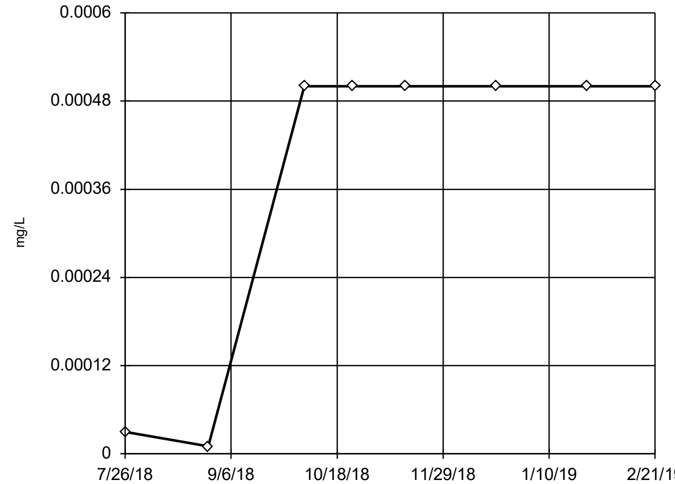
High cutoff = 0.007393, low cutoff = 0.00001378, based on IQR multiplier of 3.

Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1807B (bg)



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

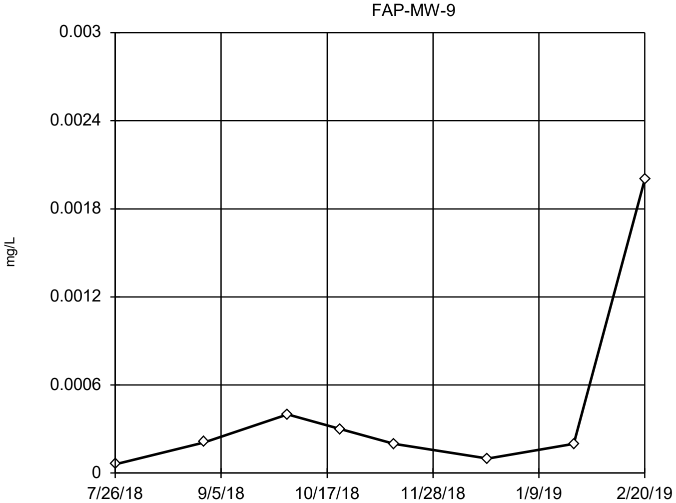
High cutoff = 0.03402, low cutoff = 0.0000018, based on IQR multiplier of 3.

Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-9



n = 8

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

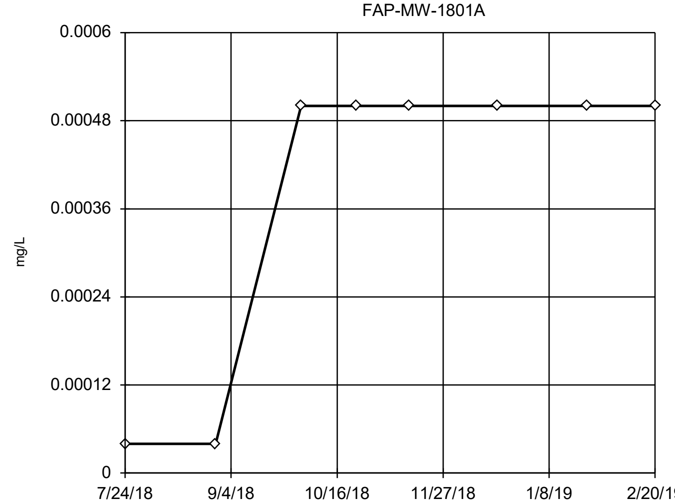
High cutoff = 0.005091, low cutoff = 0.000009623, based on IQR multiplier of 3.

Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

FAP-MW-1801A



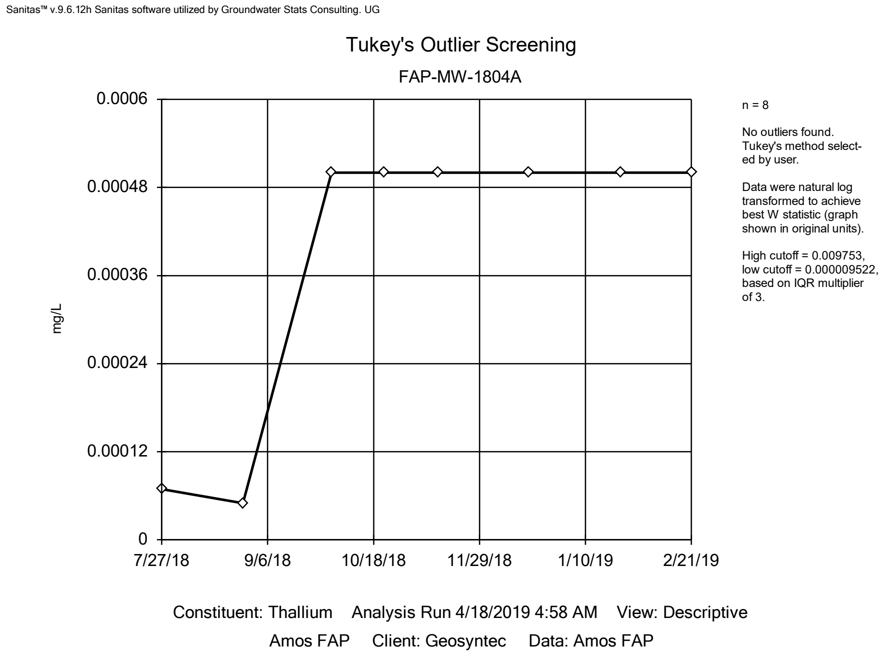
n = 8

No outliers found. Tukey's method selected by user.

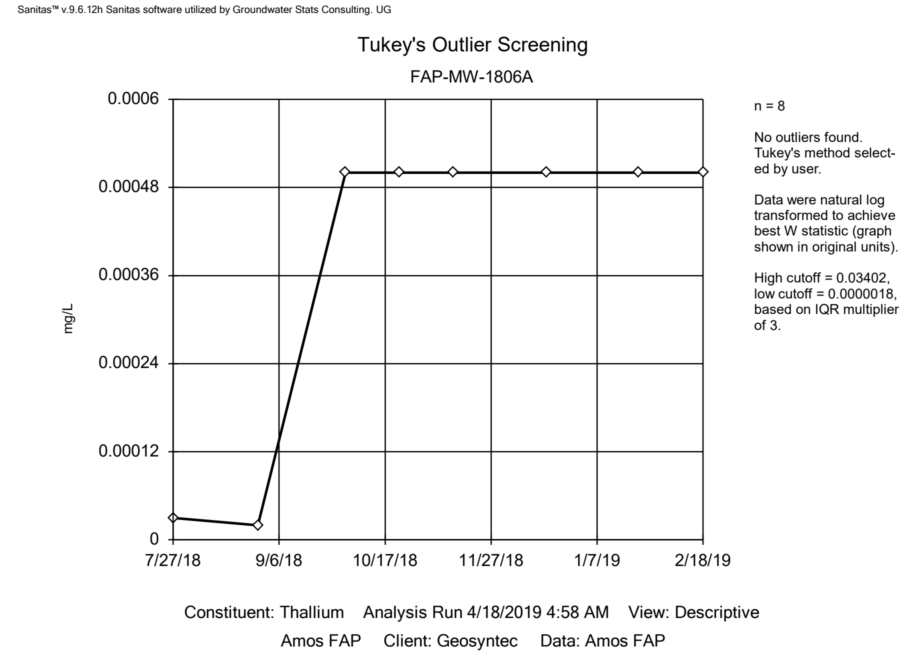
Data were square root transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.002154, low cutoff = -0.00009431, based on IQR multiplier of 3.

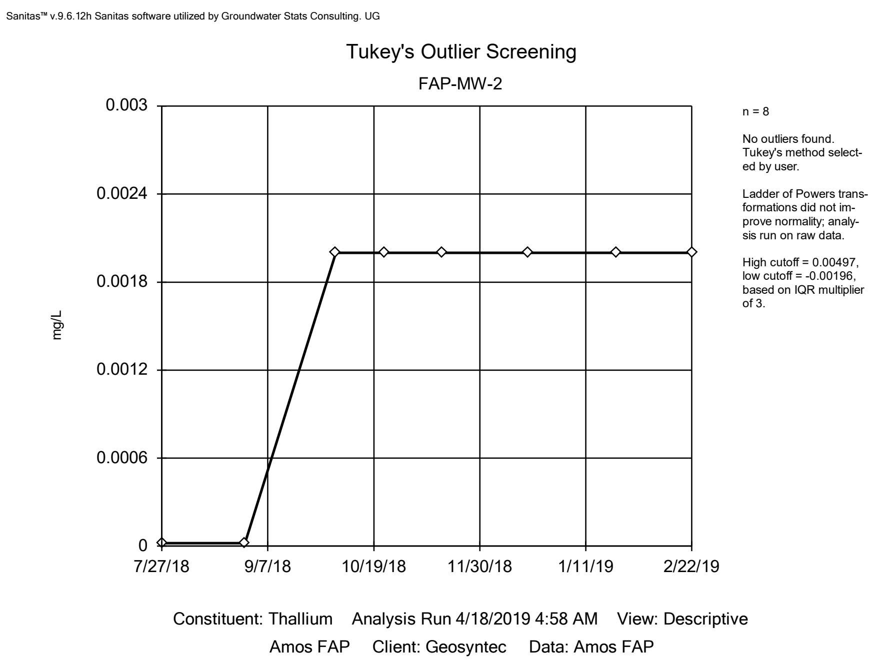
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



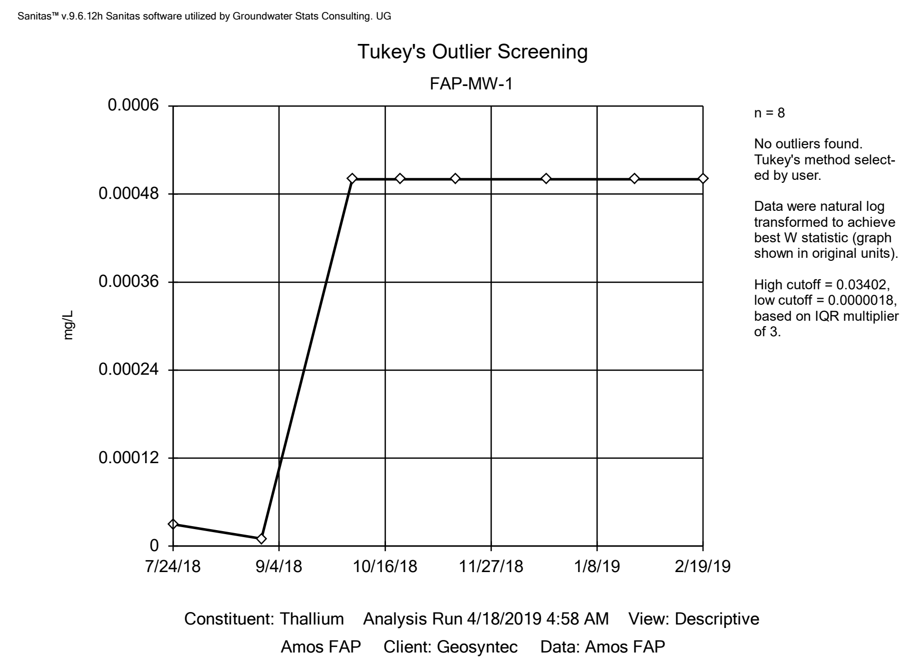
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1804A
0.0006
0.00048
0.00036
0.00024
0.00012
0
mg/L
7/27/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.009753, low cutoff = 0.000009522, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



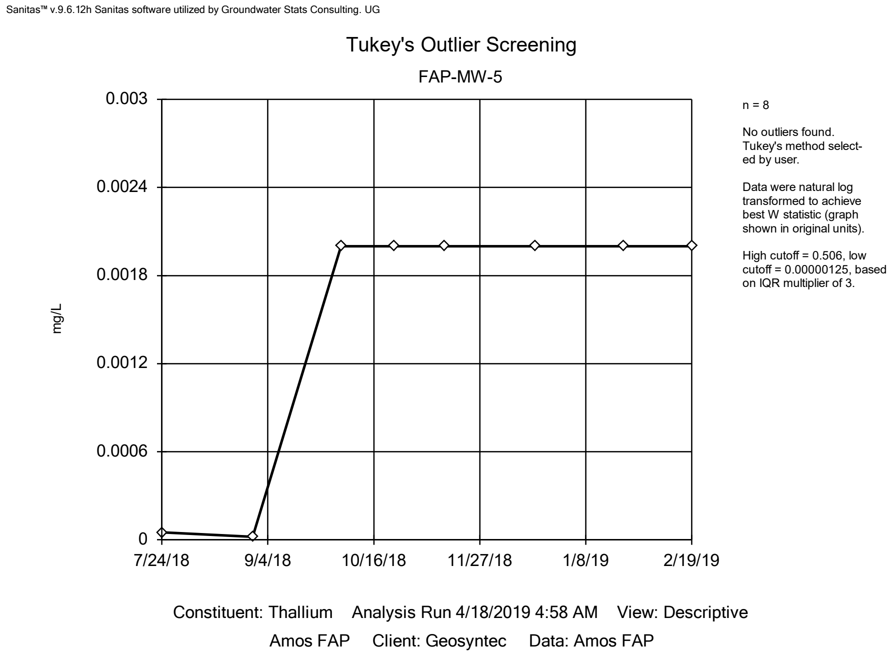
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
0.0006
0.00048
0.00036
0.00024
0.00012
0
mg/L
7/27/18
9/6/18
10/17/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.03402, low cutoff = 0.0000018, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

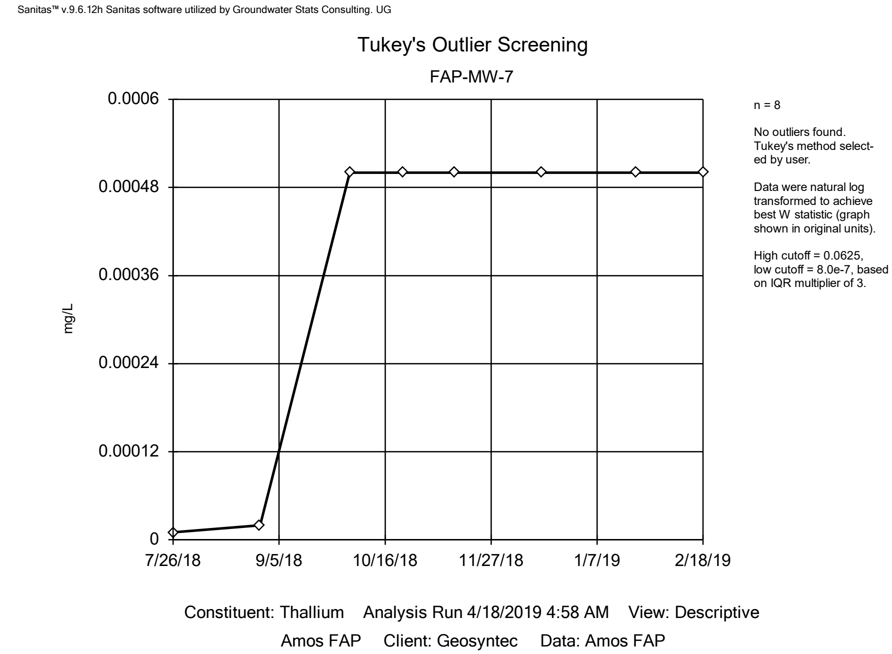


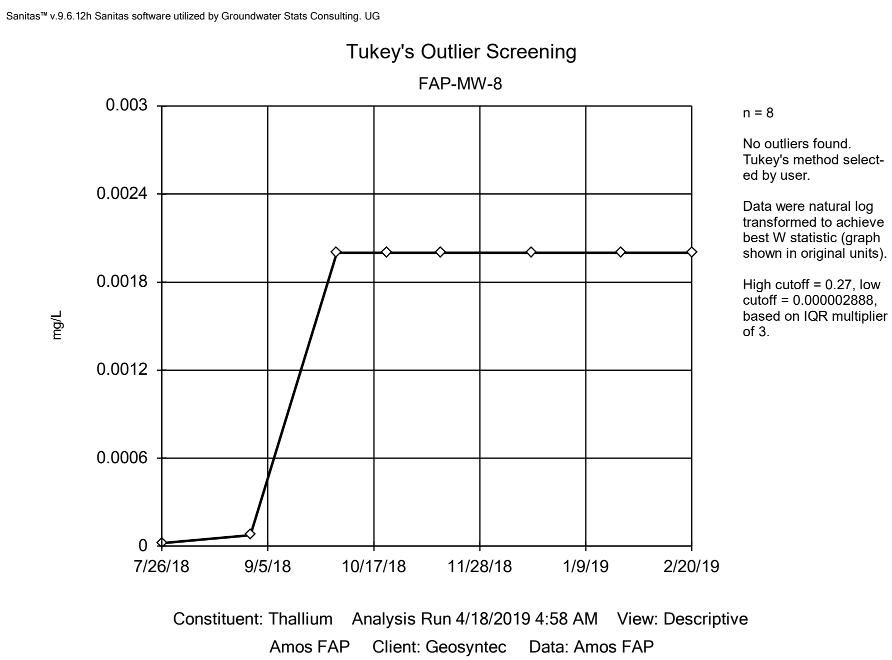
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-2
0.003
0.0024
0.0018
0.0012
0.0006
0
mg/L
7/27/18
9/7/18
10/19/18
11/30/18
1/11/19
2/22/19
n = 8
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.00497, low cutoff = -0.00196, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

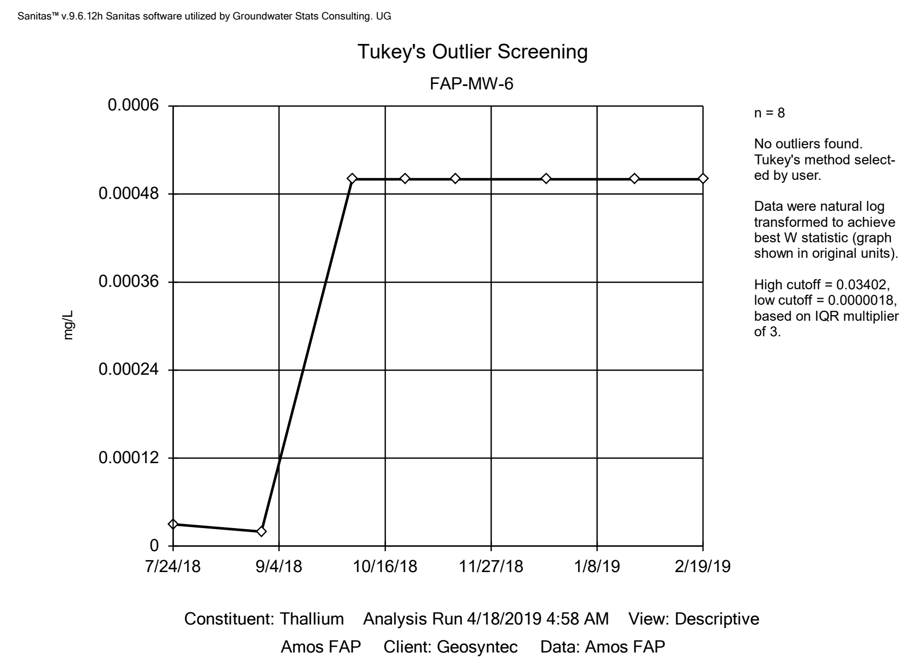


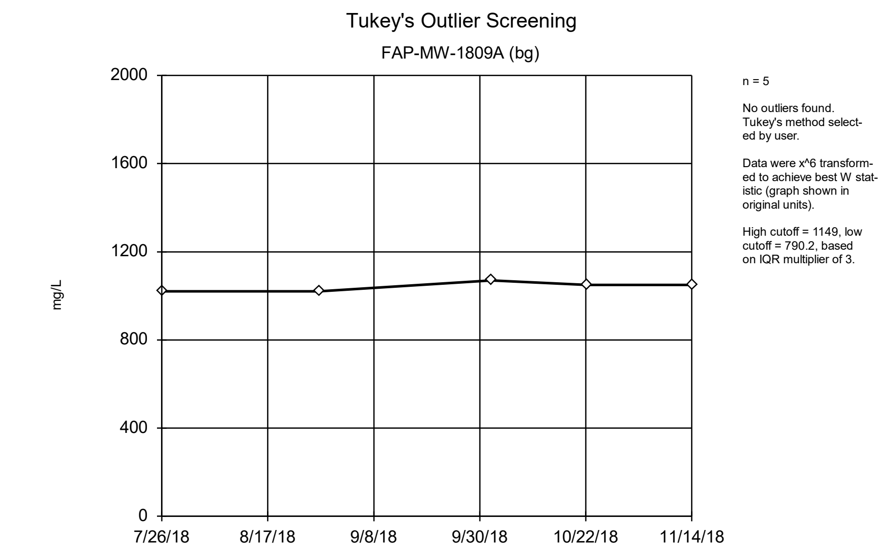
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1
0.0006
0.00048
0.00036
0.00024
0.00012
0
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.03402, low cutoff = 0.0000018, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-5
0.003
0.0024
0.0018
0.0012
0.0006
0
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.506, low cutoff = 0.00000125, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
0.0006
0.00048
0.00036
0.00024
0.00012
0
mg/L
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.0625, low cutoff = 8.0e-7, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

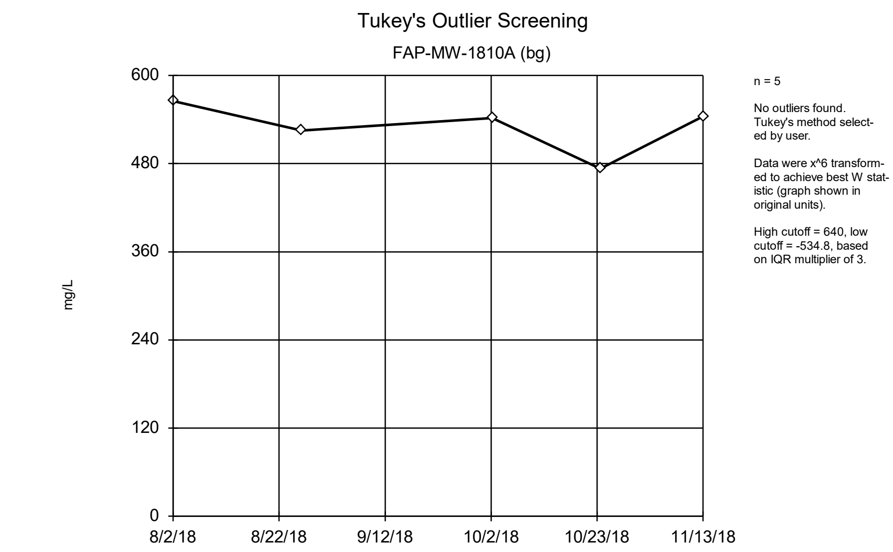

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
0.003
0.0024
0.0018
0.0012
0.0006
0
mg/L
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.27, low cutoff = 0.000002888, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-6
0.0006
0.00048
0.00036
0.00024
0.00012
0
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.03402, low cutoff = 0.0000018, based on IQR multiplier of 3.
Constituent: Thallium Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



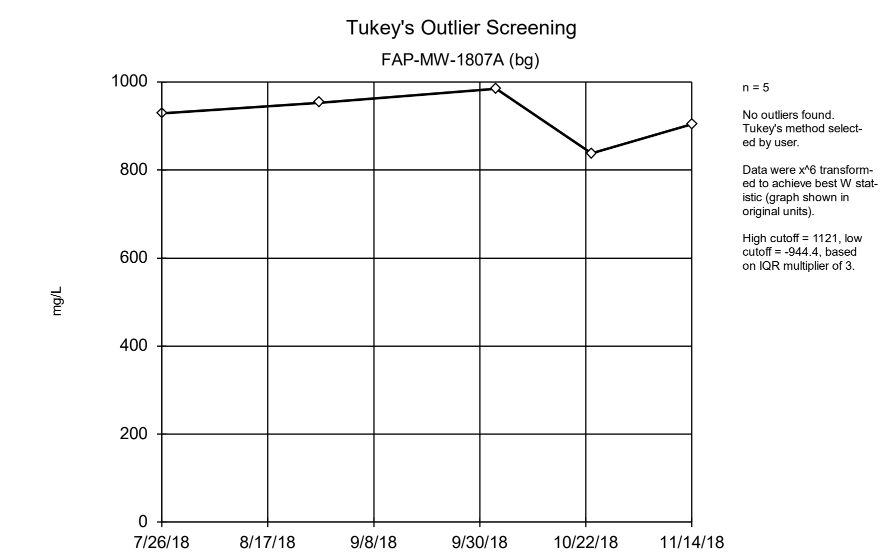
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



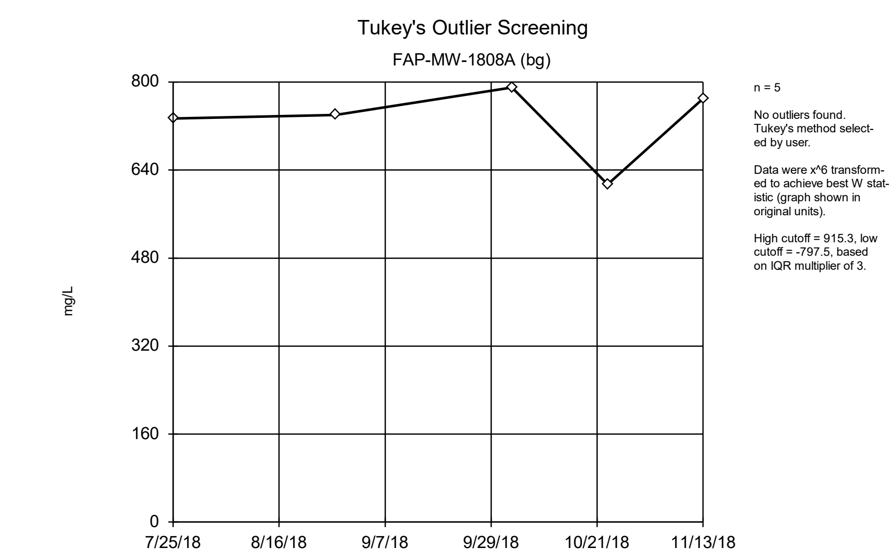
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



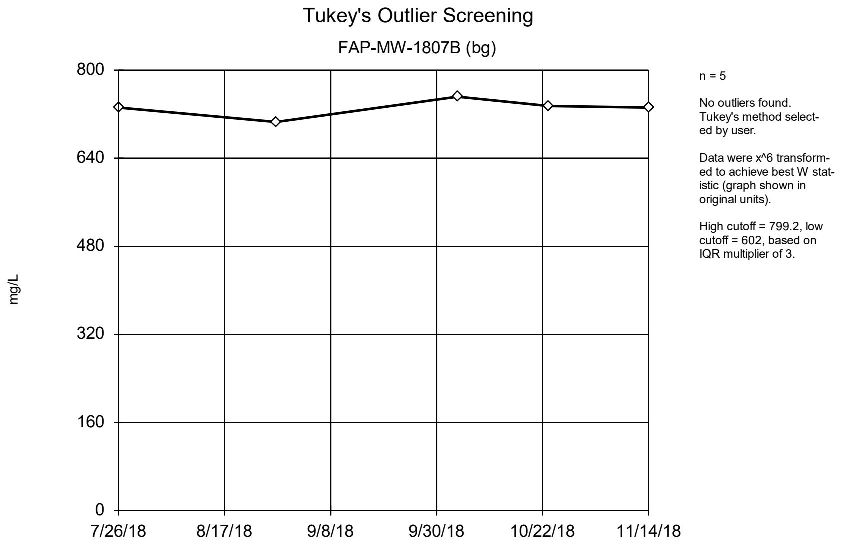
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



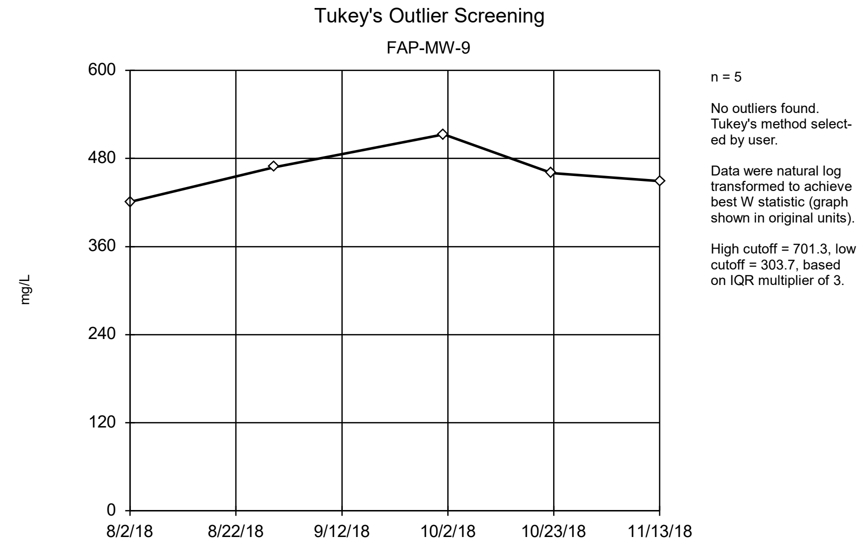
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



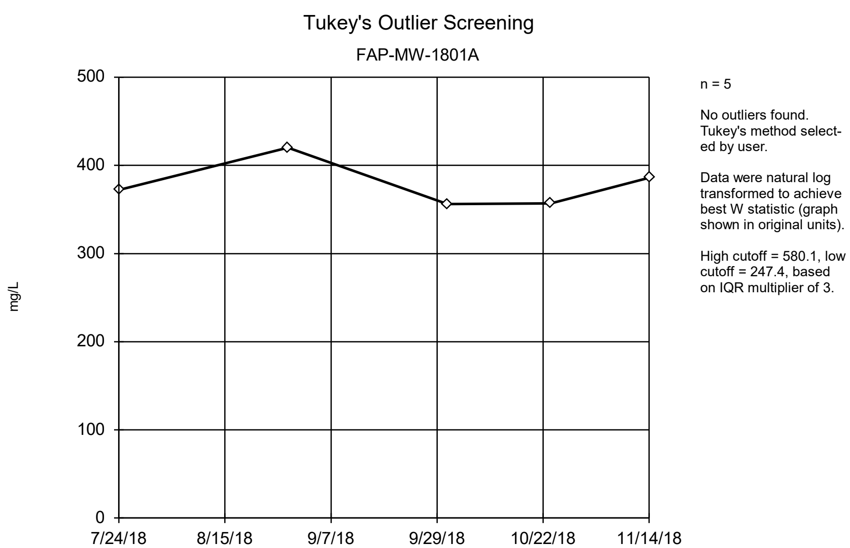
Constituent: Total Dissolved Solids   Analysis Run 4/18/2019 4:58 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



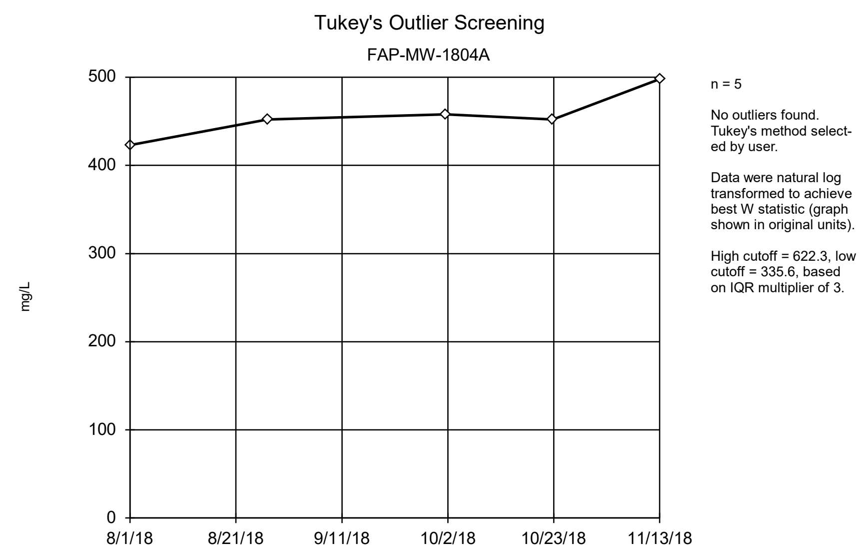
Constituent: Total Dissolved Solids   Analysis Run 4/18/2019 4:58 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

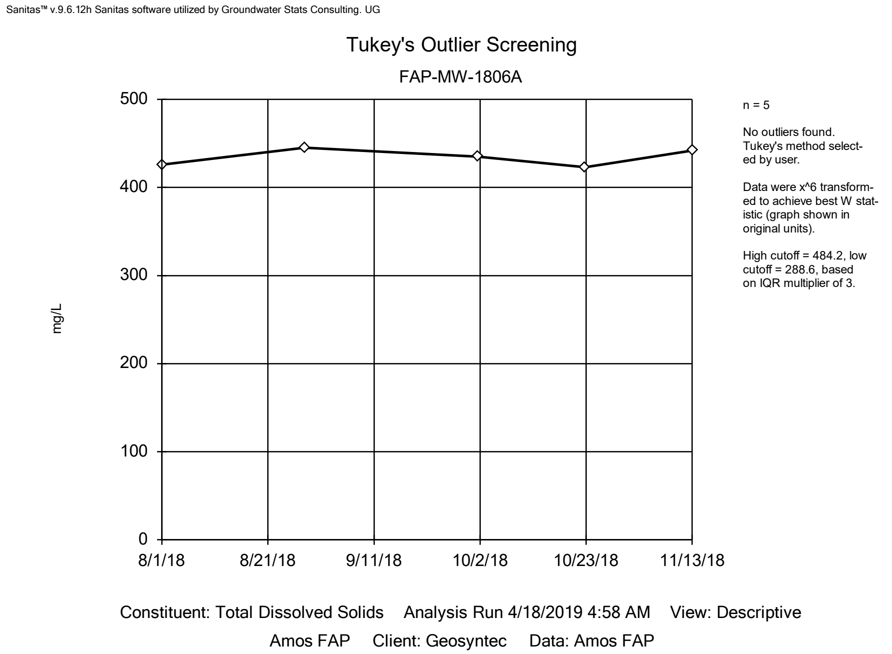


Constituent: Total Dissolved Solids   Analysis Run 4/18/2019 4:58 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP

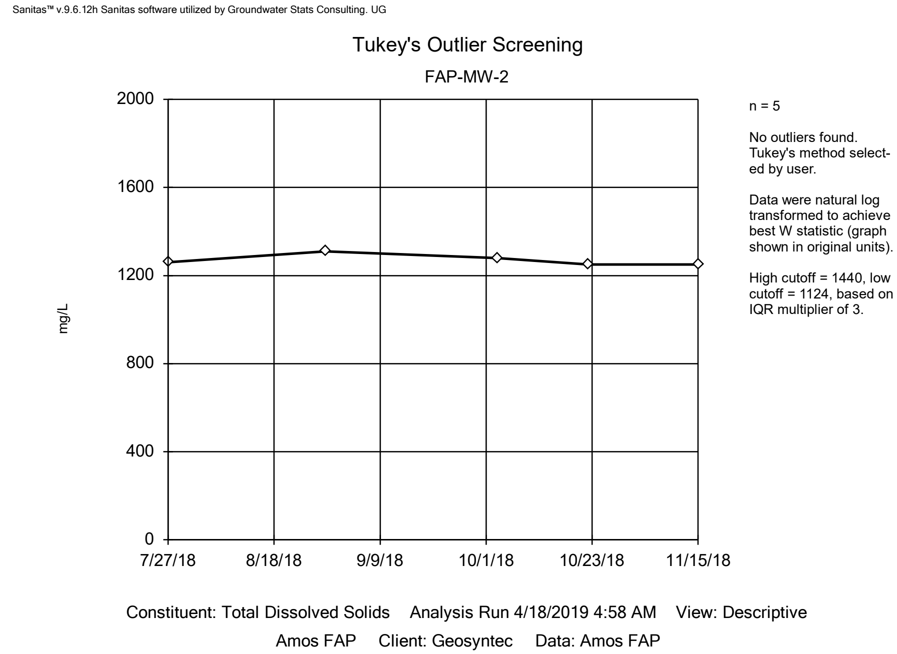
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



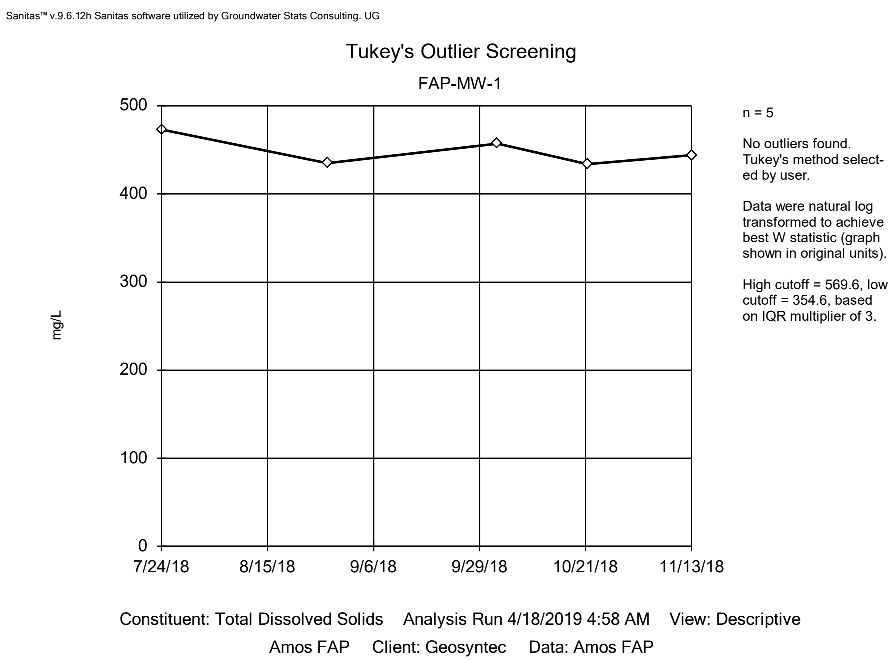
Constituent: Total Dissolved Solids   Analysis Run 4/18/2019 4:58 AM   View: Descriptive
Amos FAP   Client: Geosyntec   Data: Amos FAP



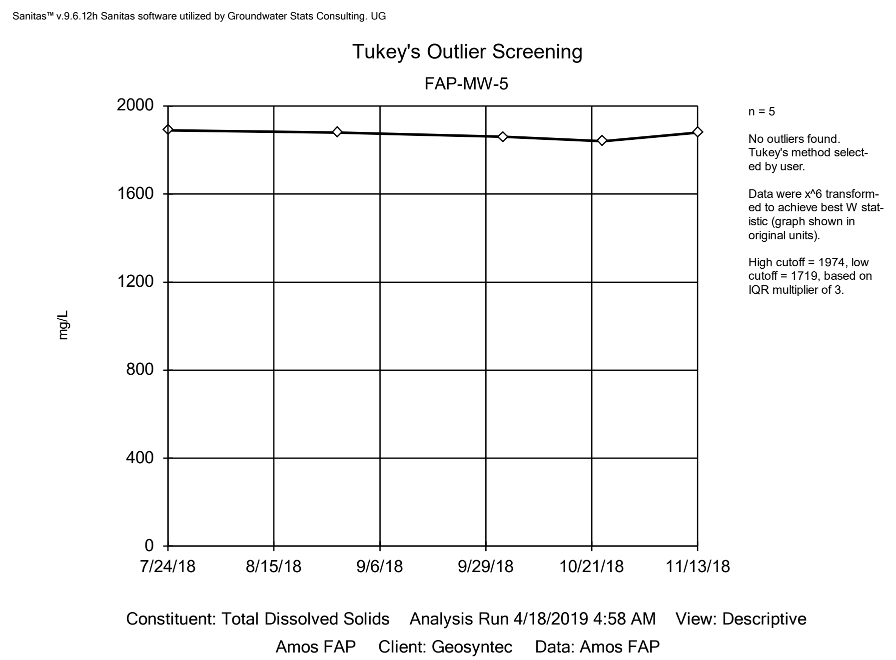
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1806A
n = 5
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 484.2, low cutoff = 288.6, based on IQR multiplier of 3.
mg/L
500
400
300
200
100
0
8/1/18
8/21/18
9/11/18
10/2/18
10/23/18
11/13/18
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



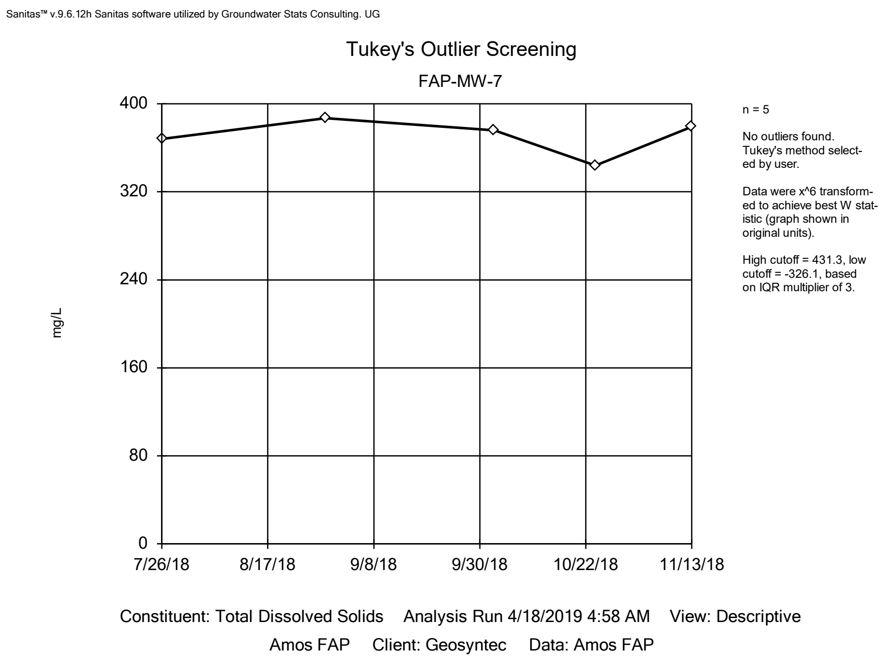
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-2
n = 5
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 1440, low cutoff = 1124, based on IQR multiplier of 3.
mg/L
2000
1600
1200
800
400
0
7/27/18
8/18/18
9/9/18
10/1/18
10/23/18
11/15/18
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



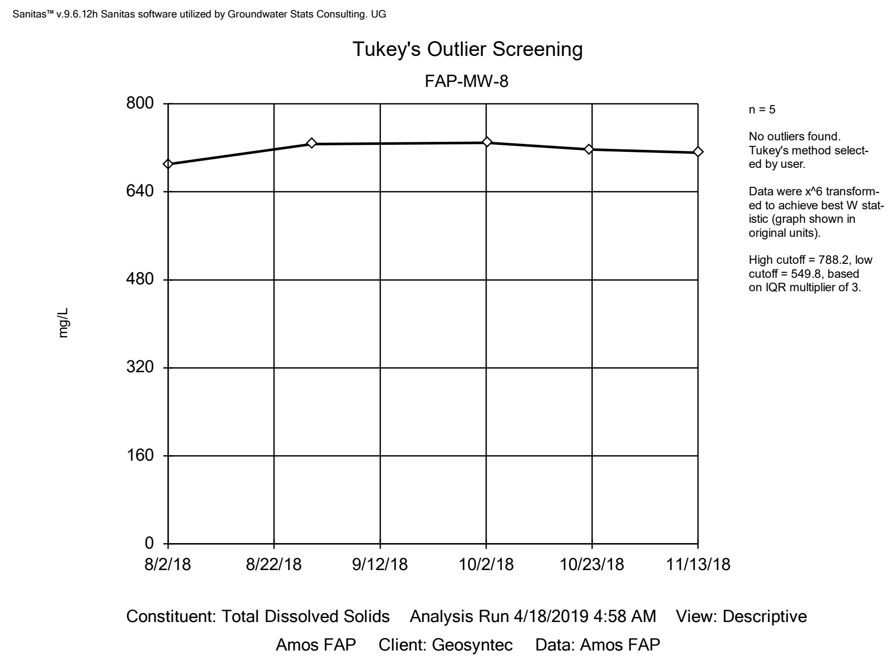
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-1
n = 5
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 569.6, low cutoff = 354.6, based on IQR multiplier of 3.
mg/L
500
400
300
200
100
0
7/24/18
8/15/18
9/6/18
9/29/18
10/21/18
11/13/18
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



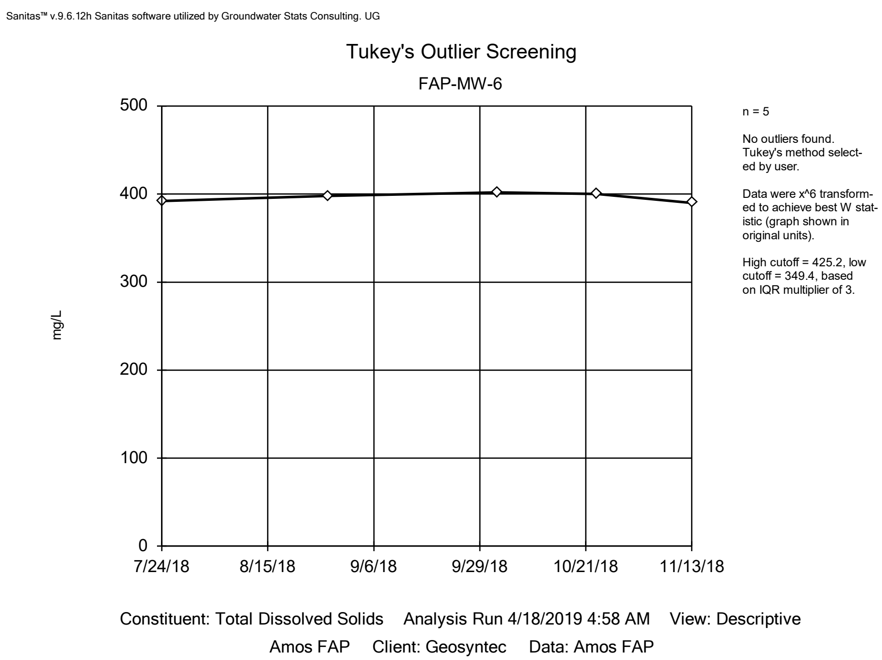
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-5
n = 5
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 1974, low cutoff = 1719, based on IQR multiplier of 3.
mg/L
2000
1600
1200
800
400
0
7/24/18
8/15/18
9/6/18
9/29/18
10/21/18
11/13/18
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-7
mg/L
400
320
240
160
80
0
7/26/18
8/17/18
9/8/18
9/30/18
10/22/18
11/13/18
n = 5
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 431.3, low cutoff = -326.1, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-8
mg/L
800
640
480
320
160
0
8/2/18
8/22/18
9/12/18
10/2/18
10/23/18
11/13/18
n = 5
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 788.2, low cutoff = 549.8, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
FAP-MW-6
mg/L
500
400
300
200
100
0
7/24/18
8/15/18
9/6/18
9/29/18
10/21/18
11/13/18
n = 5
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 425.2, low cutoff = 349.4, based on IQR multiplier of 3.
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 4:58 AM View: Descriptive
Amos FAP Client: Geosyntec Data: Amos FAP

FIGURE D: TREND TESTS

Trend Test Summary Table - Significant Results

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 8:53 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Chloride (mg/L)	**FAP-MW-1810A (bg)**	**-12.81**	**-24**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate (mg/L)	**FAP-MW-1807B (bg)**	**29.65**	**22**	**21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**

Trend Test Summary Table - All Results

Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 8:53 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	FAP-MW-1809A (bg)	-0.01635	-10	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1810A (bg)	0.01265	1	21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1807A (bg)	0.02119	2	21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1808A (bg)	-0.02126	-2	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1807B (bg)	-0.01671	-2	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-9	-0.04482	-9	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1801A	-0.2284	-8	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1804A	-0.03444	-4	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1806A	-0.01358	-3	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-2	-0.001713	0	21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-1	-0.05373	-10	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-5	-0.007	-2	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-7	-0.01383	0	21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-8	-0.0749	-14	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	FAP-MW-6	-0.07878	-12	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1809A (bg)	12.13	11	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1810A (bg)	12.8	14	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1807A (bg)	15.33	6	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1808A (bg)	1.971	6	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1807B (bg)	2.323	16	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-9	0.03687	1	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1801A	-11.87	-10	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1804A	-25.91	-18	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1806A	-8.439	-10	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-2	-0.8331	-15	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-1	-0.8673	-11	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-5	-0.648	-5	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-7	0.05532	2	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-8	0.5554	10	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	FAP-MW-6	-12.71	-9	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1809A (bg)	4.081	12	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	**FAP-MW-1810A (bg)**	**-12.81**	**-24**	**-21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Chloride (mg/L)	FAP-MW-1807A (bg)	3.009	6	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1808A (bg)	-2.363	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1807B (bg)	-1.316	-6	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-9	0.4359	10	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1801A	-1.044	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1804A	-1.541	-8	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1806A	-16	-14	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-2	-15.29	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-1	-0.743	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-5	7.371	3	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-7	-0.1309	-4	-21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-8	9.629	16	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	FAP-MW-6	-3.765	-16	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1809A (bg)	-0.03724	-11	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1810A (bg)	0.1367	5	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1807A (bg)	-0.09185	-17	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1808A (bg)	-0.3023	-17	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1807B (bg)	0.1137	4	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-9	-0.0717	-8	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1801A	0.05492	14	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1804A	0.2644	7	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-1806A	0.3342	11	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-2	0.01241	2	21	No	8	0	n/a	n/a	0.01	NP

Trend Test Summary Table - All Results

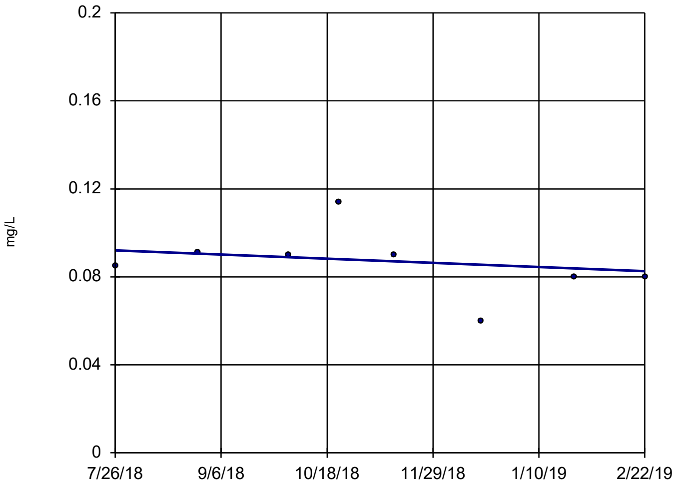
Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 8:53 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Fluoride (mg/L)	FAP-MW-1	0.01233	2	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-5	0.1028	11	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-7	-0.008816	-7	-21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-8	0.2817	8	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	FAP-MW-6	0.01233	5	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1809A (bg)	-0.4372	-9	-21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1810A (bg)	-0.1779	-2	-21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1807A (bg)	0.7476	6	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1808A (bg)	-0.8677	-13	-21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1807B (bg)	-0.6488	-2	-21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-9	2.679	14	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1801A	-0.6828	-10	-21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1804A	0.1683	1	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1806A	0.8389	12	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-2	0.1179	2	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-1	-0.01705	0	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-5	-0.1645	-6	-21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-7	0.3197	3	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-8	0.5943	3	21	No	8	0	n/a	n/a	0.01	NP
pH (SU)	FAP-MW-6	-0.5521	-9	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1809A (bg)	18.34	13	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1810A (bg)	0	0	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1807A (bg)	64.73	6	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1808A (bg)	48.24	6	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	**FAP-MW-1807B (bg)**	**29.65**	**22**	**21**	**Yes**	**8**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate (mg/L)	FAP-MW-9	16.68	14	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1801A	-15.84	-16	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1804A	-5.449	-4	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1806A	-26.5	-12	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-2	-20.64	-13	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-1	1.286	12	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-5	5.6e-9	2	21	No	8	50	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-7	0.8834	11	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-8	10.64	11	21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	FAP-MW-6	-7.303	-19	-21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1809A (bg)	110.8	4	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1810A (bg)	-104.9	-2	-12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1807A (bg)	-155.8	-2	-12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1808A (bg)	91.4	2	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1807B (bg)	6.083	1	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-9	22.57	0	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1801A	-21.46	0	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1804A	212.1	7	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1806A	19.9	0	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-2	-151.1	-5	-12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-1	-88.38	-4	-12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-5	-127.8	-5	-12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-7	-5.857	0	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-8	-23.06	0	12	No	5	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	FAP-MW-6	3.145	0	12	No	5	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1809A (bg)



n = 8

Slope = -0.01635 units per year.

Mann-Kendall statistic = -10 critical = -21

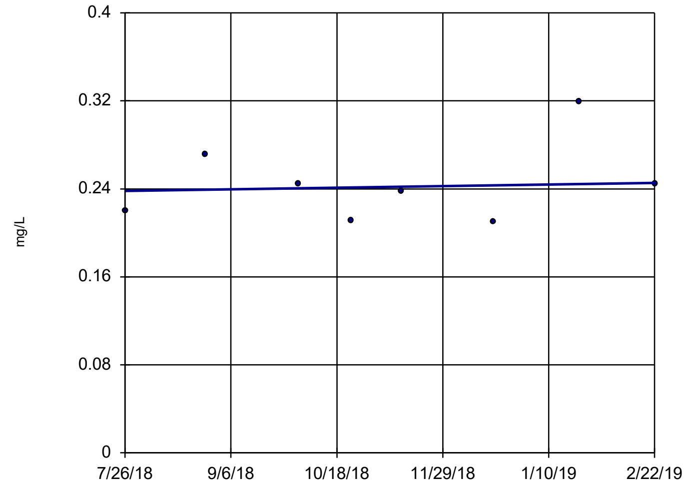
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1810A (bg)



n = 8

Slope = 0.01265 units per year.

Mann-Kendall statistic = 1 critical = 21

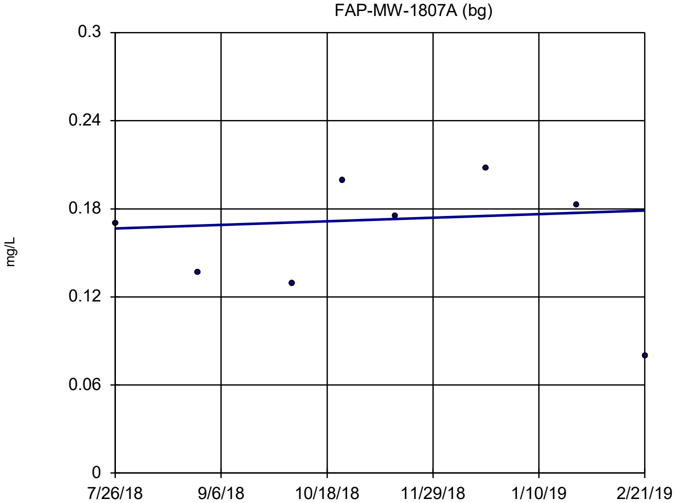
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1807A (bg)



n = 8

Slope = 0.02119 units per year.

Mann-Kendall statistic = 2 critical = 21

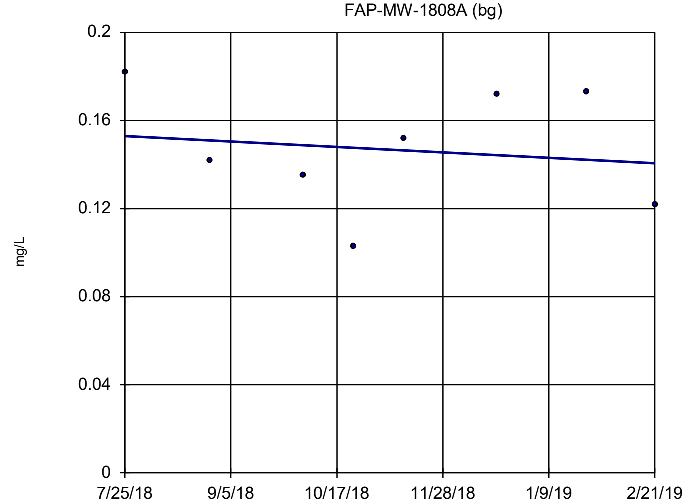
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1808A (bg)



n = 8

Slope = -0.02126 units per year.

Mann-Kendall statistic = -2 critical = -21

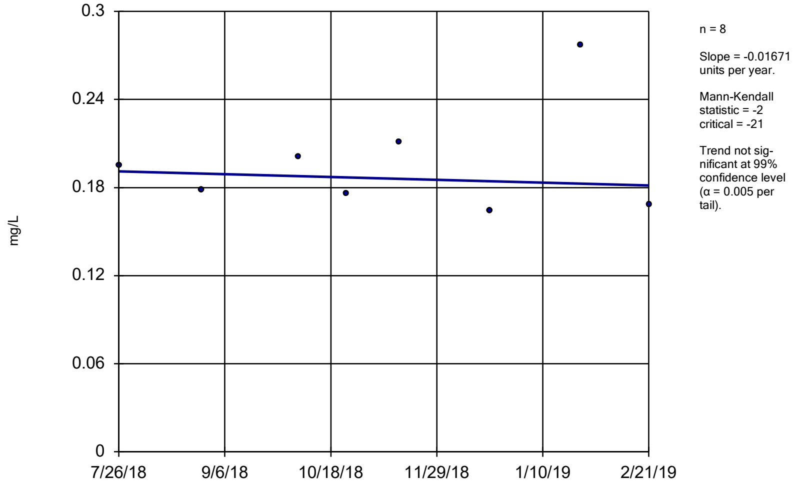
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1807B (bg)

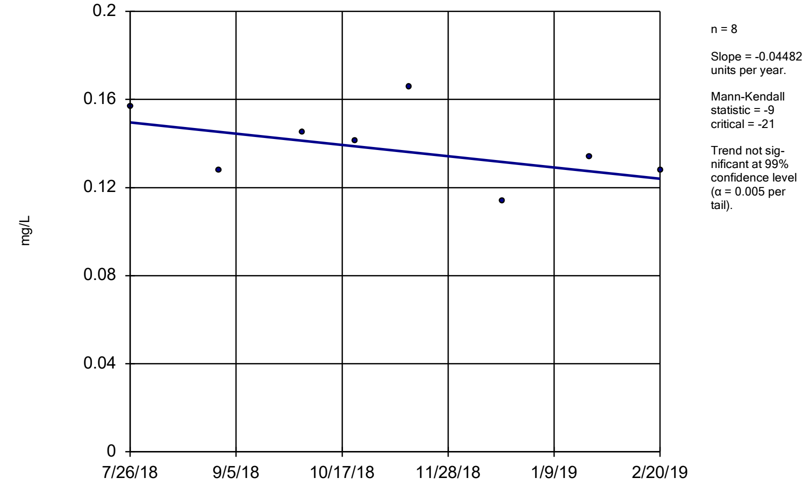


Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-9

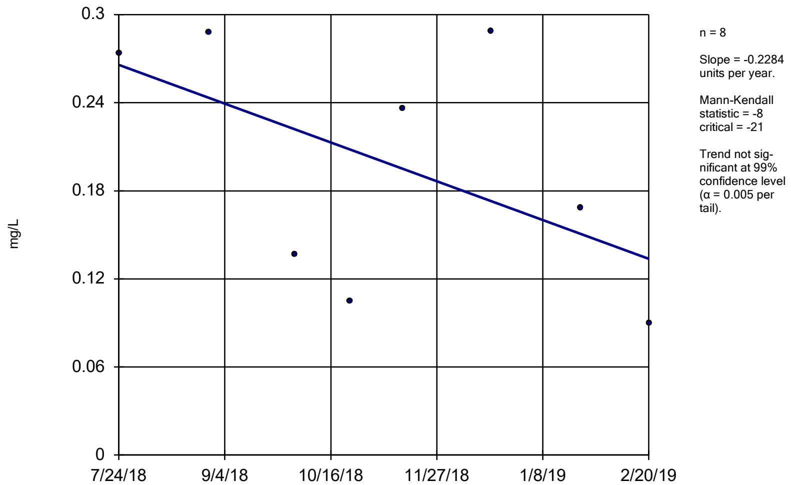


Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1801A

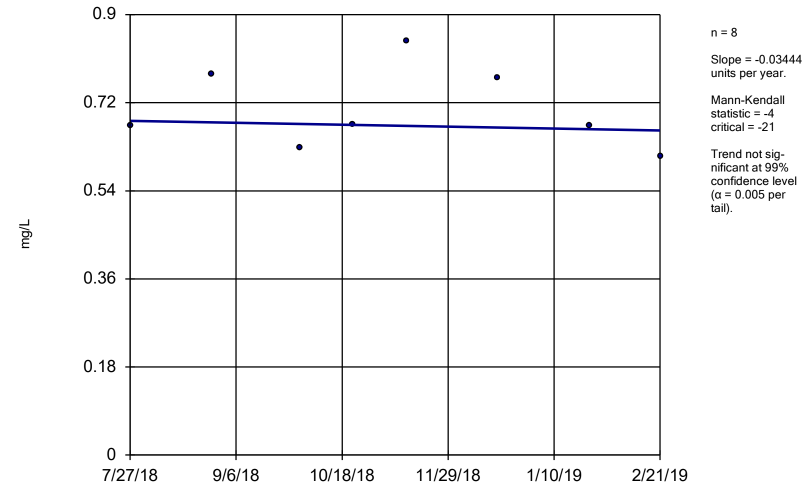


Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

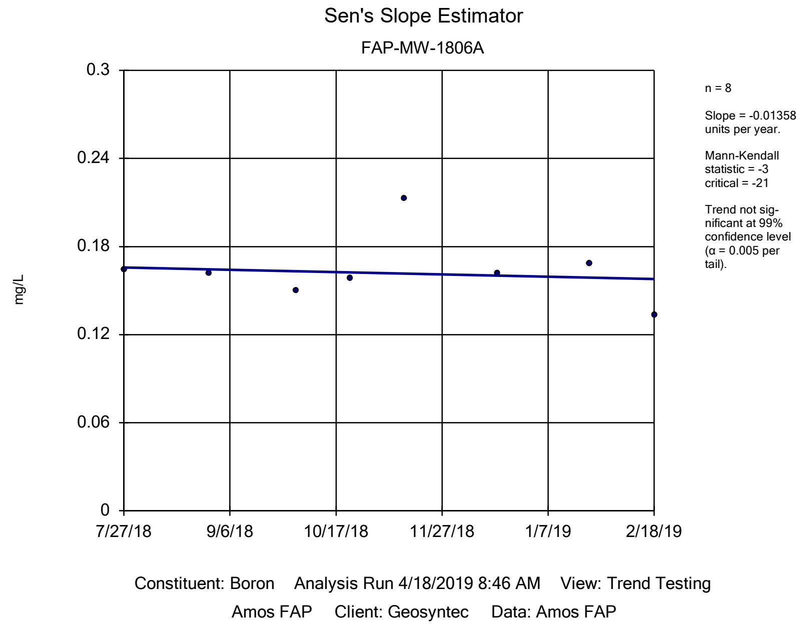
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

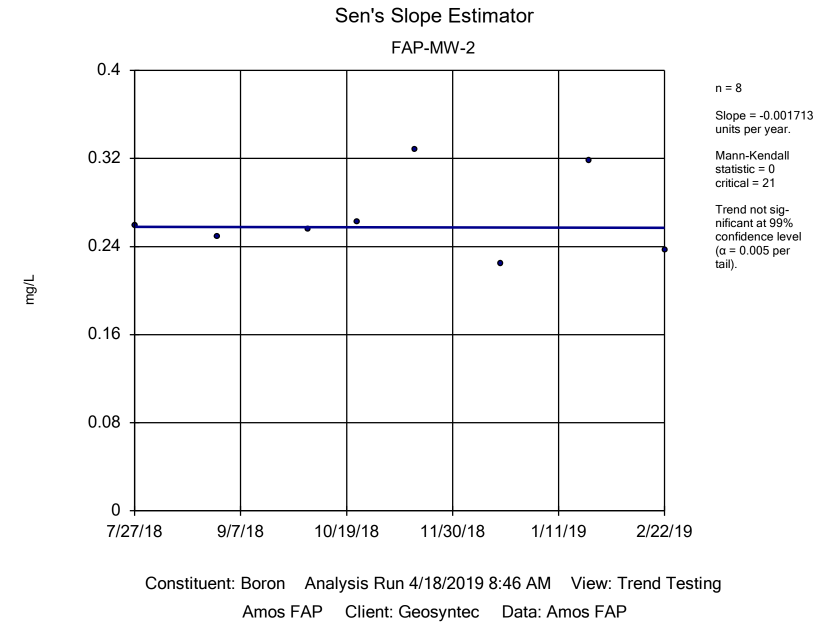
FAP-MW-1804A



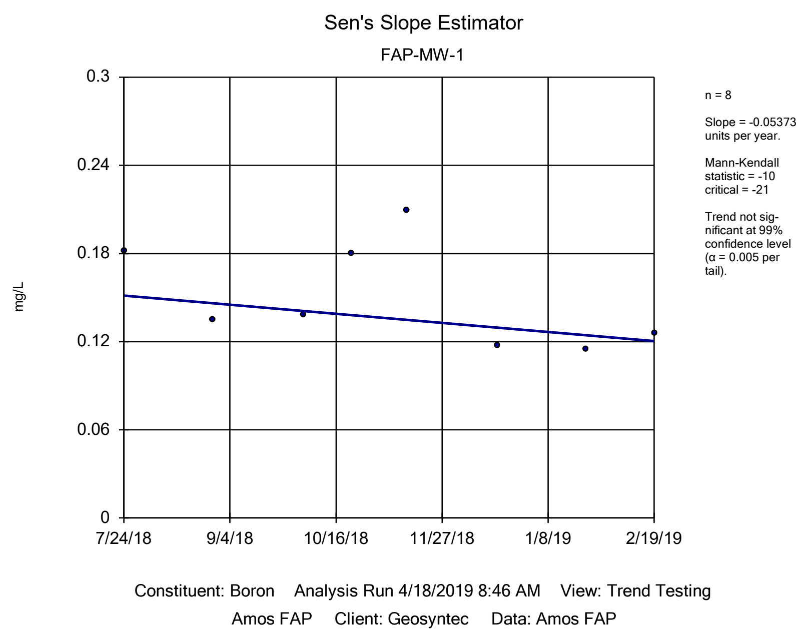
Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



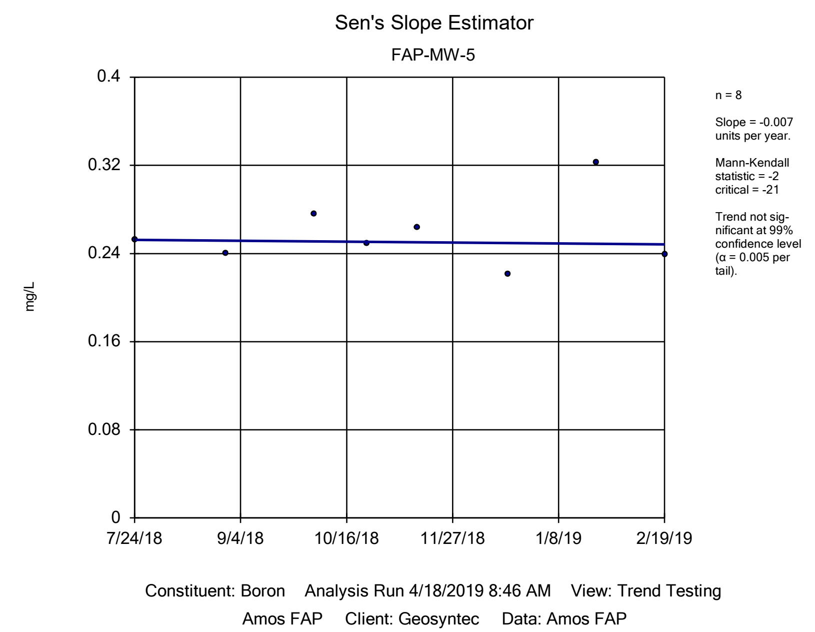
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

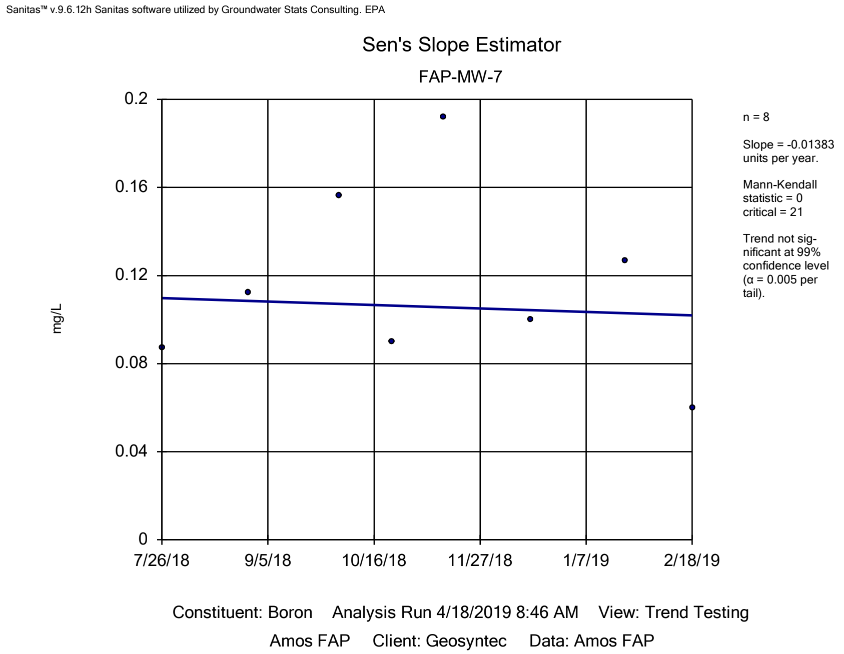


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

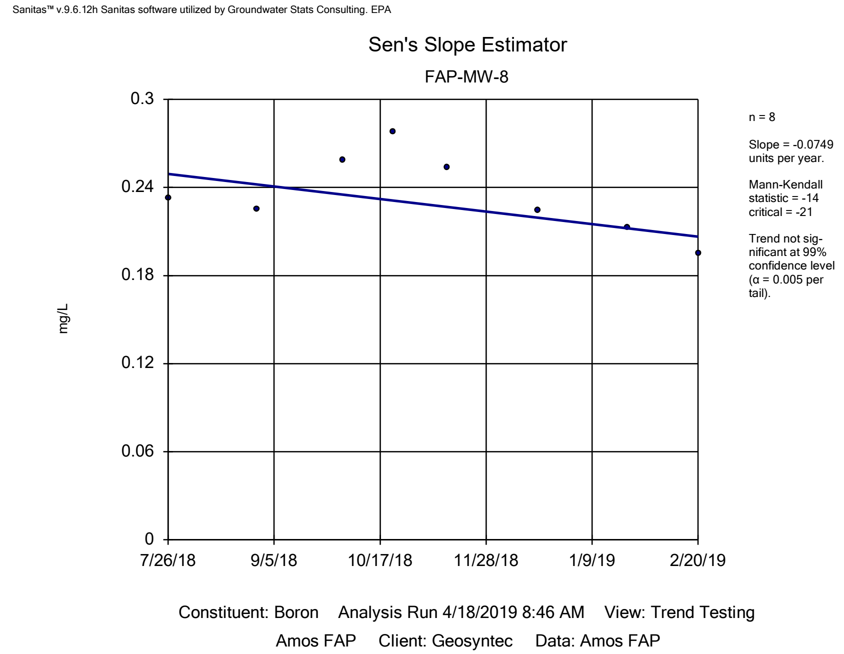


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

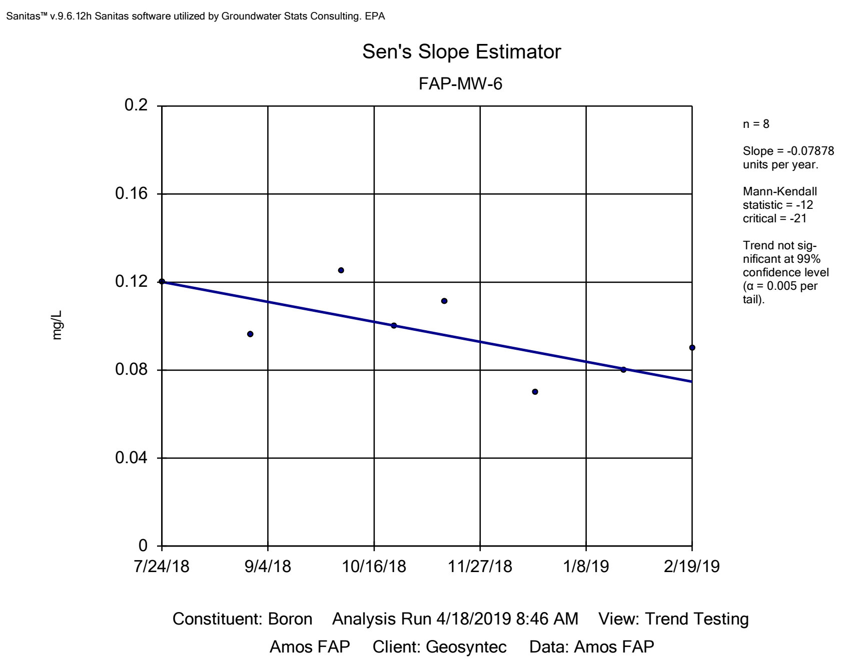




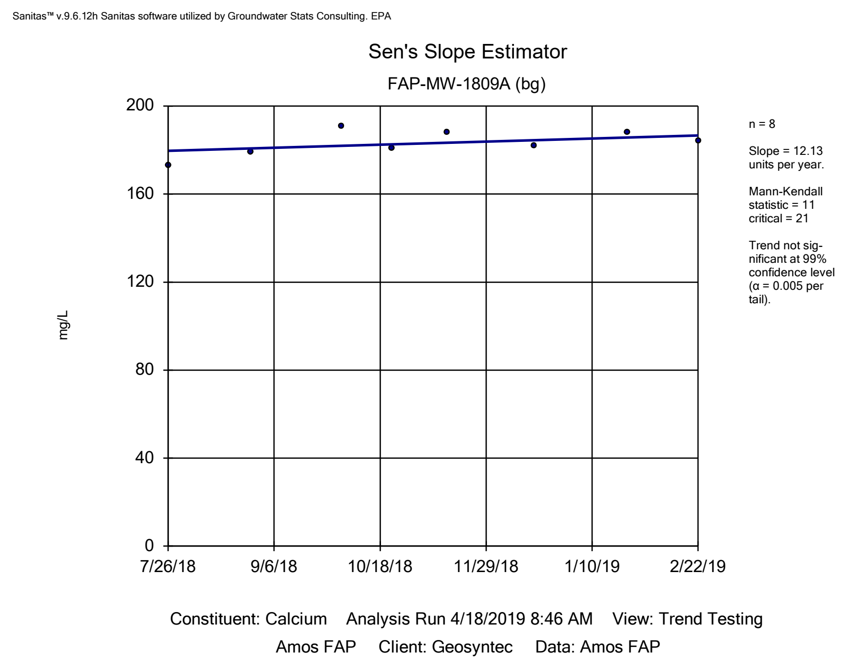
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-7
mg/L
0.2
0.16
0.12
0.08
0.04
0
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
Slope = -0.01383 units per year.
Mann-Kendall statistic = 0 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



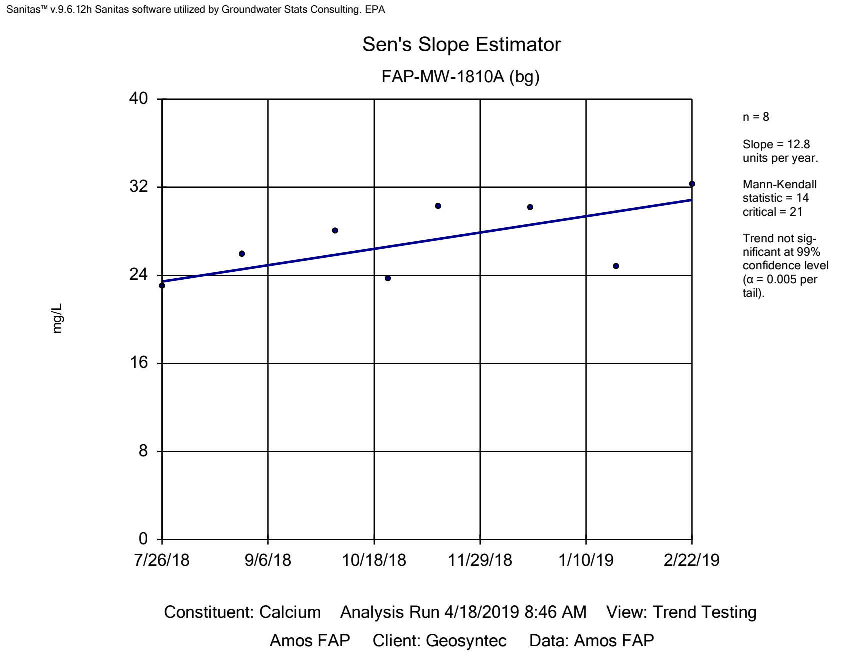
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-8
mg/L
0.3
0.24
0.18
0.12
0.06
0
7/26/18
9/5/18
10/17/18
11/28/18
1/9/19
2/20/19
n = 8
Slope = -0.0749 units per year.
Mann-Kendall statistic = -14 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



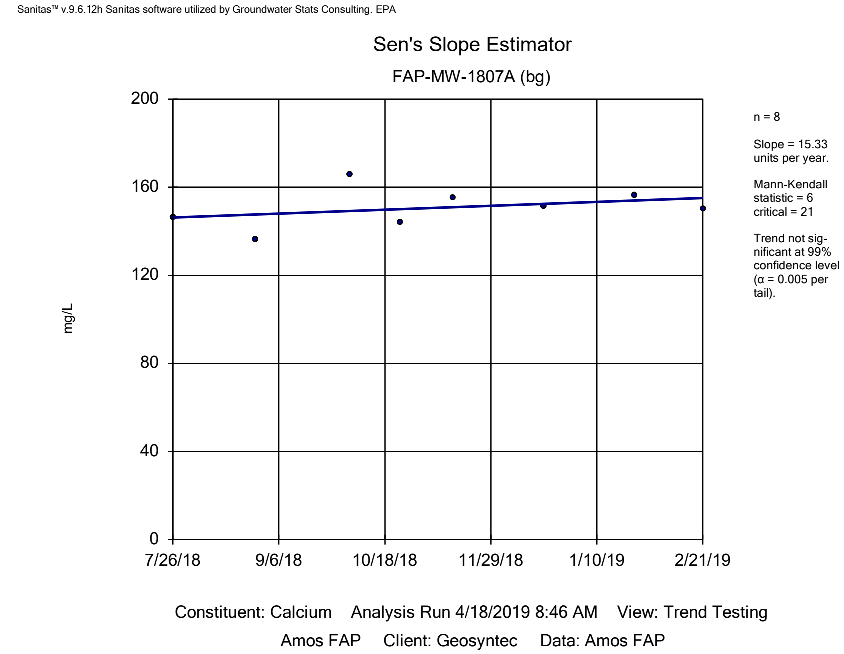
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-6
mg/L
0.2
0.16
0.12
0.08
0.04
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = -0.07878 units per year.
Mann-Kendall statistic = -12 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Boron Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



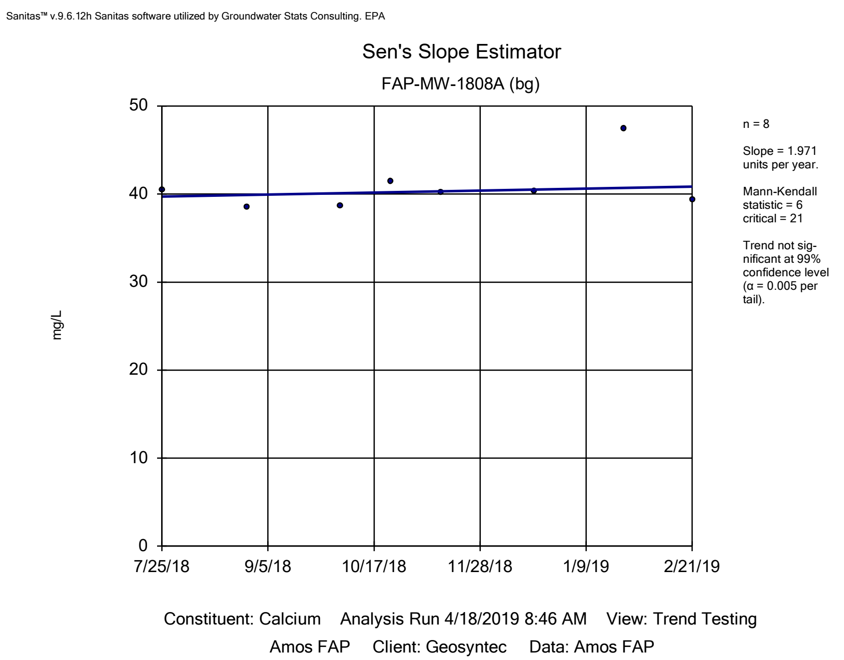
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1809A (bg)
mg/L
200
160
120
80
40
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
Slope = 12.13 units per year.
Mann-Kendall statistic = 11 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



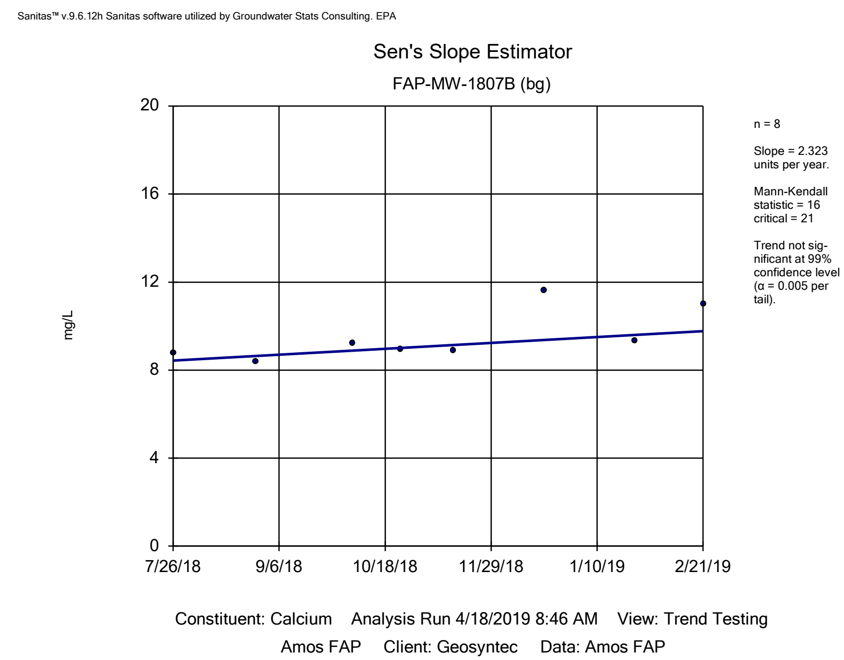
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1810A (bg)
mg/L
40
32
24
16
8
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
Slope = 12.8 units per year.
Mann-Kendall statistic = 14 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1807A (bg)
mg/L
200
160
120
80
40
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
Slope = 15.33 units per year.
Mann-Kendall statistic = 6 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1808A (bg)
mg/L
50
40
30
20
10
0
7/25/18
9/5/18
10/17/18
11/28/18
1/9/19
2/21/19
n = 8
Slope = 1.971 units per year.
Mann-Kendall statistic = 6 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

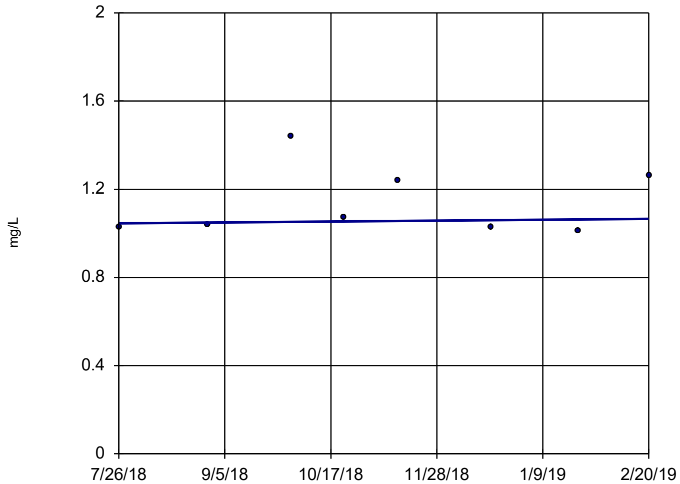


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1807B (bg)
mg/L
20
16
12
8
4
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
Slope = 2.323 units per year.
Mann-Kendall statistic = 16 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-9



n = 8

Slope = 0.03687 units per year.

Mann-Kendall statistic = 1 critical = 21

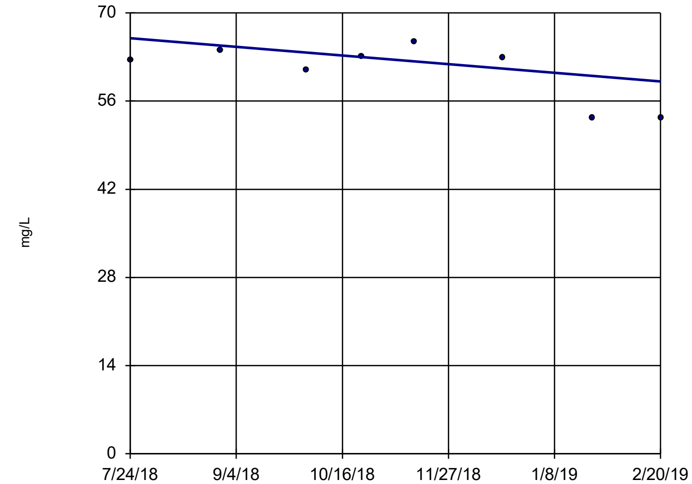
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1801A



n = 8

Slope = -11.87 units per year.

Mann-Kendall statistic = -10 critical = -21

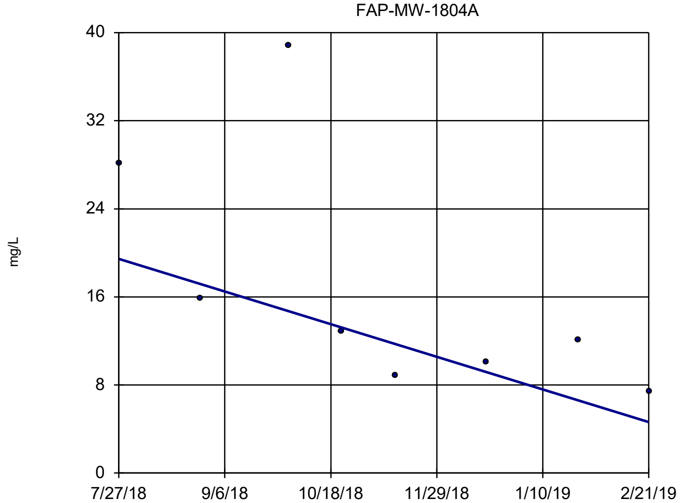
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1804A



n = 8

Slope = -25.91 units per year.

Mann-Kendall statistic = -18 critical = -21

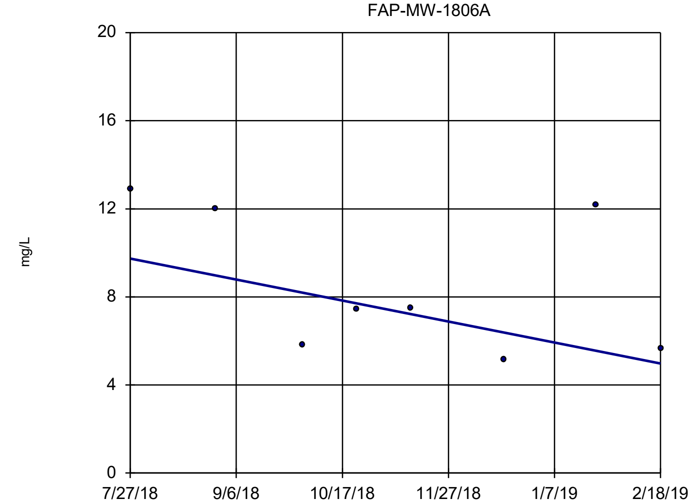
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1806A



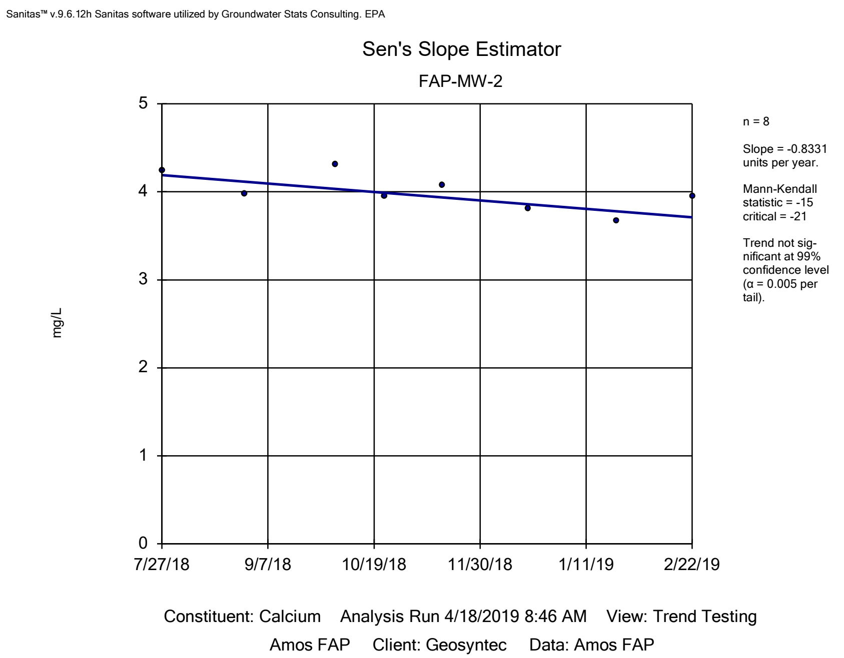
n = 8

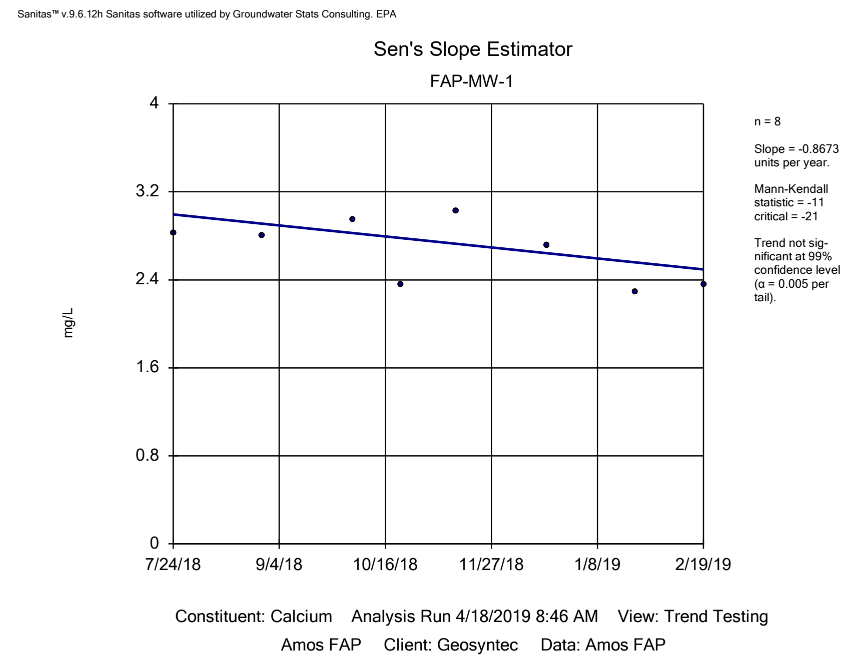
Slope = -8.439 units per year.

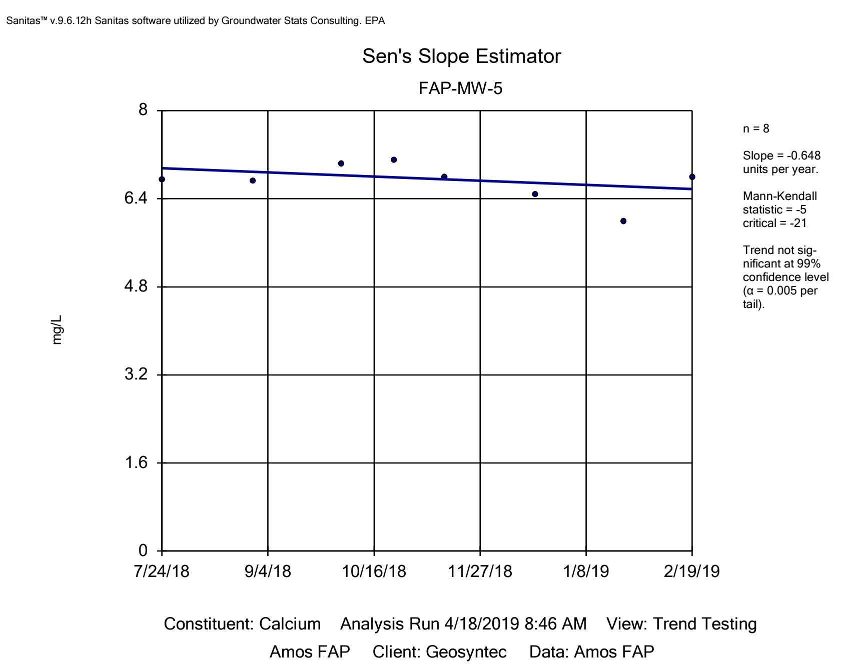
Mann-Kendall statistic = -10 critical = -21

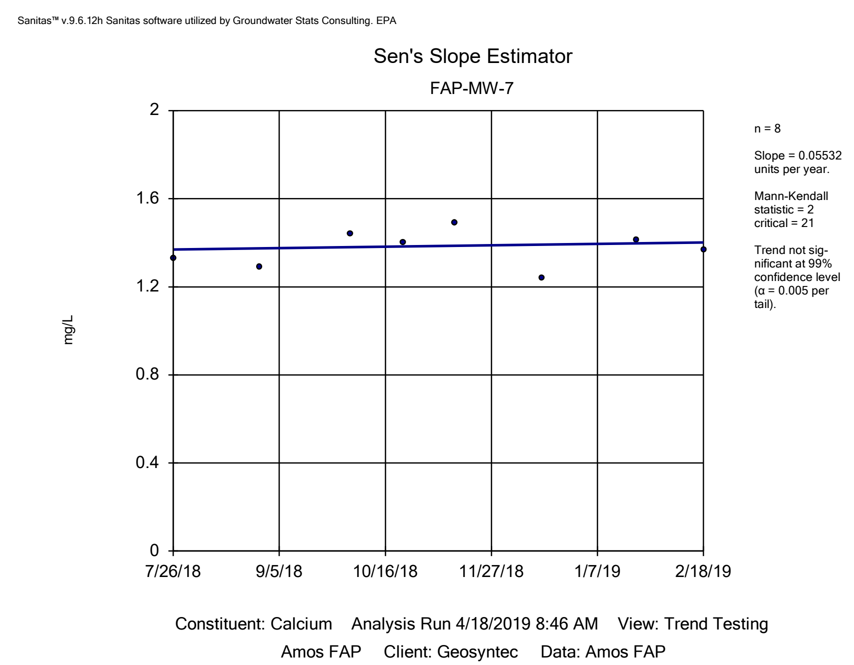
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-2
mg/L
5
4
3
2
1
0
7/27/18
9/7/18
10/19/18
11/30/18
1/11/19
2/22/19
n = 8
Slope = -0.8331 units per year.
Mann-Kendall statistic = -15 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1
mg/L
4
3.2
2.4
1.6
0.8
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = -0.8673 units per year.
Mann-Kendall statistic = -11 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

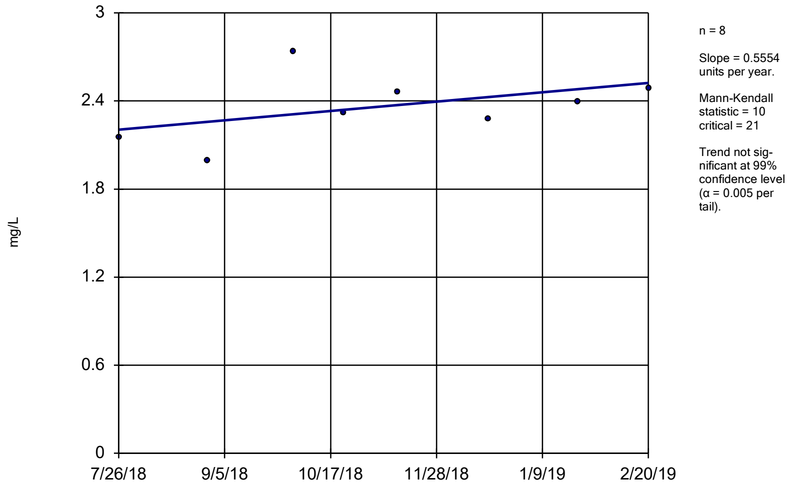

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-5
mg/L
8
6.4
4.8
3.2
1.6
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = -0.648 units per year.
Mann-Kendall statistic = -5 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-7
mg/L
2
1.6
1.2
0.8
0.4
0
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
Slope = 0.05532 units per year.
Mann-Kendall statistic = 2 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-8

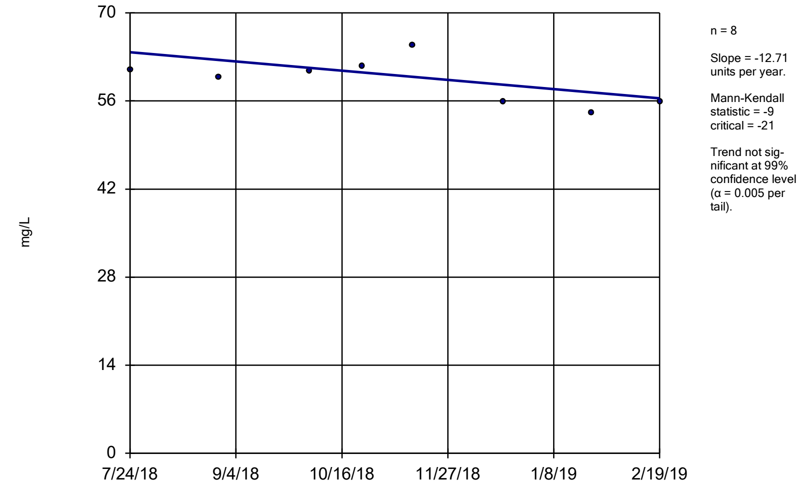


Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-6

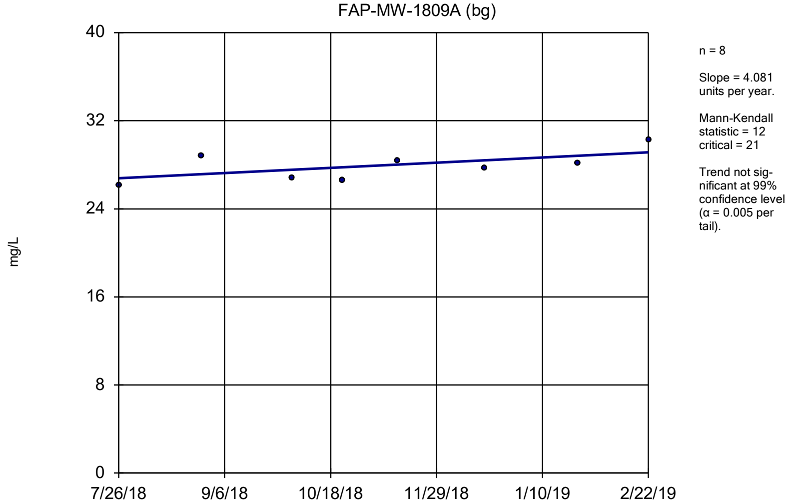


Constituent: Calcium Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1809A (bg)

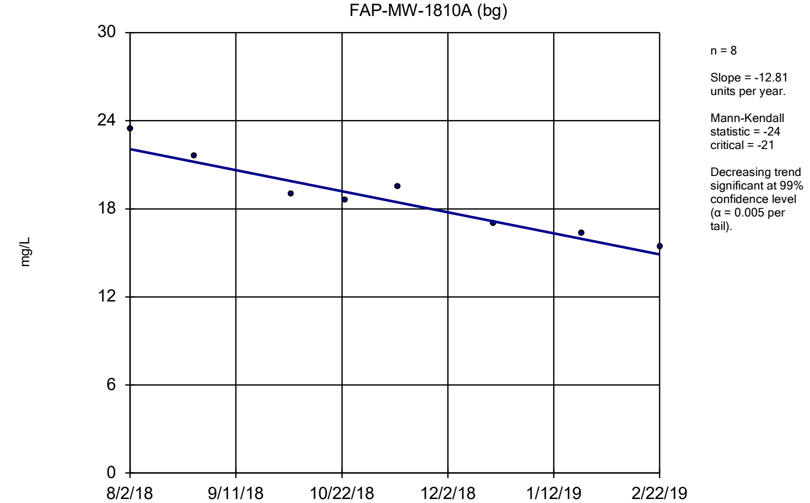


Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1810A (bg)

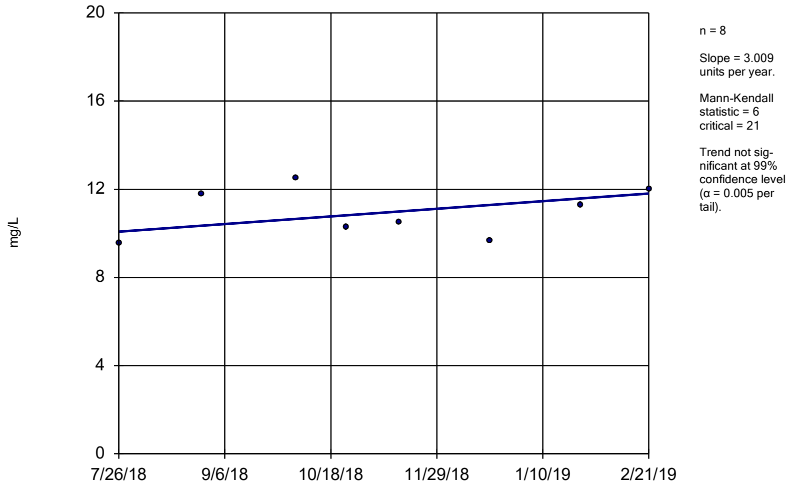


Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1807A (bg)

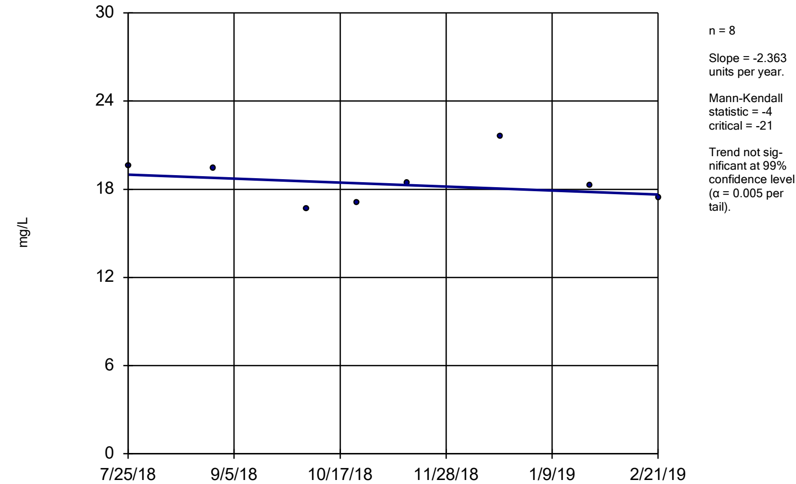


Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1808A (bg)

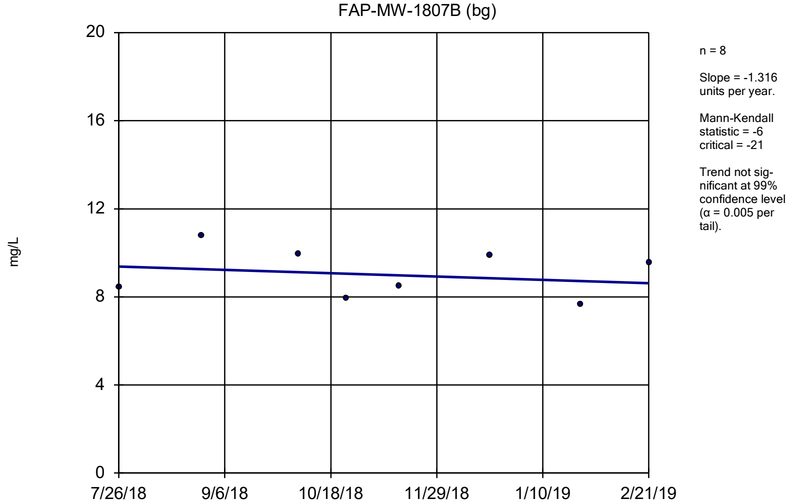


Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1807B (bg)

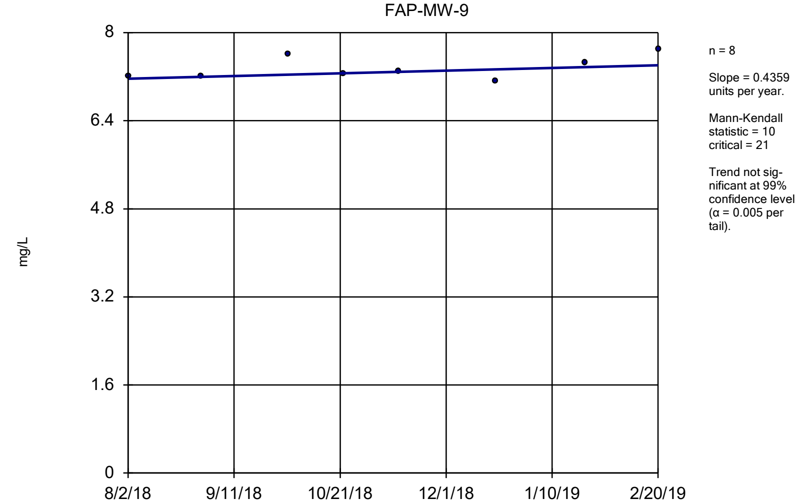


Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

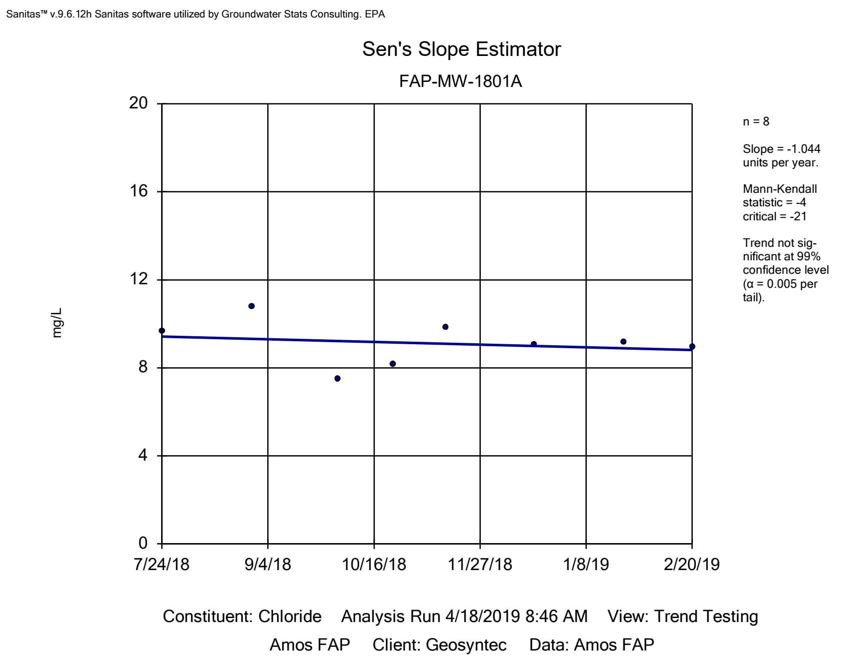
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

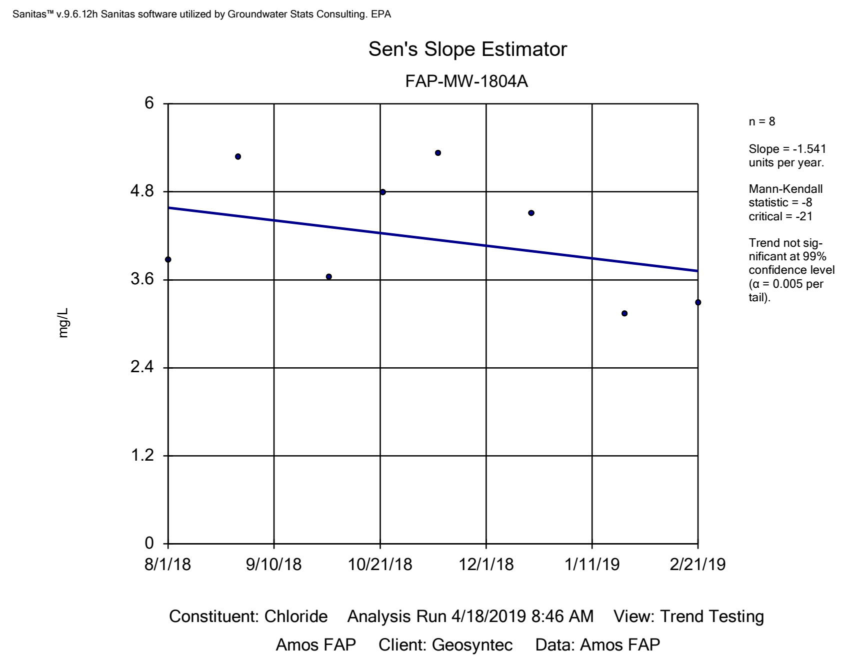
FAP-MW-9



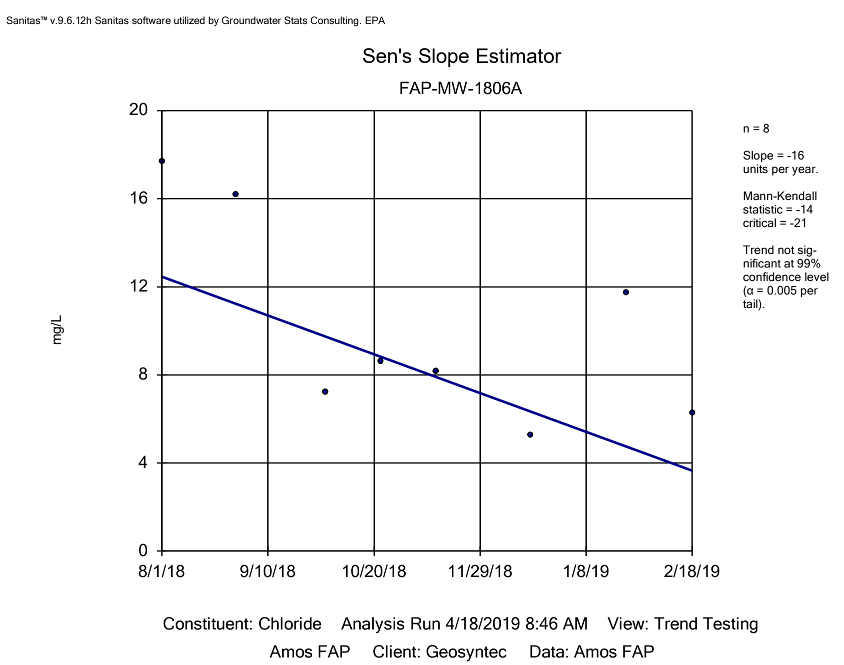
Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



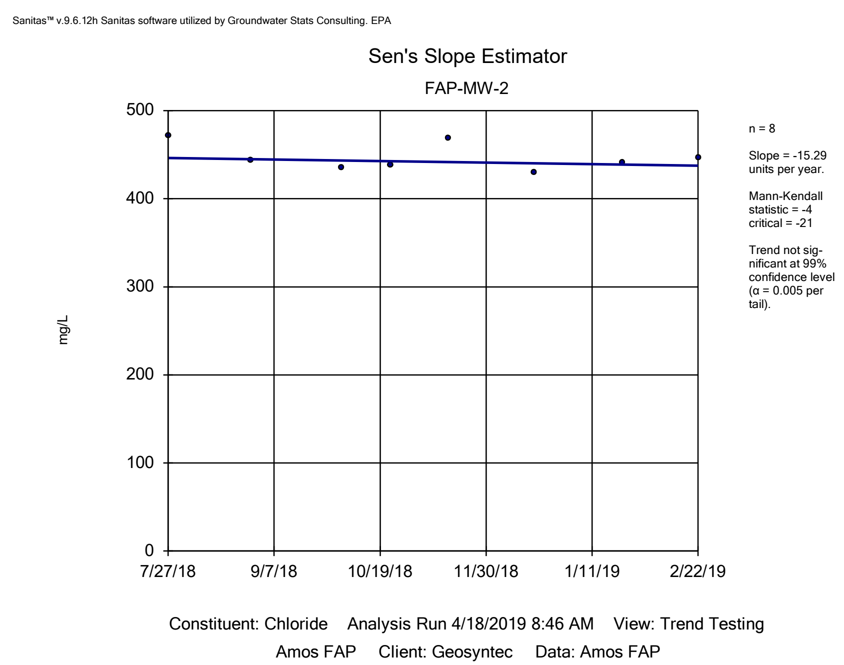
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1801A
n = 8
Slope = -1.044 units per year.
Mann-Kendall statistic = -4 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
20
16
12
8
4
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



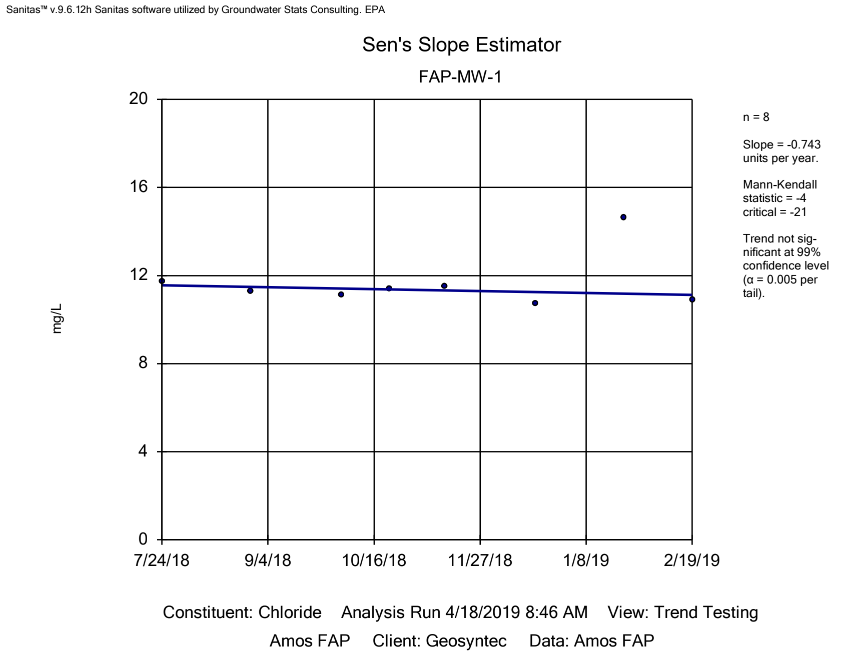
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1804A
n = 8
Slope = -1.541 units per year.
Mann-Kendall statistic = -8 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
6
4.8
3.6
2.4
1.2
0
8/1/18
9/10/18
10/21/18
12/1/18
1/11/19
2/21/19
Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

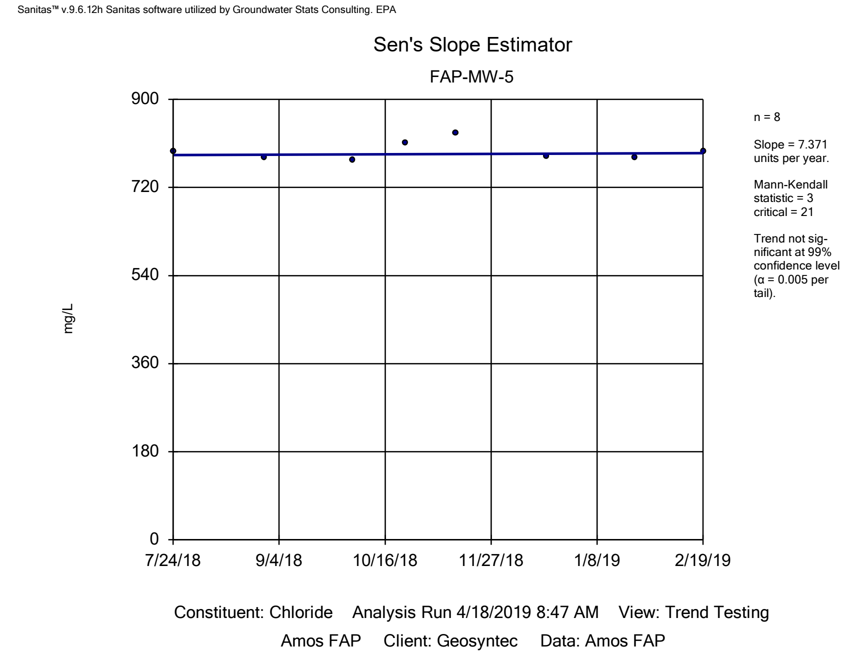


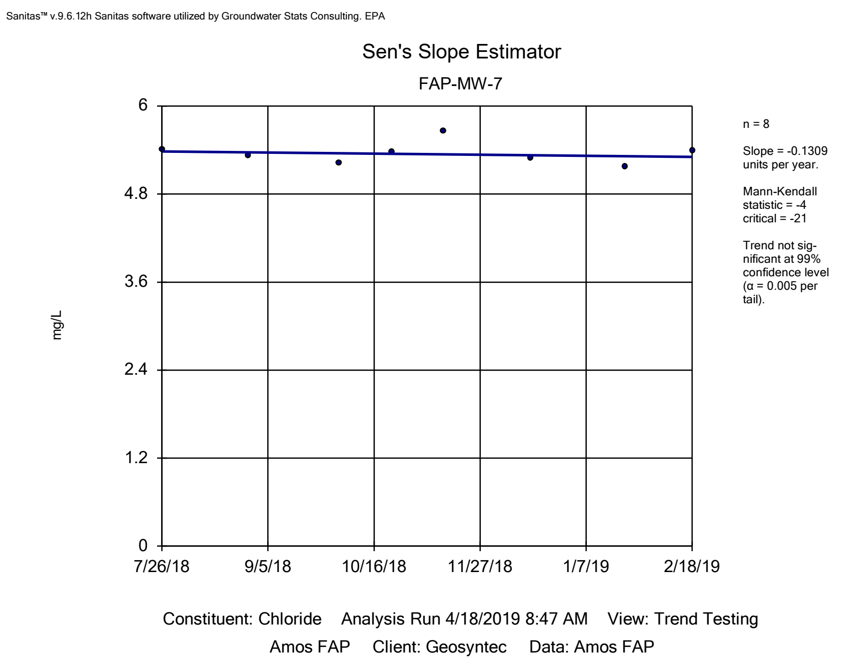
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1806A
n = 8
Slope = -16 units per year.
Mann-Kendall statistic = -14 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
20
16
12
8
4
0
8/1/18
9/10/18
10/20/18
11/29/18
1/8/19
2/18/19
Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

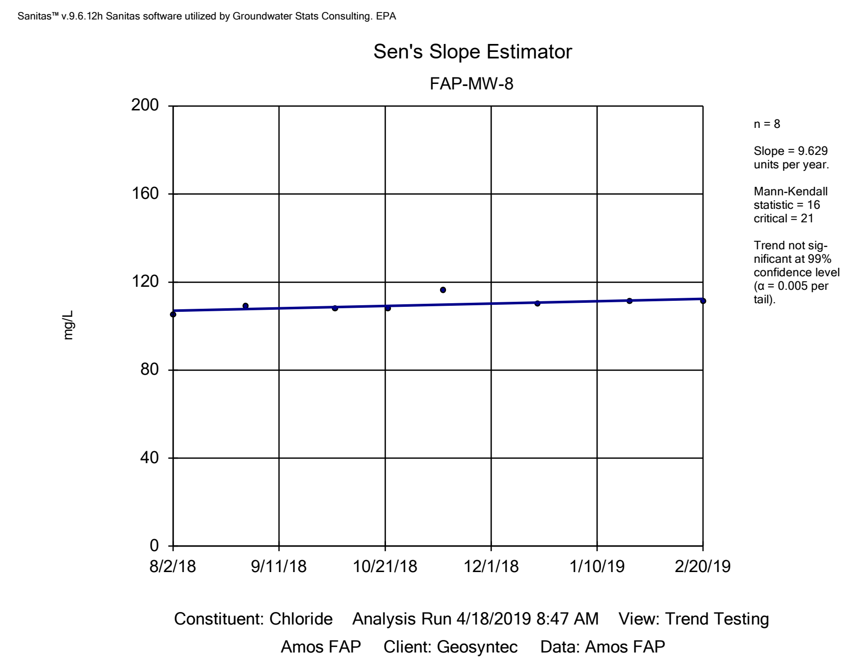


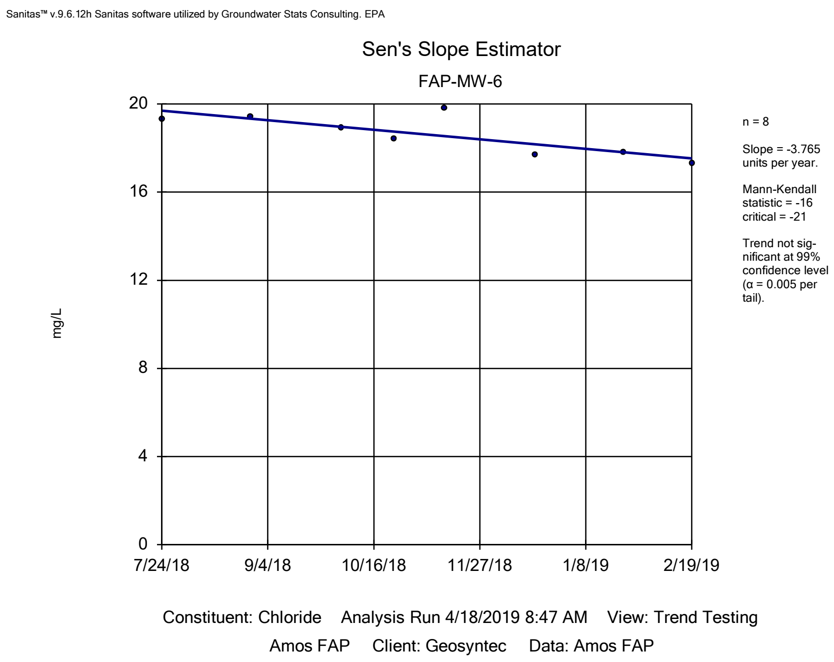
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-2
n = 8
Slope = -15.29 units per year.
Mann-Kendall statistic = -4 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
mg/L
500
400
300
200
100
0
7/27/18
9/7/18
10/19/18
11/30/18
1/11/19
2/22/19
Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1
20
16
12
8
4
0
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = -0.743 units per year.
Mann-Kendall statistic = -4 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/18/2019 8:46 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

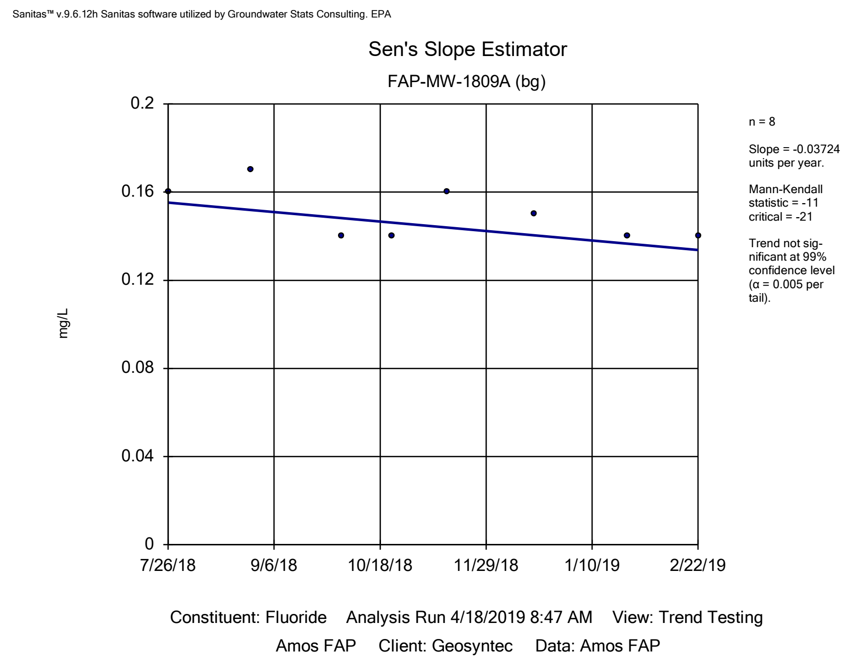

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-5
900
720
540
360
180
0
mg/L
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = 7.371 units per year.
Mann-Kendall statistic = 3 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-7
6
4.8
3.6
2.4
1.2
0
mg/L
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
Slope = -0.1309 units per year.
Mann-Kendall statistic = -4 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

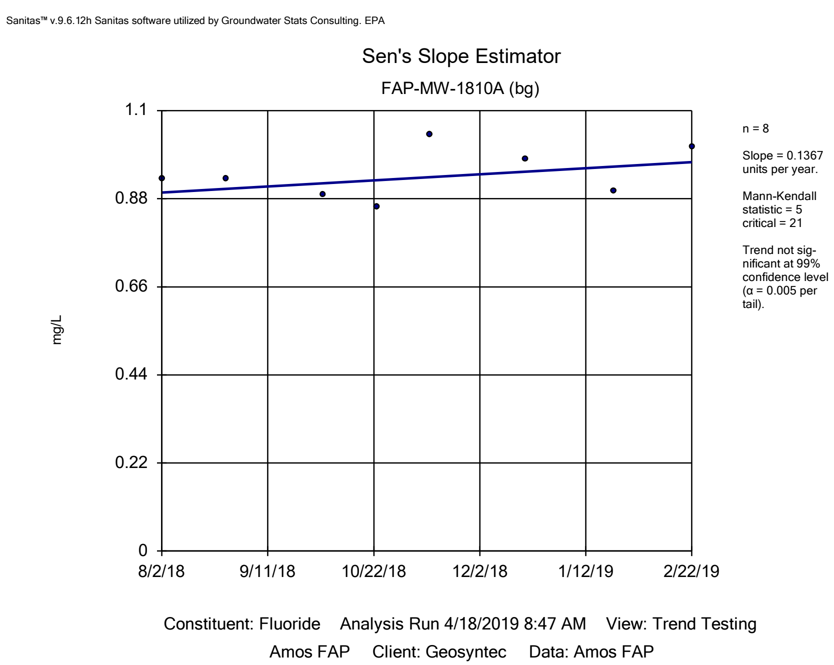

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-8
200
160
120
80
40
0
mg/L
8/2/18
9/11/18
10/21/18
12/1/18
1/10/19
2/20/19
n = 8
Slope = 9.629 units per year.
Mann-Kendall statistic = 16 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



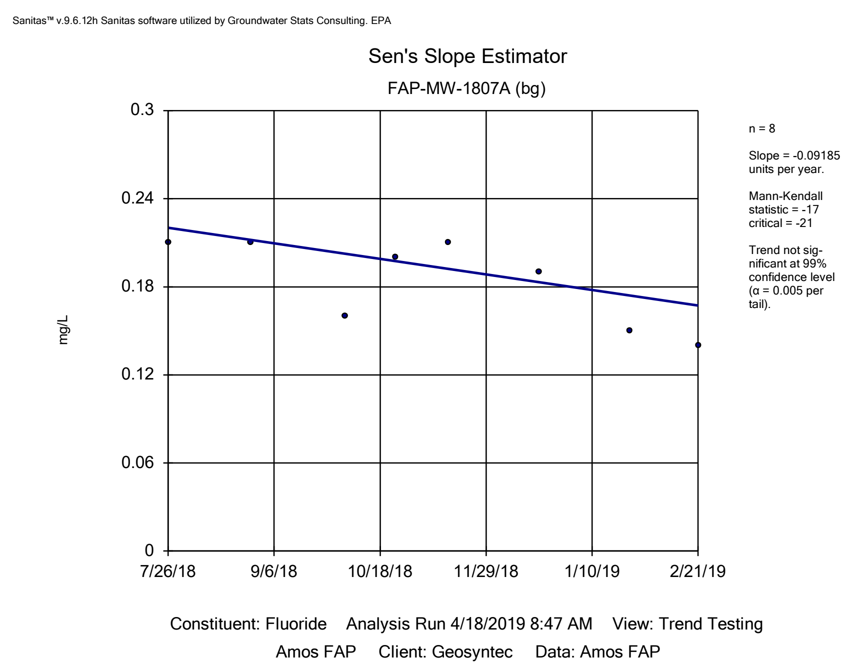
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-6
mg/L
20
16
12
8
4
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = -3.765 units per year.
Mann-Kendall statistic = -16 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Chloride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1809A (bg)
mg/L
0.2
0.16
0.12
0.08
0.04
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
Slope = -0.03724 units per year.
Mann-Kendall statistic = -11 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1810A (bg)
mg/L
1.1
0.88
0.66
0.44
0.22
0
8/2/18
9/11/18
10/22/18
12/2/18
1/12/19
2/22/19
n = 8
Slope = 0.1367 units per year.
Mann-Kendall statistic = 5 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

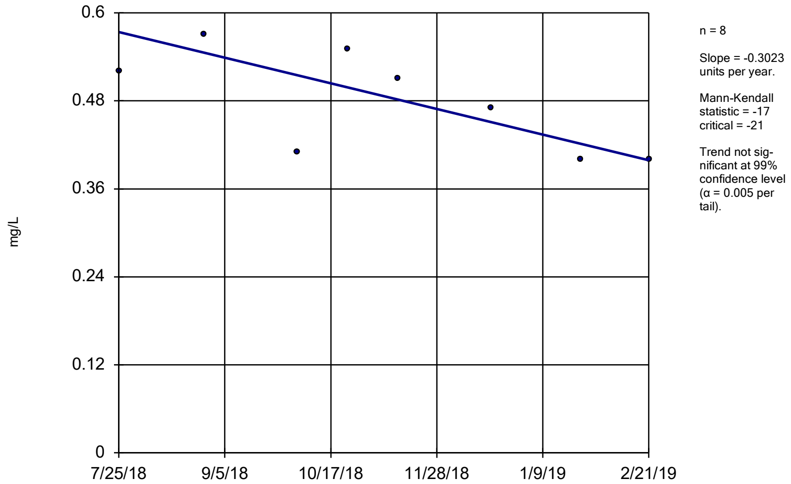


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1807A (bg)
mg/L
0.3
0.24
0.18
0.12
0.06
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
Slope = -0.09185 units per year.
Mann-Kendall statistic = -17 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1808A (bg)

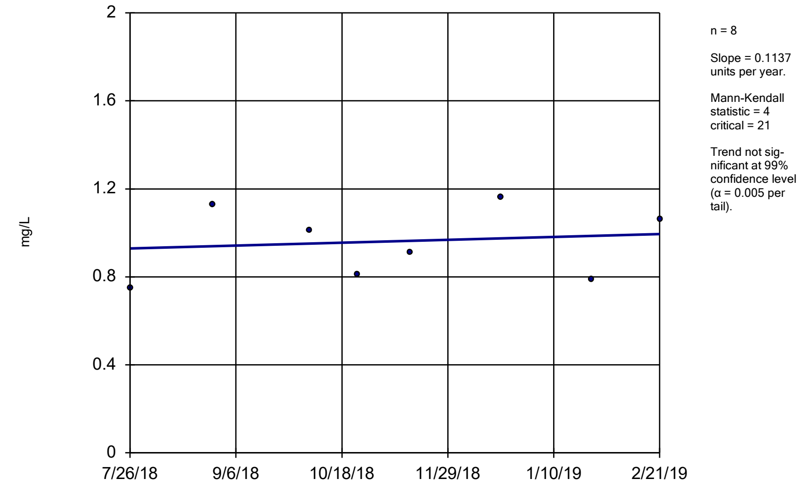


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1807B (bg)

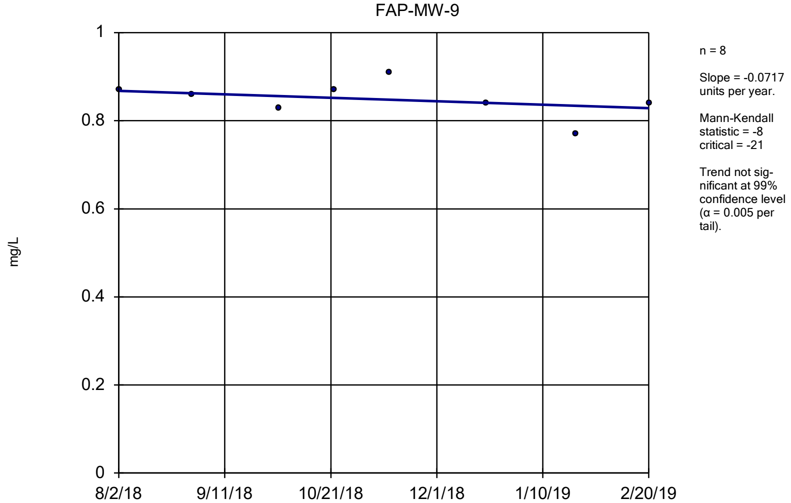


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-9

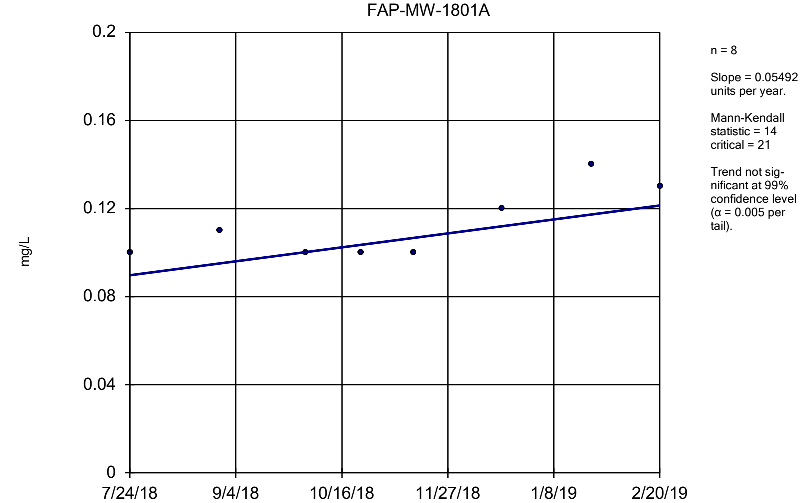


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

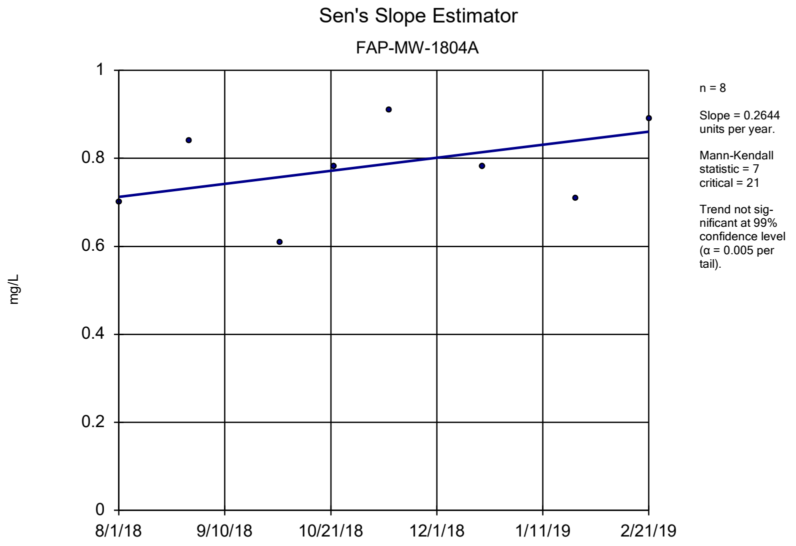
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1801A

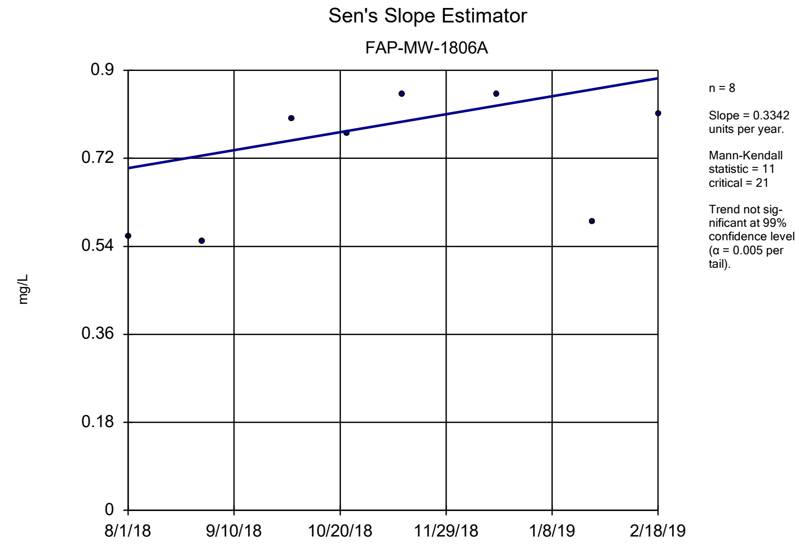


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



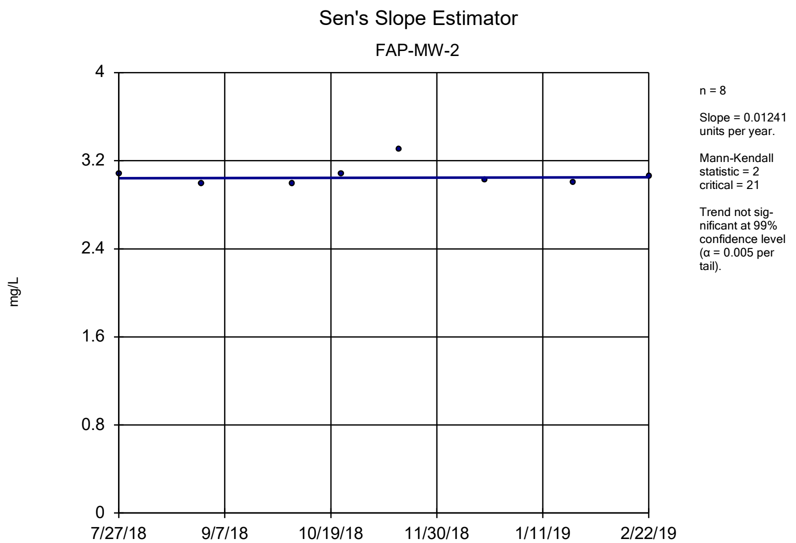
Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



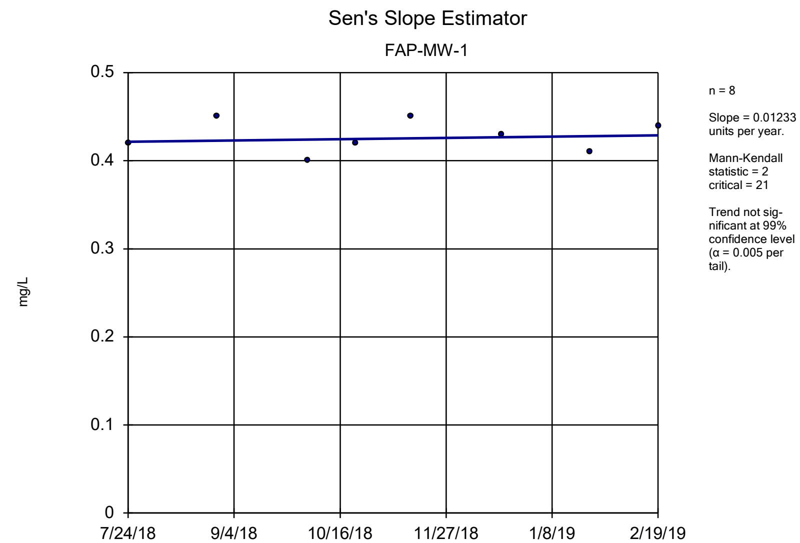
Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

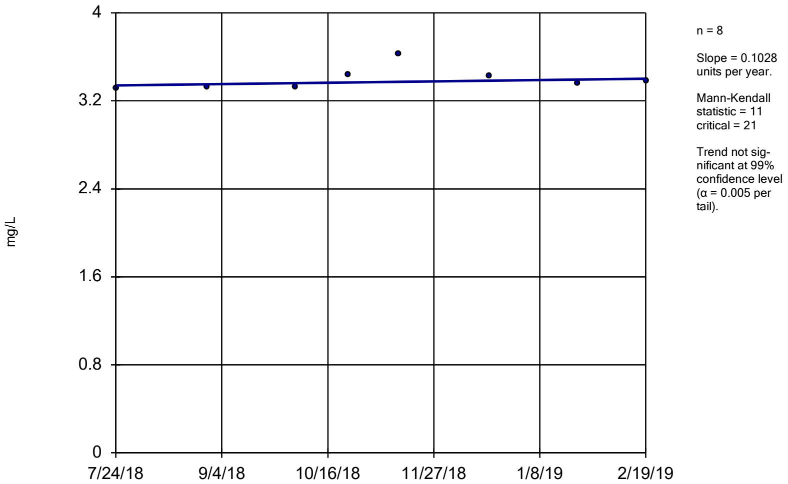


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-5

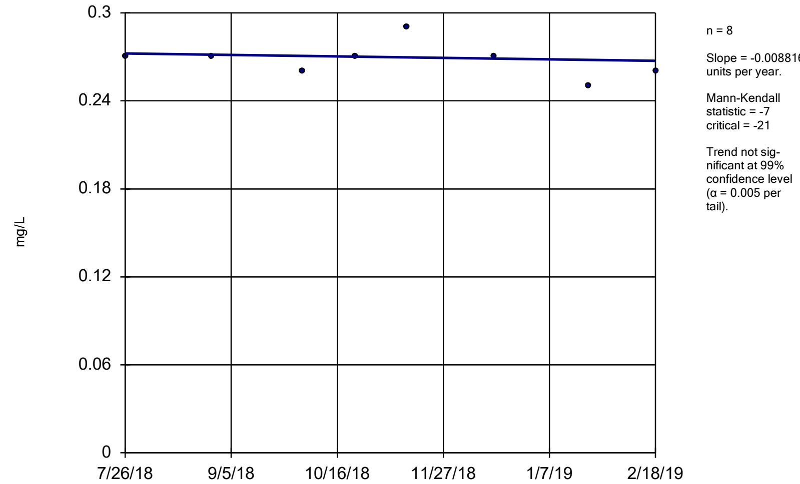


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-7

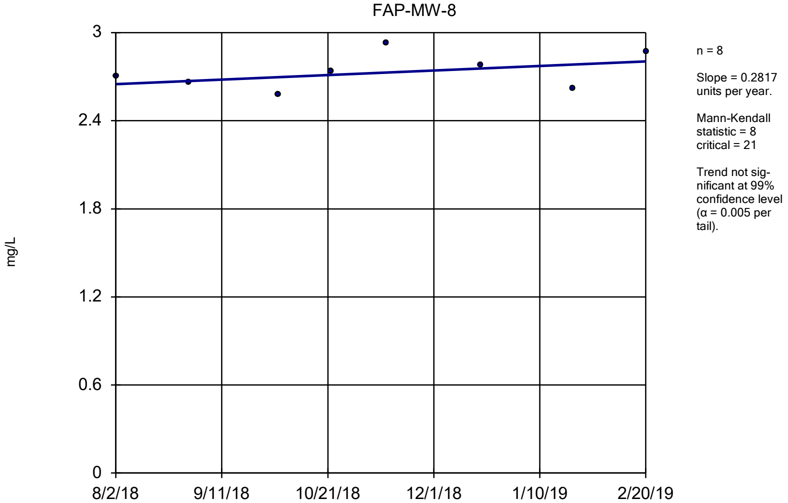


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-8

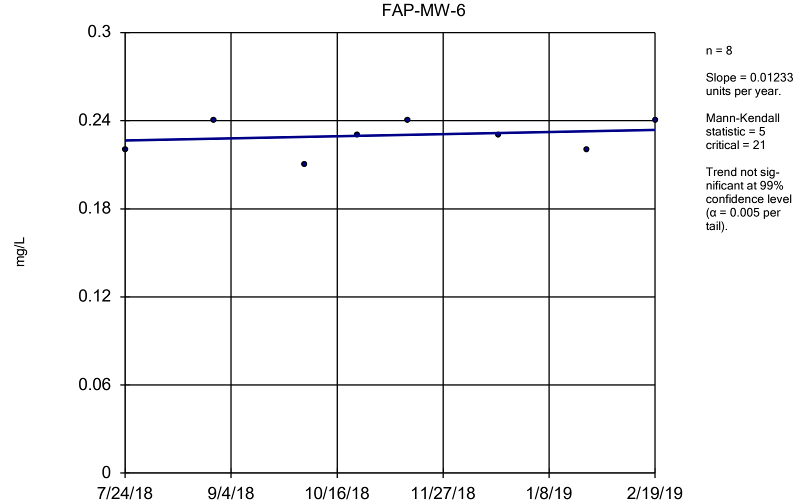


Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

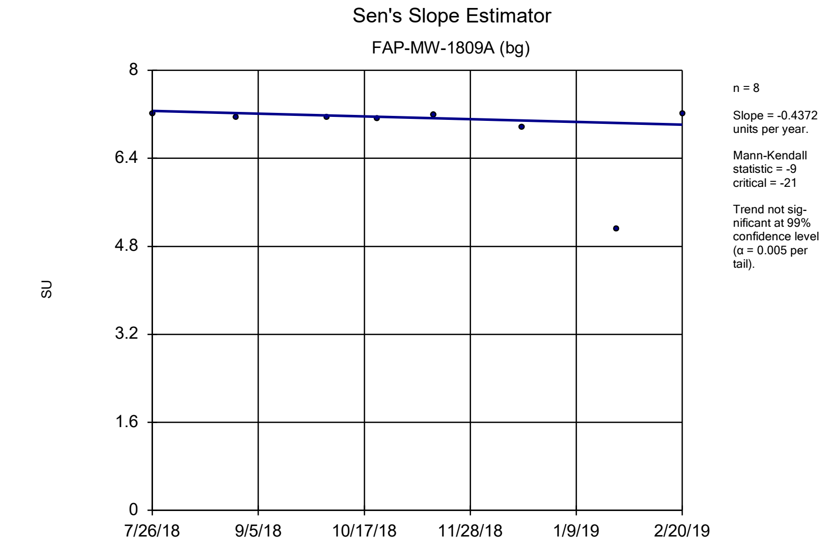
Sen's Slope Estimator

FAP-MW-6



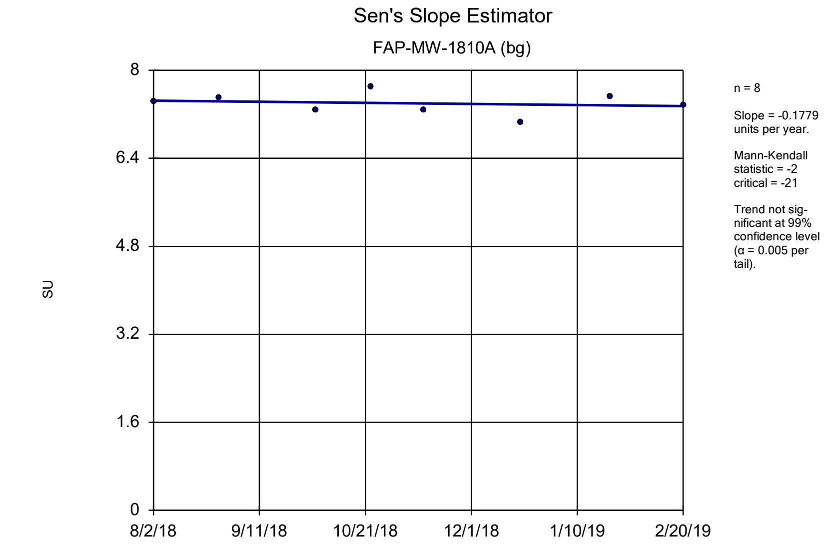
Constituent: Fluoride Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



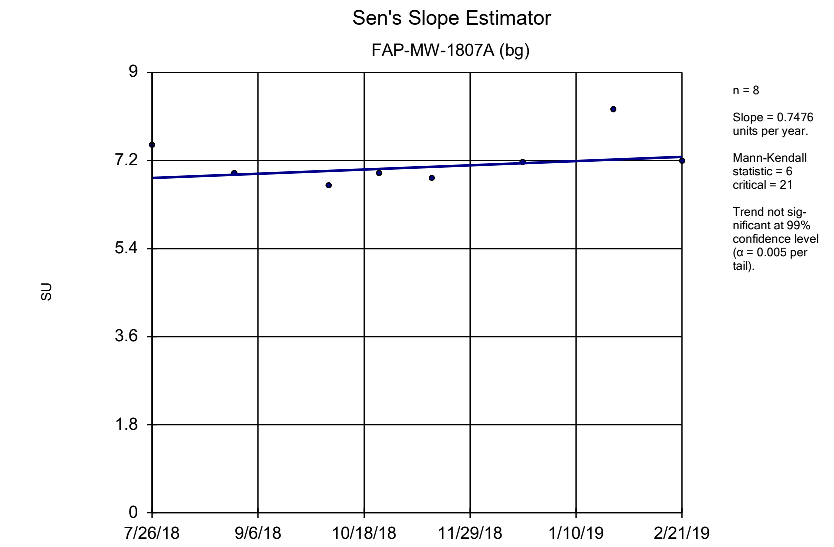
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



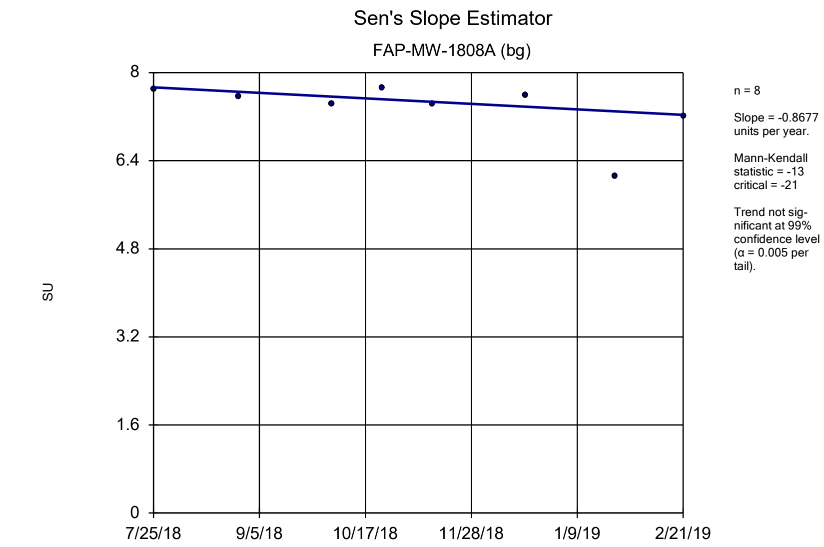
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



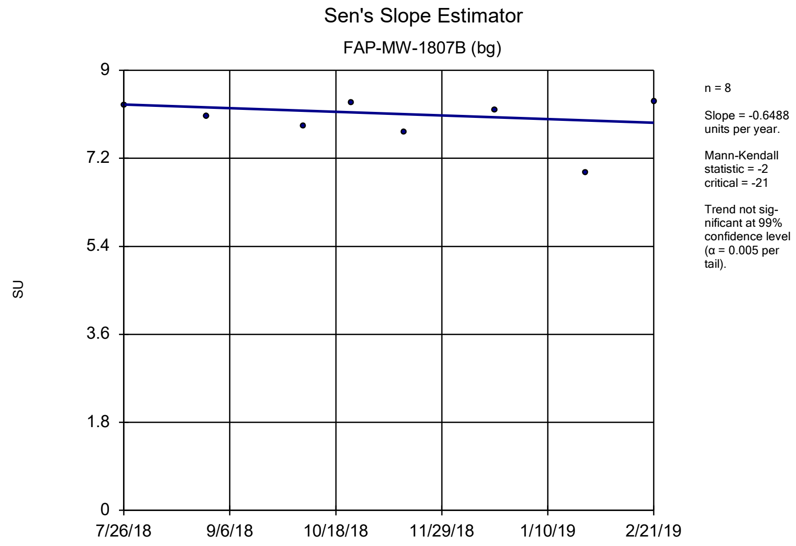
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



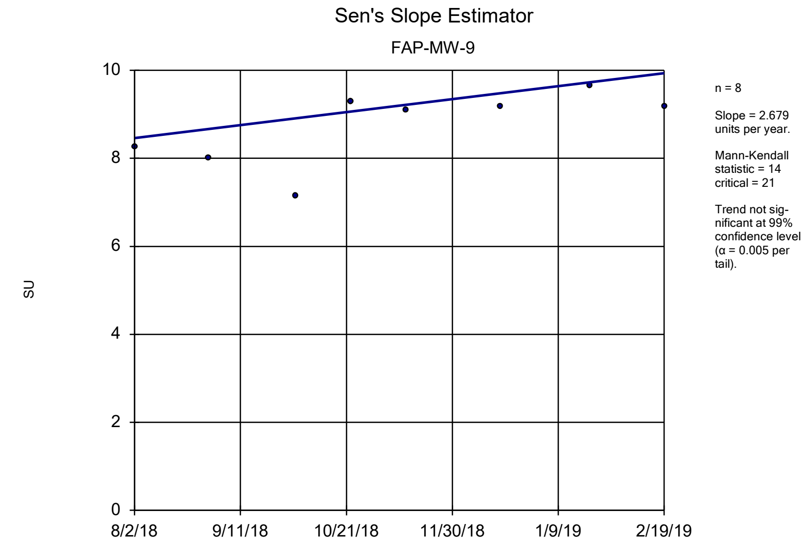
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



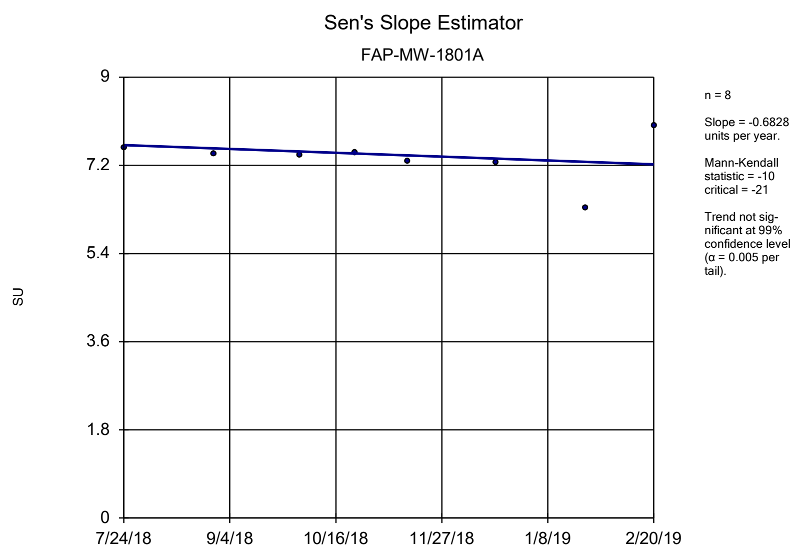
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



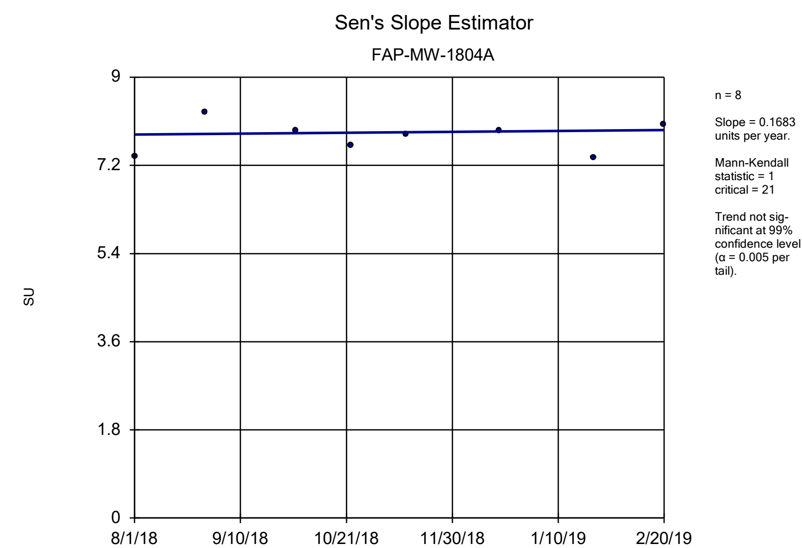
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

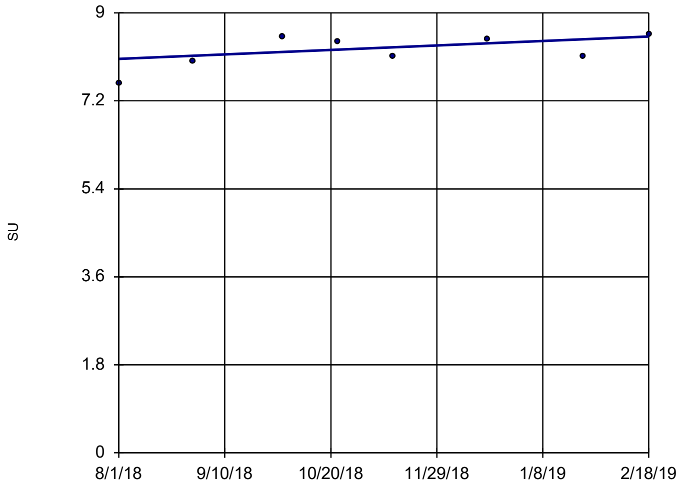


Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1806A



n = 8

Slope = 0.8389 units per year.

Mann-Kendall statistic = 12 critical = 21

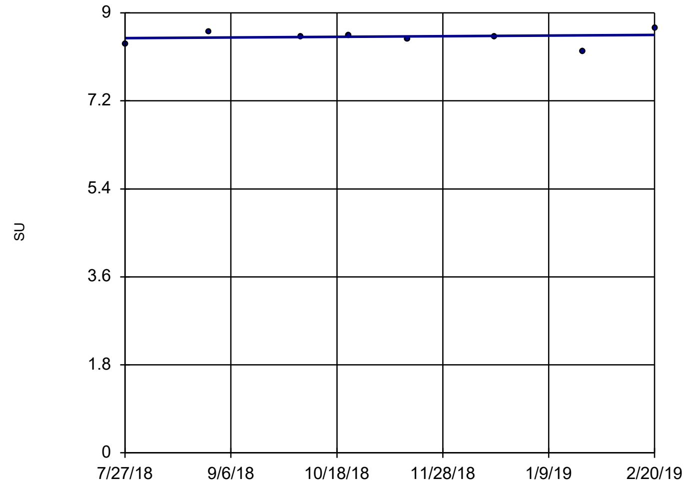
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-2



n = 8

Slope = 0.1179 units per year.

Mann-Kendall statistic = 2 critical = 21

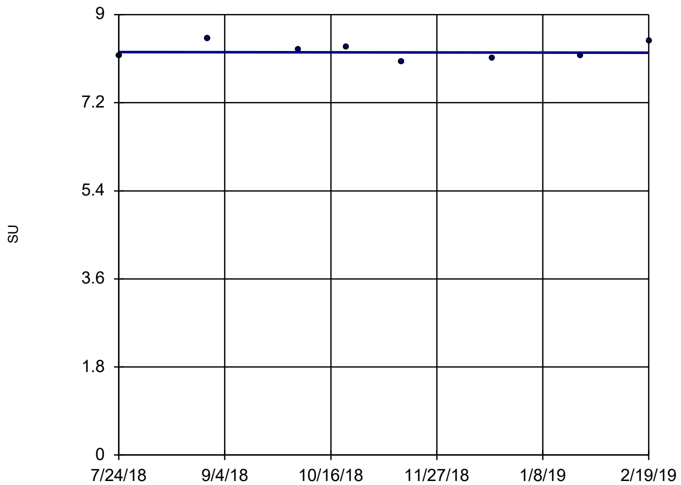
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1



n = 8

Slope = -0.01705 units per year.

Mann-Kendall statistic = 0 critical = 21

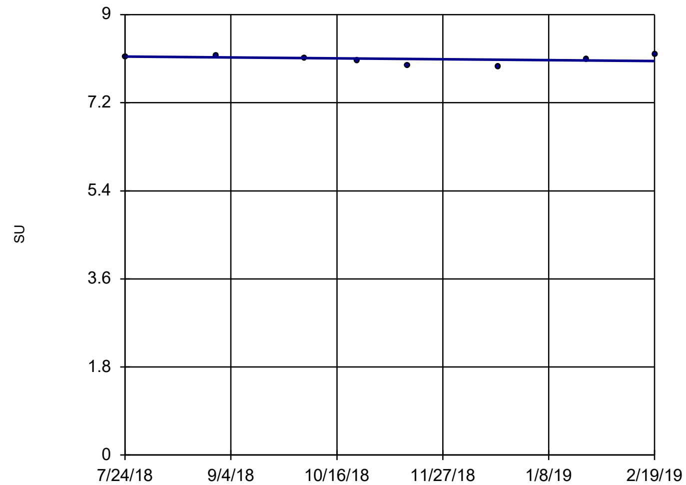
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-5



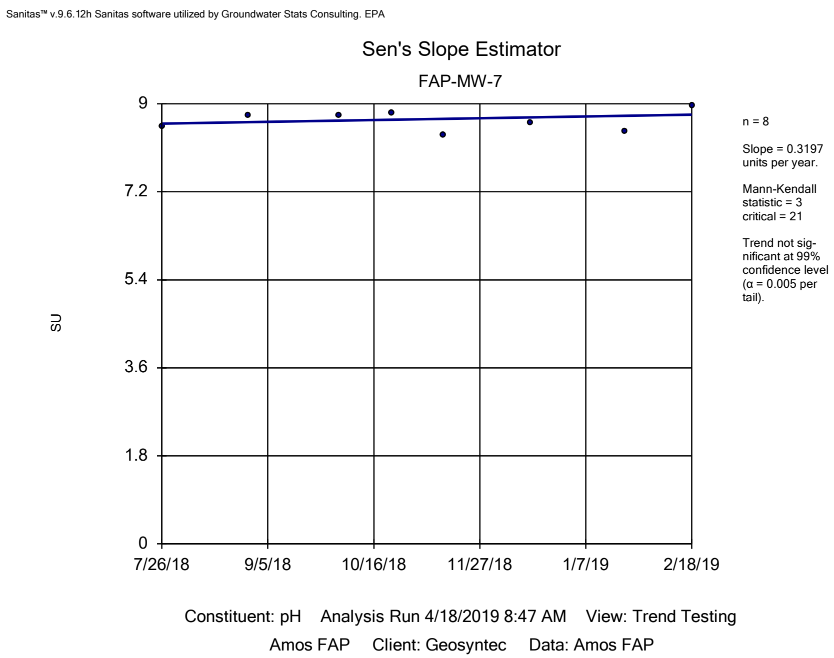
n = 8

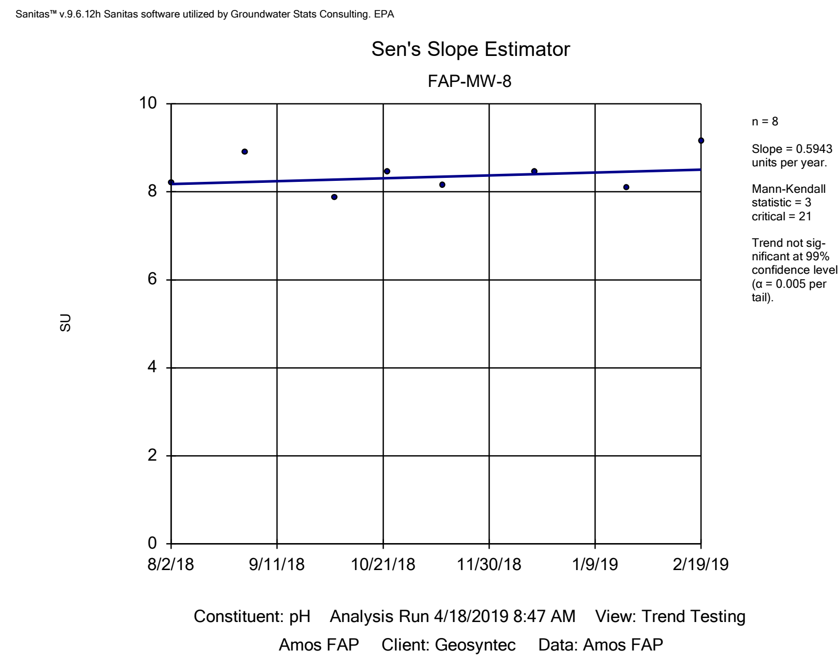
Slope = -0.1645 units per year.

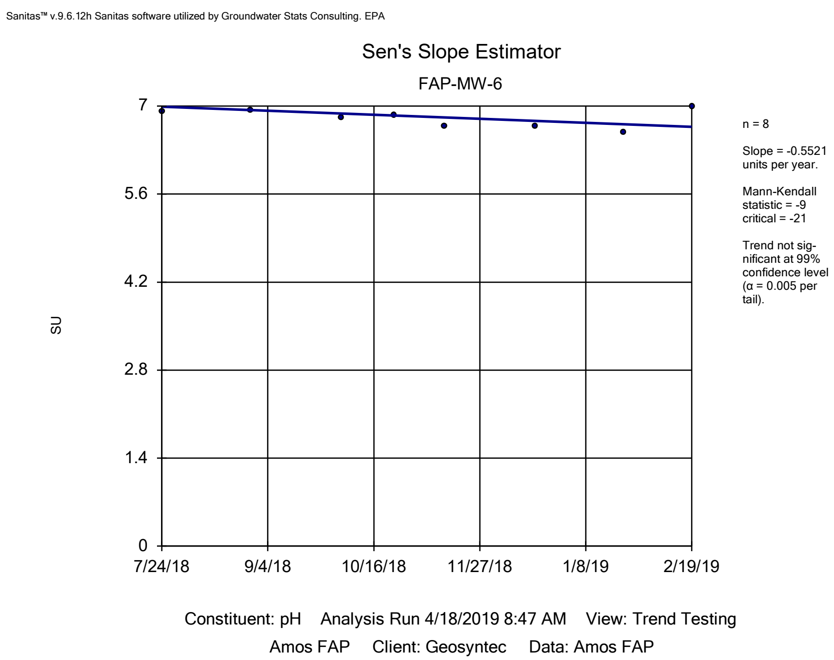
Mann-Kendall statistic = -6 critical = -21

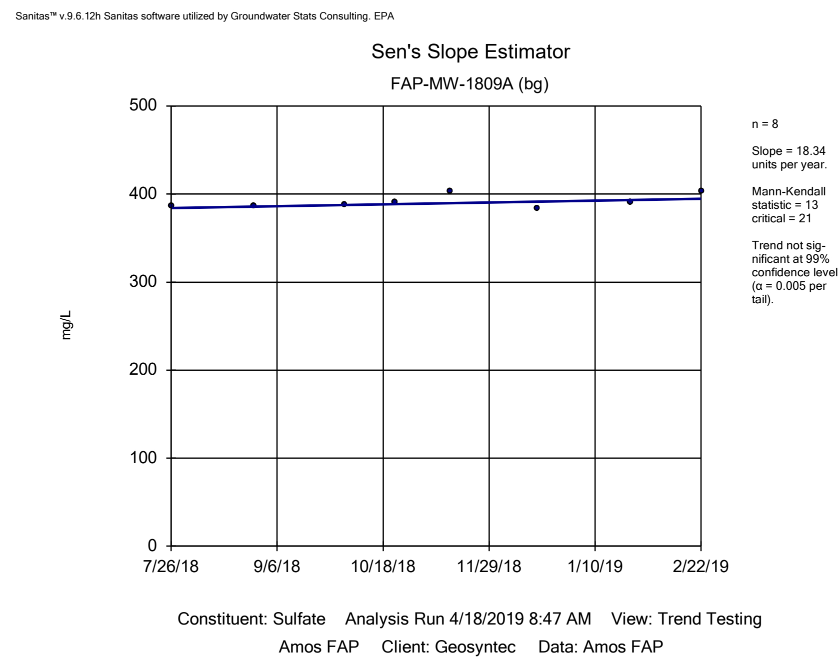
Trend not significant at 99% confidence level (α = 0.005 per tail).

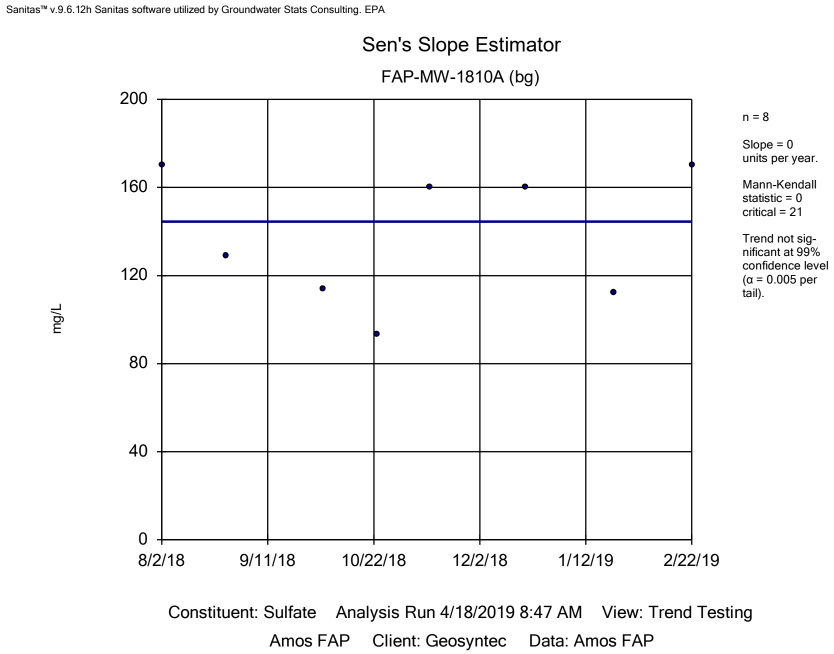
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-7
9
7.2
5.4
3.6
1.8
0
SU
7/26/18
9/5/18
10/16/18
11/27/18
1/7/19
2/18/19
n = 8
Slope = 0.3197 units per year.
Mann-Kendall statistic = 3 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

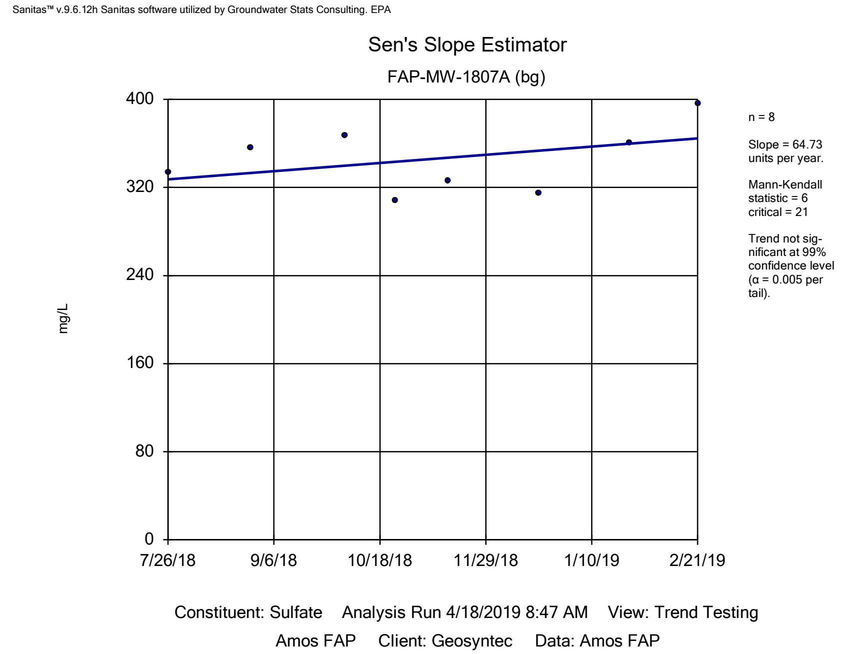

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-8
10
8
6
4
2
0
SU
8/2/18
9/11/18
10/21/18
11/30/18
1/9/19
2/19/19
n = 8
Slope = 0.5943 units per year.
Mann-Kendall statistic = 3 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-6
7
5.6
4.2
2.8
1.4
0
SU
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/19/19
n = 8
Slope = -0.5521 units per year.
Mann-Kendall statistic = -9 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: pH Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

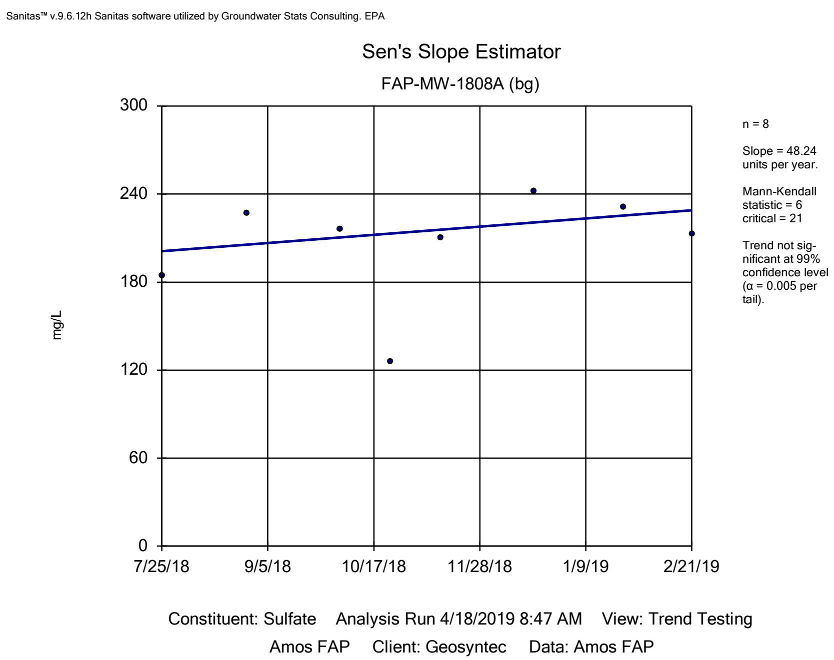

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1809A (bg)
500
400
300
200
100
0
mg/L
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/22/19
n = 8
Slope = 18.34 units per year.
Mann-Kendall statistic = 13 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



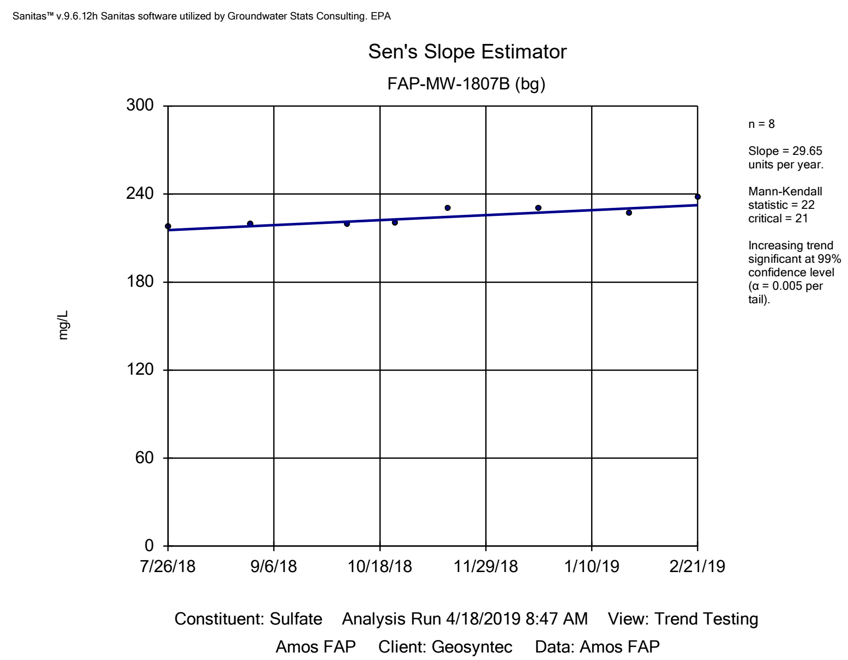
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1810A (bg)
mg/L
200
160
120
80
40
0
8/2/18
9/11/18
10/22/18
12/2/18
1/12/19
2/22/19
n = 8
Slope = 0 units per year.
Mann-Kendall statistic = 0 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP



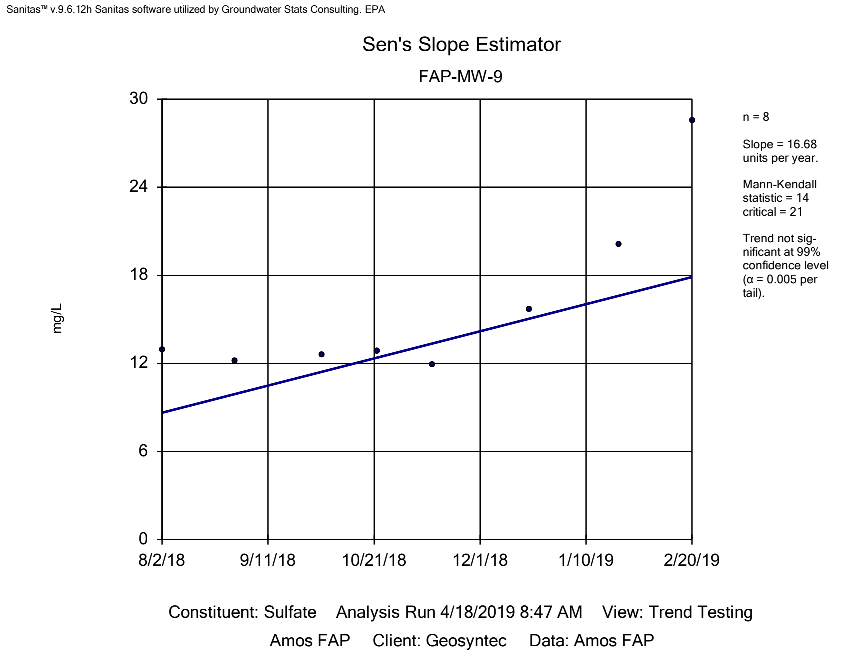
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1807A (bg)
mg/L
400
320
240
160
80
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
Slope = 64.73 units per year.
Mann-Kendall statistic = 6 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

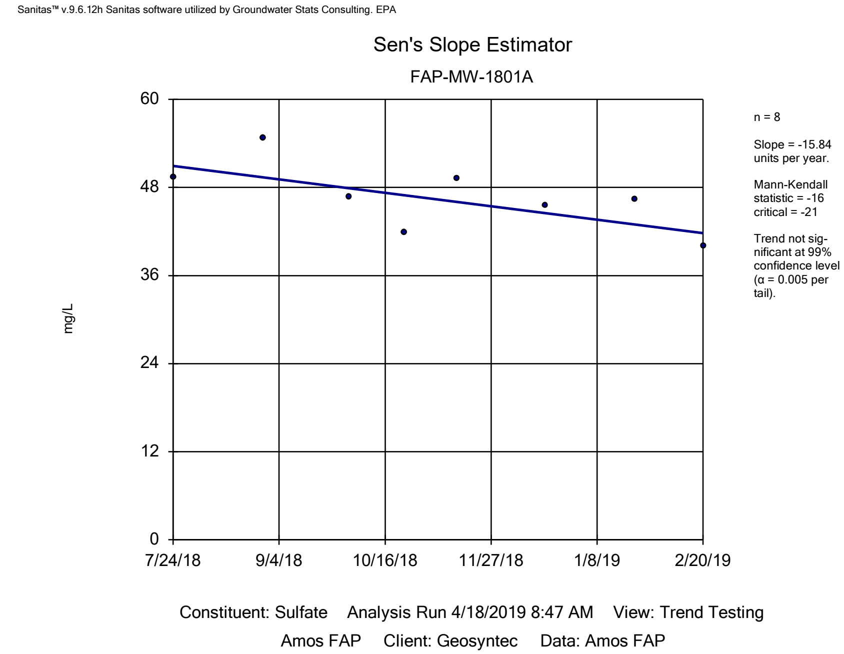


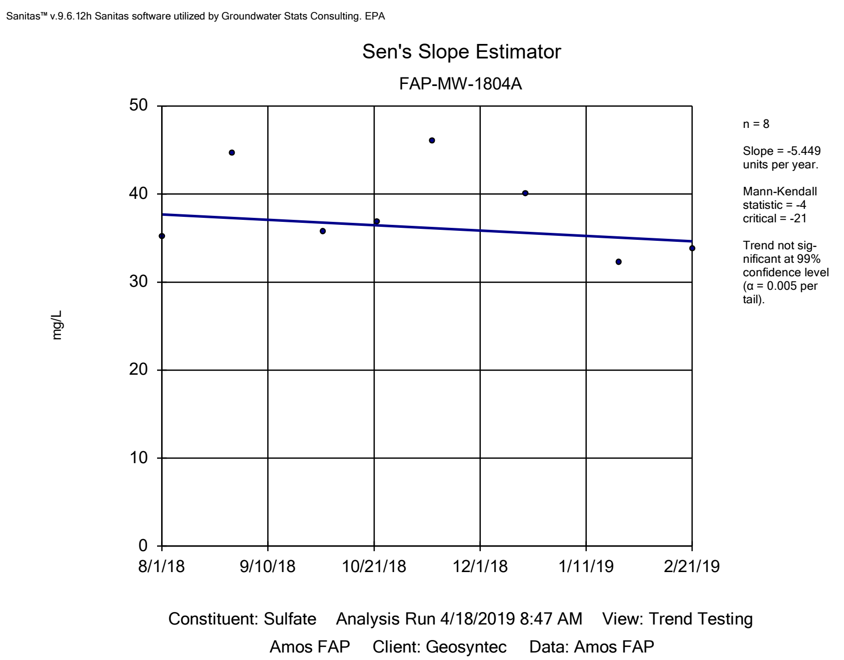
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1808A (bg)
mg/L
300
240
180
120
60
0
7/25/18
9/5/18
10/17/18
11/28/18
1/9/19
2/21/19
n = 8
Slope = 48.24 units per year.
Mann-Kendall statistic = 6 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

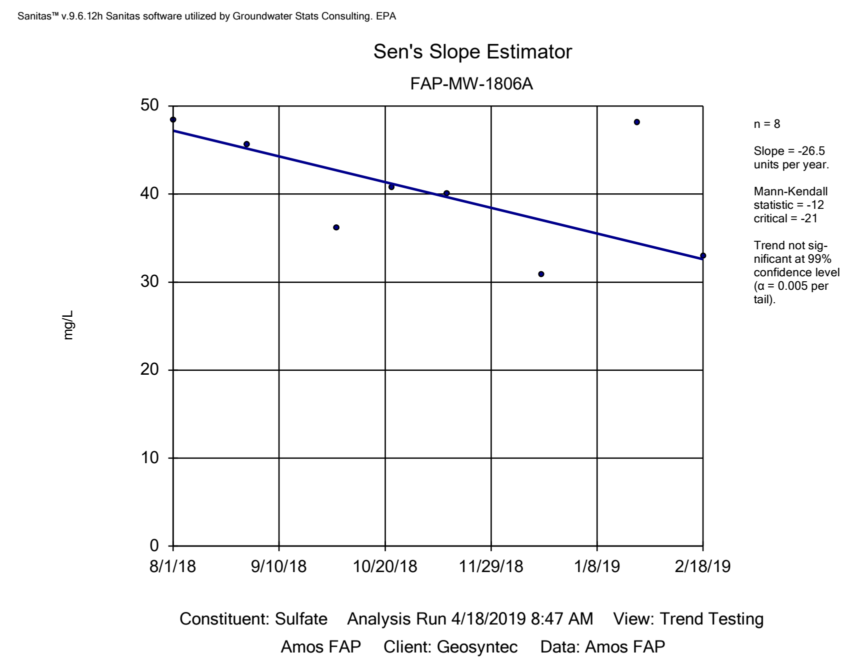


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1807B (bg)
mg/L
300
240
180
120
60
0
7/26/18
9/6/18
10/18/18
11/29/18
1/10/19
2/21/19
n = 8
Slope = 29.65 units per year.
Mann-Kendall statistic = 22 critical = 21
Increasing trend significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

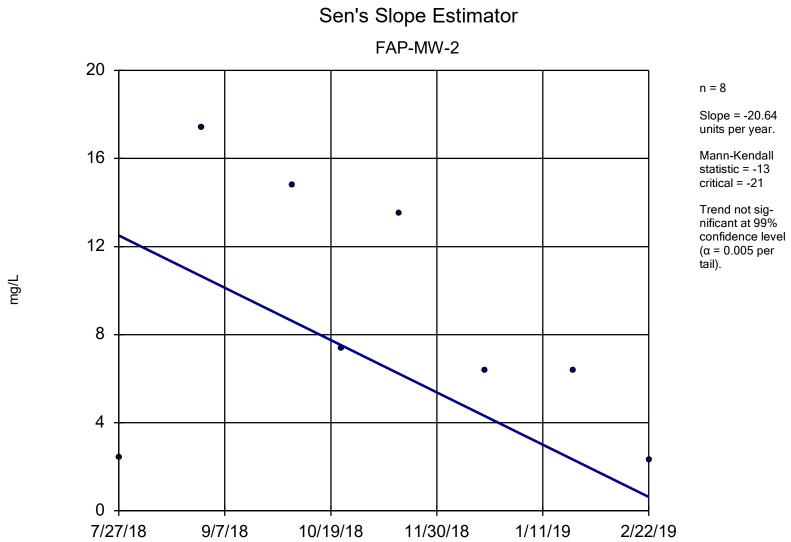

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-9
mg/L
30
24
18
12
6
0
8/2/18
9/11/18
10/21/18
12/1/18
1/10/19
2/20/19
n = 8
Slope = 16.68 units per year.
Mann-Kendall statistic = 14 critical = 21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1801A
mg/L
60
48
36
24
12
0
7/24/18
9/4/18
10/16/18
11/27/18
1/8/19
2/20/19
n = 8
Slope = -15.84 units per year.
Mann-Kendall statistic = -16 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP


Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1804A
mg/L
50
40
30
20
10
0
8/1/18
9/10/18
10/21/18
12/1/18
1/11/19
2/21/19
n = 8
Slope = -5.449 units per year.
Mann-Kendall statistic = -4 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

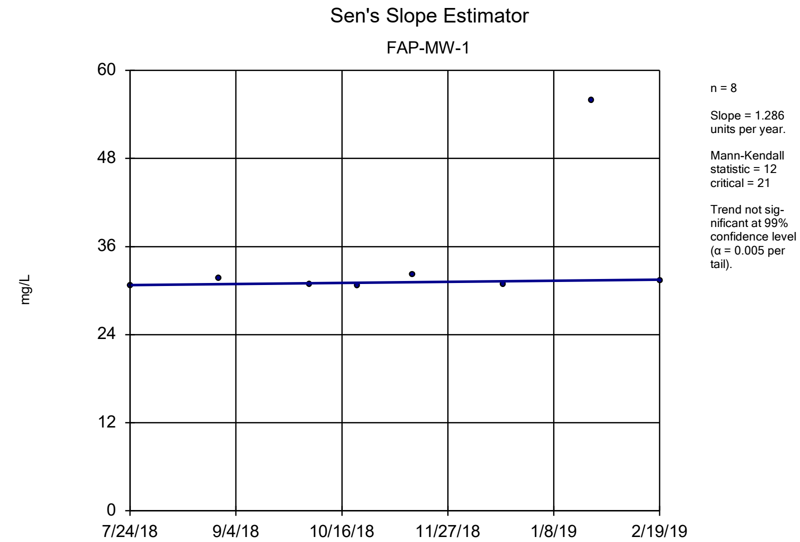

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Sen's Slope Estimator
FAP-MW-1806A
mg/L
50
40
30
20
10
0
8/1/18
9/10/18
10/20/18
11/29/18
1/8/19
2/18/19
n = 8
Slope = -26.5 units per year.
Mann-Kendall statistic = -12 critical = -21
Trend not significant at 99% confidence level (α = 0.005 per tail).
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



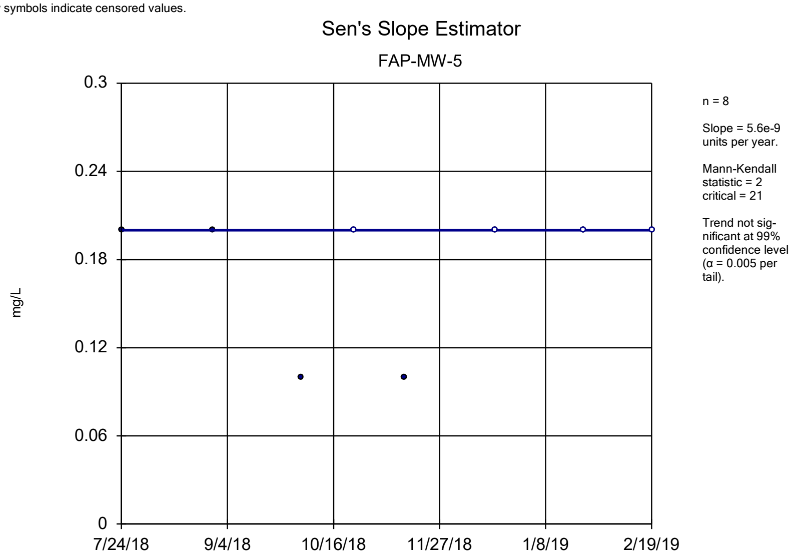
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



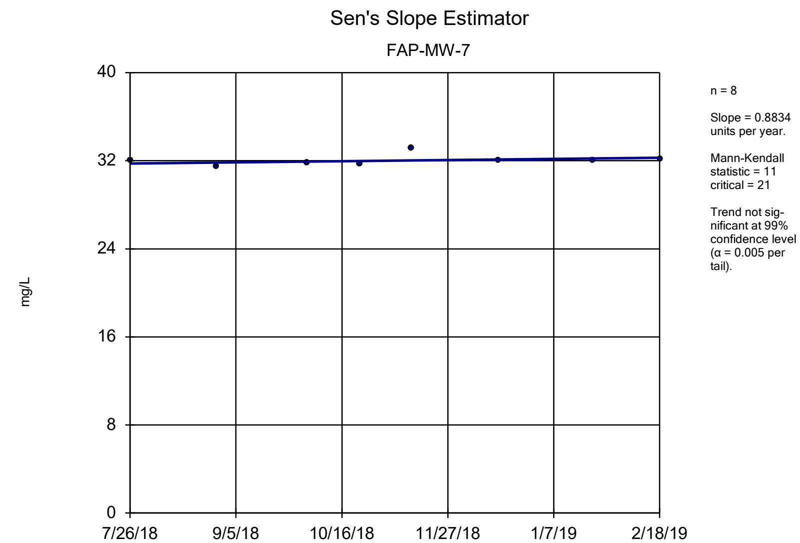
Constituent: Sulfate Analysis Run 4/18/2019 8:47 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA
Hollow symbols indicate censored values.



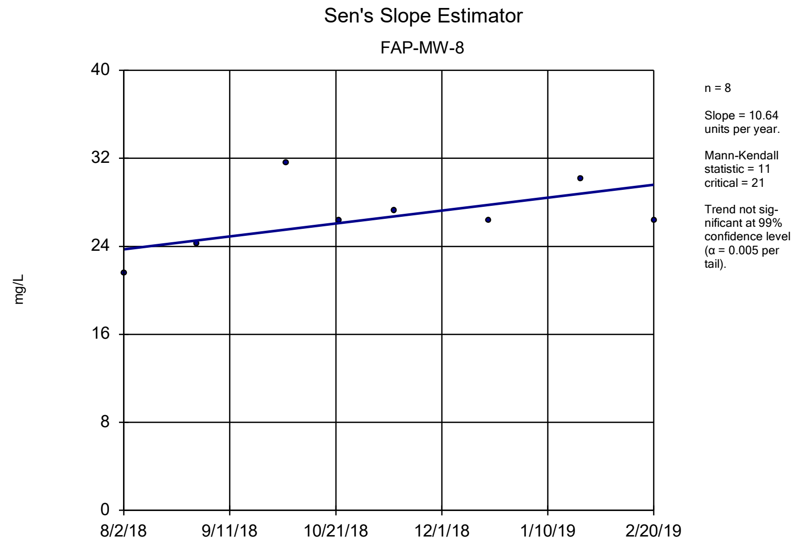
Constituent: Sulfate Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



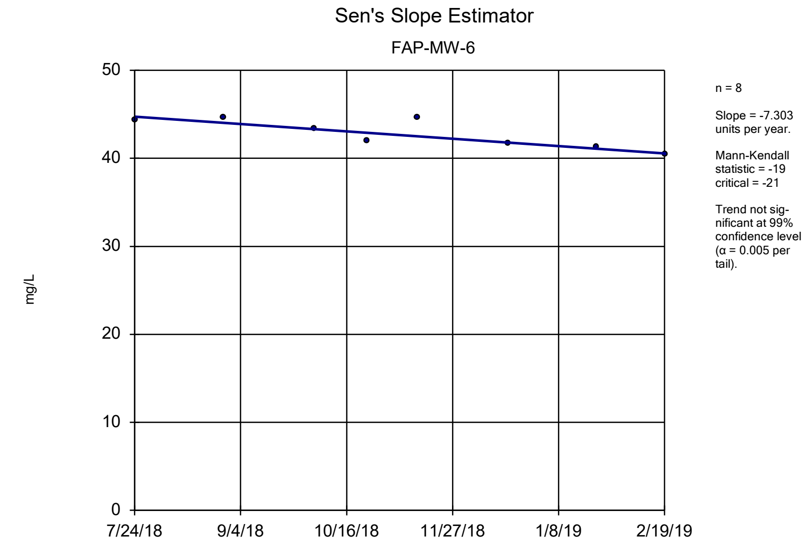
Constituent: Sulfate Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



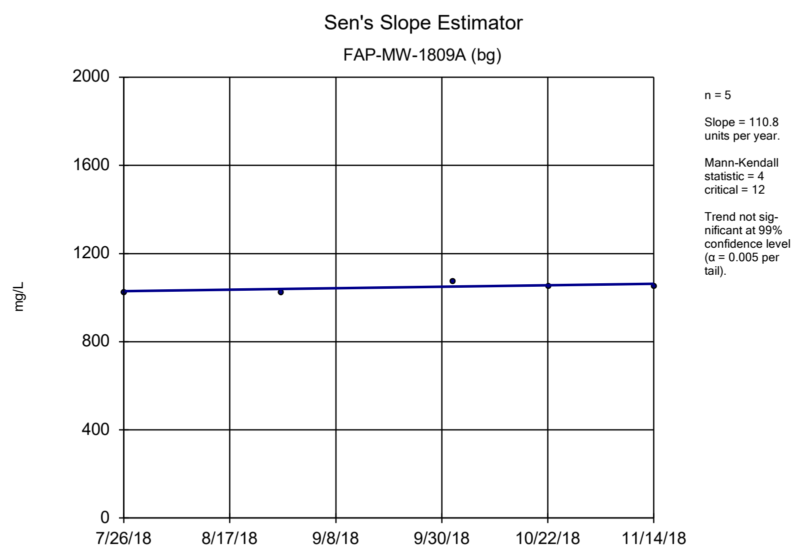
Constituent: Sulfate Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



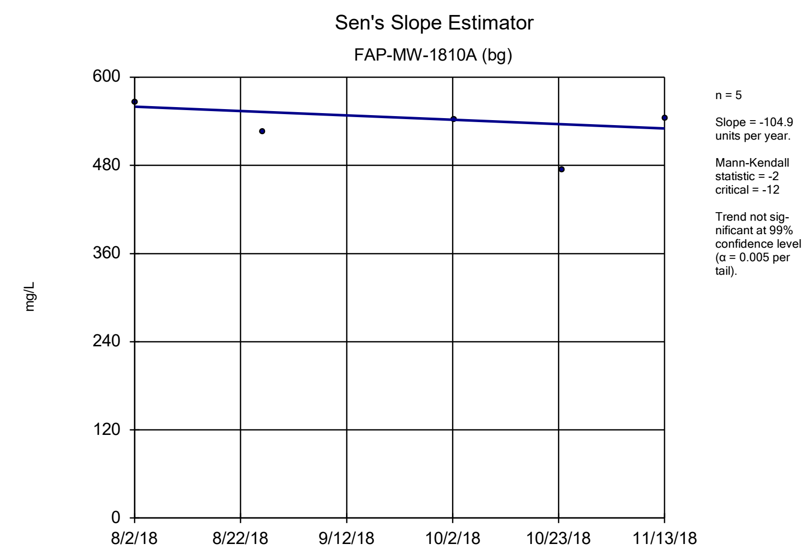
Constituent: Sulfate Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



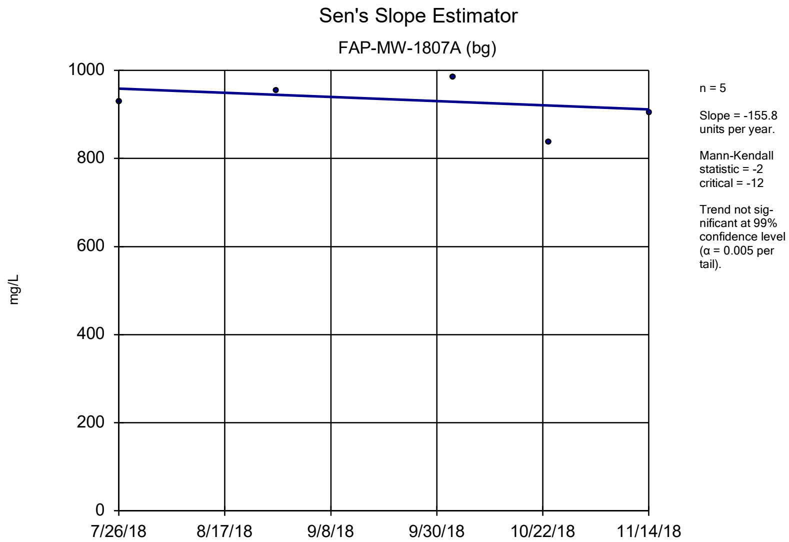
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



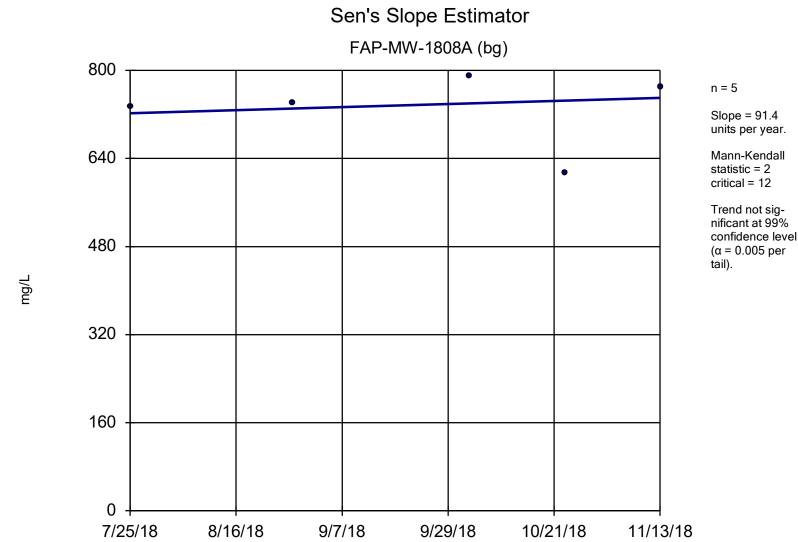
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



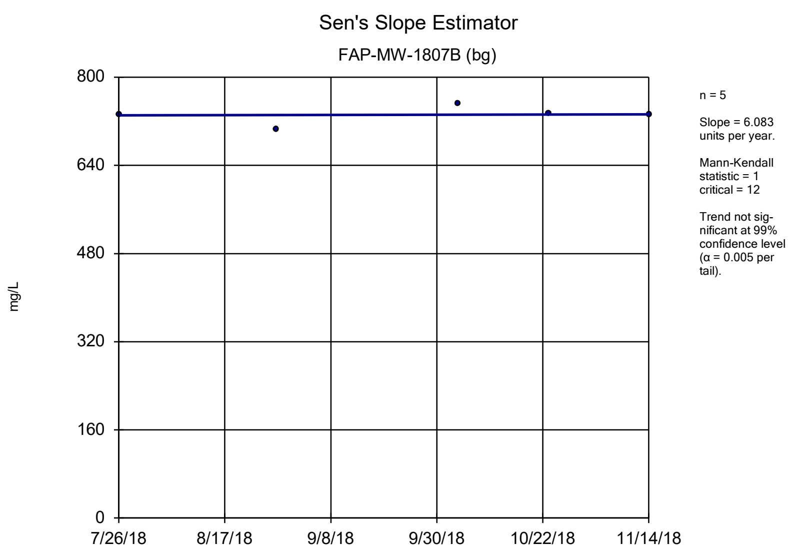
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



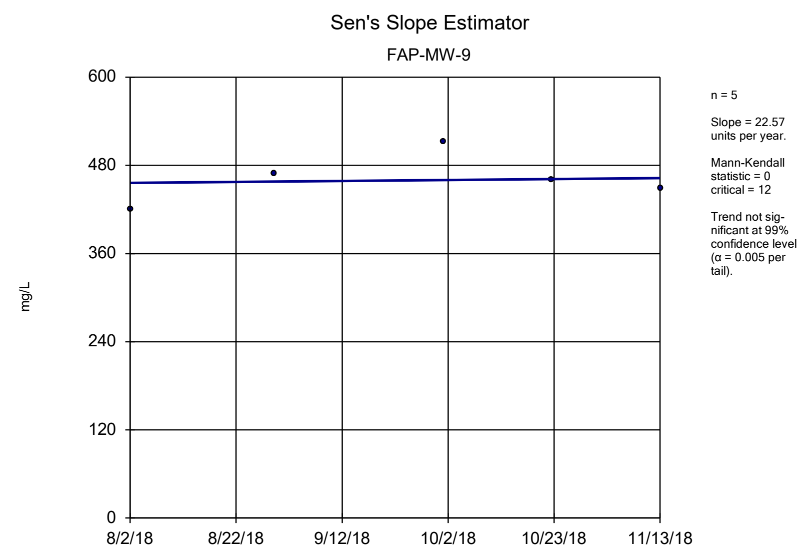
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



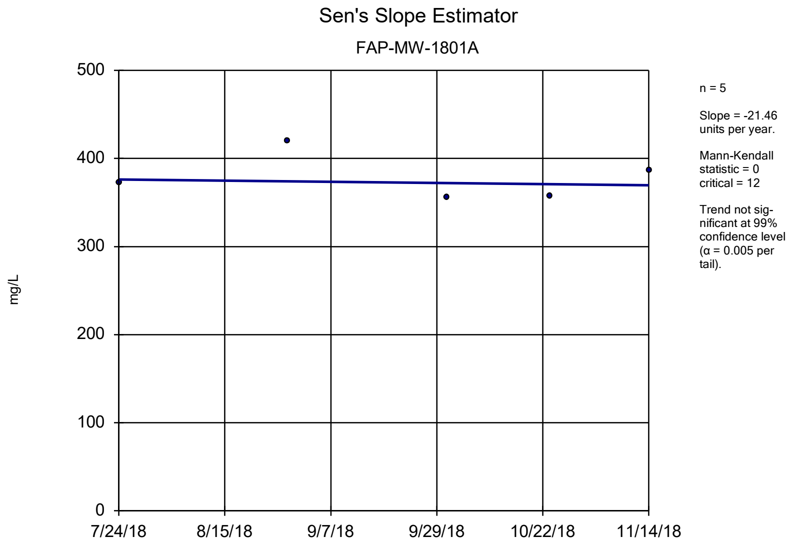
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



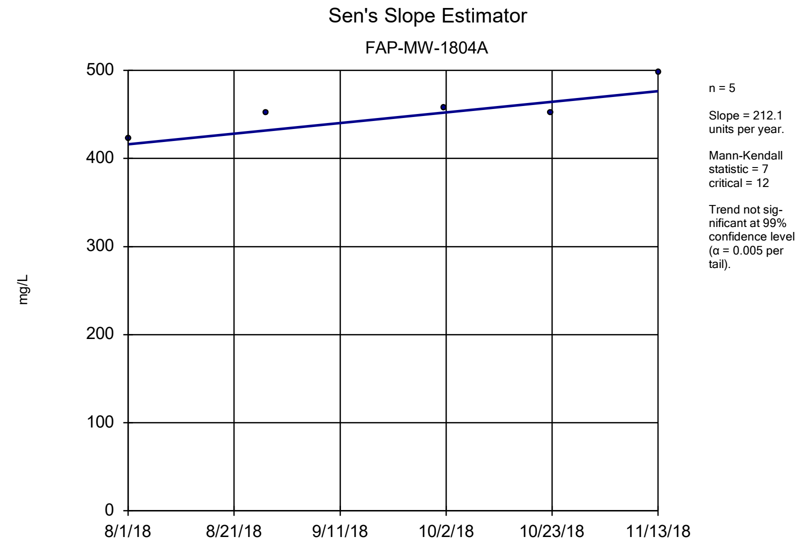
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



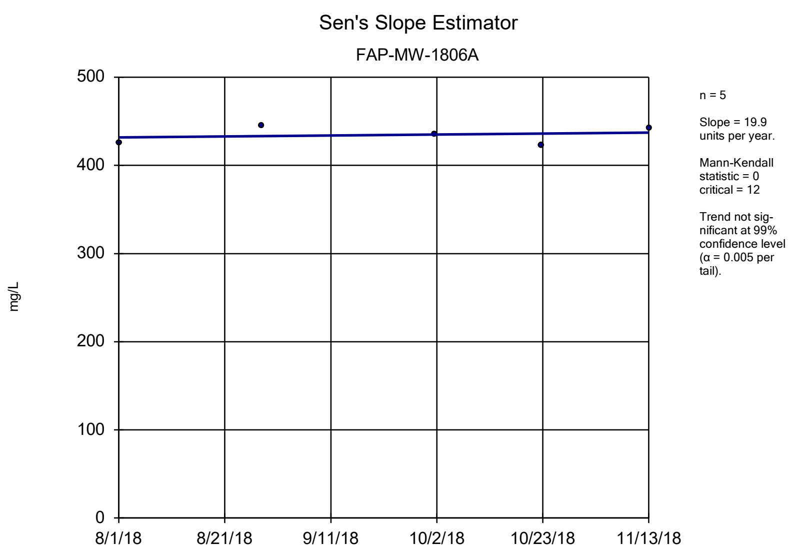
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



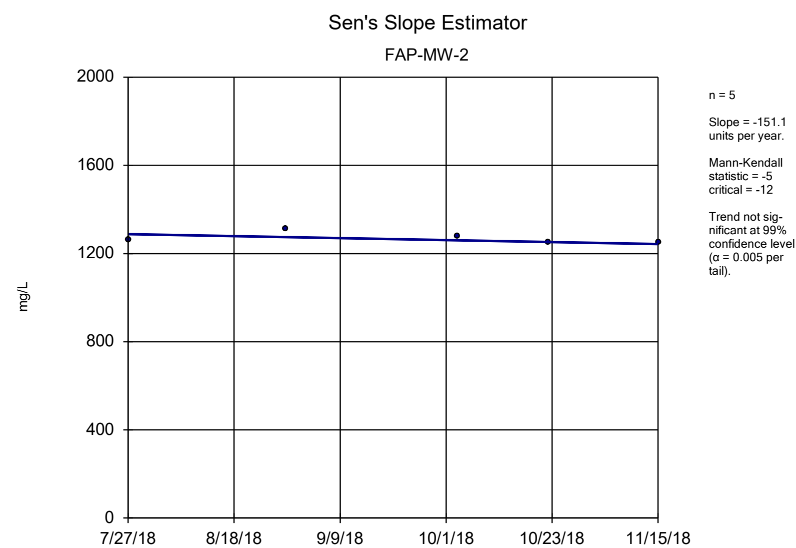
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA



Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

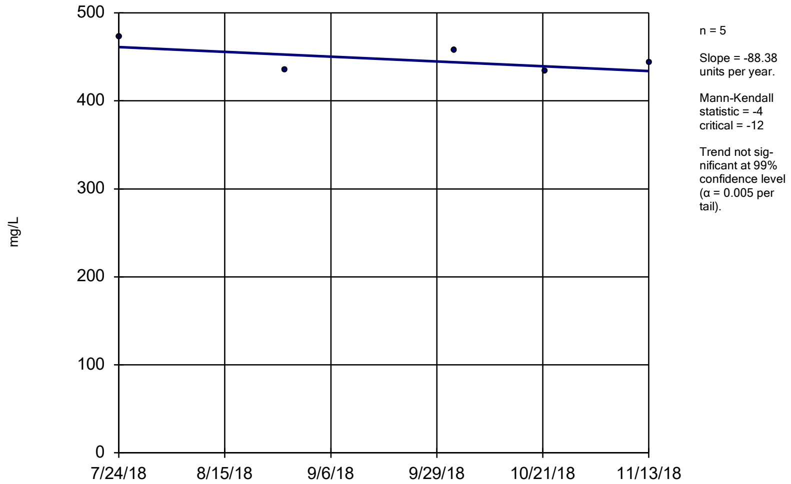


Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-1

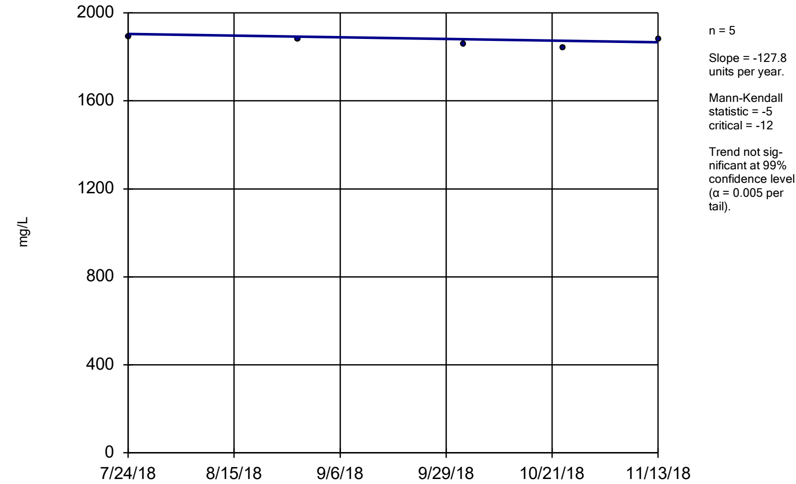


Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-5

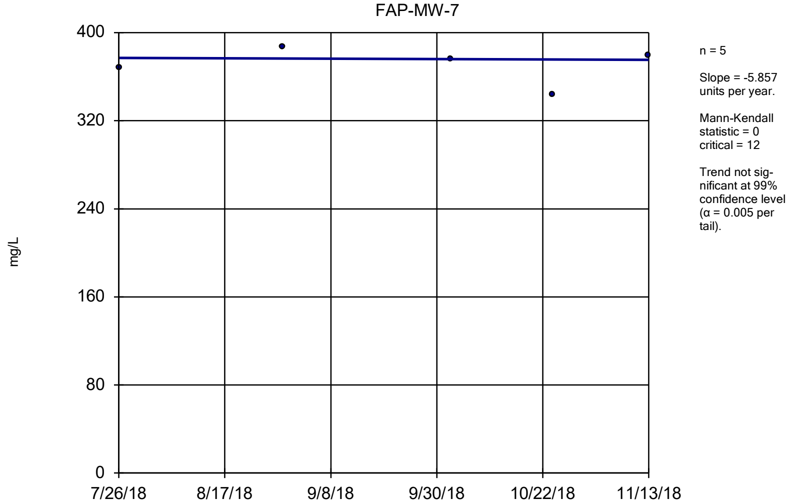


Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-7

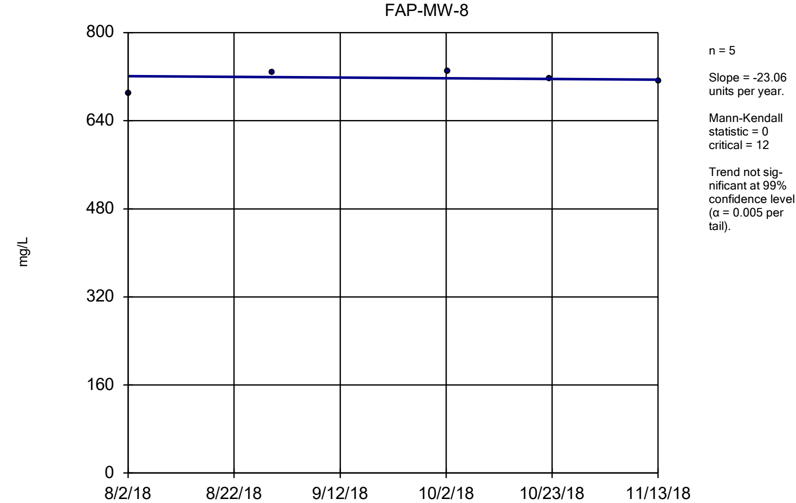


Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. EPA

Sen's Slope Estimator

FAP-MW-8



Constituent: Total Dissolved Solids Analysis Run 4/18/2019 8:48 AM View: Trend Testing
Amos FAP Client: Geosyntec Data: Amos FAP

FIGURE E: ANOVA

Analysis of Variance

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/22/2019, 7:51 PM

Constituent	Well	Calc.	Crit.	Sig.	Alpha	Transform	ANOVA Sig.	Alpha	Method
Boron (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.
Calcium (mg/L)	n/a	n/a	n/a	n/a	n/a	sqrt(x)	Yes	0.05	Param.
Chloride (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.
Fluoride (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (eq. var.)
pH (SU)	n/a	n/a	n/a	n/a	n/a	x^5	Yes	0.05	Param.
Sulfate (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	NP (eq. var.)
Total Dissolved Solids (mg/L)	n/a	n/a	n/a	n/a	n/a	No	Yes	0.05	Param.

Parametric ANOVA

Constituent: Boron Analysis Run 6/4/2019 8:03 PM
Amos FAP Client: Geosyntec Data: Amos FAP

For observations made between 7/25/2018 and 2/22/2019 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 25.55

Tabulated F statistic = 2.65 with 4 and 35 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	0.1109	4	0.02773	25.55
Error Within Groups	0.03799	35	0.001085	
Total	0.1489	39		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.01, calculated = 0.9729, critical = 0.919. Levene's Equality of Variance test passed. Calculated = 1.436, tabulated = 2.65.

Parametric ANOVA

Constituent: Calcium   Analysis Run 6/4/2019 8:04 PM

Amos FAP   Client: Geosyntec   Data: Amos FAP

For observations made between 7/25/2018 and 2/22/2019 the parametric analysis of variance test (after square root transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 2274

Tabulated F statistic = 2.65 with 4 and 35 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	667	4	166.8	2274
Error Within Groups	2.567	35	0.07333	
Total	669.6	39		

The Shapiro Wilk normality test on the residuals passed after square root transformation. Alpha = 0.01, calculated = 0.9792, critical = 0.919. Levene's Equality of Variance test passed. Calculated = 1.522, tabulated = 2.65.

Parametric ANOVA

Constituent: Chloride   Analysis Run 6/4/2019 8:04 PM
Amos FAP   Client: Geosyntec   Data: Amos FAP

For observations made between 7/25/2018 and 2/22/2019 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 158.5

Tabulated F statistic = 2.65 with 4 and 35 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1779	4	444.7	158.5
Error Within Groups	98.21	35	2.806	
Total	1877	39		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.01, calculated = 0.9779, critical = 0.919. Levene's Equality of Variance test passed. Calculated = 1.912, tabulated = 2.65.

Non-Parametric ANOVA

Constituent: Fluoride   Analysis Run 6/4/2019 8:05 PM

Amos FAP   Client: Geosyntec   Data: Amos FAP

For observations made between 7/25/2018 and 2/22/2019, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 34.59

Tabulated Chi-Squared value = 9.488 with 4 degrees of freedom at the 5% significance level.

There were 7 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 34.49
Adjusted Kruskal-Wallis statistic (H') = 34.59

Parametric ANOVA

Constituent: pH   Analysis Run 6/4/2019 8:05 PM

Amos FAP   Client: Geosyntec   Data: Amos FAP

For observations made between 7/25/2018 and 2/21/2019 the parametric analysis of variance test (after x^5 transformation) indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 7.243

Tabulated F statistic = 2.65 with 4 and 35 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	1.2e9	4	3.0e8	7.243
Error Within Groups	1.5e9	35	4.2e7	
Total	2.7e9	39		

The Shapiro Wilk normality test on the residuals passed after x^5 transformation. Alpha = 0.01, calculated = 0.935, critical = 0.919. Levene's Equality of Variance test passed. Calculated = 1.252, tabulated = 2.65.

Non-Parametric ANOVA

Constituent: Sulfate Analysis Run 6/4/2019 8:05 PM

Amos FAP Client: Geosyntec Data: Amos FAP

For observations made between 7/25/2018 and 2/22/2019, the non-parametric analysis of variance test indicates a DIFFERENCE between the medians of the groups tested at the 5% significance level. Because the calculated Kruskal-Wallis statistic is greater than the Chi-squared value, we conclude that at least one group has a significantly different median concentration of this constituent when compared to another group.

Calculated Kruskal-Wallis statistic = 34.55

Tabulated Chi-Squared value = 9.488 with 4 degrees of freedom at the 5% significance level.

There were 8 groups of ties in the data, consequently the Kruskal-Wallis statistic (H) was adjusted. The adjusted statistic (H') was utilized to determine if the medians were equal.
Kruskal-Wallis statistic (H) = 34.52
Adjusted Kruskal-Wallis statistic (H') = 34.55

Parametric ANOVA

Constituent: Total Dissolved Solids   Analysis Run 6/4/2019 8:06 PM

Amos FAP   Client: Geosyntec   Data: Amos FAP

For observations made between 7/25/2018 and 11/14/2018 the parametric analysis of variance test indicates VARIATION at the 5% significance level. Because the calculated F statistic is greater than the tabulated F statistic, the hypothesis of a single homogeneous population is rejected.

Calculated F statistic = 99.95

Tabulated F statistic = 2.87 with 4 and 20 degrees of freedom at the 5% significance level.

ONE-WAY PARAMETRIC ANOVA TABLE

Source of Variation	Sum of Squares	Degrees of Freedom	Mean Squares	F
Between Groups	778286	4	194571	99.95
Error Within Groups	38932	20	1947	
Total	817218	24		

The Shapiro Wilk normality test on the residuals passed on the raw data. Alpha = 0.01, calculated = 0.9046, critical = 0.888. Levene's Equality of Variance test passed. Calculated = 1.562, tabulated = 2.87.

FIGURE F: UPPER TOLERANCE LIMITS – APPENDIX III

UTL's - Appendix III

Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 9:02 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	n/a	0.3132	n/a	40	0.167	0.06179	0	None	No	0.01	Inter
Calcium (mg/L)	n/a	191	n/a	40	n/a	n/a	0	n/a	n/a	0.1285	NP Inter(normality)
Chloride (mg/L)	n/a	36.45	n/a	40	4.046	0.8422	0	None	sqrt(x)	0.01	Inter
Fluoride (mg/L)	n/a	1.16	n/a	40	n/a	n/a	0	n/a	n/a	0.1285	NP Inter(normality)
pH (SU)	n/a	8.787	5.625	40	54.42	8.509	0	None	x^2	0.01	Inter
Sulfate (mg/L)	n/a	403	n/a	40	n/a	n/a	0	n/a	n/a	0.1285	NP Inter(normality)
Total Dissolved Solids (mg/L)	n/a	1277	n/a	25	790.9	184.5	0	None	No	0.01	Inter

FIGURE G: CONFIDENCE INTERVALS – APPENDIX III

Confidence Interval Summary Table - Significant Results

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 9:10 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Boron (mg/L)	**FAP-MW-1804A**	**0.7944**	**0.6199**	**0.31**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Chloride (mg/L)	**FAP-MW-2**	**462.9**	**430.6**	**36.45**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Chloride (mg/L)	**FAP-MW-5**	**813.7**	**773.9**	**36.45**	**n/a**	**Yes**	**8**	**0**	**ln(x)**	**0.01**	**Param.**
Chloride (mg/L)	**FAP-MW-8**	**113.1**	**106.4**	**36.45**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Fluoride (mg/L)	**FAP-MW-2**	**3.3**	**2.99**	**1.16**	**n/a**	**Yes**	**8**	**0**	**No**	**0.004**	**NP (normality)**
Fluoride (mg/L)	**FAP-MW-5**	**3.63**	**3.32**	**1.16**	**n/a**	**Yes**	**8**	**0**	**No**	**0.004**	**NP (normality)**
Fluoride (mg/L)	**FAP-MW-8**	**2.863**	**2.607**	**1.16**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Total Dissolved Solids (mg/L)	**FAP-MW-5**	**1904**	**1836**	**1277**	**n/a**	**Yes**	**5**	**0**	**No**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 9:10 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Boron (mg/L)	FAP-MW-9	0.157	0.1213	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	FAP-MW-1801A	0.2866	0.1101	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	**FAP-MW-1804A**	**0.7944**	**0.6199**	**0.31**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Boron (mg/L)	FAP-MW-1806A	0.1873	0.1406	0.31	n/a	No	8	0	sqrt(x)	0.01	Param.
Boron (mg/L)	FAP-MW-2	0.3058	0.2277	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	FAP-MW-1	0.1875	0.113	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	FAP-MW-5	0.2909	0.2251	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	FAP-MW-7	0.1601	0.07085	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	FAP-MW-8	0.2637	0.2065	0.31	n/a	No	8	0	No	0.01	Param.
Boron (mg/L)	FAP-MW-6	0.1192	0.07875	0.31	n/a	No	8	0	No	0.01	Param.
Calcium (mg/L)	FAP-MW-9	1.44	1.01	191	n/a	No	8	0	No	0.004	NP (normality)
Calcium (mg/L)	FAP-MW-1801A	64.96	56.36	191	n/a	No	8	0	x^6	0.01	Param.
Calcium (mg/L)	FAP-MW-1804A	27.31	6.983	191	n/a	No	8	0	sqrt(x)	0.01	Param.
Calcium (mg/L)	FAP-MW-1806A	12.02	5.34	191	n/a	No	8	0	x^(1/3)	0.01	Param.
Calcium (mg/L)	FAP-MW-2	4.22	3.775	191	n/a	No	8	0	No	0.01	Param.
Calcium (mg/L)	FAP-MW-1	2.974	2.359	191	n/a	No	8	0	No	0.01	Param.
Calcium (mg/L)	FAP-MW-5	7.071	6.334	191	n/a	No	8	0	No	0.01	Param.
Calcium (mg/L)	FAP-MW-7	1.458	1.285	191	n/a	No	8	0	No	0.01	Param.
Calcium (mg/L)	FAP-MW-8	2.593	2.112	191	n/a	No	8	0	No	0.01	Param.
Calcium (mg/L)	FAP-MW-6	63.04	55.33	191	n/a	No	8	0	No	0.01	Param.
Chloride (mg/L)	FAP-MW-9	7.575	7.135	36.45	n/a	No	8	0	No	0.01	Param.
Chloride (mg/L)	FAP-MW-1801A	10.23	8.059	36.45	n/a	No	8	0	No	0.01	Param.
Chloride (mg/L)	FAP-MW-1804A	5.143	3.312	36.45	n/a	No	8	0	No	0.01	Param.
Chloride (mg/L)	FAP-MW-1806A	15.04	5.234	36.45	n/a	No	8	0	No	0.01	Param.
Chloride (mg/L)	**FAP-MW-2**	**462.9**	**430.6**	**36.45**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Chloride (mg/L)	FAP-MW-1	14.6	10.7	36.45	n/a	No	8	0	No	0.004	NP (normality)
Chloride (mg/L)	**FAP-MW-5**	**813.7**	**773.9**	**36.45**	**n/a**	**Yes**	**8**	**0**	**ln(x)**	**0.01**	**Param.**
Chloride (mg/L)	FAP-MW-7	5.507	5.203	36.45	n/a	No	8	0	No	0.01	Param.
Chloride (mg/L)	**FAP-MW-8**	**113.1**	**106.4**	**36.45**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Chloride (mg/L)	FAP-MW-6	19.54	17.61	36.45	n/a	No	8	0	No	0.01	Param.
Fluoride (mg/L)	FAP-MW-9	0.8917	0.8058	1.16	n/a	No	8	0	No	0.01	Param.
Fluoride (mg/L)	FAP-MW-1801A	0.14	0.1	1.16	n/a	No	8	0	No	0.004	NP (normality)
Fluoride (mg/L)	FAP-MW-1804A	0.8856	0.6694	1.16	n/a	No	8	0	No	0.01	Param.
Fluoride (mg/L)	FAP-MW-1806A	0.8433	0.5905	1.16	n/a	No	8	0	x^6	0.01	Param.
Fluoride (mg/L)	**FAP-MW-2**	**3.3**	**2.99**	**1.16**	**n/a**	**Yes**	**8**	**0**	**No**	**0.004**	**NP (normality)**
Fluoride (mg/L)	FAP-MW-1	0.4469	0.4081	1.16	n/a	No	8	0	No	0.01	Param.
Fluoride (mg/L)	**FAP-MW-5**	**3.63**	**3.32**	**1.16**	**n/a**	**Yes**	**8**	**0**	**No**	**0.004**	**NP (normality)**
Fluoride (mg/L)	FAP-MW-7	0.2798	0.2552	1.16	n/a	No	8	0	No	0.01	Param.
Fluoride (mg/L)	**FAP-MW-8**	**2.863**	**2.607**	**1.16**	**n/a**	**Yes**	**8**	**0**	**No**	**0.01**	**Param.**
Fluoride (mg/L)	FAP-MW-6	0.2407	0.2168	1.16	n/a	No	8	0	No	0.01	Param.
pH (SU)	FAP-MW-9	9.765	7.683	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-1801A	7.901	6.772	8.79	5.63	No	8	0	x^2	0.005	Param.
pH (SU)	FAP-MW-1804A	8.179	7.401	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-1806A	8.639	7.799	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-2	8.668	8.302	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-1	8.46	8.05	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-5	8.191	7.972	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-7	8.905	8.403	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-8	8.941	7.869	8.79	5.63	No	8	0	No	0.005	Param.
pH (SU)	FAP-MW-6	6.986	6.624	8.79	5.63	No	8	0	No	0.005	Param.
Sulfate (mg/L)	FAP-MW-9	28.5	11.9	403	n/a	No	8	0	No	0.004	NP (normality)
Sulfate (mg/L)	FAP-MW-1801A	51.63	41.82	403	n/a	No	8	0	No	0.01	Param.
Sulfate (mg/L)	FAP-MW-1804A	43.43	32.75	403	n/a	No	8	0	No	0.01	Param.
Sulfate (mg/L)	FAP-MW-1806A	47.48	33.3	403	n/a	No	8	0	No	0.01	Param.
Sulfate (mg/L)	FAP-MW-2	14.88	2.766	403	n/a	No	8	0	No	0.01	Param.

Confidence Interval Summary Table - All Results

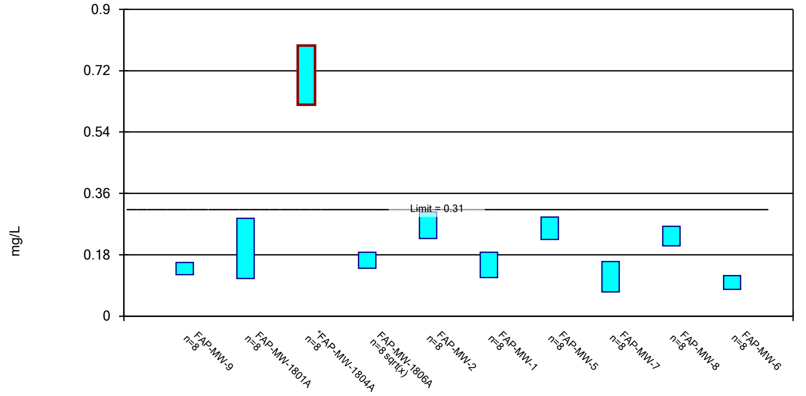
Amos FAP Client: Geosyntec Data: Amos FAP Printed 4/18/2019, 9:10 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Sulfate (mg/L)	FAP-MW-1	55.9	30.6	403	n/a	No	8	0	No	0.004	NP (normality)
Sulfate (mg/L)	FAP-MW-5	0.2	0.1	403	n/a	No	8	50	No	0.004	NP (normality)
Sulfate (mg/L)	FAP-MW-7	33.2	31.5	403	n/a	No	8	0	No	0.004	NP (normality)
Sulfate (mg/L)	FAP-MW-8	30.04	23.41	403	n/a	No	8	0	No	0.01	Param.
Sulfate (mg/L)	FAP-MW-6	44.56	41.04	403	n/a	No	8	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-9	518.3	406.1	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-1801A	422.4	334	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-1804A	501.6	411.6	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-1806A	450.3	418.1	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-2	1313	1227	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-1	476.2	421	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	**FAP-MW-5**	**1904**	**1836**	**1277**	**n/a**	**Yes**	**5**	**0**	**No**	**0.01**	**Param.**
Total Dissolved Solids (mg/L)	FAP-MW-7	398.4	343.2	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-8	741.1	688.5	1277	n/a	No	5	0	No	0.01	Param.
Total Dissolved Solids (mg/L)	FAP-MW-6	405.1	387.7	1277	n/a	No	5	0	No	0.01	Param.

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

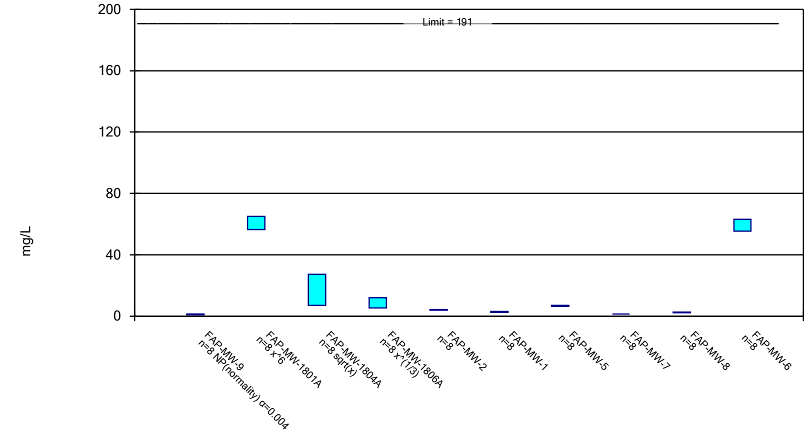


Constituent: Boron Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendix III
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

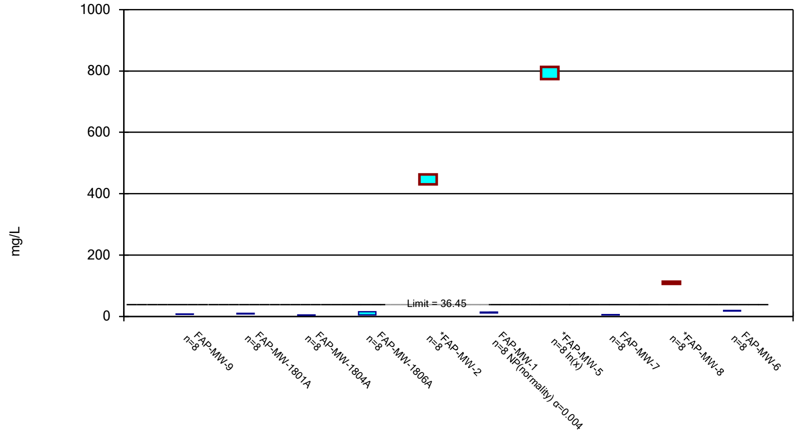


Constituent: Calcium Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendix III
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

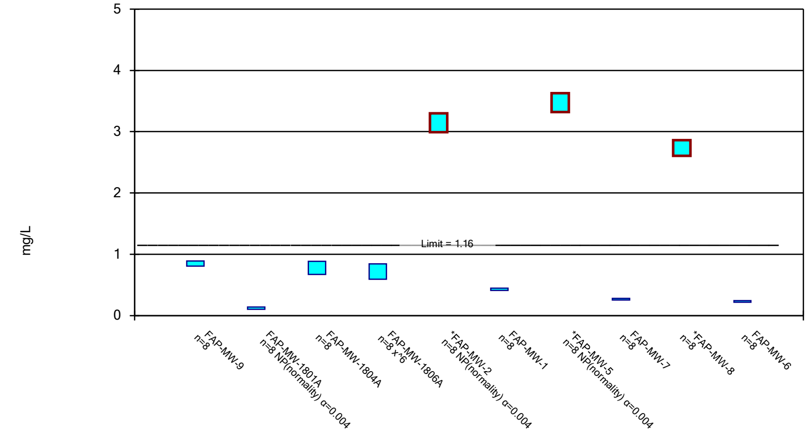


Constituent: Chloride Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendix III
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

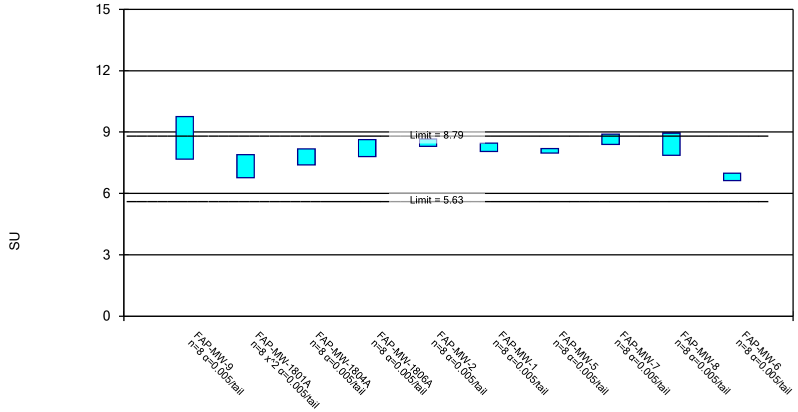


Constituent: Fluoride Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendix III
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Normality Test: Shapiro Wilk, alpha based on n.

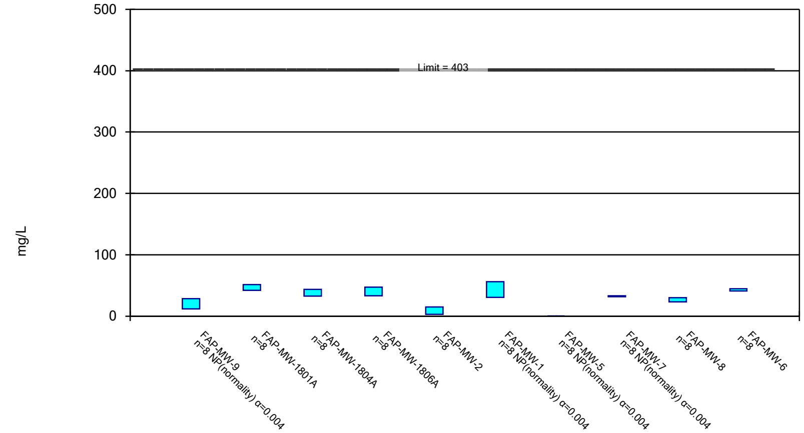


Constituent: pH Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendix III
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.

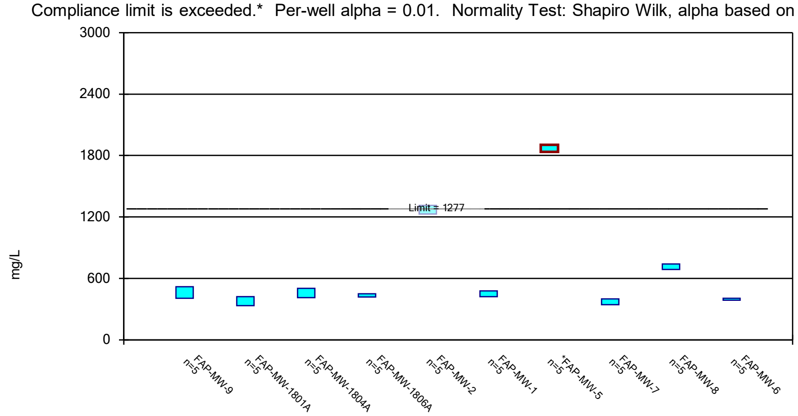


Constituent: Sulfate Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendix III
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:07 AM View: Confidence Intervals - Appendi
Amos FAP Client: Geosyntec Data: Amos FAP

FIGURE H: INTRAWELL PREDICTION LIMITS

Intrawell Prediction Limit Summary

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 9:22 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	FAP-MW-1809A	0.1335	n/a	8	0.08625	0.01507	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1810A	0.3585	n/a	8	0.2449	0.03627	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1807A	0.2929	n/a	8	0.1601	0.04237	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1808A	0.2337	n/a	8	0.1476	0.02746	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1807B	0.3107	n/a	8	0.1963	0.03653	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-9	0.1919	n/a	8	0.1391	0.01684	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1801A	0.4593	n/a	8	0.1984	0.08327	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1804A	0.965	n/a	8	0.7071	0.08232	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1806A	0.235	n/a	8	0.1638	0.02273	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-2	0.3823	n/a	8	0.2668	0.03688	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-1	0.2605	n/a	8	0.1503	0.03518	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-5	0.3553	n/a	8	0.258	0.03107	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-7	0.2475	n/a	8	0.1155	0.04212	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-8	0.3196	n/a	8	0.2351	0.02698	0	None	No	0.0007523	Param Intra 1 of 2
Boron (mg/L)	FAP-MW-6	0.1588	n/a	8	0.099	0.0191	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1809A	201.4	n/a	8	183.3	5.8	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1810A	37.93	n/a	8	27.25	3.41	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1807A	178.6	n/a	8	150.5	8.976	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1808A	49.91	n/a	8	6.383	0.2174	0	None	sqrt(x)	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1807B	13.12	n/a	8	9.51	1.152	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-9	1.629	n/a	8	1.14	0.156	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1801A	75.41	n/a	8	60.69	4.698	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1804A	51.2	n/a	8	16.78	10.99	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1806A	18.76	n/a	8	8.583	3.249	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-2	4.656	n/a	8	3.998	0.2101	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-1	3.575	n/a	8	2.666	0.29	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-5	7.792	n/a	8	6.703	0.3478	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-7	1.627	n/a	8	1.371	0.08167	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-8	3.064	n/a	8	2.353	0.227	0	None	No	0.0007523	Param Intra 1 of 2
Calcium (mg/L)	FAP-MW-6	70.59	n/a	8	59.19	3.638	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1809A	32.03	n/a	8	27.84	1.338	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1810A	27.27	n/a	8	18.85	2.689	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1807A	14.41	n/a	8	10.96	1.101	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1808A	23.59	n/a	8	18.56	1.606	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1807B	12.55	n/a	8	9.093	1.103	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-9	8.004	n/a	8	7.355	0.2072	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1801A	12.35	n/a	8	9.143	1.022	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1804A	6.934	n/a	8	4.228	0.8638	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1806A	24.64	n/a	8	10.14	4.628	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-2	494.5	n/a	8	446.8	15.24	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-1	14.6	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Chloride (mg/L)	FAP-MW-5	853.2	n/a	8	793.8	18.97	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-7	5.803	n/a	8	5.355	0.143	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-8	119.8	n/a	8	109.8	3.196	0	None	No	0.0007523	Param Intra 1 of 2
Chloride (mg/L)	FAP-MW-6	21.44	n/a	8	18.58	0.913	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1809A	0.1874	n/a	8	0.15	0.01195	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1810A	1.138	n/a	8	0.9425	0.06228	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1807A	0.2754	n/a	8	0.1838	0.02925	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1808A	0.6948	n/a	8	0.4788	0.06896	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1807B	1.453	n/a	8	0.9525	0.1599	0	None	No	0.0007523	Param Intra 1 of 2

Intrawell Prediction Limit Summary

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 9:22 AM

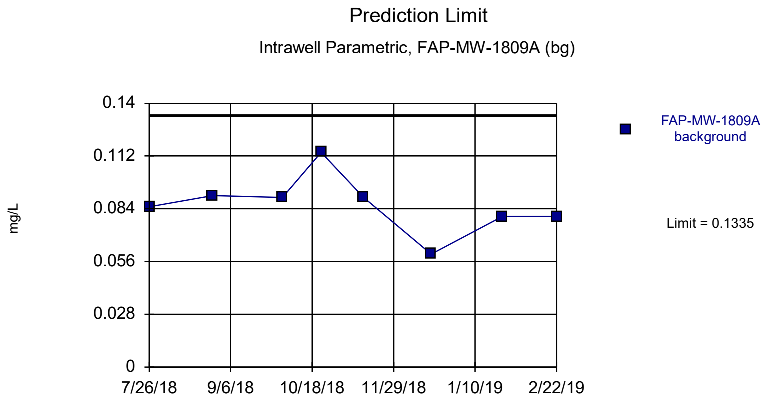
Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Fluoride (mg/L)	FAP-MW-9	0.9757	n/a	8	0.8488	0.04051	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1801A	0.162	n/a	8	0.1125	0.01581	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1804A	1.097	n/a	8	0.7775	0.1019	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1806A	1.136	n/a	8	0.7225	0.1321	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-2	3.392	n/a	8	1.12	0.03235	0	None	ln(x)	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-1	0.4849	n/a	8	0.4275	0.01832	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-5	3.724	n/a	8	3.403	0.1025	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-7	0.304	n/a	8	0.2675	0.01165	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-8	3.114	n/a	8	2.735	0.1209	0	None	No	0.0007523	Param Intra 1 of 2
Fluoride (mg/L)	FAP-MW-6	0.264	n/a	8	0.2288	0.01126	0	None	No	0.0007523	Param Intra 1 of 2
pH (SU)	FAP-MW-1809A	7.22	5.12	8	n/a	n/a	0	n/a	n/a	0.04288	NP Intra (normality) 1 of 2
pH (SU)	FAP-MW-1810A	7.994	6.786	8	7.39	0.1929	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1807A	8.742	5.62	8	7.181	0.4982	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1808A	8.476	5.309	8	2978	697.1	0	None	x^4	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1807B	9.479	6.456	8	7.968	0.4824	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-9	11.36	6.088	8	8.724	0.8413	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1801A	8.82	5.87	8	7.345	0.4707	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1804A	8.776	6.804	8	7.79	0.3147	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1806A	9.283	7.155	8	8.219	0.3396	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-2	8.948	8.022	8	8.485	0.1476	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-1	8.774	7.736	8	8.255	0.1656	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-5	8.358	7.804	8	8.081	0.08839	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-7	9.29	8.018	8	8.654	0.203	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-8	9.762	7.048	8	8.405	0.4332	0	None	No	0.0003761	Param Intra 1 of 2
pH (SU)	FAP-MW-6	7.263	6.347	8	6.805	0.1462	0	None	No	0.0003761	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1809A	414.9	n/a	8	391.3	7.536	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1810A	233	n/a	8	138.5	30.15	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1807A	438.7	n/a	8	345.4	29.79	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1808A	321	n/a	8	206.1	36.67	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1807B	247.9	n/a	8	225.1	7.259	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-9	36.17	n/a	8	3.931	0.6651	0	None	sqrt(x)	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1801A	61.24	n/a	8	46.73	4.631	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1804A	53.87	n/a	8	38.09	5.039	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1806A	61.35	n/a	8	40.39	6.689	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-2	26.73	n/a	8	8.825	5.716	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-1	55.9	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Sulfate (mg/L)	FAP-MW-5	0.2	n/a	8	n/a	n/a	50	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Sulfate (mg/L)	FAP-MW-7	33.63	n/a	8	32.04	0.5097	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-8	36.52	n/a	8	26.73	3.126	0	None	No	0.0007523	Param Intra 1 of 2
Sulfate (mg/L)	FAP-MW-6	48	n/a	8	42.8	1.659	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1809A	1157	n/a	5	1042	21.68	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1810A	714.5	n/a	5	529.8	34.78	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1807A	1217	n/a	5	921.8	55.59	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1808A	1093	n/a	5	729.6	68.5	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1807B	818.8	n/a	5	731.4	16.46	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-9	640.2	n/a	5	462.2	33.51	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1801A	518.4	n/a	5	378.2	26.4	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1804A	599.3	n/a	5	456.6	26.87	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-1806A	485.3	n/a	5	434.2	9.628	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-2	1405	n/a	5	1270	25.5	0	None	No	0.0007523	Param Intra 1 of 2

Intrawell Prediction Limit Summary

Amos FAP   Client: Geosyntec   Data: Amos FAP   Printed 4/18/2019, 9:22 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Total Dissolved Solids (mg/L)	FAP-MW-1	536.1	n/a	5	448.6	16.47	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-5	1976	n/a	5	1870	20	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-7	458.2	n/a	5	370.8	16.45	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-8	798.1	n/a	5	714.8	15.69	0	None	No	0.0007523	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	FAP-MW-6	423.9	n/a	5	396.4	5.177	0	None	No	0.0007523	Param Intra 1 of 2

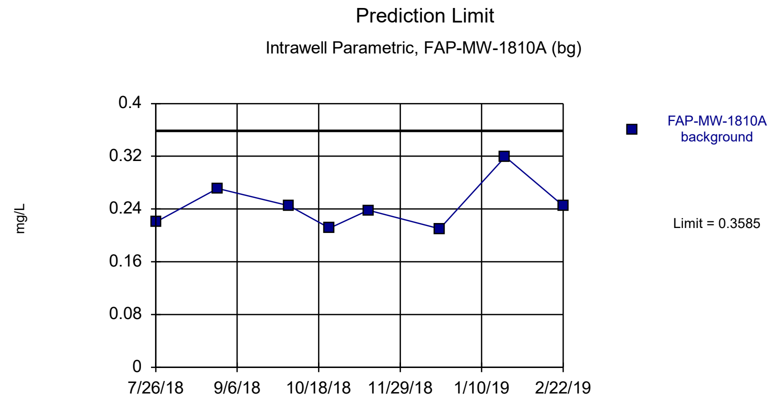
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=0.08625, Std. Dev.=0.01507, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9173, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:15 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

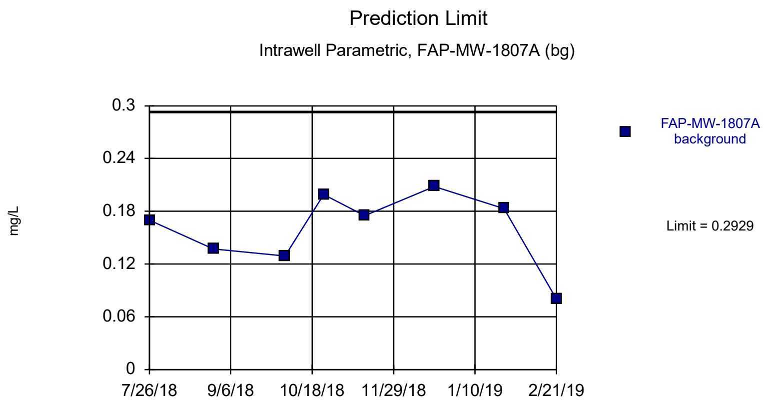
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=0.2449, Std. Dev.=0.03627, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8739, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:15 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

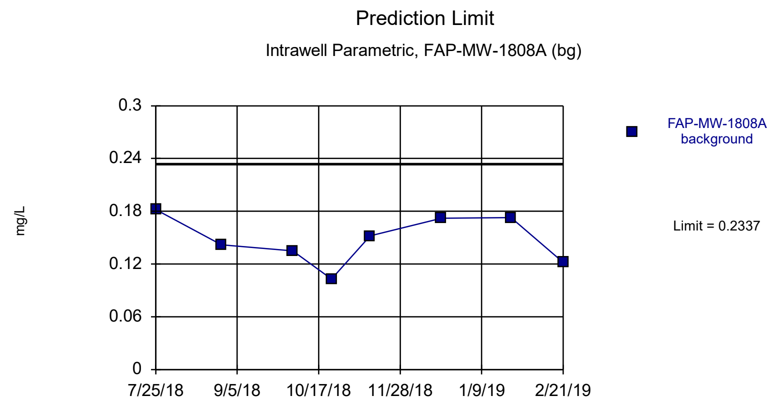
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=0.1601, Std. Dev.=0.04237, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9265, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:15 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



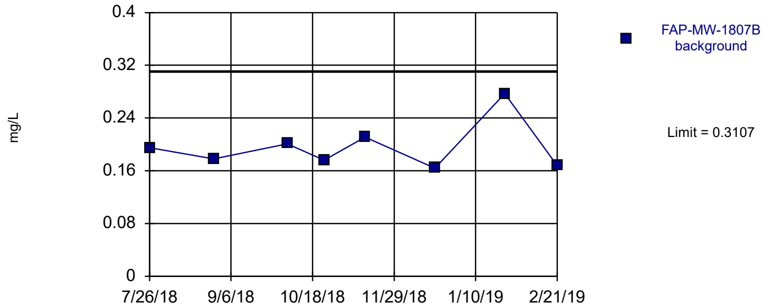
Background Data Summary: Mean=0.1476, Std. Dev.=0.02746, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.954, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:15 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)



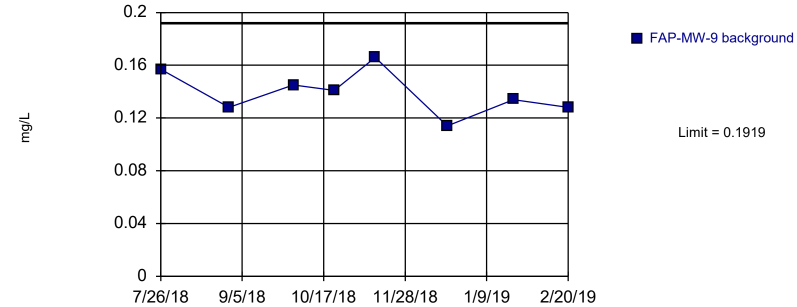
Background Data Summary: Mean=0.1963, Std. Dev.=0.03653, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8158, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-9



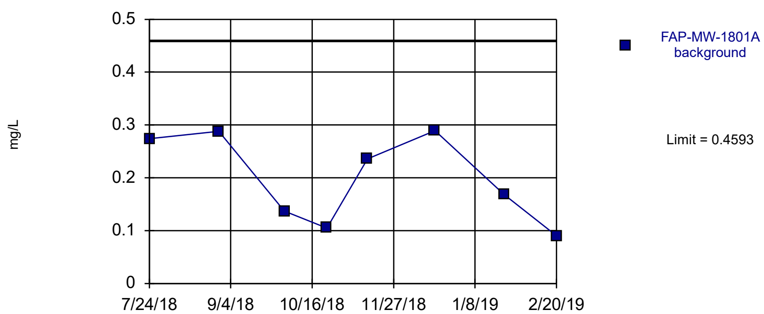
Background Data Summary: Mean=0.1391, Std. Dev.=0.01684, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9755, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1801A



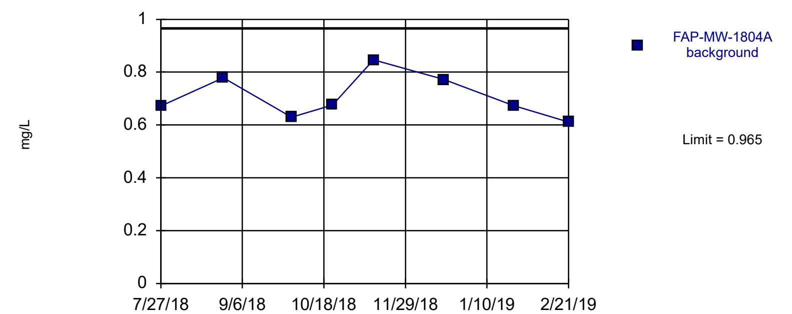
Background Data Summary: Mean=0.1984, Std. Dev.=0.08327, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8746, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1804A



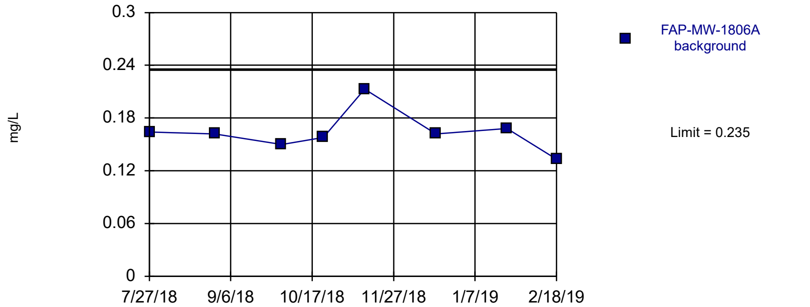
Background Data Summary: Mean=0.7071, Std. Dev.=0.08232, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9053, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



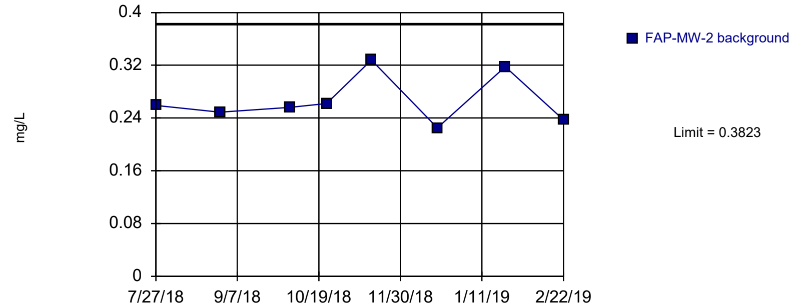
Background Data Summary: Mean=0.1638, Std. Dev.=0.02273, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.841, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-2



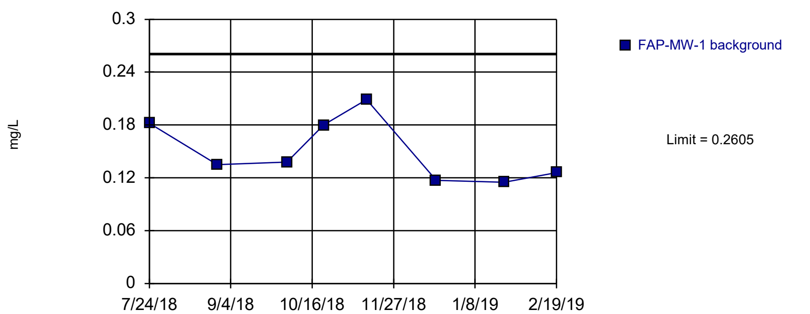
Background Data Summary: Mean=0.2668, Std. Dev.=0.03688, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8584, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1



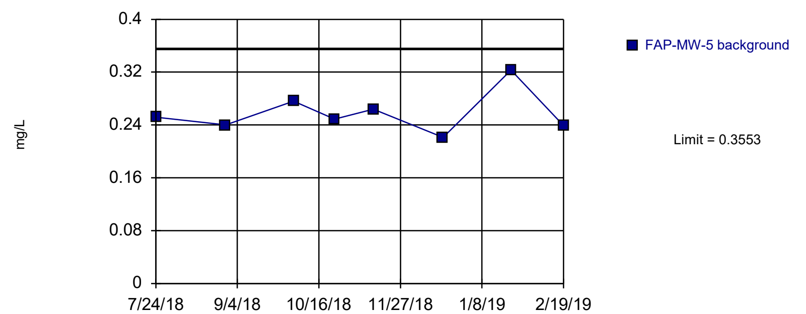
Background Data Summary: Mean=0.1503, Std. Dev.=0.03518, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8744, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-5



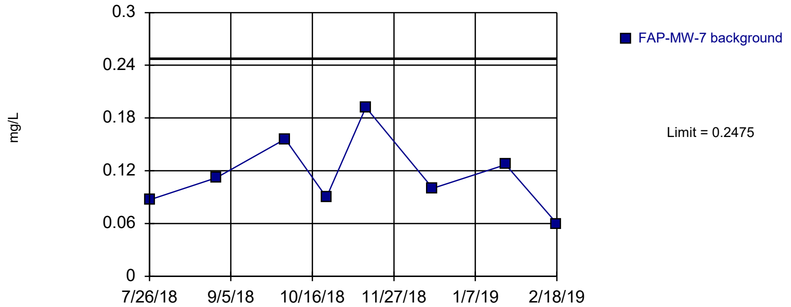
Background Data Summary: Mean=0.258, Std. Dev.=0.03107, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8957, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-7



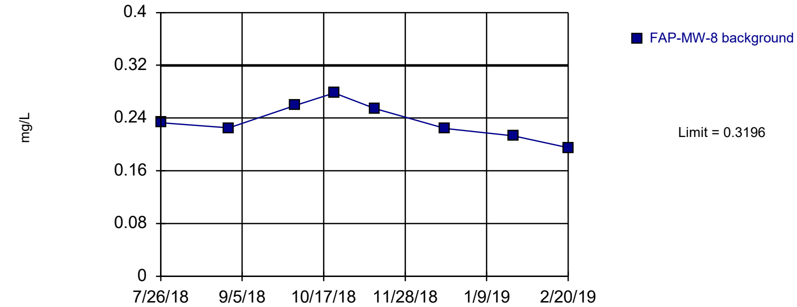
Background Data Summary: Mean=0.1155, Std. Dev.=0.04212, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9538, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-8



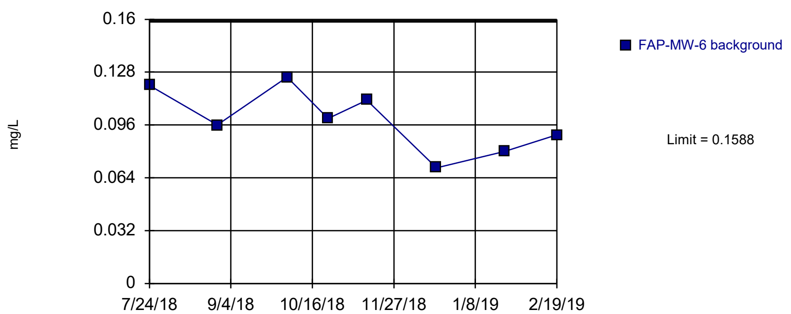
Background Data Summary: Mean=0.2351, Std. Dev.=0.02698, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9745, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-6



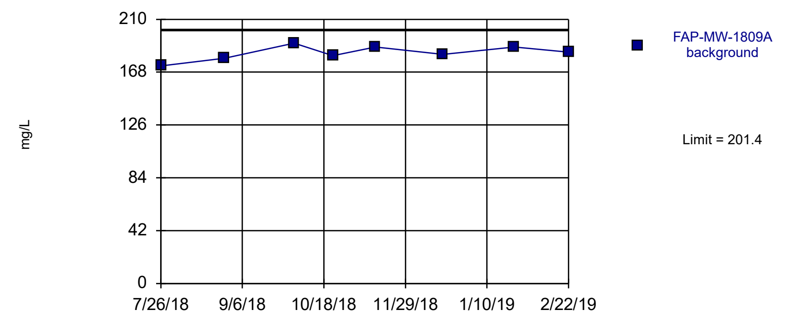
Background Data Summary: Mean=0.099, Std. Dev.=0.0191, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9721, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Boron Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1809A (bg)



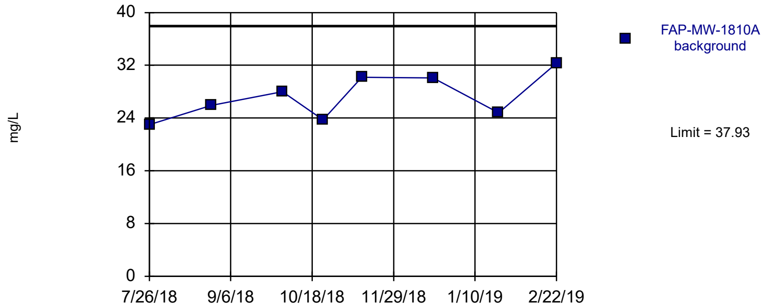
Background Data Summary: Mean=183.3, Std. Dev.=5.8, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9648, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1810A (bg)



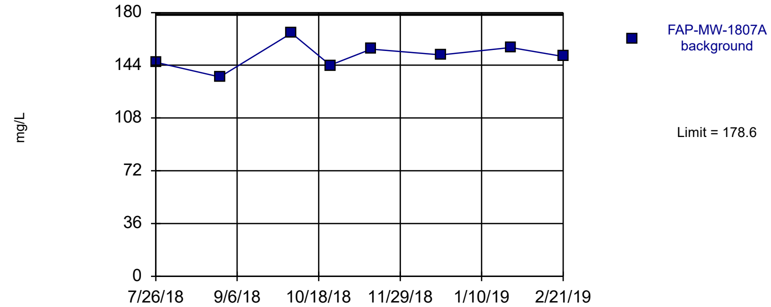
Background Data Summary: Mean=27.25, Std. Dev.=3.41, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9358, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807A (bg)



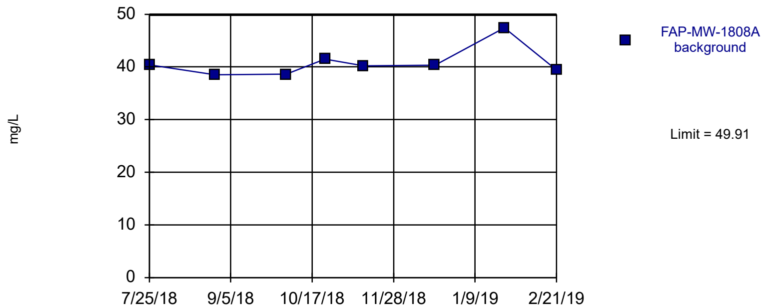
Background Data Summary: Mean=150.5, Std. Dev.=8.976, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9856, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1808A (bg)



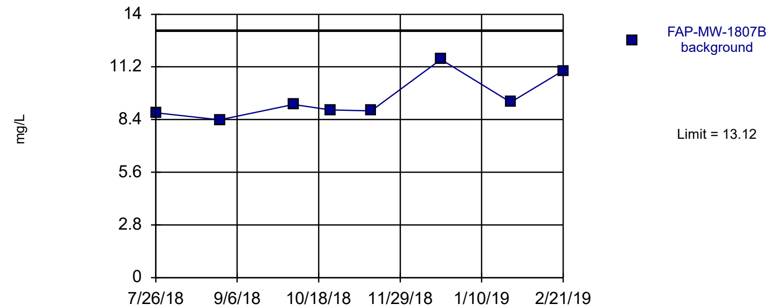
Background Data Summary (based on square root transformation): Mean=6.383, Std. Dev.=0.2174, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7501, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)

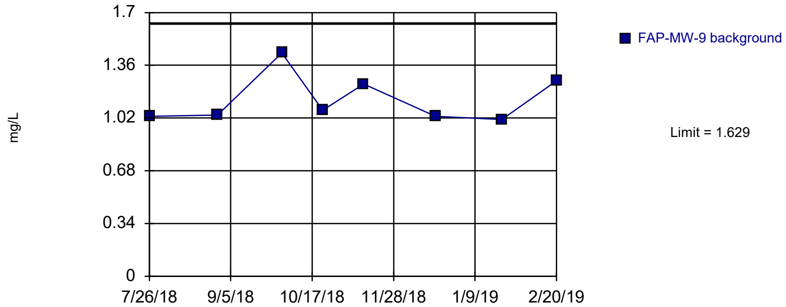


Background Data Summary: Mean=9.51, Std. Dev.=1.152, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8132, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-9

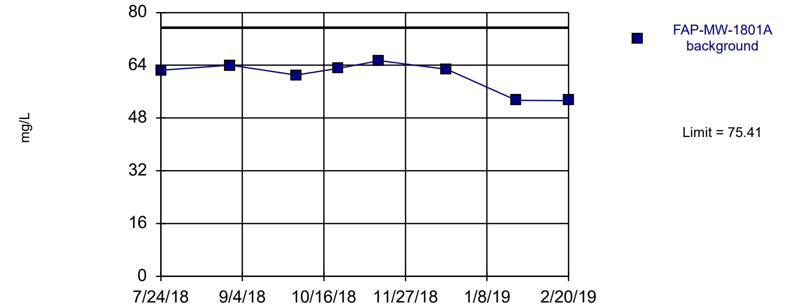


Background Data Summary: Mean=1.14, Std. Dev.=0.156, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.809, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1801A

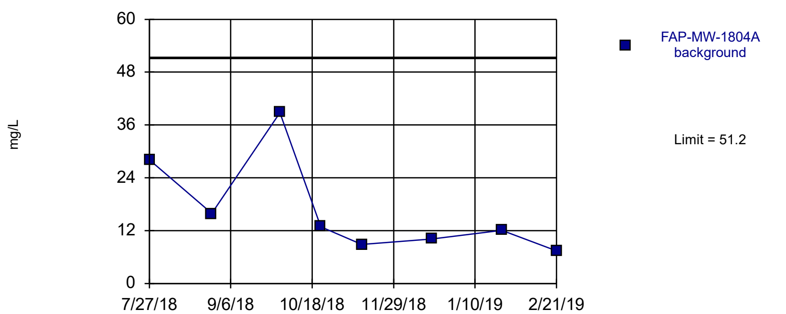


Background Data Summary: Mean=60.69, Std. Dev.=4.698, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7915, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1804A

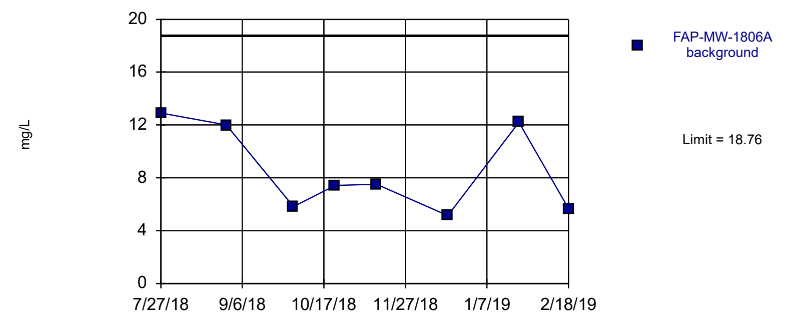


Background Data Summary: Mean=16.78, Std. Dev.=10.99, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8072, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



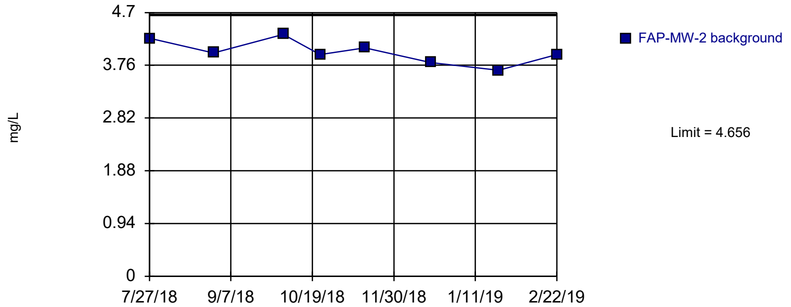
Background Data Summary: Mean=8.583, Std. Dev.=3.249, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8329, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-2



Background Data Summary: Mean=3.998, Std. Dev.=0.2101, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9649, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

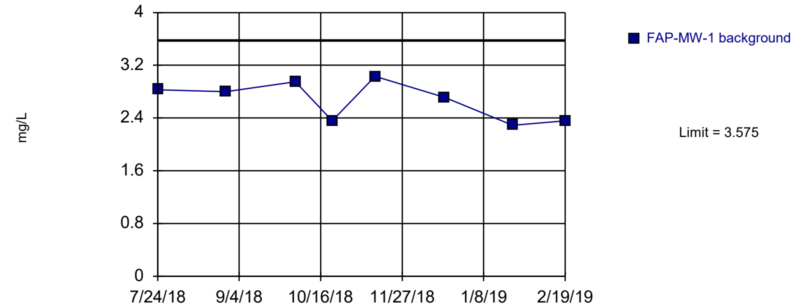
Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1



Background Data Summary: Mean=2.666, Std. Dev.=0.29, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8844, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

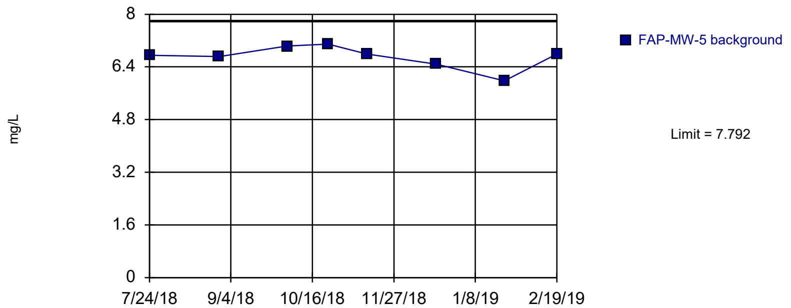
Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-5



Background Data Summary: Mean=6.703, Std. Dev.=0.3478, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8777, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

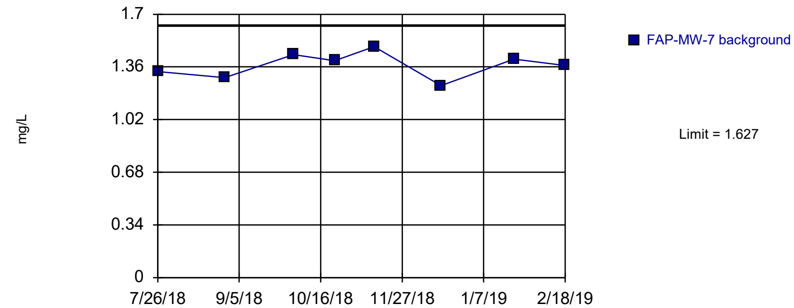
Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-7



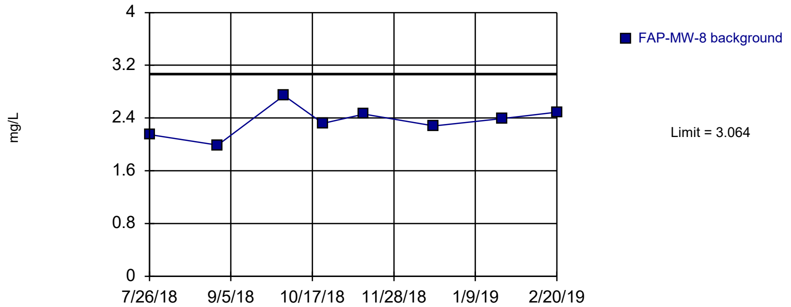
Background Data Summary: Mean=1.371, Std. Dev.=0.08167, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9845, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-8

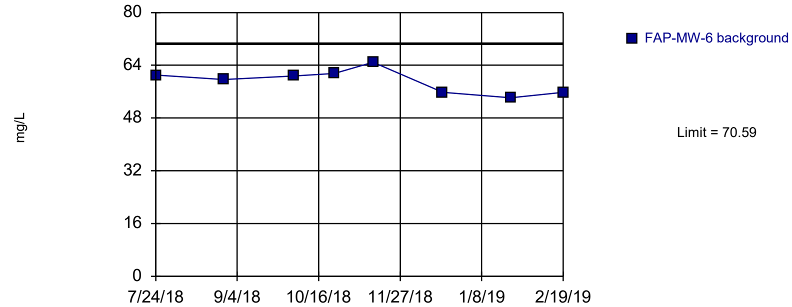


Background Data Summary: Mean=2.353, Std. Dev.=0.227, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9872, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-6

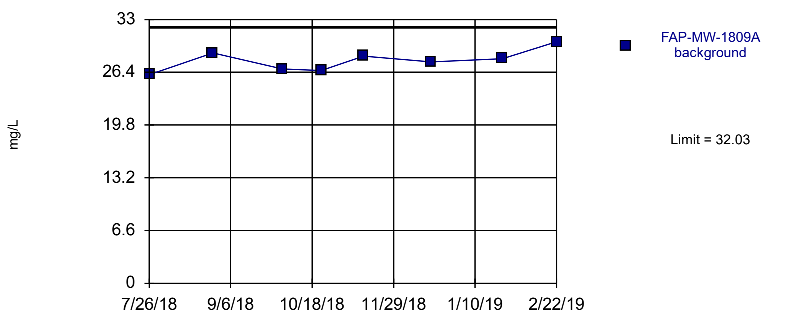


Background Data Summary: Mean=59.19, Std. Dev.=3.638, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9339, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Calcium Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1809A (bg)

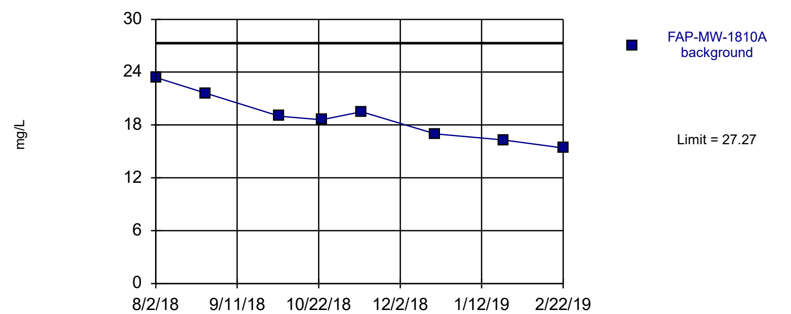


Background Data Summary: Mean=27.84, Std. Dev.=1.338, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9651, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1810A (bg)



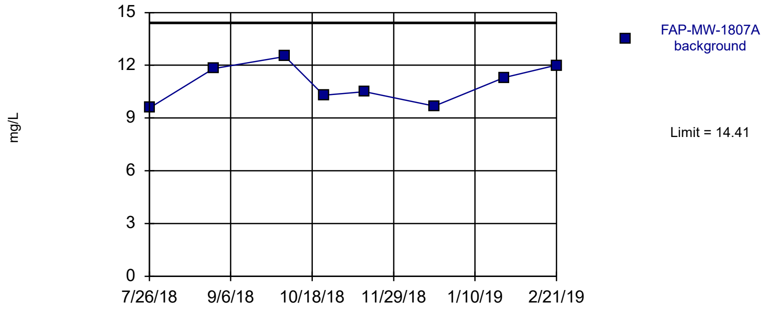
Background Data Summary: Mean=18.85, Std. Dev.=2.689, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9619, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807A (bg)



Background Data Summary: Mean=10.96, Std. Dev.=1.101, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9322, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

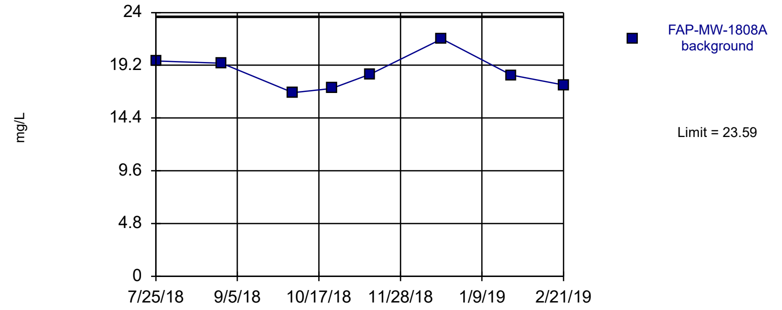
Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1808A (bg)



Background Data Summary: Mean=18.56, Std. Dev.=1.606, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9357, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

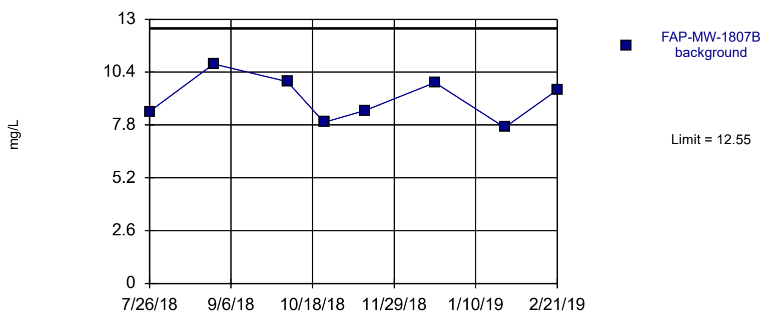
Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)



Background Data Summary: Mean=9.093, Std. Dev.=1.103, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9389, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

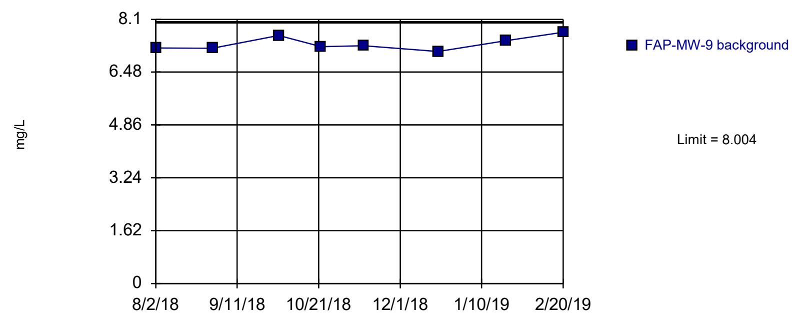
Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-9



Background Data Summary: Mean=7.355, Std. Dev.=0.2072, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9073, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

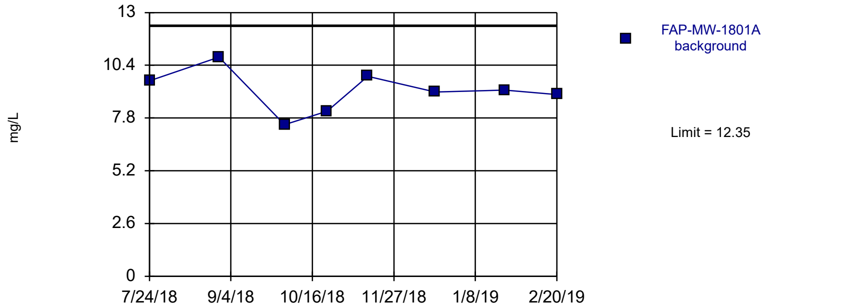
Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1801A



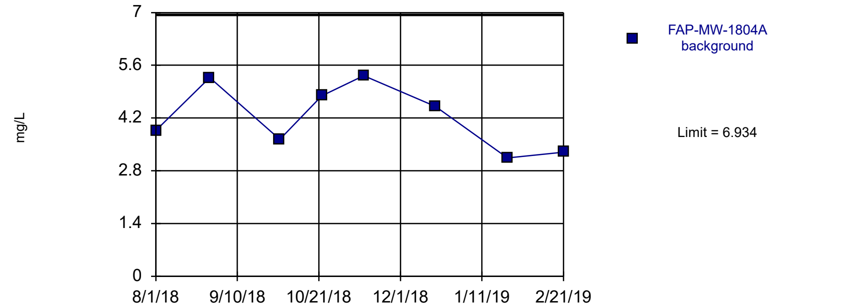
Background Data Summary: Mean=9.143, Std. Dev.=1.022, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9798, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1804A



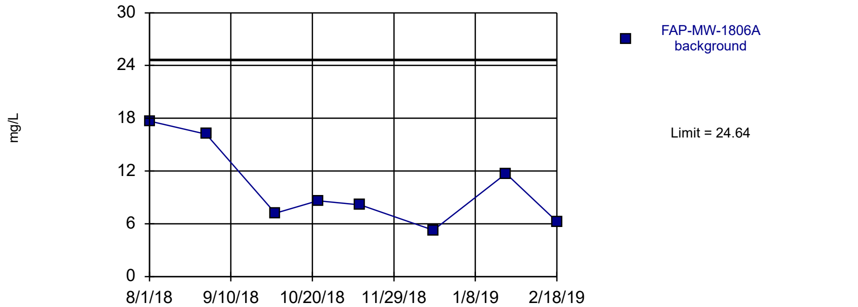
Background Data Summary: Mean=4.228, Std. Dev.=0.8638, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9132, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



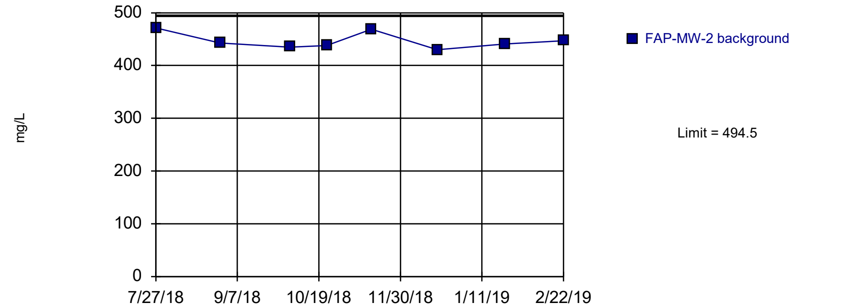
Background Data Summary: Mean=10.14, Std. Dev.=4.628, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8778, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

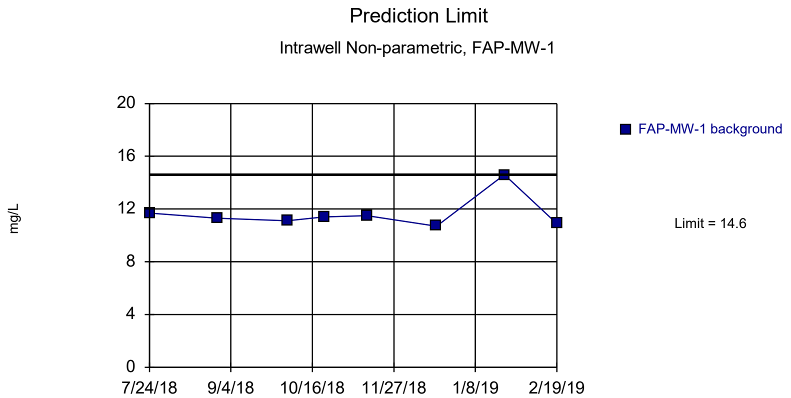
Intrawell Parametric, FAP-MW-2



Background Data Summary: Mean=446.8, Std. Dev.=15.24, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8537, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

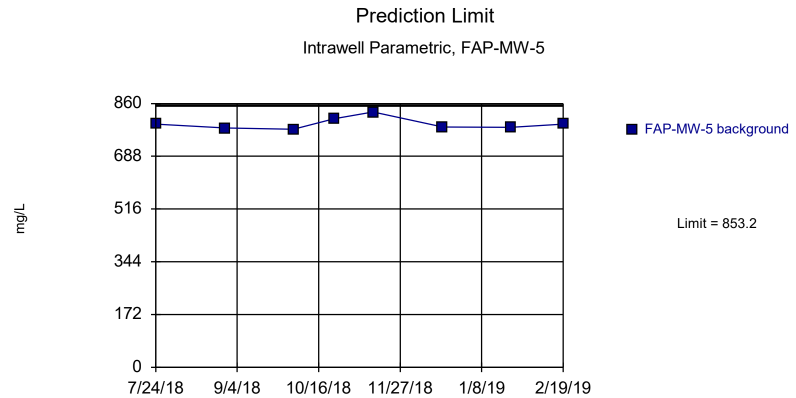
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value. Insufficient data to test for seasonality: data were not deseasonalized.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

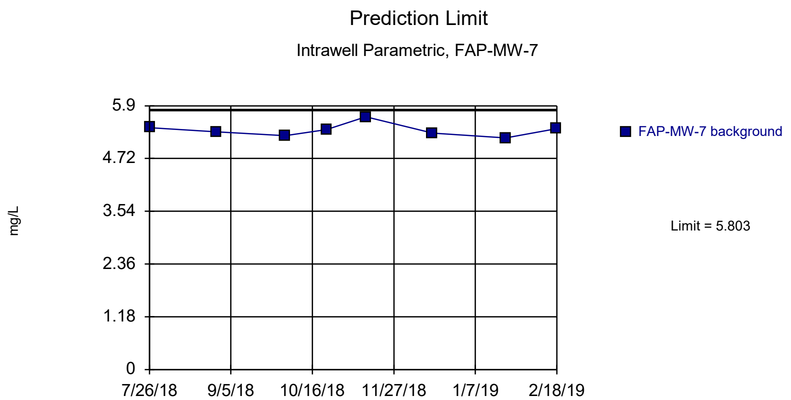
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=793.8, Std. Dev.=18.97, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8464, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

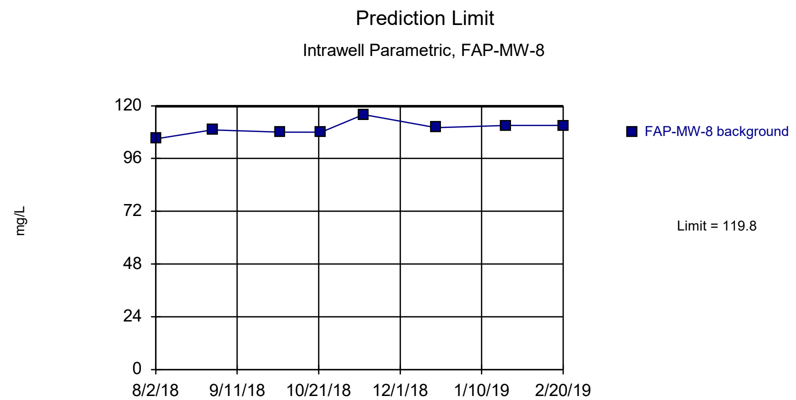
Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=5.355, Std. Dev.=0.143, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9132, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

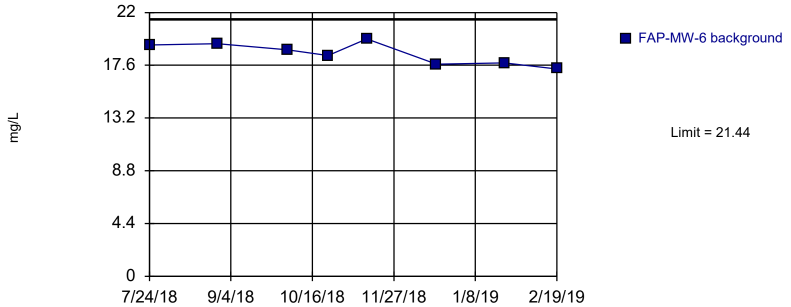


Background Data Summary: Mean=109.8, Std. Dev.=3.196, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9371, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-6



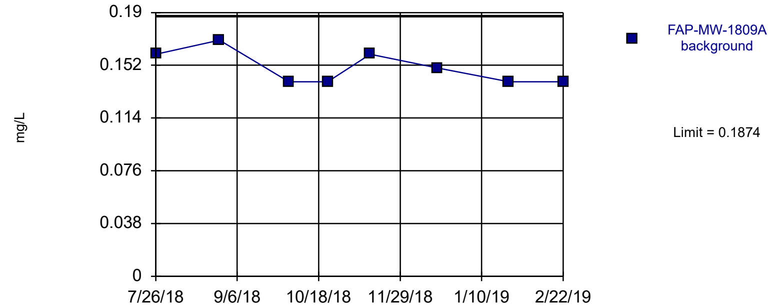
Background Data Summary: Mean=18.58, Std. Dev.=0.913, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9387, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Chloride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1809A (bg)



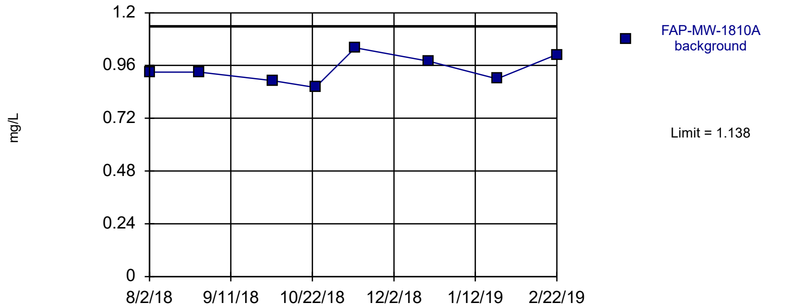
Background Data Summary: Mean=0.15, Std. Dev.=0.01195, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.814, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1810A (bg)



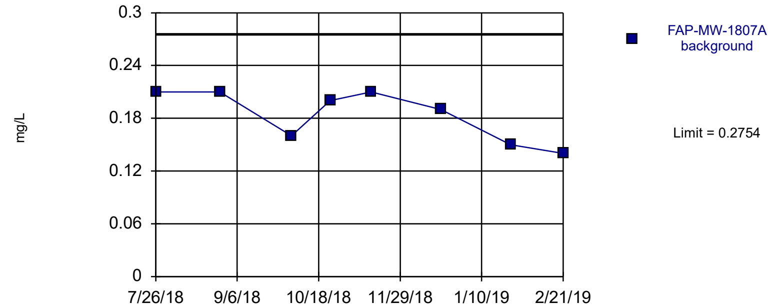
Background Data Summary: Mean=0.9425, Std. Dev.=0.06228, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9529, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807A (bg)



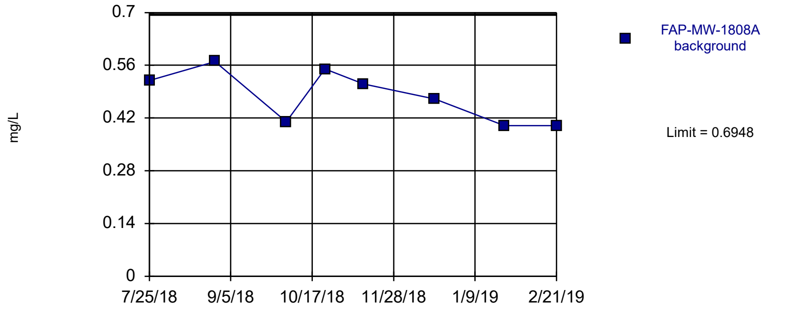
Background Data Summary: Mean=0.1838, Std. Dev.=0.02925, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.833, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:16 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1808A (bg)



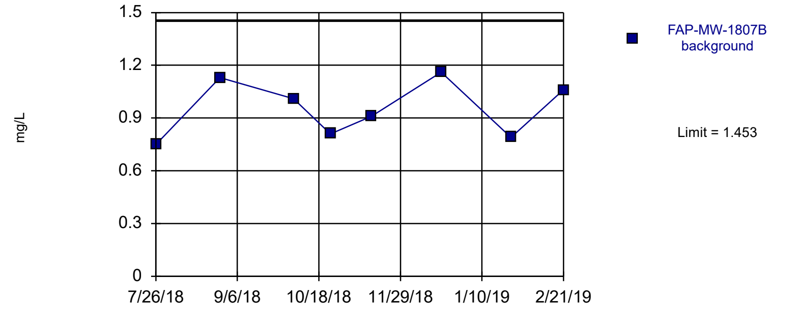
Background Data Summary: Mean=0.4788, Std. Dev.=0.06896, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8863, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)



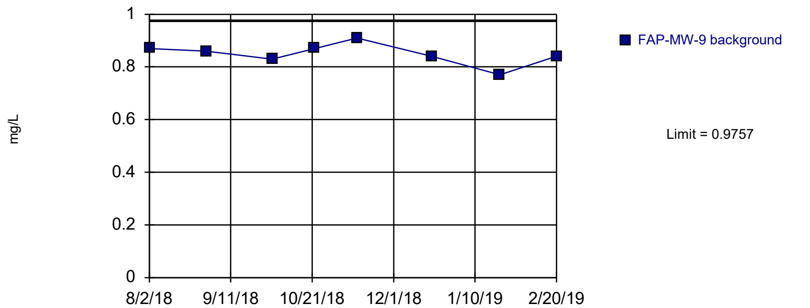
Background Data Summary: Mean=0.9525, Std. Dev.=0.1599, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9161, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-9



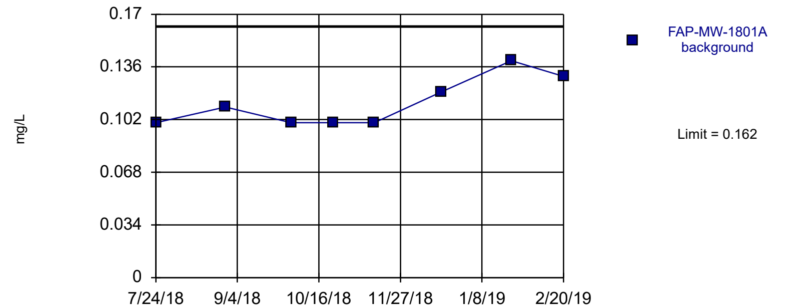
Background Data Summary: Mean=0.8488, Std. Dev.=0.04051, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9368, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1801A



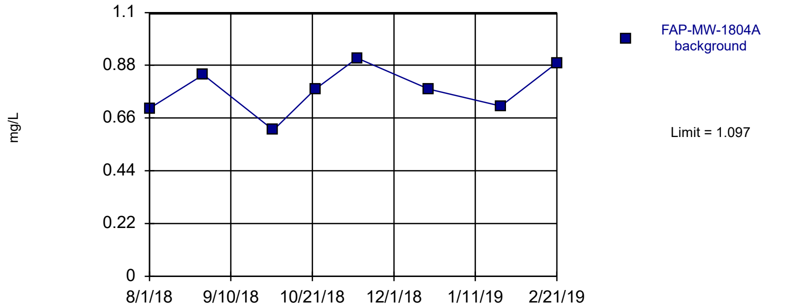
Background Data Summary: Mean=0.1125, Std. Dev.=0.01581, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8142, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1804A



Background Data Summary: Mean=0.7775, Std. Dev.=0.1019, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9605, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

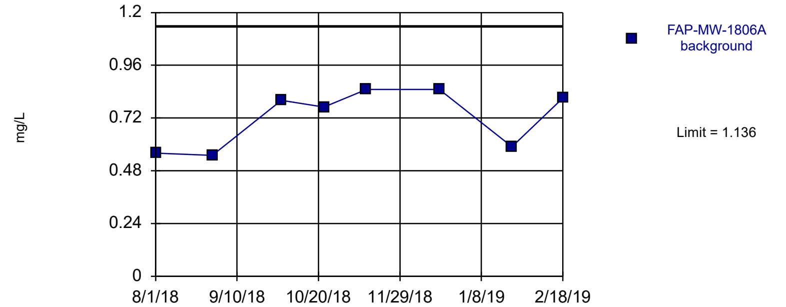
Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



Background Data Summary: Mean=0.7225, Std. Dev.=0.1321, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8038, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

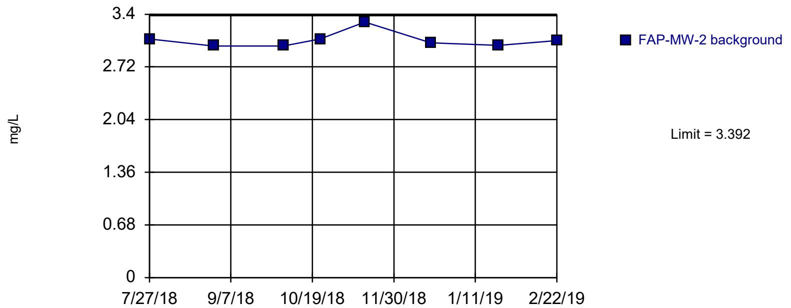
Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-2



Background Data Summary (based on natural log transformation): Mean=1.12, Std. Dev.=0.03235, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.752, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

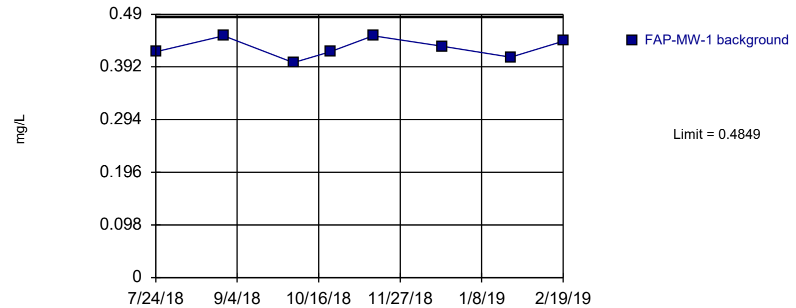
Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1



Background Data Summary: Mean=0.4275, Std. Dev.=0.01832, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9385, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

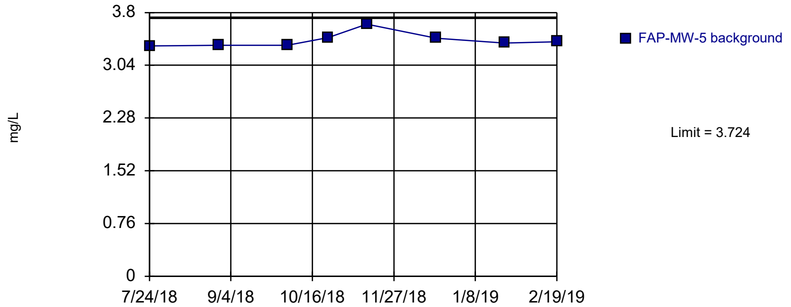
Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-5



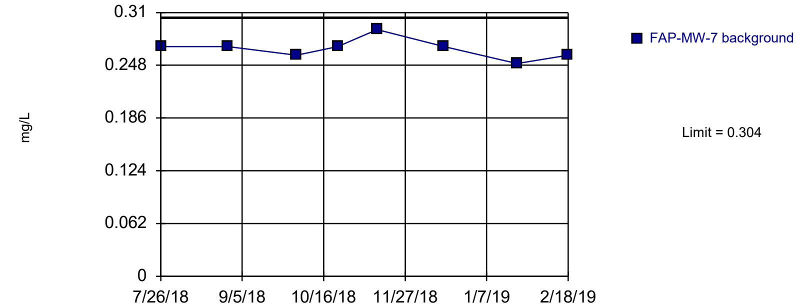
Background Data Summary: Mean=3.403, Std. Dev.=0.1025, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7895, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-7



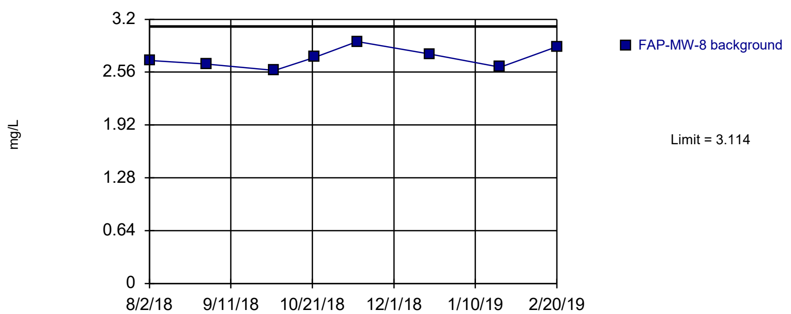
Background Data Summary: Mean=0.2675, Std. Dev.=0.01165, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8923, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-8



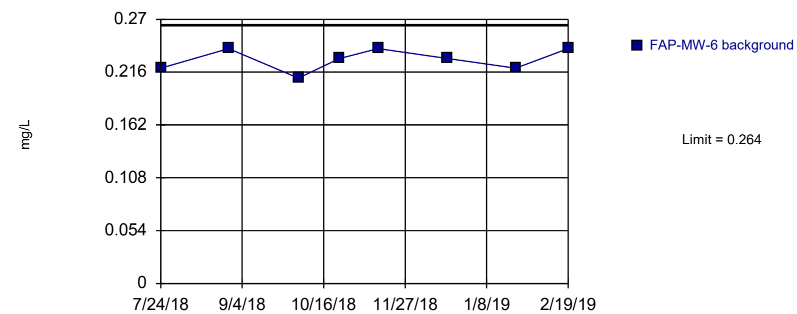
Background Data Summary: Mean=2.735, Std. Dev.=0.1209, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9633, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-6

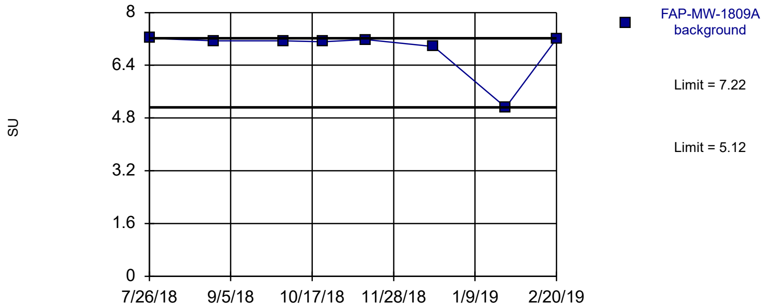


Background Data Summary: Mean=0.2288, Std. Dev.=0.01126, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8815, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Fluoride Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Non-parametric, FAP-MW-1809A (bg)

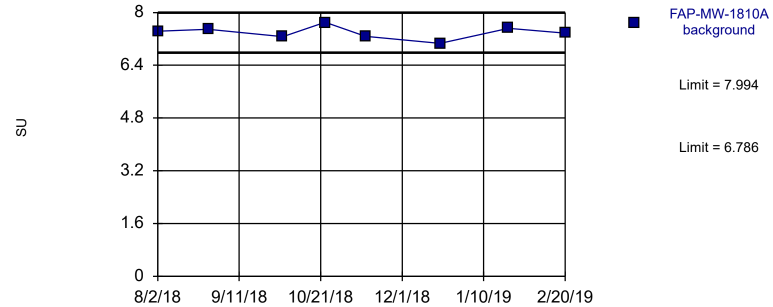


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 8 background values. Well-constituent pair annual alpha = 0.08484. Individual comparison alpha = 0.04288 (1 of 2). Assumes 1 future value. Insufficient data to test for seasonality: data were not deseasonalized.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1810A (bg)

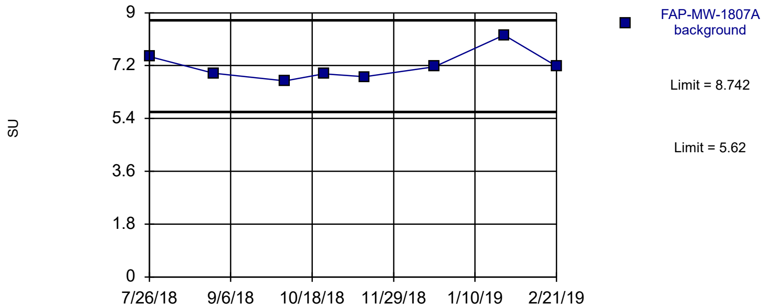


Background Data Summary: Mean=7.39, Std. Dev.=0.1929, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9848, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1807A (bg)

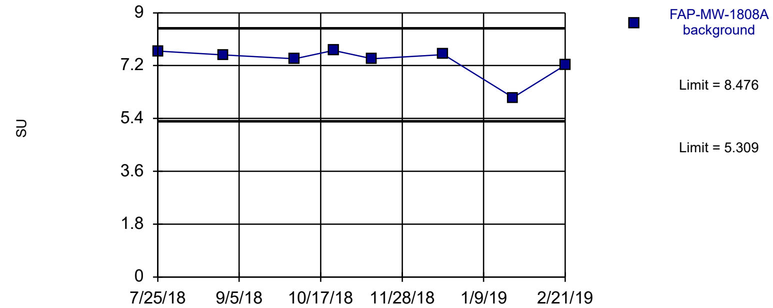


Background Data Summary: Mean=7.181, Std. Dev.=0.4982, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8567, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1808A (bg)



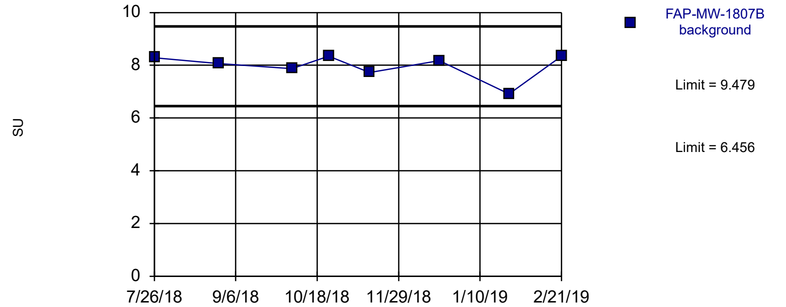
Background Data Summary (based on x^4 transformation): Mean=2978, Std. Dev.=697.1, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7714, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)



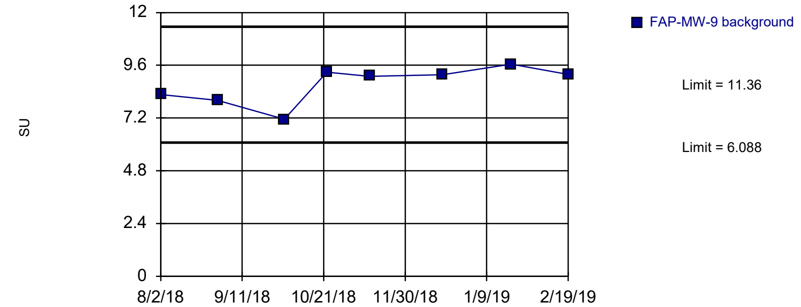
Background Data Summary: Mean=7.968, Std. Dev.=0.4824, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8032, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-9



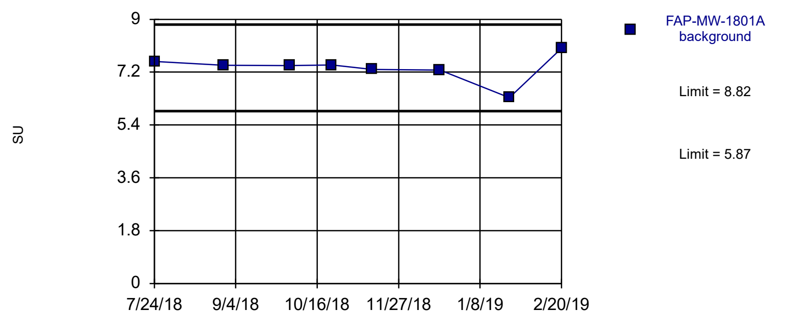
Background Data Summary: Mean=8.724, Std. Dev.=0.8413, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8788, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1801A



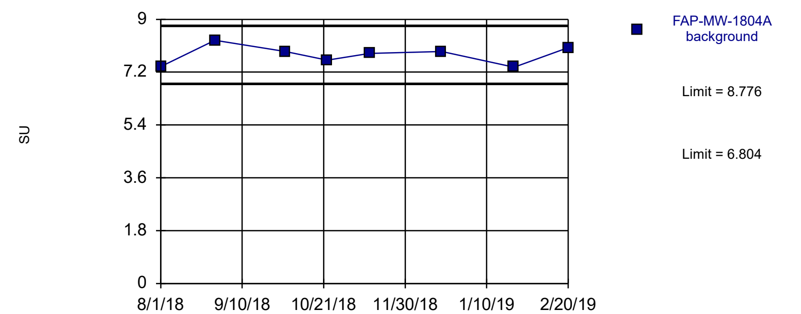
Background Data Summary: Mean=7.345, Std. Dev.=0.4707, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8333, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1804A



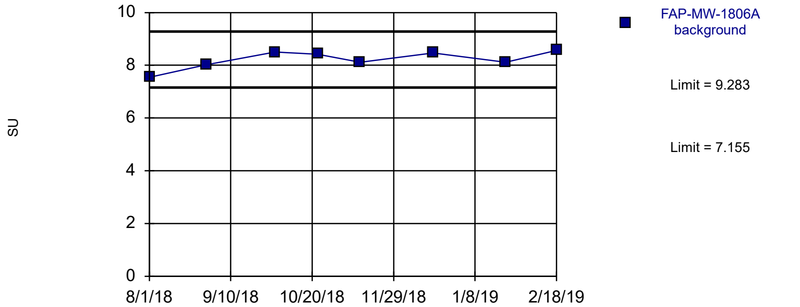
Background Data Summary: Mean=7.79, Std. Dev.=0.3147, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9398, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



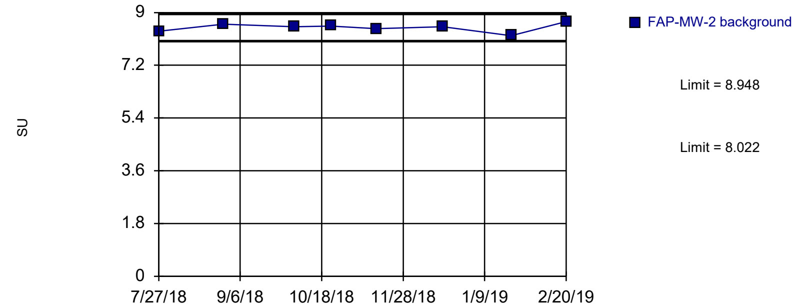
Background Data Summary: Mean=8.219, Std. Dev.=0.3396, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8795, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-2



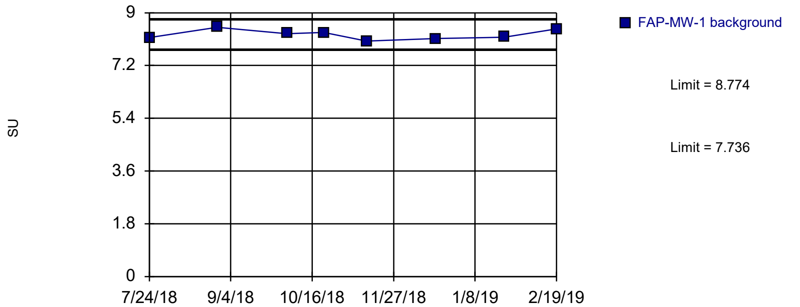
Background Data Summary: Mean=8.485, Std. Dev.=0.1476, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9597, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1



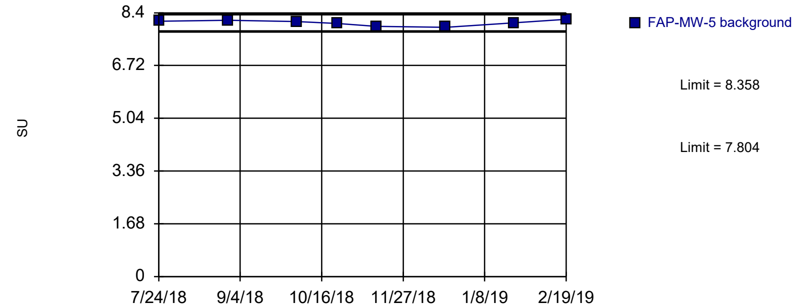
Background Data Summary: Mean=8.255, Std. Dev.=0.1656, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9495, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-5



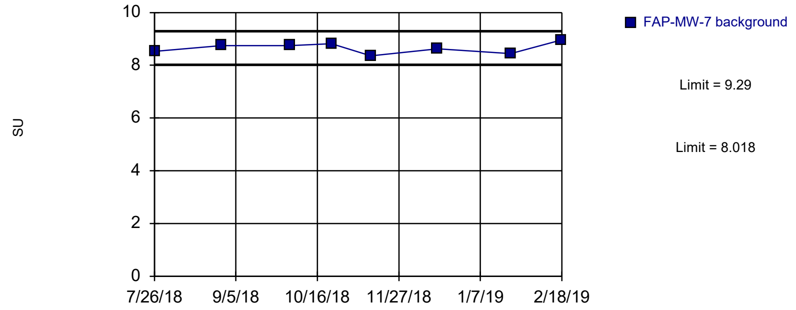
Background Data Summary: Mean=8.081, Std. Dev.=0.08839, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9328, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-7



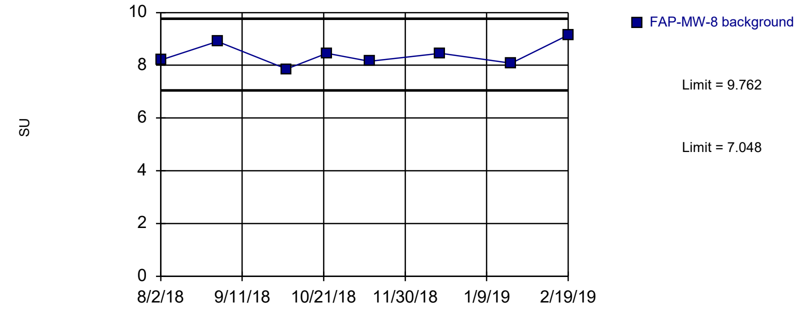
Background Data Summary: Mean=8.654, Std. Dev.=0.203, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9703, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-8



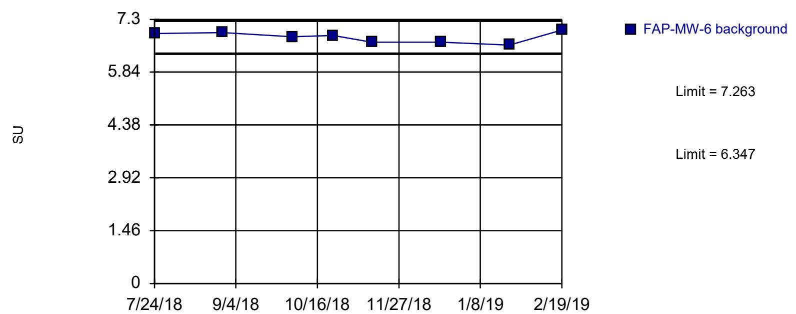
Background Data Summary: Mean=8.405, Std. Dev.=0.4332, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9319, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-6



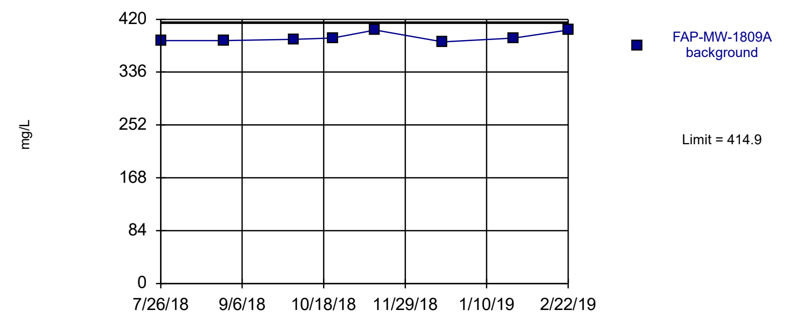
Background Data Summary: Mean=6.805, Std. Dev.=0.1462, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9346, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: pH Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1809A (bg)



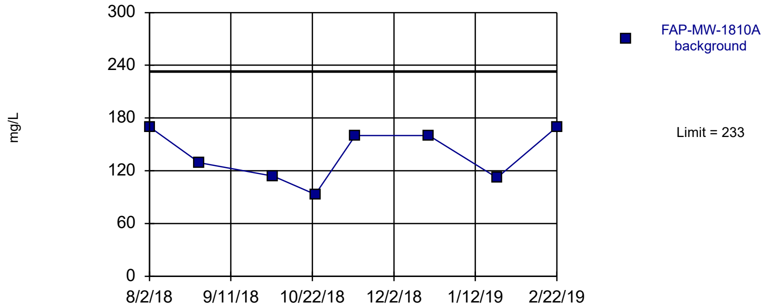
Background Data Summary: Mean=391.3, Std. Dev.=7.536, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.787, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1810A (bg)



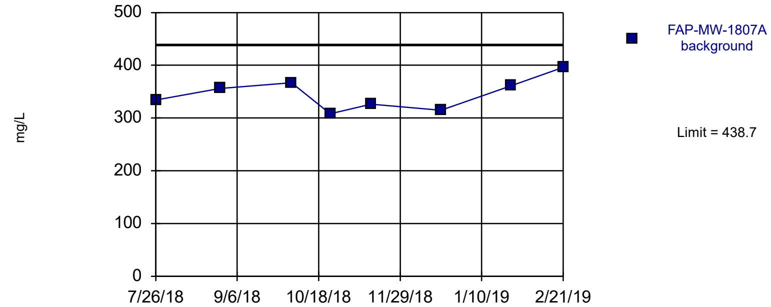
Background Data Summary: Mean=138.5, Std. Dev.=30.15, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8758, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807A (bg)



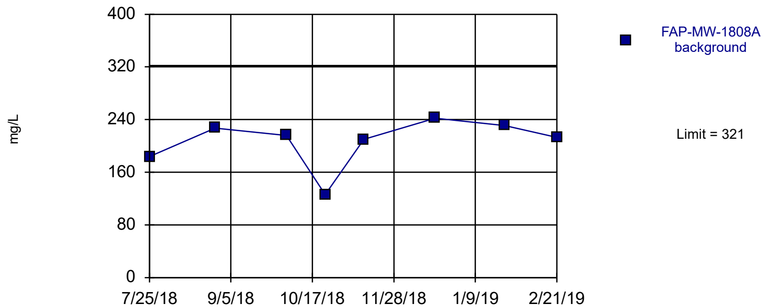
Background Data Summary: Mean=345.4, Std. Dev.=29.79, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9556, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1808A (bg)



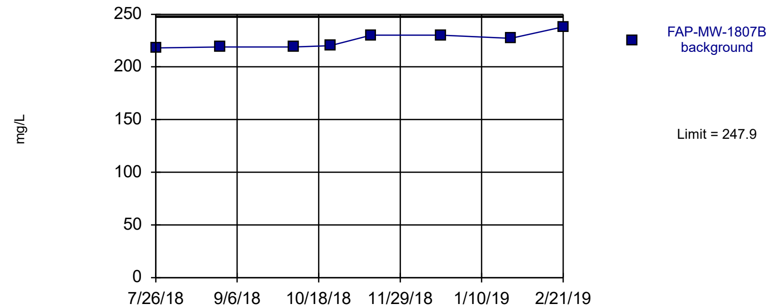
Background Data Summary: Mean=206.1, Std. Dev.=36.67, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8267, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)



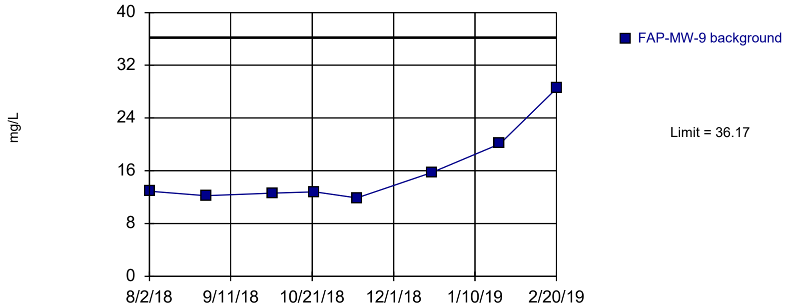
Background Data Summary: Mean=225.1, Std. Dev.=7.259, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8681, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-9



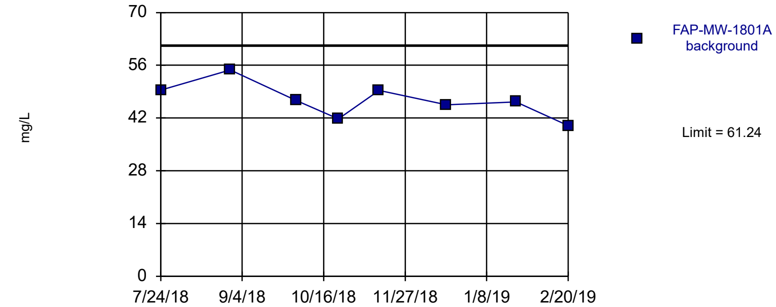
Background Data Summary (based on square root transformation): Mean=3.931, Std. Dev.=0.6651, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7553, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1801A



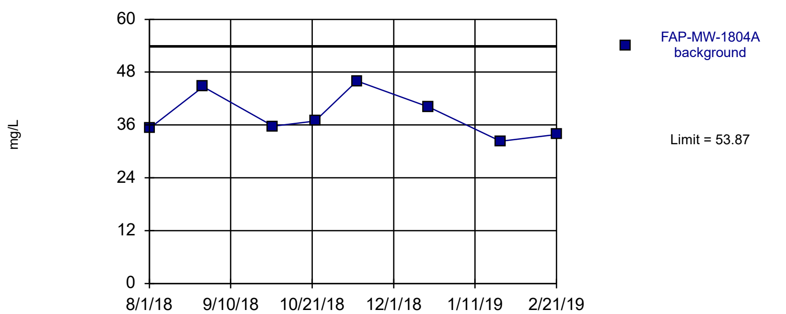
Background Data Summary: Mean=46.73, Std. Dev.=4.631, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9664, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1804A



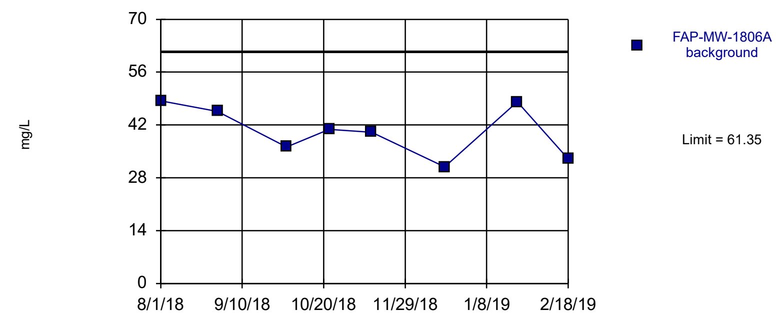
Background Data Summary: Mean=38.09, Std. Dev.=5.039, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9021, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



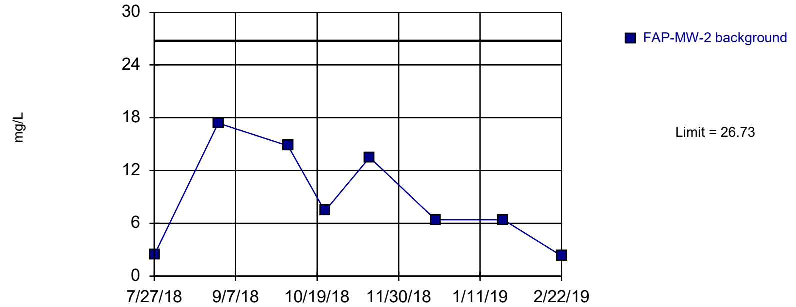
Background Data Summary: Mean=40.39, Std. Dev.=6.689, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9277, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-2



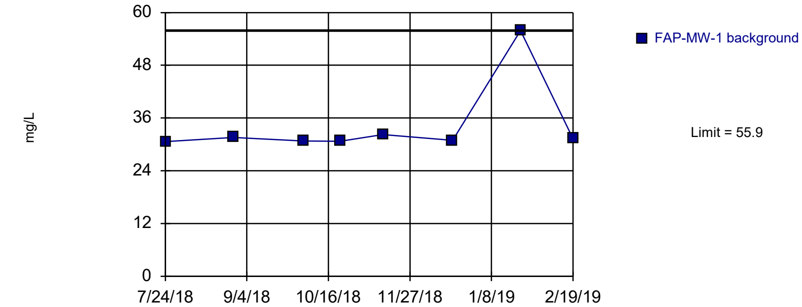
Background Data Summary: Mean=8.825, Std. Dev.=5.716, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.901, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, FAP-MW-1



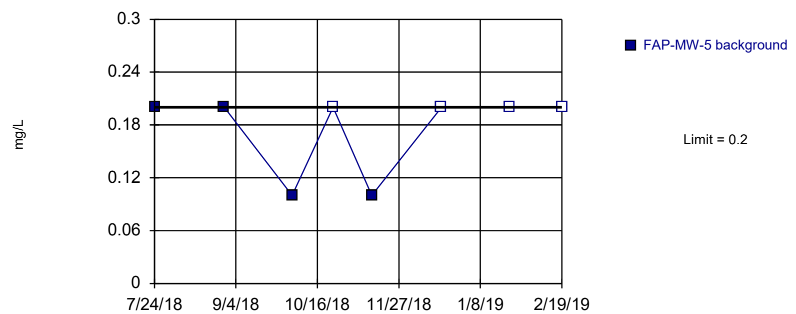
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value. Insufficient data to test for seasonality: data were not deseasonalized.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Prediction Limit

Intrawell Non-parametric, FAP-MW-5



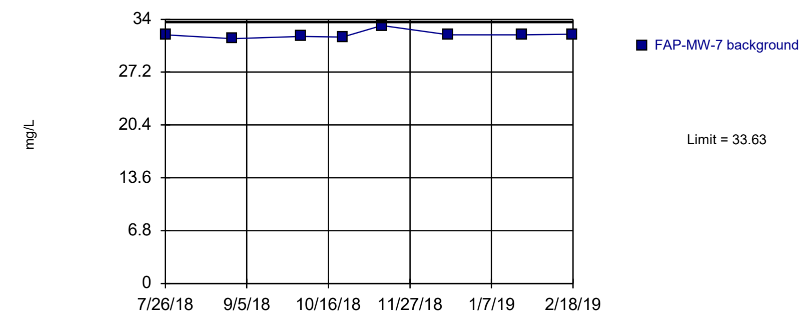
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. 50% NDs. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value. Insufficient data to test for seasonality: data were not deseasonalized.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-7



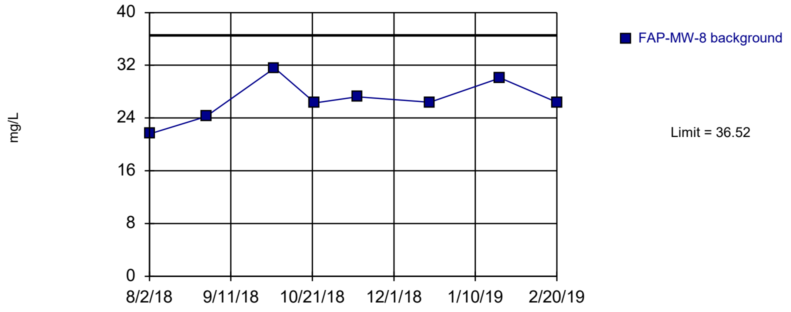
Background Data Summary: Mean=32.04, Std. Dev.=0.5097, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.779, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-8



Background Data Summary: Mean=26.73, Std. Dev.=3.126, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9532, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

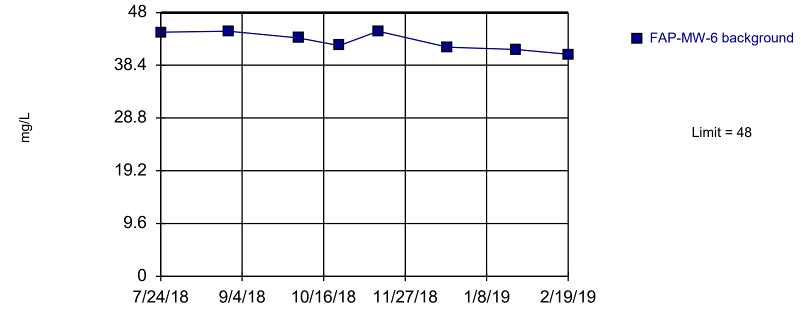
Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-6



Background Data Summary: Mean=42.8, Std. Dev.=1.659, n=8. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8878, critical = 0.749. Kappa = 3.133 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

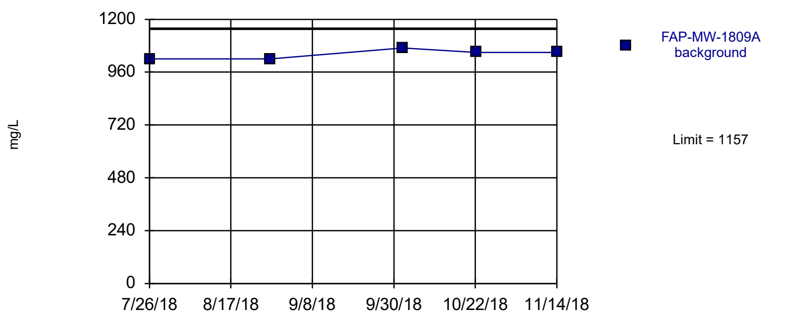
Constituent: Sulfate Analysis Run 4/18/2019 9:17 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1809A (bg)



Background Data Summary: Mean=1042, Std. Dev.=21.68, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8711, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

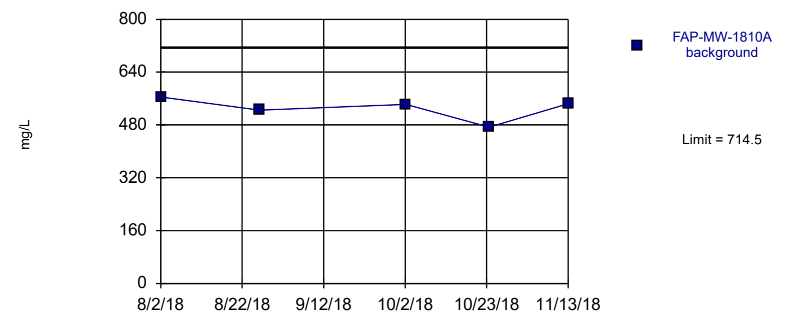
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1810A (bg)



Background Data Summary: Mean=529.8, Std. Dev.=34.78, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8928, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

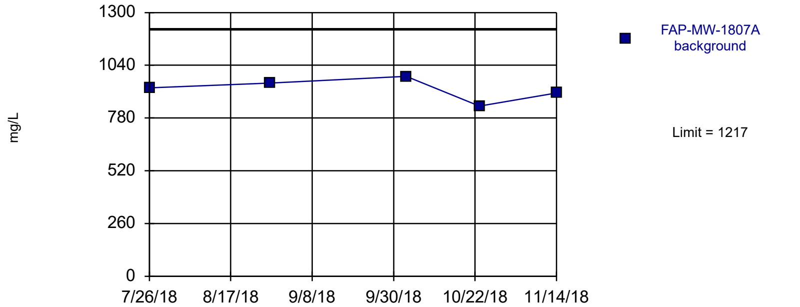
Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807A (bg)



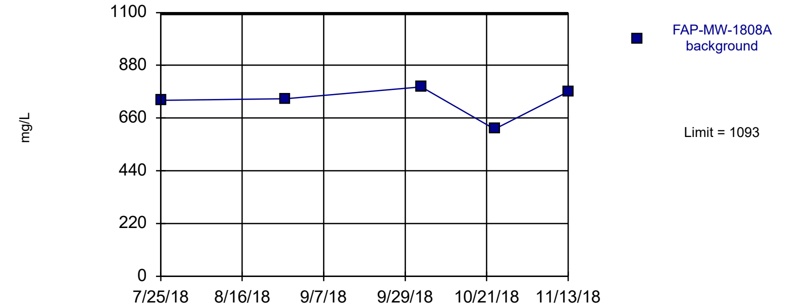
Background Data Summary: Mean=921.8, Std. Dev.=55.59, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9705, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1808A (bg)



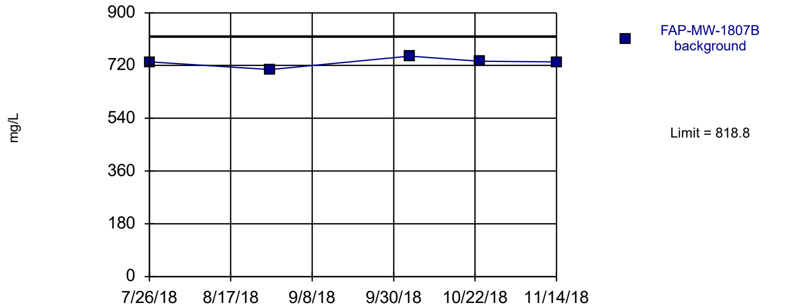
Background Data Summary: Mean=729.6, Std. Dev.=68.5, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8412, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1807B (bg)



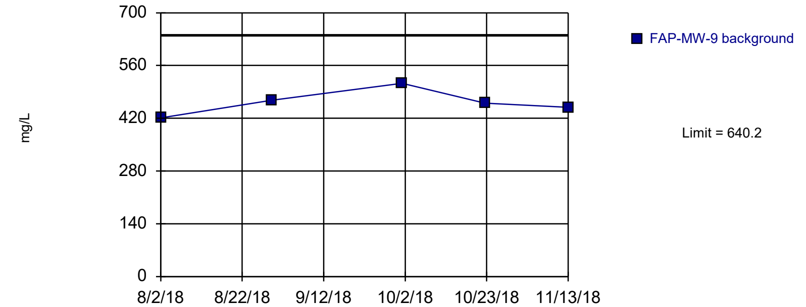
Background Data Summary: Mean=731.4, Std. Dev.=16.46, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9042, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-9



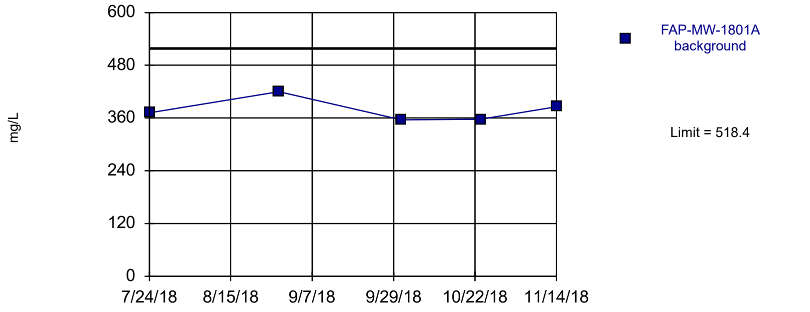
Background Data Summary: Mean=462.2, Std. Dev.=33.51, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.962, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1801A



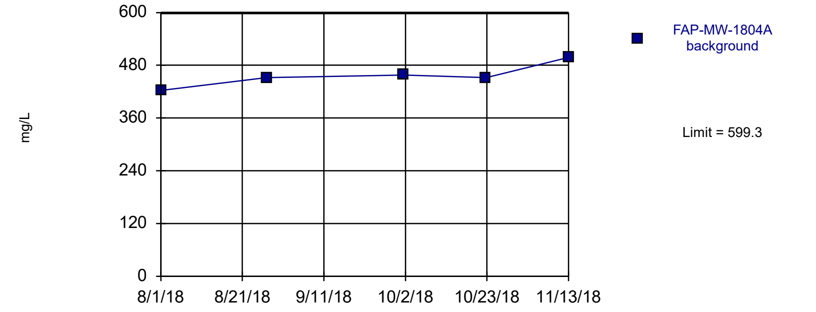
Background Data Summary: Mean=378.2, Std. Dev.=26.4, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8797, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1804A



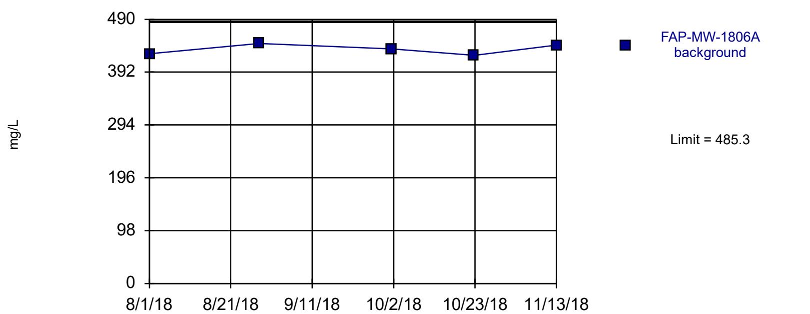
Background Data Summary: Mean=456.6, Std. Dev.=26.87, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9112, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-1806A



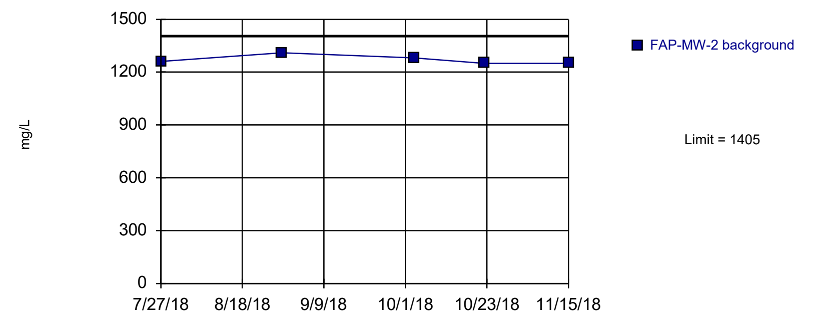
Background Data Summary: Mean=434.2, Std. Dev.=9.628, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9212, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-2

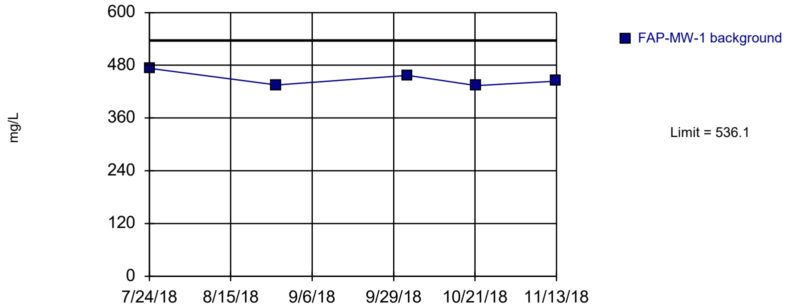


Background Data Summary: Mean=1270, Std. Dev.=25.5, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8538, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-1



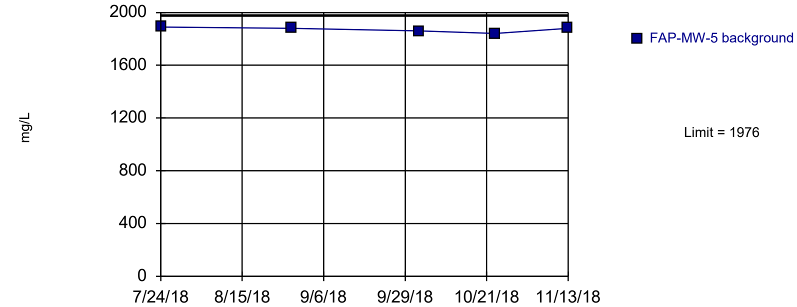
Background Data Summary: Mean=448.6, Std. Dev.=16.47, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8986, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-5



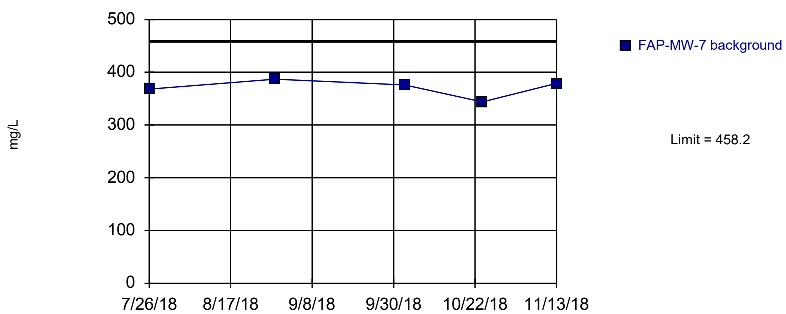
Background Data Summary: Mean=1870, Std. Dev.=20, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9052, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-7



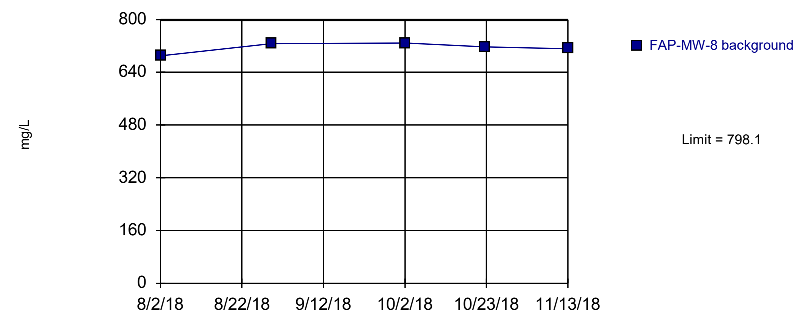
Background Data Summary: Mean=370.8, Std. Dev.=16.45, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9009, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, FAP-MW-8

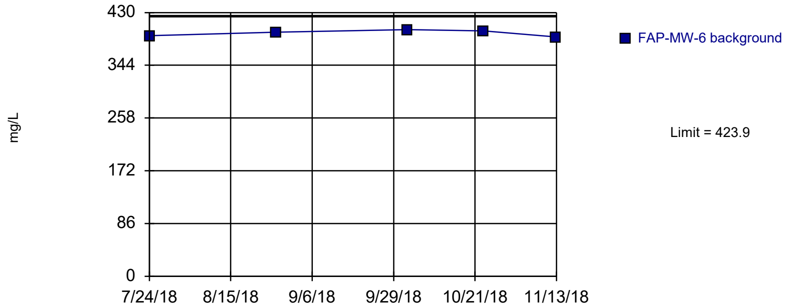


Background Data Summary: Mean=714.8, Std. Dev.=15.69, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9005, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell
Amos FAP Client: Geosyntec Data: Amos FAP

Prediction Limit

Intrawell Parametric, FAP-MW-6

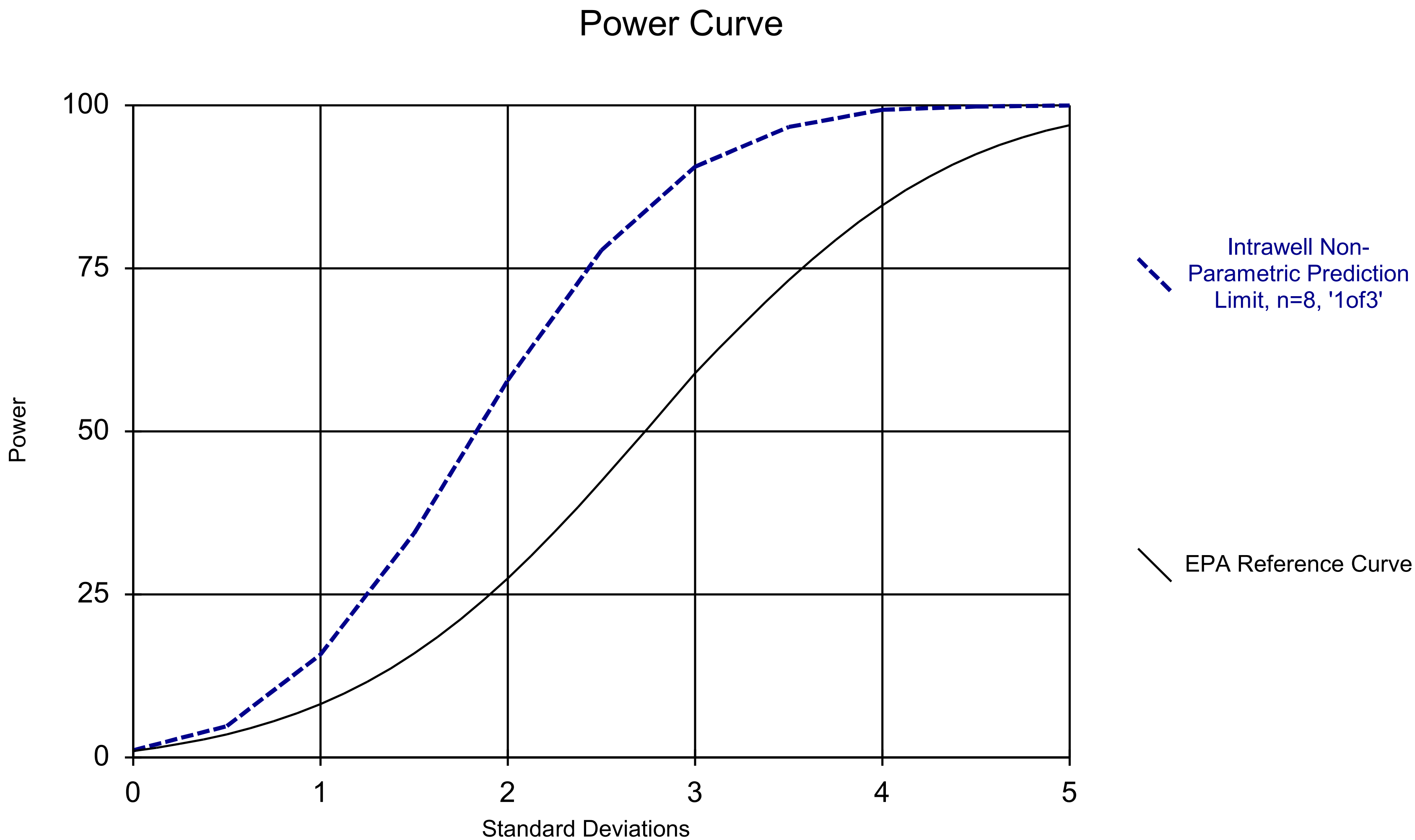


Background Data Summary: Mean=396.4, Std. Dev.=5.177, n=5. Insufficient data to test for seasonality: data were not deseasonalized. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9153, critical = 0.686. Kappa = 5.311 (c=7, w=10, 1 of 2, event alpha = 0.05132). Report alpha = 0.0007523. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 4/18/2019 9:18 AM View: PL's - Intrawell

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG

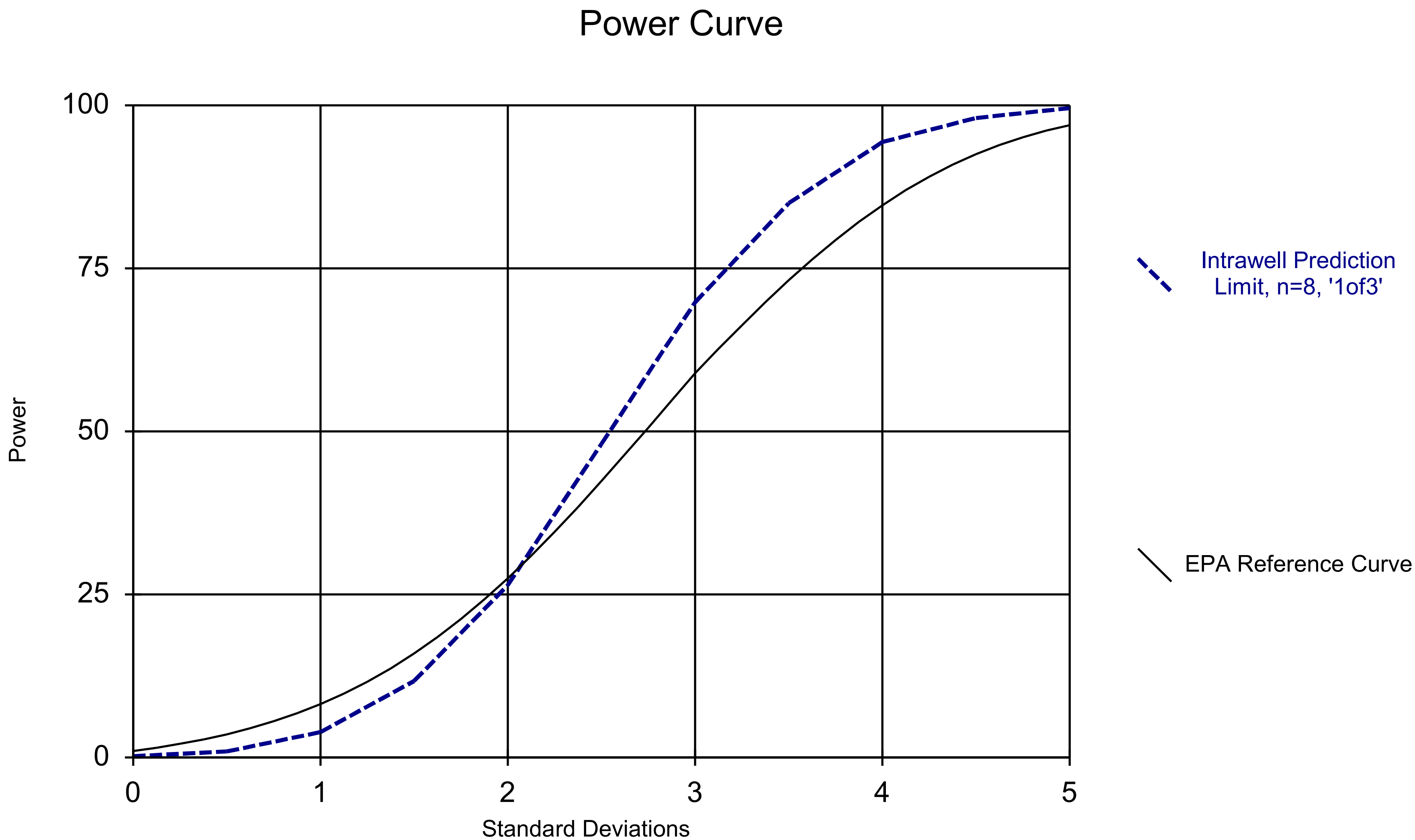


This report reflects annual total based on two evaluations per year.

Analysis Run 4/18/2019 9:13 AM View: Confidence Intervals - Appendix III

Amos FAP Client: Geosyntec Data: Amos FAP

Sanitas™ v.9.6.12h Sanitas software utilized by Groundwater Stats Consulting. UG



Kappa = 2.21, based on 10 compliance wells and 7 constituents, evaluated semi-annually (this report reflects annual total).

Analysis Run 4/18/2019 9:12 AM   View: Confidence Intervals - Appendix III

Amos FAP   Client: Geosyntec   Data: Amos FAP

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date: July 15, 2019

To: David Miller (AEP)

Copies to: Ben Kepchar (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Amos Plant's Fly Ash Pond (FAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), a detection monitoring event was completed on March 12-13, 2019 at the Fly Ash Pond (FAP), an existing CCR unit at the John E. Amos Plant located in Winfield, West Virginia.

Eight background monitoring events were conducted at the Amos FAP prior to this detection monitoring event, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated July 15, 2019.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-three retesting procedure. With this procedure, a statistically significant increase (SSI) would be concluded only if all three samples in a series of three exceeds the UPL (or is below the LPL for pH). In practice, if the initial or second result did not exceed the UPL, subsequent samples were not collected or analyzed.

Detection monitoring results and the relevant background values are summarized in Table 1. No SSIs were observed at the Amos FAP CCR unit, and as a result the Amos FAP will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Fly Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	MW-1	MW-1801A	MW-1804A	MW-1806A	MW-2	MW-5	MW-6	MW-7	MW-8	MW-9
			3/12/2019	3/12/2019	3/12/2019	3/12/2019	3/13/2019	3/13/2019	3/12/2019	3/12/2019	3/12/2019	3/12/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.261	0.459	0.965	0.235	0.382	0.355	0.159	0.248	0.320	0.192
		Detection Monitoring Result	0.11	0.09	0.568	0.13	0.23	0.229	0.08	0.06	0.192	0.122
Calcium	mg/L	Intrawell Background Value (UPL)	3.58	75.4	51.2	18.8	4.66	7.79	70.6	1.63	3.06	1.63
		Detection Monitoring Result	2.60	51.2	10.2	4.98	3.98	6.85	57.9	1.47	2.32	1.18
Chloride	mg/L	Intrawell Background Value (UPL)	14.6	12.4	6.93	24.6	495	853	21.4	5.80	120	8.00
		Detection Monitoring Result	11	9.4	3.55	5.51	441	804	17.4	5.49	110	7.5
Fluoride	mg/L	Intrawell Background Value (UPL)	0.485	0.162	1.10	1.14	3.39	3.72	0.264	0.304	3.11	0.976
		Detection Monitoring Result	0.43	0.16	0.85	0.83	3.02	3.44	0.230	0.270	2.87	0.91
pH	SU	Intrawell Background Value (UPL)	8.8	8.8	8.8	9.3	8.9	8.4	7.3	9.3	9.8	11.4
		Intrawell Background Value (LPL)	7.7	5.9	6.8	7.2	8.0	7.8	6.3	8.0	7.0	6.1
		Detection Monitoring Result	8.2	7.5	7.9	8.8	8.7	8.0	6.9	8.9	8.5	9.0
Sulfate	mg/L	Intrawell Background Value (UPL)	55.9	61.2	53.9	61.4	26.7	0.20	48	33.6	36.5	36.2
		Detection Monitoring Result	31.6	41.7	34	32.9	1.8	0.08	39.8	32.5	27.4	24
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	536	518	599	485	1405	1976	424	458	798	640
		Detection Monitoring Result	458	306	411	430	1300	1930	390	385	716	463

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
*: Designates results for a duplicate sample
-: Not Sampled
Bold values exceed the background value.
Background values are shaded gray.
Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated background value.

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos FAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

David Anthony Miller

Signature

22663	WEST VIRGINIA	07.15.19
License Number	Licensing State	Date

APPENDIX 3

Not applicable.

APPENDIX 4

Not applicable.

APPENDIX 5

Not applicable.

Annual Groundwater Monitoring Report

Appalachian Power Company

John E. Amos Plant

Landfill CCR Management Unit

Winfield, West Virginia

January 2020

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

APPALACHIAN POWER

An AEP Company

BOUNDLESS ENERGY

Table of Contents Page

I. Overview

This *Annual Groundwater Monitoring* (Report) has been prepared to report the status of activities for the preceding year for an existing Landfill CCR unit at Appalachian Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), John E. Amos Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31.

In general, the following activities were completed:

- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units.
- Statistical analyses of the November 2018 and June 2019 detection monitoring samples were completed in 2019. The statistical analysis determined that Appendix III SSIs were observed.
- As required by the CCR detection monitoring rules, semi-annual groundwater sampling events to include the Appendix III parameters were performed in June and November 2019 in accordance with 40 CFR §§257.94. Based on the results, verification sampling events were completed for respective potential SSIs. The verification sampling, analytical analysis, and statistical analysis for the November 2018 event was completed in 2019. This resulted in confirmed SSIs and an ASD was successfully completed. SSIs were confirmed for the June 2019 sampling event. Laboratory analytical is on-going for the November 2019 event. An alternative source demonstration was undertaken and completed related to the SSI confirmed for the June 2019 detection monitoring event in accordance with 40 CFR §257.94(e)(2). The demonstrations to date have been successful and are discussed below. If potential SSIs are observed from the November 2019 detection sampling, verification samples will be obtained and statistical analysis completed. If an SSI is confirmed, an ASD will be attempted and completed to determine if the SSI is valid.
- Two additional downgradient groundwater monitoring wells were installed at the CCR Unit in 2018 and were discussed in last year's annual report. These monitoring wells are discussed below. The boring logs and well construction forms are included in this report.

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

- A map/aerial photograph showing the Amos Landfill CCR management unit, all groundwater monitoring wells, and monitoring well identification numbers.
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened (**Appendix 5**).

- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (**Appendix 1**).
- Results of the required statistical analysis of groundwater monitoring results (**Appendix 2**).
- Discussion of the successful alternative source demonstrations (**Appendix 3**).
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations, if applicable (**Appendix 4**).
- Other information required to be included in the annual report such as assessment of corrective measures, if applicable.

In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

II. <u>Groundwater Monitoring Well Locations and Identification Numbers</u>

Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification numbers. The monitoring well distribution adequately covers downgradient and upgradient areas as detailed in the *Groundwater Monitoring Network Evaluation Report* that was placed in the American Electric Power CCR public internet site on March 9, 2017.The groundwater quality monitoring network includes the following:

- Five upgradient wells: MW-6, MW-7R, MW-8, MW-9, and MW-10; and
- Four downgradient wells: MW-1, MW-2, MW-4, and MW-5.

Legend

Upgradient Sampling Location

Downgradient Sampling Location

FGD Landfill

Notes

- Monitoring well coordinates provided by AEP.

700 350 0 700 Feet

Site Layout
FGD Landfill

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/01/26

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_Site_Layout.mxd. CGregory. 1/26/2018. CHA8423/04/08.

III. Monitoring Wells Installed or Decommissioned

There were two monitoring wells installed in 2018 at the Amos Plant Landfill. MW-1801 was installed downgradient of the south valley portion of the landfill. MW-1802 was installed downgradient of the north valley portion of the landfill. These wells were installed in late 2018 and are currently being evaluated for use in the CCR groundwater monitoring network as downgradient groundwater sampling and/or static water level gauging locations. Boring logs and monitoring well construction forms are included in **Appendix 5**.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction Calculations and Discussion

Appendix 1 contains tables showing the groundwater quality data collected since initiating CCR background sampling through results received in 2019 as part of the detection monitoring program. Static water elevation data from each monitoring event in 2019 are also shown in **Appendix 1**, along with the groundwater velocity calculations, groundwater flow direction, and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the November 2018 detection monitoring samples was completed in March 2019. Statistically significant increases (SSIs) in the Appendix III parameters of boron and chloride were documented in the March 6, 2019 *Evaluation of Detection Monitoring Data at Amos Plant's Landfill* memorandum (**Appendix 2**). An alternative source demonstration was undertaken for these parameters and was successful. That demonstration is discussed in the next section of this report.

Statistical analysis of the detection monitoring samples taken in June 2019 was completed in August 2019. Statistically significant increase (SSI) in the Appendix III parameter of chloride was documented in the statistical analysis memo included in **Appendix 2**. An alternative source demonstration was undertaken for this parameter and was successful. That demonstration is discussed in the next section of this report.

Statistical analysis of the detection monitoring samples taken in November 2019 will be completed in 2020. If SSIs are confirmed, an alternative source demonstration will be performed in accordance with 40 CFR §257.94(e)(2).

VI. Alternative Source Demonstration

An alternative source demonstration (ASD) relative to the Appendix III SSIs resulting from the November 2018 detection monitoring event of the federal CCR Rule was performed and completed in March 2019. The demonstration concluded that the groundwater quality and Appendix III indicator parameter SSIs identified in the statistical evaluation are attributable to an alternative source. The successful ASD for Appendix III parameters is attached in **Appendix 3**.

An alternative source demonstration (ASD) relative to the Appendix III SSI resulting from the June 2019 detection monitoring event of the federal CCR Rule was performed and completed in October 2019. The demonstration concluded that the groundwater quality and Appendix III indicator parameter SSI identified in the statistical evaluation is attributable to an alternative source. The successful ASD for the Appendix III parameter is attached in **Appendix 3**.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

As of this annual report date there has been no transition between detection monitoring and assessment monitoring. Detection monitoring will continue in 2020 pending the results of the aforementioned statistical analysis regarding the November 2019 groundwater sampling event. If the statistical analysis confirms any SSIs, an ASD will be performed if applicable. The sampling frequency of twice per year will be maintained for the Appendix III parameters upon a successful alternative source demonstration. If necessary, a transition to the assessment monitoring program will occur.

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production are high enough at this facility that no modification to the semiannual assessment monitoring frequency is needed.

VIII. Other Information Required

All required information has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support the 2019 annual groundwater report preparation covering the year 2019 groundwater monitoring activities.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2020 include:

- Complete the statistical evaluation of the November 2019 detection monitoring results and subsequent verification sampling, looking for any statistically significant increases, or decreases when pH is considered.
- Continue detection monitoring on a semi-annual basis.
- Continue evaluation of the new groundwater monitoring wells installed downgradient of the CCR unit for inclusion in the CCR groundwater monitoring network.
- Respond to any new data received in light of what the CCR rule requires.
- Preparation of the 2020 annual groundwater report.

APPENDIX 1

Tables follow, showing the groundwater monitoring data collected and received in 2019 or prior, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

Table 1 - Groundwater Data Summary: MW-1
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.044	31.1	3.45	0.09 J	6.2	182	30.6
10/18/2016	Background	0.060	29.0	3.31	0.09	6.5	232	30.8
11/9/2016	Background	0.076	29.9	3.42	0.10	6.5	194	31.3
12/13/2016	Background	0.065	29.3	3.08	0.07 J	6.1	250	27.7
2/9/2017	Background	0.050	26.8	3.16	0.09	6.3	234	27.9
3/16/2017	Background	0.046	28.4	3.32	0.09	7.5	216	29.4
5/23/2017	Background	0.123	30.2	3.19	0.09	6.6	215	28.5
6/21/2017	Background	0.037	28.1	4.94	0.08	6.4	204	31.9
11/1/2017	Detection	0.047	28.7	3.08	0.10	6.4	224	30.2
5/2/2018	Detection	0.134	27.2	3.22	0.10	6.5	194	29.9
11/29/2018	Detection	0.143	26.4	3.07	0.11	6.7	191	27.8
12/18/2018	Detection	0.07 J	- -	- -	- -	6.5	- -	- -
6/11/2019	Detection	0.04 J	28.1	2.86	0.11	7.0	184	29.9

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-1
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.04 J	0.27	207	0.024	0.02 J	0.3	0.097	0.0848	0.09 J	0.186	0.017	<0.002 U	0.04 J	0.9	0.01 J
10/18/2016	Background	0.04 J	0.62	206	0.050	0.03	0.627	0.306	1.24	0.09	0.567	0.017	0.002 J	0.08 J	1.4	0.05 J
11/9/2016	Background	0.04 J	0.44	210	0.036	0.03	0.564	0.200	1.001	0.100	0.450	0.020	<0.002 U	0.14	1.3	0.088
12/13/2016	Background	0.05 J	1.09	232	0.100	0.01 J	2.16	0.613	0.6701	0.07 J	1.45	0.027	<0.002 U	0.11	1.7	0.02 J
2/9/2017	Background	0.03 J	0.37	184	0.026	0.02 J	0.401	0.174	0.836	0.09	0.340	0.015	<0.002 U	0.21	1.6	0.02 J
3/16/2017	Background	0.06	0.67	200	0.057	0.06	0.993	0.393	0.730	0.09	1.03	0.012	0.003 J	0.10	1.1	0.02 J
5/23/2017	Background	0.08	0.40	211	0.032	0.05	0.555	0.292	3.243	0.09	0.697	0.026	<0.002 U	0.11	1.1	0.01 J
6/21/2017	Background	0.07	0.43	200	0.031	0.06	0.547	0.289	1.379	0.08	0.753	0.013	<0.002 U	0.10	1.2	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-2
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.201	1.99	4.00	1.34	8.7	362	12.0
10/17/2016	Background	0.198	1.53	4.21	1.26	9.1	354	11.8
11/8/2016	Background	0.216	1.46	4.13	1.3	8.2	378	11.3
12/13/2016	Background	0.217	1.65	2.99	1.19	8.5	350	7.6
2/8/2017	Background	0.190	1.56	2.66	1.33	8.7	374	7.4
3/14/2017	Background	0.184	1.81	3.91	1.20	8.4	354	7.7
5/23/2017	Background	0.187	1.42	4.23	1.17	8.7	354	8.1
6/21/2017	Background	0.189	1.56	3.47	1.19	8.5	356	7.4
11/1/2017	Detection	0.202	1.88	2.34	1.46	8.8	394	8.6
1/8/2018	Detection	0.251	- -	- -	1.07	8.4	353	- -
5/1/2018	Detection	0.241	3.50	3.90	1.45	8.5	344	9.4
6/19/2018	Detection	0.338	1.79	- -	1.28	8.5	- -	- -
9/24/2018	Detection	0.215	- -	- -	- -	- -	- -	- -
11/28/2018	Detection	0.235	1.84	5.09	1.15	8.5	355	8.5
12/17/2018	Detection	0.285	- -	- -	- -	8.6	- -	- -
1/24/2019	Detection	0.218	- -	- -	- -	- -	- -	- -
6/11/2019	Detection	0.215	1.80	3.26	1.63	8.7	379	9.4
7/22/2019	Detection	- -	- -	- -	1.41	8.7	- -	- -

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-2
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.03 J	6.57	51.8	0.129	0.14	1.3	1.02	0.904	1.34	1.24	0.009	<0.002 U	6.04	0.2 J	0.03 J
10/17/2016	Background	0.01 J	3.94	25.7	0.040	0.005 J	0.592	0.290	0.208	1.26	0.258	0.010	<0.002 U	3.70	0.09 J	0.067
11/8/2016	Background	0.01 J	3.54	23.7	0.02 J	<0.004 U	0.295	0.107	0.8825	1.3	0.077	0.008	<0.002 U	3.84	0.05 J	<0.01 U
12/13/2016	Background	0.01 J	4.36	27.1	0.009 J	<0.004 U	0.952	0.075	0.288	1.19	0.068	0.011	<0.002 U	6.11	0.05 J	<0.01 U
2/8/2017	Background	<0.01 U	4.09	25.5	0.032	0.005 J	0.571	0.287	1.109	1.33	0.279	0.009	<0.002 U	5.55	0.1	0.02 J
3/14/2017	Background	0.02 J	3.72	31.9	0.071	0.02	1.01	0.573	2.863	1.20	0.651	0.010	0.002 J	3.46	0.2	0.02 J
5/23/2017	Background	0.03 J	3.59	27.2	0.043	0.009 J	0.605	0.341	0.796	1.17	0.333	0.010	<0.002 U	3.70	0.1	<0.01 U
6/21/2017	Background	0.03 J	3.80	27.7	0.028	0.01 J	0.490	0.234	1.1188	1.19	0.229	0.004	0.003 J	4.57	0.08 J	0.03 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-4
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.173	0.914	14.1	1.49	9.9	368	10.7
10/18/2016	Background	0.165	0.807	13.9	1.33	9.8	386	11.7
11/7/2016	Background	0.203	0.842	14.6	1.44	9.5	376	11.1
12/13/2016	Background	0.180	0.836	15.7	1.34	9.0	372	8.0
2/8/2017	Background	0.17	0.807	14.9	1.4	9.3	412	8.0
3/14/2017	Background	0.173	0.855	14.5	1.46	8.8	381	7.4
5/23/2017	Background	0.190	0.750	15.3	1.38	9.2	390	7.9
6/20/2017	Background	0.161	0.814	15.1	1.36	9.1	392	7.6
11/1/2017	Detection	0.194	0.766	14.2	1.36	9.4	404	9.3
1/8/2018	Detection	0.145	- -	- -	1.37	3.3	- -	- -
5/1/2018	Detection	0.199	0.783	14.9	1.47	9.2	380	9.0
11/28/2018	Detection	0.188	0.807	14.1	1.42	8.8	383	8.8
6/12/2019	Detection	0.167	0.788	14.4	1.46	8.6	415	9.0

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-4
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.01 J	9.61	24.1	0.020	0.11	0.9	0.158	0.444	1.49	0.371	0.008	<0.002 U	8.82	0.09 J	<0.01 U
10/18/2016	Background	<0.01 U	8.81	20.2	<0.005 U	0.006 J	0.064	0.014	0.152	1.33	0.021	0.002	<0.002 U	8.01	<0.03 U	0.03 J
11/7/2016	Background	<0.01 U	9.07	21.5	<0.005 U	<0.004 U	1.68	0.029	1.56	1.44	0.007 J	0.003	<0.002 U	8.14	<0.03 U	<0.01 U
12/13/2016	Background	<0.01 U	9.44	22.4	<0.005 U	<0.004 U	0.169	0.011	0.16	1.34	0.009 J	0.007	<0.002 U	8.94	<0.03 U	0.02 J
2/8/2017	Background	<0.01 U	8.78	19.2	0.006 J	<0.004 U	0.122	0.043	0.567	1.4	0.064	0.006	<0.002 U	8.15	<0.03 U	0.03 J
3/14/2017	Background	<0.01 U	10.1	20.4	0.005 J	0.005 J	0.523	0.041	1.456	1.46	0.114	0.006	<0.002 U	9.7	<0.03 U	<0.01 U
5/23/2017	Background	0.02 J	8.96	21.1	<0.004 U	<0.005 U	0.104	0.008 J	0.872	1.38	0.01 J	0.012	<0.002 U	8.21	<0.03 U	<0.01 U
6/20/2017	Background	0.02 J	9.15	21.8	0.004 J	0.005 J	0.157	0.037	0.905	1.36	0.039	0.005	<0.002 U	7.86	0.05 J	<0.01 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-5
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.032	18.4	3.59	0.14	9.9	124	29.3
10/18/2016	Background	0.034	15.6	3.61	0.12	6.4	148	29.3
11/8/2016	Background	0.034	14.3	3.52	0.11	6.3	92	25.5
12/13/2016	Background	0.015	14.6	3.61	0.07	8.2	100	24.3
2/8/2017	Background	0.030	14.1	3.54	0.09	6.4	126	24.0
3/16/2017	Background	0.026	15.9	3.72	0.09	7.0	158	24.9
5/23/2017	Background	0.032	13.7	3.7	0.09	6.3	108	24.2
6/20/2017	Background	0.017	14.5	3.66	0.08	6.0	102	27.8
11/1/2017	Detection	0.046	15.6	4.09	0.09	6.1	136	28.4
1/8/2018	Detection	- -	- -	4.22	- -	6.7	- -	- -
5/2/2018	Detection	0.123	14.3	4.39	0.09	6.2	122	26.3
6/20/2018	Detection	0.126	- -	4.61	- -	6.1	- -	- -
11/28/2018	Detection	- -	- -	- -	- -	7.4	- -	- -
11/29/2018	Detection	<0.02 U	14.1	4.86	0.13	- -	113	24.5
12/17/2018	Detection	- -	- -	4.77	- -	6.2	- -	- -
6/12/2019	Detection	0.02 J	16.2	4.60	0.11	6.1	132	26.4
7/22/2019	Detection	- -	- -	4.61	- -	6.0	- -	- -

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-5
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.04 J	0.47	93.3	0.02 J	0.07	0.3	0.188	1.025	0.14	0.263	0.006	<0.002 U	0.17	0.1	0.01 J
10/18/2016	Background	0.04 J	0.34	82.5	0.02 J	0.02	0.546	0.198	0.353	0.12	0.250	0.005	<0.002 U	0.16	0.2	0.03 J
11/8/2016	Background	0.04 J	0.49	80.1	0.050	0.05	0.945	0.446	1.847	0.11	0.698	<0.0002 U	<0.002 U	0.14	0.1	0.01 J
12/13/2016	Background	0.04 J	0.51	80.9	0.033	0.03	0.622	0.339	1.18	0.07	0.442	0.010	<0.002 U	0.18	0.2	0.07
2/8/2017	Background	0.02 J	0.30	70.2	0.022	0.02 J	0.465	0.217	0.5868	0.09	0.257	0.005	<0.002 U	0.14	0.1	0.02 J
3/16/2017	Background	0.09	2.32	121	0.183	0.21	4.43	2.92	1.096	0.09	3.77	0.002	0.008	0.40	0.9	0.04 J
5/23/2017	Background	0.06	0.21	77.7	0.01 J	0.02	0.248	0.072	1.312	0.09	0.093	0.011	<0.002 U	0.14	0.09 J	<0.01 U
6/20/2017	Background	0.02 J	0.25	80.6	0.01 J	0.03	0.291	0.092	1.141	0.08	0.097	<0.0002 U	<0.002 U	0.09 J	0.09 J	<0.01 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-6
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.095	40.7	7.78	0.26	7.6	408	41.3
10/19/2016	Background	0.093	39.8	7.67	0.23	7.9	438	51.1
11/7/2016	Background	0.147	42.7	7.76	0.25	7.7	426	51.6
12/12/2016	Background	0.109	44.4	8.17	0.20	7.5	414	54.0
2/7/2017	Background	0.122	36.7	7.2	0.23	7.5	380	31.1
3/16/2017	Background	0.098	37.1	7.09	0.24	7.9	388	29.1
5/22/2017	Background	0.171	33.7	6.89	0.23	7.7	359	24.7
6/19/2017	Background	0.154	37.2	7.01	0.21	7.4	386	33.1
11/2/2017	Detection	0.159	41.3	7.77	0.22	7.5	440	51.8
5/1/2018	Detection	0.163	33.4	6.94	0.26	7.4	358	24.7
11/28/2018	Detection	0.156	35.8	6.85	0.24	7.6	333	22.9
6/12/2019	Detection	0.08 J	32.8	6.85	0.28	7.7	363	21.9

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-6
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.04 J	6.03	245	0.036	0.03	0.5	0.183	2.318	0.26	0.461	0.015	<0.002 U	0.77	0.09 J	0.138
10/19/2016	Background	0.02 J	6.42	235	0.033	0.005 J	0.413	0.148	0.697	0.23	0.381	0.015	<0.002 U	0.36	0.09 J	0.02 J
11/7/2016	Background	0.01 J	6.64	250	0.009 J	<0.004 U	0.160	0.023	2.70	0.25	0.053	0.011	<0.002 U	0.36	<0.03 U	<0.01 U
12/12/2016	Background	0.01 J	7.36	246	0.006 J	0.01 J	0.104	0.020	1.878	0.20	0.039	0.023	<0.002 U	0.39	0.04 J	0.03 J
2/7/2017	Background	<0.01 U	5.47	199	0.02 J	<0.004 U	0.207	0.073	1.151	0.23	0.160	0.013	<0.002 U	0.44	0.05 J	0.01 J
3/16/2017	Background	0.03 J	4.44	224	<0.005 U	0.005 J	0.498	0.028	1.844	0.24	0.048	0.009	0.003 J	0.53	0.03 J	<0.01 U
5/22/2017	Background	0.04 J	4.58	218	0.02 J	0.009 J	0.175	0.063	2.40	0.23	0.117	0.019	<0.002 U	0.50	0.04 J	0.01 J
6/19/2017	Background	0.03 J	4.86	233	0.01 J	<0.005 U	0.274	0.051	1.617	0.21	0.136	0.011	<0.002 U	0.44	0.04 J	<0.01 U

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-7R
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.106	31.0	4.13	0.36	7.7	678	228
10/18/2016	Background	0.083	30.9	3.86	0.32	8.0	706	229
11/8/2016	Background	0.102	33.5	3.78	0.31	7.0	618	209
12/14/2016	Background	0.084	32.2	3.94	0.26	7.6	606	217
2/9/2017	Background	0.071	37.7	3.45	0.22	7.6	542	186
3/14/2017	Background	0.078	33.6	3.79	0.30	7.7	640	215
5/24/2017	Background	0.072	30.4	3.80	0.29	7.6	663	226
6/21/2017	Background	0.092	32.5	3.60	0.26	7.6	680	246
11/2/2017	Detection	0.109	31.7	3.59	0.28	7.6	636	211
5/1/2018	Detection	0.145	30.3	4.09	0.36	7.7	688	239
11/28/2018	Detection	0.118	44.4	3.65	0.26	7.4	627	201
6/12/2019	Detection	0.1 J	36.8	3.75	0.35	7.4	700	226

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-7R
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.11	8.37	60.8	0.155	0.04	1.0	0.368	1.043	0.36	1.52	0.016	0.004 J	25.7	0.4	0.061
10/18/2016	Background	0.07	7.13	51.4	0.111	0.01 J	0.760	0.279	0.959	0.32	0.961	0.012	0.002 J	23.2	0.3	0.03 J
11/8/2016	Background	0.08	5.81	42.2	0.026	0.02	2.82	0.084	1.895	0.31	0.261	0.013	<0.002 U	17.5	0.2	0.01 J
12/14/2016	Background	0.09	7.33	44.3	0.028	0.01 J	1.73	0.103	0.962	0.26	0.249	0.014	<0.002 U	24.6	0.2	0.02 J
2/9/2017	Background	0.05	4.21	41.7	0.01 J	0.01 J	0.217	0.065	0.0996	0.22	0.156	0.012	<0.002 U	11.7	0.08 J	0.02 J
3/14/2017	Background	0.08	7.02	40.2	0.01 J	0.01 J	0.234	0.064	2.735	0.30	0.154	0.010	<0.002 U	24.6	0.1	0.02 J
5/24/2017	Background	0.10	7.48	42.0	0.01 J	0.01 J	0.242	0.080	0.3888	0.29	0.171	0.016	<0.002 U	25.7	0.2	0.01 J
6/21/2017	Background	0.08	6.69	39.1	0.006 J	0.006 J	0.154	0.043	1.497	0.26	0.064	0.010	<0.002 U	22.9	0.1	0.01 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-8
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.021	141	13.3	0.16	7.0	578	73.6
10/19/2016	Background	0.037	135	12.6	0.15	7.2	538	66.5
11/9/2016	Background	0.029	137	5.12	0.07	6.9	532	26.1
12/14/2016	Background	0.017	136	14.2	0.13	6.8	504	59.7
2/8/2017	Background	0.092	132	12.9	0.15	6.9	540	67.5
3/15/2017	Background	0.074	151	13.5	0.16	7.2	623	74.5
5/24/2017	Background	0.031	137	13.9	0.14	6.8	596	73.2
6/20/2017	Background	0.034	139	12.6	0.13	6.9	574	77.2
11/2/2017	Detection	0.031	125	12.1	0.15	6.8	526	63.1
5/1/2018	Detection	0.065	136	13.1	0.17	6.9	592	78.8
11/29/2018	Detection	0.05 J	126	13.2	0.17	6.8	558	58.8
6/12/2019	Detection	0.03 J	125	8.58	0.20	7.6	540	54.5

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-8
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.04 J	0.41	221	0.021	0.04	0.4	0.27	0.776	0.16	0.393	0.013	<0.002 U	0.4	0.2	0.03 J
10/19/2016	Background	0.03 J	0.35	195	0.01 J	0.04	0.158	0.14	0.746	0.15	0.279	0.006	<0.002 U	0.07 J	0.2	0.02 J
11/9/2016	Background	0.02 J	0.25	209	0.008 J	<0.004 U	0.164	0.082	1.113	0.07	0.028	0.004	<0.002 U	0.08 J	0.2	0.02 J
12/14/2016	Background	0.03 J	0.32	212	0.008 J	0.008 J	0.097	0.083	1.582	0.13	0.062	0.013	<0.002 U	0.10	0.2	0.02 J
2/8/2017	Background	0.03 J	0.37	192	0.01 J	0.007 J	0.131	0.059	1.223	0.15	0.109	0.007	<0.002 U	0.47	0.1	0.136
3/15/2017	Background	0.05 J	1.44	270	0.069	0.02 J	2.39	1.02	3.405	0.16	1.43	0.011	0.003 J	0.28	0.4	0.02 J
5/24/2017	Background	0.07	0.47	201	0.02 J	0.009 J	0.354	0.201	1.257	0.14	0.260	0.016	<0.002 U	0.11	0.2	0.01 J
6/20/2017	Background	0.03 J	0.35	182	0.02 J	0.007 J	0.192	0.077	1.065	0.13	0.142	0.005	<0.002 U	0.07 J	0.3	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-9
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.064	80.1	6.3	0.24	7.3	414	37.3
10/19/2016	Background	0.042	103	6.09	0.18	7.5	444	36.4
11/9/2016	Background	0.076	90.6	6.11	0.22	7.2	420	34.5
12/13/2016	Background	0.057	94.4	6.59	0.18	7.1	390	35.1
2/8/2017	Background	0.052	99.0	6.22	0.16	7.1	382	34.9
3/15/2017	Background	0.093	99.1	6.26	0.22	7.4	402	35.8
5/23/2017	Background	0.084	86.4	6.21	0.18	7.1	438	34.8
6/20/2017	Background	0.079	93.8	6.17	0.15	7.0	424	38.4
11/2/2017	Detection	0.075	79.1	5.97	0.20	7.1	404	33.1
5/1/2018	Detection	0.200	73.1	6.14	0.26	7.2	402	30.9
11/29/2018	Detection	0.09 J	78.8	6.08	0.21	7.1	412	31.6
6/11/2019	Detection	0.04 J	97.6	6.03	0.20	7.3	436	37.9

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-9
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.07	1.45	443	0.025	0.03	0.8	0.464	1.831	0.24	0.565	0.017	<0.002 U	0.48	0.2	0.03 J
10/19/2016	Background	0.04 J	3.75	441	0.025	0.01 J	0.625	0.372	3.035	0.18	0.478	0.010	<0.002 U	0.27	0.1	0.03 J
11/9/2016	Background	0.05 J	1.12	491	<0.005 U	0.02 J	0.207	0.020	1.735	0.22	0.046	0.008	<0.002 U	0.41	0.1	0.03 J
12/13/2016	Background	0.04 J	1.23	497	<0.005 U	0.04	0.540	0.032	0.39	0.18	0.084	0.019	<0.002 U	0.56	0.2	<0.01 U
2/8/2017	Background	0.02 J	1.78	388	<0.005 U	0.03	0.078	0.033	1.448	0.16	0.058	0.012	<0.002 U	0.27	0.1	0.02 J
3/15/2017	Background	0.04 J	4.40	603	0.074	0.04	1.43	1.51	2.365	0.22	1.81	0.009	0.002 J	0.37	0.5	0.04 J
5/23/2017	Background	0.07	0.96	425	<0.004 U	0.02 J	0.117	0.021	2.173	0.18	0.063	0.021	<0.002 U	0.37	0.2	0.02 J
6/20/2017	Background	0.05 J	1.35	441	<0.004 U	0.03	0.094	0.066	1.992	0.15	0.038	0.014	<0.002 U	0.33	0.07 J	0.02 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 1 - Groundwater Data Summary: MW-10
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.087	1.68	5.54	0.89	9.0	512	19.1
10/19/2016	Background	0.081	1.09	4.49	0.72	9.6	504	18.0
11/9/2016	Background	0.118	2.31	5.46	0.92	8.9	546	16.9
12/13/2016	Background	0.076	1.24	4.15	0.38	8.7	482	14.1
2/8/2017	Background	0.113	1.37	4.24	0.57	9.1	504	14.4
3/14/2017	Background	0.125	1.18	4.6	0.50	8.7	499	13.3
5/24/2017	Background	0.081	1.16	4.19	0.43	8.9	467	14.3
6/20/2017	Background	0.078	1.04	4.11	0.44	8.6	492	14.9
11/2/2017	Detection	0.095	1.12	5.08	0.55	9.2	508	17.0
5/2/2018	Detection	0.157	1.74	5.67	0.69	9.2	522	16.7
11/29/2018	Detection	0.174	1.03	5.27	0.59	8.7	506	15.3
6/11/2019	Detection	0.08 J	1.03	5.12	0.72	9.0	524	16.0

Notes:
mg/L: milligrams per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed

Table 1 - Groundwater Data Summary: MW-10
Amos - LF
Appendix IV Constituents

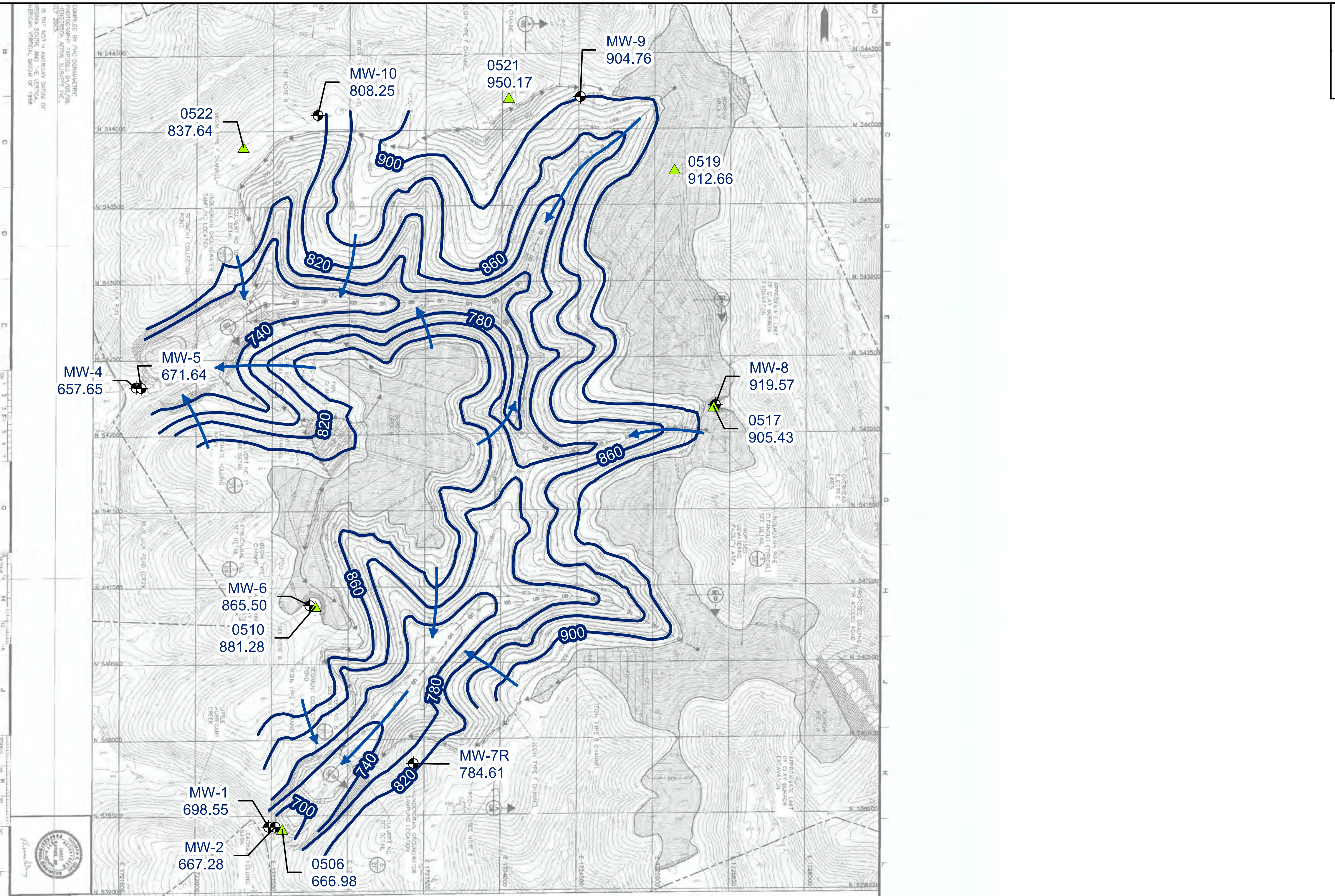
Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.36	24.5	105	0.058	0.26	0.5	0.367	0.769	0.89	1.11	0.010	0.003 J	3.08	0.5	0.01 J
10/19/2016	Background	0.26	19.4	62.4	0.02 J	0.01 J	0.373	0.102	0.0283	0.72	0.357	0.008	<0.002 U	2.58	0.4	0.082
11/9/2016	Background	0.38	21.5	144	0.264	0.05	3.96	1.66	0.168	0.92	3.41	0.007	0.004 J	2.53	1.1	0.057
12/13/2016	Background	0.63	17.1	69.8	0.029	0.20	1.63	0.212	0.0992	0.38	0.895	0.019	<0.002 U	2.79	0.7	<0.01 U
2/8/2017	Background	0.38	22.8	92.9	0.124	0.04	2.28	0.850	0.14643	0.57	1.89	0.008	0.003 J	2.76	1.9	0.071
3/14/2017	Background	0.32	21.2	69.0	0.039	0.01 J	0.965	0.28	2.089	0.50	0.635	0.01	0.003 J	3.38	2.3	0.02 J
5/24/2017	Background	0.23	9.07	55.6	0.022	0.02 J	0.500	0.151	1.06	0.43	0.469	0.011	<0.002 U	3.52	0.5	0.01 J
6/20/2017	Background	0.30	17.7	61.7	0.025	0.01 J	0.577	0.170	0.1376	0.44	0.448	0.004	<0.002 U	2.40	1.0	0.01 J

Notes:
µg/L: micrograms per liter
SU: standard unit
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed
pCi/L: picocuries per liter

Table 2: Residence Time Calculation Summary
Amos Landfill

			2019-06	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW-1 [2]	2.0	3.1	19.3
	MW-2 [2]	2.0	0.6	94.3
	MW-4 [2]	2.0	1.8	33.5
	MW-5 [2]	2.0	1.8	33.5
	MW-6 [1]	2.0	1.9	31.3
	MW-7R [1]	2.0	0.8	72.3
	MW-8 [1]	2.0	2.3	26.2
	MW-9 [1]	2.0	3.4	18.2
	MW-10 [1]	2.0	1.1	56.7

Notes:
[1] - Background Well
[2] - Downgradient Well



Legend
- Groundwater Monitoring Well
- Piezometer
- Groundwater Flow Direction
- Groundwater Elevation Contour

Notes
- Monitoring well coordinates and water level data (collected on June 10, 2019) provided by AEP.
- Potentiometric surface contour interval is 40 feet.
- Topography and drainage system basemap from AEP Drawing No. 13-30500-05-A (topographic contour interval: 10 feet).
- Groundwater elevation units are feet above mean sea level.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
June 2019

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/01/29

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_Landfill_GW_2019-06.mxd. ARevezzo. 1/29/2020. CHA8423/04/08.

APPENDIX 2

The statistical analysis reports follow.

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date: March 6, 2019

To: David Miller (AEP)

Copies to: Benjamin Kepchar (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Amos Plant's Landfill

---

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Part D, "CCR rule"), detection monitoring events were completed on November 28-29, 2018 and December 17-18, 2018 at the Landfill (LF), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values based on the eight background monitoring events conducted prior to October 17, 2017. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 13, 2018 which resulted in a revision to the calculated prediction limits for boron and fluoride.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.

- Boron concentrations exceeded the intrawell UPL of 0.231 mg/L in both the initial (0.235 mg/L) and second (0.285 mg/L) samples collected at MW-2. Therefore, an SSI over background is concluded for boron at MW-2.

- Chloride concentrations exceeded the intrawell UPL of 3.81 mg/L in both the initial (4.86 mg/L) and second (4.77 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for chloride at MW-5.

In response to the exceedances noted above the Amos LF CCR unit will either transition to assessment monitoring or an alternate source demonstration for boron and chloride will be conducted.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 259.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Landfill

Parameter	Units	Description	MW-1		MW-2		MW-4	MW-5	
			11/29/2018	12/18/2018	11/28/2018	12/17/2018	11/28/2018	11/29/2018	12/17/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.134		0.231		0.213	0.047	
		Detection Monitoring Result	**0.143**	0.070	**0.235**	**0.285**	0.188	0.02	-
Calcium	mg/L	Intrawell Background Value (UPL)	32.6		2.12		0.951	19.1	
		Detection Monitoring Result	26.4	-	1.84	-	0.807	14.1	-
Chloride	mg/L	Intrawell Background Value (UPL)	4.94		5.26		16.4	3.81	
		Detection Monitoring Result	3.07	-	5.09	-	14.1	**4.86**	**4.77**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.11		1.43		1.55	0.16	
		Detection Monitoring Result	0.11	-	1.15	-	1.42	0.13	-
pH	SU	Intrawell Background Value (UPL)	7.66		9.29		10.33	10.57	
		Intrawell Background Value (LPL)	5.36		7.91		8.29	3.55	
		Detection Monitoring Result	6.21	6.52	8.49	8.61	8.84	7.39	6.16
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0		15.5		13.7	32.1	
		Detection Monitoring Result	27.8	-	8.5	-	8.8	24.5	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275		387		421	182	
		Detection Monitoring Result	191	-	355	-	383	113	-

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
-: Not Sampled
Bold values exceed the background value.
Background values are shaded gray.
Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663	WEST VIRGINIA	03.19.19
License Number	Licensing State	Date

Geosyntec consultants

941 Chatham Lane, Suite 103
Columbus, Ohio 43212
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date: August 27, 2019

To: David Miller (AEP)

Copies to: Benjamin Kepchar (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Amos Plant's Landfill

---

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Part D, "CCR rule"), detection monitoring sampling events were completed on June 11-12, 2019 and July 22, 2019 at the Landfill (LF), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values based on the eight background monitoring events conducted prior to October 17, 2017. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 13, 2018 which resulted in a revision to the calculated prediction limits for boron and fluoride.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1. Chloride concentrations exceeded the intrawell UPL of 3.81 mg/L in both the initial (4.60 mg/L) and second (4.61 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for chloride at MW-5.

In response to the exceedances noted above the Amos LF CCR unit will either transition to assessment monitoring or an alternate source demonstration for chloride will be conducted.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 259.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Geosyntec Consultants, Inc.

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Landfill

Parameter	Units	Description	LF-MW-1	LF-MW-2		LF-MW-4	LF-MW-5	
			6/11/2019	6/11/2019	7/22/2019	6/12/2019	6/12/2019	7/22/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.134	0.231		0.213	0.0473	
		Detection Monitoring Result	0.0400	0.215	--	0.167	0.0200	--
Calcium	mg/L	Intrawell Background Value (UPL)	32.6	2.12		0.951	19.1	
		Detection Monitoring Result	28.1	1.80	--	0.788	16.2	--
Chloride	mg/L	Intrawell Background Value (UPL)	4.94	5.26		16.4	3.81	
		Detection Monitoring Result	2.86	3.26	--	14.4	**4.60**	**4.61**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.111	1.43		1.55	0.159	
		Detection Monitoring Result	0.110	**1.63**	1.41	1.46	0.110	--
pH	SU	Intrawell Background Value (UPL)	7.7	9.3		10.3	10.6	
		Intrawell Background Value (LPL)	5.4	7.9		8.3	3.6	
		Detection Monitoring Result	7.0	8.7	--	8.6	6.1	--
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0	15.5		13.7	32.1	
		Detection Monitoring Result	29.9	9.40	--	9.00	26.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275	387		421	182	
		Detection Monitoring Result	184	379	--	415	132	--

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

Bold values exceed the background value.

Background values are shaded gray.

--: Not Sampled

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the UPL.

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

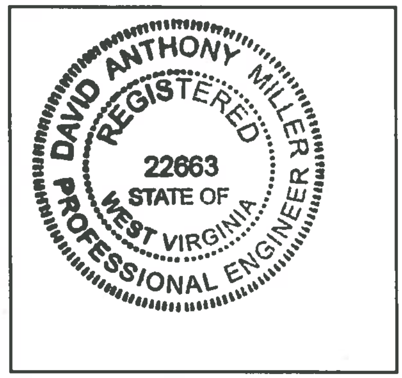
I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature



22663	WEST VIRGINIA	08.29.19
License Number	Licensing State	Date

APPENDIX 3

The alternative source demonstrations follow.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Amos Plant Landfill
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

March 15, 2019

CHA8462

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
bgs	Below ground surface
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

Eight background monitoring events were previously conducted at the Amos Plant Landfill according to the Coal Combustion Residuals (CCR) Rule [40 CFR 257.90 *et seq.*]. Upper prediction limits (UPLs) were calculated for each Appendix III parameter and lower prediction limits (LPLs) were also calculated for pH, to represent background values. A one-of-two retesting procedure was employed for all groundwater samples collected in the monitoring well network. On this basis a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL or lie below the LPL in the case of pH. Generally, if the initial result did not exceed a prediction limit, a second sample was not collected. These prediction limits were recalculated to reflect natural variability, as described in the Alternate Source Demonstration (ASD) report prepared on April 13, 2018 (Geosyntec, 2018).

The second semi-annual detection monitoring event of 2018 was completed in November and December 2018, and the results were compared to the calculated prediction limits. SSIs were identified for the following constituents listed in 40 CFR Part 257 Appendix III:

- Boron at MW-2; and
- Chloride at MW-5.

The two SSIs above were based on intrawell comparisons, following the procedure indicated in the April 2018 ASD report. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared are listed in Table 1.

1.1 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of CCR in landfills and surface impoundments, Rule 40 CFR 257.94(e)(2) states the following:

> *The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.*

The second semi-annual detection monitoring event for 2018 was completed in November and December 2018 at the Amos Plant Landfill to identify SSIs over background limits. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report, which documents that the SSIs cited above should not be attributed to the Amos Plant Landfill.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which identified SSIs could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the increases in constituent concentrations were based on a Type I cause at MW-2 and a Type V cause at MW-5 and not by a release from the Amos Plant Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that a source other than the CCR unit caused the SSI. Identified SSIs, evaluation methodology, and the proposed alternative source are described below.

2.1 <u>Proposed Alternative Source</u>

A review of the sampling methods used identified a Type I issue for the boron SSI at MW-2. A review of the laboratory and statistical methods used did not identify any Type II or Type III issues. A review of site geochemistry revealed anthropogenic impacts as a source of the chloride SSI at MW-5, which is a Type V ASD.

2.1.1 MW-2

A review of the field quality control (QC) sample results for the November 2018 sampling event identified boron contamination in the equipment blanks and field blanks, which likely impacted the associated sample result as a high bias for boron. An equipment blank and field blank were routinely collected during each sampling event to evaluate the equipment decontamination procedure and ambient environmental conditions where sample collection took place.

The boron concentration at MW-2 was 0.235 milligrams per liter (mg/L). However, boron was detected in the equipment blank and field blank at 0.04 and 0.05 mg/L, respectively. Because the blank concentrations are greater than 10% of the sample concentration, the sample result is considered suspect. The QC procedure indicates that the sample result should be considered estimated with a high bias. The November 2018 analytical report may be found in Attachment A.

A verification sample was collected at MW-2 in December 2018, with a reported boron concentration of 0.285 mg/L. Again, boron was detected in the equipment blank and field blank (0.03 mg/L and 0.02 mg/L, respectively). The boron detection in the equipment blank is greater than 10% of the sample concentration and, therefore, the sample result is considered suspect. The QC procedure again indicates that the sample result should be considered estimated with a high bias. These results are contained in the December 2018 analytical report (Attachment B).

To verify whether cross contamination resulted in biased sample results, an additional sample and duplicate sample were collected at MW-2 on January 24, 2019. A field blank and equipment blank were also collected during this event. The reported boron concentrations for the primary and duplicate samples at MW-2 were 0.218 and 0.212 mg/L, respectively, which are below the intrawell UPL (0.231 mg/L). Boron was not detected in either the field blank or the equipment blank during this sampling event, suggesting that cross-contamination was not an issue during the January 2019 sampling event. The analytical report for this event may be found in Attachment C.

These observations indicate that a Type I alternative source was responsible for the boron SSI at MW-2. The additional samples collected at MW-2 on January 24, 2019, in which the boron concentration was found to be 0.218 mg/L in the primary sample (and 0.212 mg/L in the duplicate), is considered more representative of the groundwater conditions at MW-2 than both the initial sample collected in November 2018 and the verification sample collected in December 2018 for the reasons described above.

2.1.2 MW-5

The Amos Plant Landfill consists of a northern valley and southern valley which are surrounded by bedrock ridges. A topographic high point separates the two valleys (Arcadis, 2016), as shown in Figure 1. MW-5 is a designated downgradient well in the northern valley, which is hydrologically distinct from the southern valley, due to separation by the topographic high point. Significantly, no CCR waste has yet been placed in the northern valley, although landfill construction has been ongoing since 2013. The absence of CCR waste in the northern valley makes it extremely unlikely that the chloride SSI is attributable to CCRs at MW-5.

In addition, MW-5 is a shallow well which is screened between 5 and 10 feet below ground surface (bgs) and intercepts a perched groundwater zone (referred to in Figure 5B of the Groundwater Monitoring Well Network Evaluation report by Arcadis, 2016). The proximity of the screened interval to the ground surface suggests that MW-5 may be susceptible to impacts from surface activities in the northern valley. For example, construction activities, which include excavation and stockpiling as well as road salting may have released chloride which has affected the perched water table.

In conclusion, because MW-5 was installed in the perched groundwater zone and has a shallow screen depth (5-10 ft bgs), groundwater quality at MW-5 is potentially susceptible to influence from non-CCR sources as described above. Additionally, the absence of waste placement at hydrologically upgradient locations suggest that the SSIs for chloride have not been caused by a release from the storage unit. Thus, the exceedance at MW-5 was attributed to a Type V issue.

2.2 <u>Sampling Requirements</u>

As this ASD supports a position that the identified SSIs are not due to a release from the Amos Plant Landfill, the unit will remain in the detection monitoring program. Groundwater at the unit will continue to be sampled for Appendix III parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Amos Plant Landfill during the second semi-annual detection monitoring event that was conducted in November and December 2018. A review of sampling results identified sampling errors which likely resulted in the boron SSI at MW-2. The lack of waste placement upgradient of MW-5 provides evidence that the observed chloride concentrations were not caused by a release from the Landfill. Therefore, no further action is warranted, and the Amos Plant Landfill will remain in the detection monitoring program.

SECTION 4

REFERENCES

Arcadis. 2016. FGD Landfill – CCR Groundwater Monitoring Well Network Evaluation. October 2016.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Site. 3002010920. October 2017.

Geosyntec Consultants, 2018. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. April 2018.

U.S. EPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

TABLES

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Landfill

Parameter	Units	Description	MW-1		MW-2		MW-4	MW-5	
			11/29/2018	12/18/2018	11/28/2018	12/17/2018	11/28/2018	11/29/2018	12/17/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.134		0.231		0.213	0.047	
		Detection Monitoring Result	**0.143**	0.070	**0.235**	**0.285**	0.188	0.02	-
Calcium	mg/L	Intrawell Background Value (UPL)	32.6		2.12		0.951	19.1	
		Detection Monitoring Result	26.4	-	1.84	-	0.807	14.1	-
Chloride	mg/L	Intrawell Background Value (UPL)	4.94		5.26		16.4	3.81	
		Detection Monitoring Result	3.07	-	5.09	-	14.1	**4.86**	**4.77**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.11		1.43		1.55	0.16	
		Detection Monitoring Result	0.11	-	1.15	-	1.42	0.13	-
pH	SU	Intrawell Background Value (UPL)	7.66		9.29		10.33	10.57	
		Intrawell Background Value (LPL)	5.36		7.91		8.29	3.55	
		Detection Monitoring Result	6.21	6.52	8.49	8.61	8.84	7.39	6.16
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0		15.5		13.7	32.1	
		Detection Monitoring Result	27.8	-	8.5	-	8.8	24.5	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275		387		421	182	
		Detection Monitoring Result	191	-	355	-	383	113	-

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
-: Not Sampled
Bold values exceed the background value.
Background values are shaded gray.
Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated

FIGURES

Legend
- Upgradient Sampling Location
- Downgradient Sampling Location

Name
- Northern Valley
- Southern Valley
- Inferred Groundwater Flow Direction
- FGD Landfill

Notes
- Monitoring well coordinates provided by AEP.
- Aerial imagery provided by DigitalGlobe and dated 8/30/2016.

700 350 0 700 Feet

Site Layout
FGD Landfill

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/09/28

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_Site_Layout_GW Flow_2018-04_April.mxd. SKaroly. 9/28/2018. CHA8423/04/08.

ATTACHMENT A

ANALYTICAL LABORATORY DATA
NOVEMBER 2018 QUALITY CONTROL SAMPLES

LF-CCR-Dup Dissolved

Sample Number: 184013-010A **Date Collected:** 11/28/2018 **Date Received:** 11/30/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Iron, Fe	0.02	mg/L	J	0.02	0.003	DAM	12/07/2018 08:43	EPA 200.7-1994, Rev. 4.4
Manganese, Mn	0.0478	mg/L		0.001	0.0002	DAM	12/07/2018 08:43	EPA 200.7-1994, Rev. 4.4

LF-CCR-FB

Sample Number: 184013-011 **Date Collected:** 11/29/2018 11:10 **Date Received:** 11/30/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.05	mg/L	J	0.1	0.02	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.1	mg/L	J	0.3	0.04	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	0.02	mg/L	J	0.05	0.01	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	0.5	0.2	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Sodium, Na	0.2	mg/L	J	0.2	0.06	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	0.0008	mg/L	J	0.005	0.0008	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 3	mg/L	U	10	3	MGK	12/03/2018	SM 2320B-2011
Bromide, Br	< 0.04	mg/L	U	0.2	0.04	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.01	mg/L	U	0.04	0.01	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.01	mg/L	U	0.06	0.01	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	< 5	mg/L	U	20	5	KAL	12/04/2018	SM 2540C-2011
Sulfate, SO4	< 0.06	mg/L	U	0.4	0.06	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0

LF-CCR-EB

Sample Number: 184013-012 **Date Collected:** 11/29/2018 11:00 **Date Received:** 11/30/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.04	mg/L	J	0.1	0.02	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.1	mg/L	J	0.3	0.04	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	< 0.01	mg/L	U	0.05	0.01	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	0.5	0.2	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Sodium, Na	< 0.06	mg/L	U	0.2	0.06	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	< 0.0008	mg/L	U	0.005	0.0008	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 3	mg/L	U	10	3	MGK	12/03/2018	SM 2320B-2011
Bromide, Br	< 0.04	mg/L	U	0.2	0.04	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.01	mg/L	U	0.04	0.01	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.01	mg/L	U	0.06	0.01	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	< 5	mg/L	U	20	5	KAL	12/04/2018	SM 2540C-2011
Sulfate, SO4	< 0.06	mg/L	U	0.4	0.06	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit
J: Analyte was positively identified, though the quantitation was below Reporting Limit.

Michael Ohlinger, Chemist

Email msohlinger@aep.com *Tel.*

Fax 614-836-4168 *Audinet 8-210-*

ATTACHMENT B

ANALYTICAL LABORATORY DATA
DECEMBER 2018 QUALITY CONTROL SAMPLES

Form REP-703
Rev. 1, 11/2013

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Amos Plant ***Report Date: 12/26/2018***

LF-CCR-MW-1

Sample Number: 184285-001 **Date Collected: 12/18/2018 10:10** **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.07	mg/L	J	0.1	0.02	DAM	12/21/2018 11:20	EPA 200.7-1994, Rev. 4.4

LF-CCR-MW-2

Sample Number: 184285-002 **Date Collected: 12/17/2018 11:25** **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.285	mg/L		0.1	0.02	DAM	12/21/2018 11:32	EPA 200.7-1994, Rev. 4.4

LF-CCR-MW-5

Sample Number: 184285-003 **Date Collected: 12/17/2018 13:20** **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.08	mg/L	J	0.1	0.02	DAM	12/21/2018 11:42	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	4.77	mg/L		0.04	0.01	CRJ	12/20/2018 16:15	EPA 300.1-1997, Rev. 1.0

LF-Verification-EB-1

Sample Number: 184285-004 **Date Collected: 12/18/2018 08:50** **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.03	mg/L	J	0.1	0.02	DAM	12/21/2018 11:45	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	0.01	mg/L	J	0.04	0.01	CRJ	12/20/2018 15:29	EPA 300.1-1997, Rev. 1.0

LF-Verification-FB-1

Sample Number: 184285-005 **Date Collected: 12/18/2018 10:15** **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.02	mg/L	J	0.1	0.02	DAM	12/21/2018 11:48	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	0.03	mg/L	J	0.04	0.01	CRJ	12/20/2018 15:52	EPA 300.1-1997, Rev. 1.0

LF-Verification-DUP-1

Sample Number: **184285-006** **Date Collected:** **12/18/2018** **Date Received:** **12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.04	mg/L	J	0.1	0.02	DAM	12/21/2018 11:51	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	4.77	mg/L		0.04	0.01	CRJ	12/20/2018 16:38	EPA 300.1-1997, Rev. 1.0

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit
J: Analyte was positively identified, though the quantitation was below Reporting Limit.

Michael S Ohlinger

Michael Ohlinger, Chemist
Email msohlinger@aep.com *Tel.*
Fax 614-836-4168 *Audinet 8-210-*

ATTACHMENT C

ANALYTICAL LABORATORY DATA
JANUARY 2019 QUALITY CONTROL SAMPLES

Form REP-703
Rev. 1, 11/2013

Dolan Chemical Laboratory
4001 Bixby Road
Groveport, OH 43125
T: 614-836-4221, Audinet 210-4221
F: 614-836-4168, Audinet 210-4168
http://aepenv/labs

Water Analysis

Location: Amos Plant ***Report Date: 2/7/2019***

LF-CCR-MW-2

Sample Number: 190294-001 **Date Collected: 01/24/2019 13:40** **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.218	mg/L		0.1	0.02	DAM	02/07/2019 10:50	EPA 200.7-1994, Rev. 4.4

LF-CCR-Dup-2

Sample Number: 190294-002 **Date Collected: 01/24/2019** **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.212	mg/L		0.1	0.02	DAM	02/07/2019 10:53	EPA 200.7-1994, Rev. 4.4

LF-CCR-EB-2

Sample Number: 190294-003 **Date Collected: 01/24/2019 13:40** **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.02	mg/L	U	0.1	0.02	DAM	02/07/2019 10:56	EPA 200.7-1994, Rev. 4.4

LF-CCR-FB-2

Sample Number: 190294-004 **Date Collected: 01/24/2019 13:40** **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.02	mg/L	U	0.1	0.02	DAM	02/07/2019 10:59	EPA 200.7-1994, Rev. 4.4

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit
J: Analyte was positively identified, though the quantitation was below Reporting Limit.

Michael S. Ohlinger

Michael Ohlinger, Chemist
Email msohlinger@aep.com *Tel.*
Fax 614-836-4168 *Audinet 8-210-*

ATTACHMENT D

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Amos Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

John Seymour

Printed Name of Licensed Professional Engineer

John Seymour

Signature

JOHN P. SEYMOUR
REGISTERED
17091
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

17091

License Number

WV

Licensing State

3/15/2019

Date

941 Chatham Lane, Suite 103
Columbus, Ohio 43221
PH 614.468.0415
FAX 614.468.0416
www.geosyntec.com

Memorandum

Date: October 3, 2019

To: Ben Kepchar, American Electric Power (AEP)

From: John Seymour, P.E., Geosyntec

Subject: Amos Plant Landfill Alternative Source Demonstration

A semi-annual detection monitoring event was recently completed at the Amos Plant Landfill in accordance with the Coal Combustion Residual (CCR) Rule [40CFR257.94]. The results of this event (Table 1) were compared to previously calculated upper prediction limits (UPLs) for each Appendix III parameter. In addition, the reported pH values were also compared to previously calculated lower prediction limits (LPLs). A statistically significant increase (SSI) was noted for chloride at well MW-5 during this detection monitoring event. No other SSIs were observed in the well network during this semi-annual detection monitoring event (Table 1).

DEMONSTRATION OF AN ALTERNATIVE SOURCE

SSIs for chloride were identified at well MW-5 for three previous detection monitoring events (November 2017, April 2018, and November 2018). In all three instances, alternative source demonstrations (ASD) were prepared (Geosyntec, 2018a; Geosyntec, 2018b; Geosyntec, 2019).
For the current semi-annual detection monitoring event, the SSI was concluded after the intrawell background UPL for chloride was exceeded in both the initial and verification sampling events completed on June 12, 2019 and July 22, 2019, respectively. An evaluation was completed to assess possible alternative sources to which the identified SSI could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and

- ASD Type V: Alternative Sources.

The lack of waste placement hydrologically upgradient of MW-5 provides evidence that the observed chloride concentrations were not caused by a release from the Landfill. Using EPRI (2017) nomenclature, the SSI for chloride at well MW-5 was determined to be a Type IV alternative source.
The Amos Plant Landfill consists of a northern valley and southern valley which are surrounded by bedrock ridges. A topographic high point separates the two valleys (Arcadis, 2016) as shown in Figure 1. MW-5 is a designated downgradient well in the northern valley, which is hydrologically distinct from the southern valley, due to separation by the topographic high point. Significantly, no CCR waste has yet been placed in the northern valley, although landfill construction has been ongoing since 2013. The absence of CCR waste in the northern valley makes it extremely unlikely that the chloride SSI is attributable to CCRs at MW-5.

MW-5 is a shallow well that is screened between 5 and 10 feet below ground surface (bgs) and intercepts a perched groundwater zone (referred to in Figure 5B of the Groundwater Monitoring Well Network Evaluation report by Arcadis, 2016). The proximity of the screened interval to the ground surface suggests that MW-5 may be susceptible to impacts from surface activities in the northern valley. Landfill construction has been ongoing in the northern valley since 2013. Activities completed this year and in the past, such as excavation, stockpiling, road salting, and blasting, may have released chloride that has affected the perched water table.

In conclusion, because MW-5 was installed in the perched groundwater zone and has a shallow screen depth (5-10 ft bgs), groundwater quality at this location is potentially susceptible to influence from non-CCR sources such as construction road salting. Additionally, the absence of waste placement at hydrologically upgradient locations suggest that the SSI for chloride was not caused by a release from the storage unit. Therefore, the exceedance at MW-5 was attributed to a Type IV issue. The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and in agreement with the previous ASDs prepared for this unit (Geosyntec, 2018a; Geosyntec, 2018b; Geosyntec, 2019). Certification of this ASD by a qualified professional engineer is provided in Attachment A.

******

Arcadis, 2016. FGD Landfill – CCR Groundwater Monitoring Network Evaluation. October.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. 3002010920. October.

Geosyntec, 2018a. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. Winfield, West Virginia. April.

Geosyntec, 2018b. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. Winfield, West Virginia. October.

Geosyntec, 2019. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. Winfield, West Virginia. March

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Landfill

Parameter	Units	Description	LF-MW-1	LF-MW-2		LF-MW-4	LF-MW-5	
			6/11/2019	6/11/2019	7/22/2019	6/12/2019	6/12/2019	7/22/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.134	0.231		0.213	0.0473	
		Detection Monitoring Result	0.0400	0.215	--	0.167	0.0200	--
Calcium	mg/L	Intrawell Background Value (UPL)	32.6	2.12		0.951	19.1	
		Detection Monitoring Result	28.1	1.80	--	0.788	16.2	--
Chloride	mg/L	Intrawell Background Value (UPL)	4.94	5.26		16.4	3.81	
		Detection Monitoring Result	2.86	3.26	--	14.4	**4.60**	**4.61**
Fluoride	mg/L	Intrawell Background Value (UPL)	0.111	1.43		1.55	0.159	
		Detection Monitoring Result	0.110	**1.63**	1.41	1.46	0.110	--
pH	SU	Intrawell Background Value (UPL)	7.7	9.3		10.3	10.6	
		Intrawell Background Value (LPL)	5.4	7.9		8.3	3.6	
		Detection Monitoring Result	7.0	8.7	--	8.6	6.1	--
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0	15.5		13.7	32.1	
		Detection Monitoring Result	29.9	9.40	--	9.00	26.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275	387		421	182	
		Detection Monitoring Result	184	379	--	415	132	--

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
--: Not Sampled
Based on a 1-of-2 resampling,a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the UPL.

Legend
Upgradient Sampling Location
Downgradient Sampling Location

Name
Northern Valley
Southern Valley
Inferred Groundwater Flow Direction
FGD Landfill

Notes
- Monitoring well coordinates provided by AEP.
- Aerial imagery provided by DigitalGlobe and dated 8/30/2016.

Site Layout
FGD Landfill

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/09/28

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_Site_Layout_GW Flow_2018-04_April.mxd. SKaroly. 9/28/2018. CHA8423/04/08.

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Amos Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

John Seymour

Printed Name of Licensed Professional Engineer

Signature

17091	West Virginia	10/3/2019
License Number	Licensing State	Date

* * * * *

APPENDIX 4

Not applicable.

APPENDIX 5

Well installation/decommissioning logs follow.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **1** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

COORDINATES **N 38.5 E 81.6** PIEZOMETER TYPE **PVC** WELL TYPE **OW**

GROUND ELEVATION **735.6** SYSTEM **NAVD88** HGT. RISER ABOVE GROUND **2.8** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **50.4** BOTTOM **114.4**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 21.0	▼	▼
TIME			
DATE	8/15/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									CL ML	0-5': SILTY CLAY; 2.5YR 5/6 (red); moist; backfill material.		0-49': Riser
		5.0	6.5	50/4	3.6		5			5-6': SANDSTONE.		
										6-6.3': SHALE; GLEY1 5/N (gray); dry; thin bedded; hard.		
		6.5	8.0	48-23-15	3.6				CL ML	6.3-6.5': SILTY CLAY; red; moist; hard		
									ML	6.5-8': SILT; 10YR 6/2 (tan); with sandstone and shale fragments; compacted fill material.		
		8.0	9.5	11-3-5	7.2				MH	8-9.5': CLAYEY SILT; 5YR 4/2 (brown); firm; moist; fill material.		
		9.5	11.0	4-4-7	10.8		10		CL ML	9.5-11': SILTY CLAY; 10YR 6/3 (brown) to brown clayey silt; dry; crumbly; fill material.		
		11.0	12.5	4-8-50/3	10.8				CL ML	11-12.5': SILTY CLAY; 5YR 4/2 (brown); moist; firm.		
										Note: Sandstone at 12-12.3'.		
		12.5	14.0	50/3					ML	12.5-14': SILT, compacted; 10YR 7/4 (tan); very hard; dry; fill material.		
		14.0	15.5	50/4						14-14.5': SILTY SHALE material, weathered; mottled tan and dark brown; dry; very hard.		
		14.9	19.9		51		15			14.5-14.9': SANDSTONE; strong field strength; 2.5Y 6/2; fine-grained texture; massive structure; slightly to moderately decomposed; moderately disintegrated with Fe staining; fracture at 14.3-14.5'.		
										14.9-19.9': SHALE; moderate field strength; GLEY1 5/GY; fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated along bedding planes and fracture; vertical fracture with Fe staining at 15.5-16.5'.		

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER **A. Gillespie**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **2** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		19.9	24.9	8-7-6	55					19.9-24.9': SHALE; moderate field strength; GLEY1 5/GY; fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated; moderately to intensely fractured. Transition to strong field strength, 2.5YR 4/4; fine-grained texture; massive structure to thinly bedded; slightly decomposed; slightly disintegrated; slightly to moderately fractured.		
		24.9	34.9	4-4-13	72		25			24.9-25.2': SHALE; strong field strength; fine-grained structure; massive structure to thinly bedded; slightly decomposed; slightly disintegrated; slightly to moderately fractured. 25.2-30.7': CLAYSTONE/MUDSTONE, highly weathered; very weak field strength; 10YR 5/3; very fine-grained texture with sandstone fragments; massive structure; highly decomposed; intensely disintegrated; unfractured.		
							30			30.7-32.5': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated; slightly to moderately fractured. 32.5-34.9': CLAYSTONE/MUDSTONE; moderate field strength; GLEY1 4/104; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately to intensely fractured.		
		34.9	38.3	4-5-8	36		35			34.9-38.3': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; moderately to highly decomposed; intensely disintegrated, mottling tan and gray; moderately to intensely fractured.		
		38.3	44.9	5-7-13-9-6-6	70		40			38.3-44.9': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; highly decomposed; intensely disintegrated; intensely fractured.		
		44.9	50.0	4-4-7-8	50		45			44.9-50': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos - FGD Landfill**

BORING NO. **MW-1801** DATE **5/3/19** SHEET **3** OF **5**

BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		44.9	50.0	4-4-7-8	50					tan, black, and gray; fine-grained texture; massive structure; highly decomposed; intensely disintegrated; intensely fractured.		49-52': Bentonite Pellets
		50.0	55.0	4-4-5-4	50		50			50-56.7': CLAYSTONE/MUDSTONE; moderate field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; moderately to highly decomposed, becomes less weathered at 50.3'; highly disintegrated, highly mottled; moderately to intensely fractured.		52-53': Secondary Filter Pack 53-75': Primary Filter Pack
		55.0	59.8	5-7-5-36	52		55			56.7-58': SANDSTONE, interbedded; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture; moderately fractured at 56.7' and 57.1-57.5'. 58-58.8': SHALE, interbedded; strong field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture. 58.8-59.2': SANDSTONE, interbedded; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture. 59.2-59.8': SHALE, interbedded; strong field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated along fracture.		55-75': Screen
		59.8	64.8	8-5-4-4-7-5-5-4	60		60			59.8-60.7': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated; unfractured. 60.7-63.9': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintigrated with silt filled fractures; moderately fractured. 63.9-64.3': SANDSTONE; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated; unfractured.		
		64.8	74.8	4-5-4-6	76		65 70			64.3-64.8': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed; moderately		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION
AEP CIVIL ENGINEERING LABORATORY
LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **4** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										disintigrated; moderately fractured.		
		64.8	74.8	4-5-4-6	76					64.8-74.8': SHALE, highly weathered at base; moderate to weak field strength along some bedding planes; 2.5YR 3/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintigrated, becomes more limestone fragments last 1 ft, 3-5 cm; moderately to intensely fractured.		
		74.8	85.0				75			74.8-85': SHALE, highly weathered; weak field strength; 2.5YR 4/4 (red) with tan and gray mottling; fine-grained texture; massive structure; highly decomposed; highly disintigrated, mottled; intensely fractured.		75-105': Bentonite
							80					
		85.0	95.0	5-4-4	120		85			85-92.7': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintigrated, calcite in light colored beds/thin; slightly fractured.		
							90					
										92.7-94.6': SHALE; moderate field strength; fine-grained texture; massive structure; slightly decomposed; slightly disintigrated, some mottling; moderately fractured.		
										94.6-95': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintigrated, calcite in light colored beds/thin; slightly fractured at 94.6-95'.		
		95.0	105.0	7-4-4	120		95			95-100.1': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintigrated; slightly fractured at 95-95.2'.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1801** DATE **5/3/19** SHEET **5** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/7/18** BORING FINISH **8/8/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		95.0	105.0	7-4-4	120							
							100			100.1-101.5': SHALE and sandstone interbedded; moderate field strength; fine-grained texture; thinly bedded; slightly decomposed; slightly disintigrated; slightly fractured at 100.2-100.5'.		
										101.5-105': SHALE; moderate to weak field strength; fine-grained texture; massive structure; highly decomposed; moderately to highly disintigrated mottling with silt filled fractures; highly fractured.		
							105					
							110					
							115					
							120					

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER WV015976.0005

COMPANY American Electric Power

PROJECT Amos - FGD Landfill

COORDINATES N 38.5 E 81.9

GROUND ELEVATION 709.8 SYSTEM NAVD88

BORING NO. MW-1802 DATE 5/3/19 SHEET 1 OF 5

BORING START 8/20/18 BORING FINISH 8/21/18

PIEZOMETER TYPE NA WELL TYPE OW

HGT. RISER ABOVE GROUND 2.91 DIA 2"

DEPTH TO TOP OF WELL SCREEN 50 BOTTOM 114.4

WELL DEVELOPMENT Surge/Purge BACKFILL Bentonite Grout

FIELD PARTY Zachary Racer (AEP) RIG Direct Circulation - Wireline Core

Water Level, ft	▽ 35.0	▼	▼
TIME			
DATE	8/21/2019		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
									GW	0-3.5': GRAVEL backfill; large rip-rap and smaller compacted gravels.		0-41': Bentonite Grout
									CL	3.5-4.5': SILTY CLAY; brown; moist; soft; backfill material.		
		4.5	6.0	6-4-5	0		5			4.5-6': NO RECOVERY, due to gravel blocking cutting shoe.		
		6.0	7.5	4-3-4	3.6				CL	6-17': SILTY CLAY; 7.5YR 4/3 (brown); moist; firm; compacted backfill material; becomes wet at 12.5'.		
		7.5	9.0	3-4-5	7.2							
		9.0	10.5	4-4-6	18		10					
		10.5	12.0	5-4-5	13.2							
		12.0	13.5	3-4-6	15.6							
		13.5	15.0	3-5-8	14.4		15					
		15.0	16.5	4-7-9	15.6							
		16.5	18.0	6-25-8	16.8					17-17.5': SANDSTONE, weathered; GLEY1 7/N (gray); dry.		
		18.0	19.5	7-23-15	14.4				CL	17.5-19.5': SILTY CLAY; GLEY1 6/N (gray) mottled with brown, red, tan; moist; soft; crumbles easily.		
		19.5	21.0	20->50/4	10.8				CL			

TYPE OF CASING USED

X	NQ-2 ROCK CORE	
NA	6" x 3.25 HSA	
NA	9" x 6.25 HSA	
NA	HW CASING ADVANCER	4"
NA	NW CASING	3"
NA	SW CASING	6"
NA	AIR HAMMER	8"

Continued Next Page

PIEZOMETER TYPE: PT = OPEN TUBE POROUS TIP, SS = OPEN TUBE SLOTTED SCREEN, G = GEONOR, P = PNEUMATIC

WELL TYPE: OW = OPEN TUBE SLOTTED SCREEN, GM = GEOMON

RECORDER A. Gillespie

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos - FGD Landfill**

BORING NO. **MW-1802** DATE **5/3/19** SHEET **2** OF **5**

BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		19.5	21.0	20->50/4	10.8					19.5-22.5': SILTY CLAY; GLEY1 6/N (gray) mottled with brown, tan; dry; soft; crumbles easily.		
		21.0	22.5	27-50/5	9.6							
		22.5	24.4	4	23					22.5-24': SILTSTONE; moderate to weak field strength; GLEY1 6/N; fine-grained texture; massive structure; highly decomposed; moderately to highly disintegrated with tan/brown mottling; moderately to intensely fractured.		
		24.4	29.4		22		25			24-24.4': SILTSTONE; weak field strength; 10R 4/4 (red) mottled; fine-grained texture; massive structure; highly decomposed; moderately to intensely fractured. 24.4-29.4': SILTSTONE; weak field strength; 10R 4/4 (red) mottled with tan, gray, and black; fine-grained texture; massive structure; highly decomposed; highly disintegrated, highly mottled; moderately fractured.		
		29.4	33.7	5-11-6	40		30			29.4-32.8': SHALE, weathered; moderate field strength; 10YR 4/4 (red) mottled; fine-grained texture; massive structure; moderately decomposed; moderately to intensely disintegrated; moderately fractured. 32.8-33.7': SHALE; moderate field strength; 5YR 5/4 (tan) mottled; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; moderately to intensely fractured.		
		33.7	39.4	5-4-4-7-5	59		35			33.7-39.4': SHALE; moderate field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; intensely fractured.		
		39.4	44.4	4-6-4-4	57		40			39.4-44.4': SHALE; moderate field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; intensely fractured.		41-44': Bentonite Pellets 44-45': Secondary Filter Pack
		44.4	54.4	7-8-7-5-5-24-5	120		45			44.4-47.8': SHALE, highly weathered; weak field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure;		45-71': Primary Filter Pack

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **3** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		44.4	54.4	7-8-7-5-5-24-5	120					highly decomposed; intensely disintegrated; intensely fractured.		
										47.8-49.9': SHALE, less weathered; moderate field strength; 10R 3/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		
							50			49.9-50.8': SHALE, interbedded with sandstone; moderate field strength; GLEY1 4/N; fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; moderately fractured.		50-70': Screen
										50.8-52.8': SHALE; moderate to strong field strength; 10R 4/3 (red); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated; slightly fractured.		
										52.8-53.1': SHALE, interbedded with sandstone; strong field strength; GLEY1 4/5GY; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
		54.4	64.4	8-12-5-6-7-4-4-4	114		55			53.1-54.4': SHALE; moderate field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		
										54.4-55.4': SANDSTONE, interbedded with shale; moderate field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; slightly to moderately fractured.		
							60			55.4-57.1': SHALE, interbedded with sandstone; moderate field strength; GLEY1 4/3, 10R 4/3; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
										57.1-64.4': SHALE, weathered; moderate to weak field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated with intense gray mottling; intensely fractured.		
		64.4	74.4	4-6-8-6-4-5-4-4-5	117		65			64.4-70.5': SHALE, highly weathered; moderate to weak field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately to intensely disintegrated with gray mottling; intensely fractured.		
							70			70.5-74.4': SHALE, interbedded with sandstone; strong field strength; 10R 4/3 (red) interbedded with GLEY1 4/N (gray-green); fine-grained		

Continued Next Page

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **4** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		64.4	74.4	4-6-8-6-4-5-4-4-5	117					texture; thinly bedded; slightly to moderately decomposed along some bedding planes; moderately disintegrated with silt filled fractures; moderately fractured.		
		74.4	84.4	8-7-5-5-14-8-7-22-12	120		75			74.4-77.1': SHALE, with some interbedded sandstone lenses; moderate field strength; 10R 4/3 (red); fine-grained texture; thinly bedded; slightly to moderately decomposed at some bedding planes; slightly disintegrated; moderately fractured.		
							80			77.1-82.7': SANDSTONE, with some red shale lenses; strong field strength; GLEY1 4/N; fine-grained texture; thinly bedded; fresh; moderately disintegrated, calcite reacts to HCl in light colored bands within 0.5' of surrounding contact lines, no HCl/calcite in fractures, no Fe staining; moderately fractured.		
										82.7-84.4': SHALE, with some interbedded sandstone lenses; moderate field strength; 10R 4/3 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
		84.4	94.4	10-11-6-7-7-8-9-8-7-6-6-7-10	120		85			84.4-86.7': SHALE, with sandstone lenses; moderate field strength; 10R 4/2 (red) with GLEY1 4/N lenses; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
										86.7-89.2': SANDSTONE, with shale lenses; moderate field strength; GLEY1 4/N with 10R 4/2 lenses; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
							90			89.2-94.4': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded, micaceous; fresh; slightly disintegrated, some calcite in light bands, no staining, no calcite in fractures; slightly to moderately fractured along bedding planes; fracture at 92.8'.		
		94.4	104.4	7-4-5-4-9-9-8-5-11-5-6-10-19	120		95			94.4-104.4': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded, micaceous, cross-bedding at 94.4-94.8; fresh; slightly disintegrated, calcite in some light bedded planes, no calcite or Fe staining noted in fractures; slightly to moderately fractured along bedding planes.		

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1802** DATE **5/3/19** SHEET **5** OF **5**

PROJECT **Amos - FGD Landfill** BORING START **8/20/18** BORING FINISH **8/21/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		94.4	104.4	7-4-5-4-9-9-8-5-11-5-6-10-19	120		100					
		104.4	114.4	15-6-21-6-4-4-8-8-6-4-13-5-7	120		105			104.4-108': SANDSTONE; strong field strength; GLEY1 6/N; fine to medium-grained texture; thinly bedded, micaceous, shale fragments; fresh; moderately disintegrated, calcite along entire sandstone void and shale fragments at base, calcite in void; slightly fractured.		
							110			108-108.9': SHALE, with interbedded sandstone; moderate field strength; GLEY1 4/N, 10R 4/3 bands; thinly bedded; moderately decomposed between bedding planes; moderately disintegrated along bedding planes; moderately fractured. 108.9-114.4': SHALE; moderate field strength; 10R 4/3 (red) with GLEY1 4/N mottling; fine-grained texture; massive structure; moderately decomposed; moderately to intensely disintegrated, mottling; moderately fractured.		
							115					
							120					

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0016-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0016-18
Grid Location:
a. Latitude: 38 28 46 .0
b. Longitude: 81 51 28 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1801

Purpose of Monitoring Well:
Assessment

Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

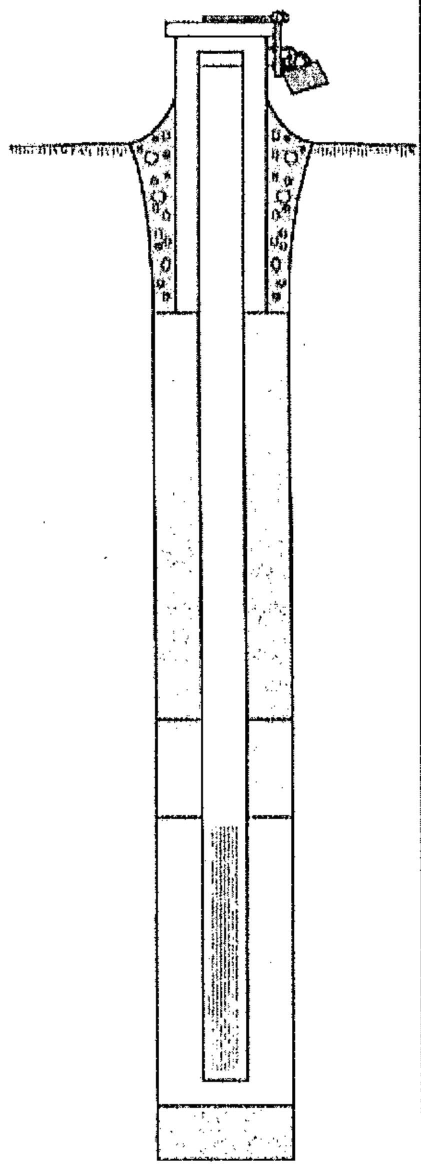
Installed By (Name, Firm, Address):
Installer: AEP Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/16/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)

1.Cap and Lock:	YES
2.Protective Cover:	Protective Cover Pipe
3.Monitoring Well Reference Point:	0 ft.
4.Borehole Diameter:	6 inches.
5.Ground Surface Seal:	
a.Material: bentonite-cement grout	
b.Installation Procedure: gravity	
6.Surface Seal Bottom/Annular Space Top:	2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.	
c.Material: PVC	
d.Installation Procedure: hand set	
8.Annular Space Seal:	
a.Material: bentonite pellet -	
b.Installation Procedure: tremie pipe-gravity	
9.Well Development Procedure: airlift -	
10.Drilling Method Used: air rotary -	
11.Annular Space Seal Bottom/Filter Seal Top:	43.7 ft.
12.Drilling Fluid Used: Yes Source: Water	
13.Filter Pack Seal:	
a.Material: bentonite pellet	
b.Installation Procedure: Gravity Fed	
c.Volume Added: 125 pounds	
14.Bottom of Bentonite Seal/Filter Pack Top:	53 ft.
15.Depth to Top of Screen:	55.4 ft.
16.Screen:	
a.Material: PVC	
b.Installation Procedure: hand set	
c.Slot Size: 0.01 inches. d.Screen Length: 19.6 ft.	
17.Filter Pack:	
a.Material: fine sand	
b.Installation Procedure: gravity	
18.Well Depth:	75 ft.
19.Bottom of Filter Pack:	76 ft.
20.Bottom of Borehole:	105 ft.
21.Backfill Material (below filter pack): N/A	
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump	
23.Special Circumstances and Exceptions: No Variance Number:	



[redacted]

<< Return

Home | Log Out

State of West Virginia
Department of Environmental Protection

Monitoring Well Construction
Well Number: WV00528-0017-18
Approved

Site Name/Physical Address:
Site: John E. Amos Plant
Line 1: 1530 Winfield Rd.
Line 2:
City: Winfield
State: WV
Zip: 25213-
County: Putnam

Well Registration No. WV00528-0017-18
Grid Location:
a. Latitude: 38 29 15 .0
b. Longitude: 81 51 35 .0
c. Method Used: GPS

Company/Project Well No.:
MW-1802

Purpose of Monitoring Well:
Assessment

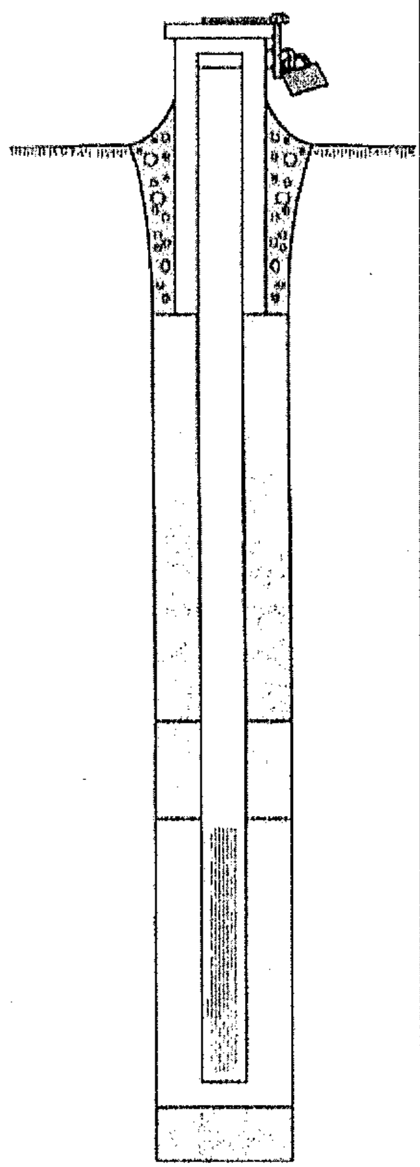
Well Owner (Name, Firm, Address):
Owner: American Electric Power
Line 1: 1 Riverside Plaza
Line 2:
City: Columbus
State: OH
Zip: 43215-
Phone: 614-836-4200

Installed By (Name, Firm, Address):
Installer: AEP / Dolan Lab
Line 1: 4001 Bixby Rd.
Line 2:
City: Groveport
State: OH
Zip: 43125-
Phone: 614-836-4200

Date Well Installed:
08/22/2018

Driller's WV Cert No.
WV00528

Section B: (all number fields must be in decimal format)



1.Cap and Lock:	YES
2.Protective Cover:	Protective Cover Pipe
3.Monitoring Well Reference Point:	0 ft.
4.Borehole Diameter:	6 inches.
5.Ground Surface Seal:	
a.Material: bentonite-cement grout	
b.Installation Procedure: gravity	
6.Surface Seal Bottom/Annular Space Top:	2 ft.
7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.	
c.Material: PVC	
d.Installation Procedure: hand set	
8.Annular Space Seal:	
a.Material: bentonite pellet -	
b.Installation Procedure: tremie pipe-gravity	
9.Well Development Procedure: airlift -	
10.Drilling Method Used: air rotary -	
11.Annular Space Seal Bottom/Filter Seal Top:	30 ft.
12.Drilling Fluid Used: Yes Source: Water	
13.Filter Pack Seal:	
a.Material: bentonite pellet	
b.Installation Procedure: Gravity Fed	
c.Volume Added: 650 pounds	
14.Bottom of Bentonite Seal/Filter Pack Top:	45 ft.
15.Depth to Top of Screen:	50.4 ft.
16.Screen:	
a.Material: PVC	
b.Installation Procedure: hand set	
c.Slot Size: 0.01 inches. d.Screen Length: 19.6 ft.	
17.Filter Pack:	
a.Material: fine sand	
b.Installation Procedure: gravity	
18.Well Depth:	70 ft.
19.Bottom of Filter Pack:	71 ft.
20.Bottom of Borehole:	114.4 ft.
21.Backfill Material (below filter pack): N/A	
22.Decontamination Procedures: Liqui-Nox w/high pressure water pump	
23.Special Circumstances and Exceptions: No Variance Number:	

24.WV Contractor License No. [redacted]

<< Return

Home | Log Out

Appendix F

Structural stability assessment required at § 257.73(d)

STRUCTURAL STABILITY ASSESSMENT

CFR 257.73(d)

Bottom Ash Ponds

John E. Amos Plant

October, 2016

Prepared for : Appalachian Power Company – John E. Amos Plant

1530 Winfield Rd,

Winfield, West Virginia 25213

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

AEP AMERICAN® ELECTRIC POWER

Document ID: GERS-16-124

Structural Stability Assessment
CFR 257.73(d)
JOHN E. AMOS PLANT
BOTTOM ASH COMPLEX

PREPARED BY John T. Massey-Norton DATE 10/3/2016
John T. Massey-Norton

REVIEWED BY DATE 10-3-2016
Shahriyar S. Baig, P.E.

APPROVED BY Gary F. Zych DATE 10/7/2016
Gary F. Zych, P.E.
Manager – AEP Geotechnical Engineering

Gary F. Zych
GARY F. ZYCH
REGISTERED
21201
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER
10/7/2016

I certify to the best of my knowledge, information and belief that the information contained in this structural stability assessment meets the requirements of 40 CFR 257.73(d)

Table of CONTENTS

1.0 OBJECTIVE 257.73(d)

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257.73(d) and document whether the design, construction, operations, and maintenance of the CCR unit is consistent with recognized and generally accepted good engineering practices. This is the initial assessment as per the Rule.

2.0 NAME AND DESCRIPTION OF CCR SURFACE IMPOUNDMENT

The John E. Amos Power Plant is located near Winfield, Putnam County, West Virginia.
It is owned and operated by Appalachian Power Company (APCO). The facility operates one surface impoundment for storing CCR called the Bottom Ash Complex.

The Bottom Ash Complex is comprised of diked embankments on the north, east, and west sides. The south side of the Bottom Ash Complex is incised. There are four main ponds within the Bottom Ash Pond Complex as listed below.

List of Main Ponds within the Bottom Ash Complex
Bottom Ash Pond 1A
Bottom Ash Pond 1B
Reclaim Pond
Treatment/Clearwater Pond

The north dike is approximately 800 feet long and is the highest dike at about 29 feet with a design crest width of 10 feet. The dike is comprised of concrete blocks back-filled with compacted soil that transitions to an earthen embankment. The top of the dike is at elevation 588.0 feet with the natural ground surface beneath the dikes is at about elevation 559 feet.

The north dike is located across a small tributary to Bill's Creek. This portion of Bill's Creek is controlled by the backwaters of the Kanawha River. The side slopes of embankment fill are designed to be 3:H to 1:V that transition to design side slopes 2:H to 1:V.

3.0 STABLE FOUNDATION AND ABUTMENTS 257.73(d)(1)(i)

[Was the facility designed for and constructed on stable foundations and abutments? Describe any foundation improvements required as part of construction.]

Based on the design drawings, a portion of the foundation was constructed on random rock fill within the former channel of Bill's Creek to form a working base for placement of a compacted shale/soil fill. A crushed limestone filter blanket was placed over the upstream face of the rock fill and capped with a clay soil. At a later date, an asphalt stabilization blanket was constructed along the upstream face.

The dike was raised in 2010 using a concrete block wall that transitions to an earthen embankment which in turn transitions to existing ground along the southern portion of the pond complex.

Based on recent subsurface investigations, the relative density and description of the foundation materials are adequate for this CCR unit.

4.0 SLOPE PROTECTION 257.73(d)(1)(ii)

[Describe the slope protection measures on the upstream and downstream slopes.]

The downstream slope of the north dike that parallels Bill's Creek is protected with a layer of riprap and transitions to a grass covered slope to the crest of the dike or to the base of the concrete block wall. The remaining downstream and upstream dike slopes are protected with a vegetative cover.

The current condition of the riprap layer is adequate. The remaining sections of the slopes above the riprap is vegetated and maintained. Any erosion that may occur is repaired within a timely period.

5.0 EMBANKMENT CONSTRUCTION 257.73 (d)(1)(iii)

[Describe the specifications for compaction and/or recent boring to give a relative comparison of density.]

Construction specifications for the 2010 dike raising required a QA/QC construction certification plan to ensure that the cohesive soils were placed and compacted in accordance with the design specifications.

Recent borings through the embankment indicate that the material is stiff and representative of compacted earthen materials.

6.0 VEGETATION CONTROL 257.73 (d)(1)(iv)

[Describe the maintenance plan for vegetative cover.]

The vegetative areas are mowed to facilitate inspections and maintain the growth of the vegetative layer; and prevent the growth of woody vegetation.

7.0 SPILLWAY SYSTEM 257.73(d)(1)(v)

[Describe the spillway system and its capacity to pass the Inflow Design Flood as per its Hazard Classification.]

The spillway system consists of a primary weir box and pipe for normal operations and two 36 inch diameter spillway pipes located along the north dike to pass flood events. The CCR unit has a Significant Hazard rating and is designed to safely pass ½ the probable maximum precipitation in accordance with the WV DEP dam safety regulations.

8.0 BURIED HYDRAULIC STRUCTURES 257.73 (d)(1)(vi)

[Describe the condition of the sections of any hydraulic structure that in buried beneath and/or in the embankment.]

The two 36 inch diameter spillway pipes are constructed through the concrete block wall and extend downslope such that the discharge is directed to the protective rip rap layer. The pipes are encased within a concrete fill as part of the wall construction.

9.0 SUDDEN DRAWDOWN 257.73 (d)(1)(vii)

[If the downstream slope is susceptible to inundation, discuss the stability due to a sudden drawdown.]

The north downstream slope may be partially inundated by the Kanawha River during extreme flood events. The condition for a sudden drawdown depends on the rate and duration of any given event.

A sudden drawdown scenario was not modeled for the embankment since flooding from the Kanawha River would not create the conditions necessary to be considered as a rapid drawdown event.

Appendix G

Safety factor assessment required at § 257.73(e)

CCR RULES CERTIFICATION REPORT
JOHN AMOS PLANT - BOTTOM ASH COMPLEX
PUTNAM COUNTY, WEST VIRGINIA

Prepared For:

AEP Service Corporation
Geotechnical Engineering Group
1 Riverside Plaza
Columbus, OH 43215-2373

Prepared By:

Geo/Environmental Associates, Inc.
3502 Overlook Circle
Knoxville, TN 37909

GA Project No. 15055009
December 21, 2015

TABLE OF CONTENTS

APPENDICES

CCR RULES ASSESSMENT AND CERTIFICATION
JOHN AMOS PLANT - BOTTOM ASH COMPLEX
POCA, PUTNAM COUNTY, WEST VIRGINIA
DECEMBER 21, 2015

INTRODUCTION

Geo/Environmental Associates, Inc. (GA) has performed a site visit, conducted an engineering assessment, and prepared a certification statement for the John Amos Plant - Bottom Ash Complex. These services were performed to meet specific requirements set forth in the Environmental Protection Agency's CCR Rules (i.e., 40 CFR Parts 257 and 261, "Hazardous and Solid Waste Management System, Disposal of Coal Combustion Residuals From Electric Utilities, Final Rule," dated April 17, 2015). Provided in this report is a discussion of GA's findings and a certification statement pertaining to the facility. Photographs, supplemental field and laboratory data, engineering analyses, and a drawing are included in the appendices.

REVIEW OF PREVIOUS ANALYSES AND SITE DESCRIPTION

The Amos Power Plant is situated in Putnam County, West Virginia within the physiographic province of the Appalachian Plateau. A more detailed description of the site geology is included in Appendix II. The Amos Power Plant primary and ancillary facilities are located along the southern bank of the Kanawha River along S.R. 35 approximately two miles northwest of Interstate I-64 at Scary, WV. The Bottom Ash Complex consists of two dams #1A WVA ID #07918 and #1B WVA ID #07919. The dams share a common earthen embankment across Bill's Creek with a series of splitter dikes to create four distinct cells referred to as Bottom Ash Pond No. 1A, Bottom Ash Pond No. 1B, Reclaim Water Pond and the Treatment Basin.

The earliest record available of the Bottom Ash Complex is dated June 28, 1970. There was an open channel that acted as the emergency spillway of an earthen dike structure on the northwest corner of the Bottom Ash Pond No. 1B.

Modifications to the site include: the 1977 construction of a road embankment on the northwest corner of the Bottom Ash Pond No. 1B, a sedimentation pond, and a splitter dike constructed on the southeast corner of the Bottom Ash Pond No. 1A for the sedimentation of pyrites (referred to as the Pyrites Pond). The construction of the roadway embankment effectively eliminated the northwest corner of the Bottom Ash Pond No. 1B from collecting additional bottom ash and from ponding water. An open channel spillway, that was part of the original construction, was abandoned prior to 1977.

Subsequent modifications, mostly associated with the operations of the ponds, have taken place since 1977. Perhaps the most relevant has been the elimination, from active use, of the sedimentation pond located along the west side of the Bottom Ash Pond No. 1B, illustrated on the 1977 drawing. In addition, higher than anticipated operating water levels could occur sporadically in the ponds during certain plant maintenance operations. Ash handling operations can also result in the localized accumulation of bottom ash at or above the operational water levels. The current configuration of the Bottom Ash Complex is shown on the drawings in Appendix VI.

Current operations of the ponds consist of sluicing bottom ash into ponds #1A or #1B, allowing the particles to settle and the overflow to circulate to the reclaim pond from where the majority of the water is pumped back to the plant and the remaining water is allowed to overflow into the treatment pond before it is released into the Kanawha River at outfall No. 003. During the course of the year, the Bottom Ash Ponds are alternately taken out of service to allow for the removal of the bottom ash for beneficial re-use. Thus, it is commonly expected that, at the same time bottom ash slurry is sluiced into one pond, the other pond is being excavated.

The Bottom Ash Pond Complex is inspected by Plant personnel on a monthly basis and, under the direct supervision of a professional engineer, it is inspected annually. Reports of the engineer's inspection are forwarded to the West Virginia DEP Dam Safety office with the frequency established in the regulations for Class II facilities.

The main dike of the facility is about 1350 feet long. We were provided with a copy of a report titled "Report on Dam Safety Inspection Amos Fly Ash Dam and Amos Bottom Ash Dikes" dated March 1981, prepared by Woodward-Clyde Consultants. According to that report, the maximum height of the main dike above natural ground is about 24 feet.

GA performed design and analysis services for the facility in 2005 and 2008. We provided two reports, "Responses to February 15, 2005 DEP Review Letter," dated December 5, 2005 and "Responses to May 12, 2008 DEP Review Letter," dated May 22, 2008. Our work involved addressing West Virginia DEP concerns and also raising the main dikes from a minimum crest elevation of about 584 feet with a minimum crest width of about 15 feet, to a minimum elevation of 588 feet. The increased dike elevation was needed to operate the pool levels in Ash Ponds 1A and 1B and the Reclaim Pond as high as elevation 583 feet under certain operating conditions while providing adequate storm storage and routing and maintaining at least one foot of freeboard during the design storm. Our work at the time included hydrologic, hydraulic, and stability analyses. The facility previously had an open channel spillway with bottom elevation 581 feet through the main dike at the Reclaim Water Pond. In our design we proposed two 36-inch diameter polyethylene spillway pipes, both with inlet elevations of 583.5 feet.

In 2010, the main dikes were raised to the minimum proposed crest elevation of 588 feet. In addition to the main dike, the eastern side of the complex was raised to elevation 588 feet. In some areas the elevation 584 crest was wide enough such that it could be raised with 4 feet of soil fill and still maintain a minimum 10-foot-wide crest. In other areas that were too narrow to raise the crest with soil fill, a segmented retaining block system (Redi-rock) was used to achieve the elevation 588 feet crest. The drawings in Appendix VI show the areas where the block walls were constructed and a construction detail of the block wall system.

<u>Field Investigation and Laboratory Testing</u>

At the direction of AEPSC, eight borings were drilled through the main dike in August 2005 by H.C. Nutting Company of Charleston, West Virginia. The boring locations are shown on the drawings in Appendix VI. Boring logs are included in Appendix III. Standard Penetration Tests (SPT) were performed generally on 5-foot intervals. Relatively undisturbed samples were collected at selected locations using a thin walled sampler. Additionally, three standpipe piezometers were installed in the main dike during the drilling.

Borings B-1 through B-6 were drilled from the crest of the main dike. These borings generally encountered a stiff, lean clay, referred to as shale fill, from the ground surface to a depth of about 15 to 20 feet. Below the shale fill an interval of clayey gravel fill 8 to 10 feet thick was encountered. Below the clayey gravel, a 4 to 6-foot thick layer of soft clay and about a 20-foot thick layer of silty sand, both likely alluvial in origin, were encountered. Below the silty sand, residual weathered shale was encountered to the boring termination depths. Borings B-7 and B-8 were drilled on the downstream face of the main dike, near the water level of Bill's Creek. These two borings encountered strata consistent with borings B-1 through B-6.

Laboratory testing was performed by AEPSC on the SPT split-spoon samples and relatively undisturbed samples. Laboratory testing included moisture content, grain size analysis, classification, permeability, and strength testing. Laboratory test results are included in Appendix III. Laboratory test results are discussed in our comments regarding the stability of the dike.

SITE VISIT BY A PROFESSIONAL ENGINEER

At the request of AEPSC, GA personnel performed a site visit of the Bottom Ash Complex to observe and document the prevalent site conditions. Specifically, Seth W. Frank, P.E. (GA), performed a site inspection of the Bottom Ash Complex on August, 18, 2015. GA believes that the conditions observed, during the August 18, 2015, site visit, are representative of the conditions modeled in the assessment and analyses provided in this report. Pictures taken during the site visit are included in Appendix I.

HYDROLOGIC AND HYDRAULIC ANALYSES

GA's 2008 report included hydrologic and hydraulic analyses to meet WVDEP's design storm requirements for a Class II structure, which is one-half of the 6-hour Probable Maximum Precipitation (PMP) event (about 14 inches of rainfall in 6 hours). The spillway pipes, pool levels, and crest elevation were designed based on this event. GA used the U.S. Army Corps of Engineers HEC-1 computer program for the analyses. A summary of the results are shown in Table 1, and complete results are included in Appendix IV. As shown, the facility passes the design storm while maintaining adequate freeboard.

Table 1. Summary of Hydrologic Analyses

Pond	Crest Elev., ft	Normal Pool Elev., ft	Peak Pool Elev. During Storm, ft	Minimum Freeboard During Storm, ft
1A and Reclaim	588	583.2	585.43	2.57
1B	588	583.7	585.47	2.53

STABILITY ANALYSES AND ACTION VALUES

We have performed stability analyses in general accordance to EPA's CCR requirements.

The requirements specify the following stability assessments:

1. Static factor of safety under the long-term, maximum storage pool condition,
2. Static factor of safety under the maximum surcharge pool condition,
3. Seismic factor of safety,
4. Liquefaction factor of safety,
5. End-of-construction factor of safety,

Limit equilibrium stability analyses were performed on sections B-B and C-C to assess the stability of the embankment. The stability analyses were performed with *SLOPE/W*, a component of the *GeoStudio* software package. *SLOPE/W* is formulated in terms of moment and force equilibrium factor of safety equations. Specifically, the Morgenstern-Price method was used to calculate the factor of safety of each section.

Strength parameters for the various materials used in the analyses are listed in Table 2. The properties of the various materials that comprise the embankment were determined from laboratory tests where appropriate samples could be obtained for testing. The parameters for other materials are based on typical material properties and our experience with similar materials. The Redi-rock reinforced embankment was conservatively assumed to have the strength parameters of the shale fill.

Table 2. Summary of Strength Parameters

Material	EFFECTIVE STRENGTH PARAMETERS	
	c′ (psf)	φ′ (°)
Bottom Ash (2)	0	28
Shale Fill (1)	370	27.2
Clayey Gravel Fill (1)	300	32
Clay (natural) (1)	150	35.2
Silty Sand (natural) (1)	0	36.8

(1) Estimated from laboratory tests (See Appendix III).

(2) Estimated based on material properties and experience with similar materials.

Stability analyses were performed with phreatic conditions at the maximum level measured in piezometers or during drilling. A summary of the safety factors is shown in Table 4. Stability analysis results are included in Appendix V.

Static Factor of Safety under the Long-Term Storage Pool Condition

The CCR regulations specify the factor of safety should meet or exceed 1.5 when the pool is at the maximum, long-term level (i.e., normal pool) and a steady state seepage condition has developed. GA selected two critical sections, designated as B-B and C-C, for the analyses. The sections and their locations are shown on the drawings in Appendix VI. GA determined the embankment material types and stratigraphy from the aforementioned drilling and laboratory testing performed by AEPSC.

Static Factor of Safety under the Maximum Surcharge Pool Condition

The CCR regulations specify the factor of safety should meet or exceed 1.4 when the pool is at the maximum surcharg pool condition. We performed the stability analyses with the pool at the peak level during the one-half PMP design storm event, discussed previously. As shown in Table 1, the peak level in either pond was elevation 585.5 feet. We used this level for the stability analyses of both B-B and C-C.

A summary of the safety factors, from the maximum surcharge stability analyses, is shown in Table 4. Stability analysis results are included in Appendix V.

Seismic Factor of Safety

The CCR regulations specify the factor of safety should meet or exceed 1.0 under seismic conditions. Furthermore, the recommended design earthquake event should have a 2% exceedance in 50 years (an approximate return period of 2,475 years). GA performed pseudo-static stability analyses on sections B-B and C-C with the elevation 583.5 normal pool level and steady state seepage conditions based on maximum, measured piezometric levels.

Based on the *2008 Interactive Deaggregations* website, provided online through the USGS Geologic Hazards Science Center, the Amos Bottom Ash Complex facility has a peak ground acceleration of 0.065g for a seismic loading event with a mean return time of 2,475 years. Conservatively assuming soft soil ground conditions above rock, translates to a peak horizontal ground surface acceleration of approximately 0.15g. Using a commonly applied factor of 0.5 times the peak horizontal acceleration yields the conservative horizontal seismic coefficient of 0.075 that was applied in the slope stability analyses.

A summary of the pseudo-static safety factors is shown in Table 4. Stability analysis results are included in Appendix V.

Liquefaction Assessment

The CCR regulations specify the liquefaction factor of safety should meet or exceed 1.2. This requirement applies to facilities with embankment materials that have been determined to contain soils susceptible to liquefaction.

We used the Standard Penetration Testing (SPT) results from the exploratory drilling program and laboratory testing results to determine the embankment soils' susceptibility to liquefaction. We used methods from Mine Safety and Health Administration's *Engineering and Design Manual for Coal Refuse Disposal Facilities* (2010) to make the determination. First, the SPT blow counts were corrected to $N_{1,60}$ values for each soil layer and a median value was calculated. Calculation spreadsheets are included in Appendix V, and the median values for embankment materials are in shown in Table 3.

Table 3. Corrected SPT Data and Soil Type

Soil	Median Corrected SPT Blow Count	Sand-like or Clay-like
Shale Fill	19.6	clay-like
Clayey Gravel	15.2	clay-like

MSHA manual guidelines state a clay-like soil can be susceptible to liquefaction if the corrected SPT value is less than 6. As shown in Table 3, using these guidelines, the shale fill and clayey gravel should not be susceptible to liquefaction. Because the embankment materials are not susceptible to liquefaction, no additional analyses were performed for this assessment. Note that this assessment does not extend to foundation materials, below the embankment.

<u>End-of-construction Factor of Safety</u>

The CCR regulations specify the factor of safety should meet or exceed 1.3 for the end-of-construction loading condition. End of construction factors of safety are typically calculated for new construction. Given that the facility has been in service for more than 40 years and is considered to be in its long-term condition, no additional analyses were performed.

<u>Summary of Results</u>

A summary of results from the slope stability analyses is provided in Table 4. *SLOPE/W* computer output, showing the modeled profiles, loading conditions, and critical failure surfaces are provided in Appendix V. As shown in the slope stability analysis results in Table 4, the factors of safety satisfy the requirements set forth in the CCR Rules.

Table 4. Summary of Slope Stability Analyses Results

Analysis Condition	Section B-B	Section C-C
Maximum Long Term Pool	2.1	2.2
Maximum Surcharge Pool	2.0	2.2
Pseudo Static (Downstream)	1.6	1.8
Pseudo Static (Upstream)	3.1	3.2

CERTIFICATION STATEMENT

Based on the site visit, the results of the field and laboratory testing of the materials used in the embankment construction, and our review of the as-built embankment geometry; it is our opinion that the Amos Plant Bottom Ash Complex has slope stability factors of safety that meet or exceed the requirements in the CCR Rules. Furthermore, based on our review of the as-built embankment geometry, current operating pool levels, and the spillway system; we believe that the facility is capable of storing/routing the runoff from one-half of the 6-hour PMP design storm event.

Accordingly, I hereby certify that the John Amos Plant – Bottom Ash Complex meets the applicable requirements in the CCR Rules. It should be clearly noted that this certification is not a legal guarantee. This certification is merely a statement by a registered professional engineer that, to the best of his knowledge, the facility meets the applicable requirements set forth in the CCR Rules. No warranties, expressed or implied, are provided.

Seth W. Frank

Seth W. Frank, P.E.
West Virginia R.P.E. No. 20574

12-21-2015

Date

SETH W. FRANK
REGISTERED
20574
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

GA

Geologic Description

The Amos Power Plant is situated in Putnam County, West Virginia within the physiographic province of the Appalachian Plateau. The Amos Power Plant primary and ancillary facilities are located along the southern bank of the Kanawha River along S.R. 35 approximately two miles northwest of Interstate I-64 at Scary, WV. The plant facility and accompanying Bottom Ash Complex just to the west are situated on relatively level alluvium with surface drainage to towards the Kanawha River, located along the eastern and northern boundaries of the facility. The Kanawha flows westward into the Ohio River at Point Pleasant, West Virginia. Surface flow in the northwestern area of the site, where the Bottom Ash Complex is located, is northwestward towards Bill's Creek, a tributary of the Kanawha. The plant area is underlain by Quaternary age alluvium consisting of lenticular floodplain deposits of clay, silt and fine to coarse sand with some gravel lenses to a depth of about 50 feet (elevation of approximately 530 feet). Bedrock consists of Pennsylvanian age shale, coal, clay and very limited amounts of limestone. The Pennsylvanian deposits range from about 3,000 to 3,800 feet in thickness and are typically relatively horizontal to slightly folded.

In the upland areas of the Amos Power Plant property in the vicinity of the Fly Ash Reservoir and Quarrier Landfill, the hilltops are capped by nominal thickness of residual soils varying up to about six feet in occurrence underlain by low permeability Permian age Dunkard Formation strata. The Monongahela Formation underlies the hill slopes and valley bottoms and is, in turn, underlain by the Conemaugh Formation. The bedrock underlying the alluvial sediments in the power plant vicinity along the Kanawha River valley is the Pennsylvanian deposits of the Conemaugh Formation. Underlying the Pennsylvanian deposits are Mississippian aged sandstone and shale with minor amounts of limestone. Structurally the area is relatively quiescent with no faults having been identified within the study area of the Amos facility. Accordingly, there are no seismic impact zones within or near the plant area.

According to the 1968 geologic map of West Virginia produced by the Geologic and Economic Survey of West Virginia, there is no karst terrain underlying or within the site area.

There are no economically feasible coal deposits underlying the Amos facility either in the plant or upland areas to the south in the vicinity of the Fly Ash Reservoir. There are economic oil and gas deposits in Putnam County with wells having been installed on the Amos Plant property into the Berea Sandstone.

Groundwater in the plant area is near the pool level of the Kanawha River (about 566 feet) within the alluvial sediments underlying the facility while the upland areas are primarily stress relief fracture flow marked by secondary porosity resulting from fracturing. Groundwater flow in the upland areas tends to follow the stress relief fracture flow pattern that typically mimics surface topography while flow within the alluvium sediments underlying the plant is primarily towards the Kanawha River or Bill's Creek, as is the case with the western area of the plant site in the vicinity of the Bottom Ash Complex.

At the direction of AEP, eight borings were drilled through the main dike of the Bottom Ash

Complex in August 2005 by H.C. Nutting Company of Charleston, West Virginia. The boring locations are shown on the drawings in Appendix IX. Boring logs are included in Appendix II. Standard Penetration Tests (SPT) were performed generally on 5-foot intervals and relatively undisturbed samples were collected at selected locations using a thin walled sampler.

Below the fill materials, a 4 to 6-foot thick layer of soft clay and about a 20-foot thick layer of silty sand, both likely alluvial in origin, were encountered in each of the borings. Below the silty sand, residual weathered shale was encountered to the boring termination depths. The natural materials encountered in the borings are consistent with the general geology description included herein.

References:

GAI Consultants , Inc., (2004), FGD Landfill Siting Study, JE Amos Power Plant, West Virginia.

Ehlke, T.A., Runner, G.S. And Downs, S.C., 1982 Hydrology of Area 9, Eastern Coal Province, West Virginia Geological Survey Water-Resources Investigations Open-File Report 81-803.

White, I.C., and Krebs, C.E. (1911) West Virginia Geological Survey; Jackson, Mason and Putnam Counties, Wheeling, WV; Wheeling News Litho. Company.

White, I.C., and Krebs, C.E. and Tetts, D.D. (1914) West Virginia Geological Survey; Kanawha County Jackson, Wheeling News Litho. Company

B. M. Wilmouth, Movement of Ground Water in the Kanawha River Alluvium in West Virginia, (Abstract - Geology and Mining), Proceedings of the West Virginia Academy of Sciences, 1961, Volume 33.

B. M. Wilmouth, Hydrology of the Kanawha Valley, Proceedings of the West Virginia Academy of Sciences, 1968, Volume 40.

Geology and Economic Resources of the Ohio River Valley in West Virginia, West Virginia Geologic Survey, Volume XXII, 1956.

Appendix H

Fly Ash Pond Structural Stability and Safety Factor Assessments required at § 257.73(d) and (e)

INACTIVE CCR SURFACE IMPOUNDMENT

Design and Operating Criteria

CFR 257.71; 257.73; 257.74;257.82

Fly Ash Pond

John E. Amos Plant

April, 2018

Prepared for: Appalachian Power Company – John E. Amos Plant

1530 Winfield Rd,

Winfield, West Virginia 25213

Prepared by: American Electric Power Service Corporation

1 Riverside Plaza

Columbus, OH 43215

Document ID: GERS-18-012

INACTIVE CCR SURFACE IMPOUNDMENT
Design and Operating Criteria
JOHN E. AMOS PLANT
FLY ASH POND

PREPARED BY	Gary F. Zych Gary F. Zych, P.E.	DATE	APR 4, 2018
REVIEWED BY	J. T. Massey-Norton John T. Massey-Norton	DATE	4/4/2018
APPROVED BY	Gary F. Zych Gary F. Zych, P.E. Manager – AEP Geotechnical Engineering	DATE	APR 4, 2018

Gary F. Zych

GARY F. ZYCH
REGISTERED
21201
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

4/4/2018

I certify to the best of my knowledge, information and belief that the information contained in this summary meets the requirements of 40 CFR 257.71; 257.73; 257.74 and 257.82

Table of CONTENTS

Attachment: Closure Design Report (report text only)

1.0 OBJECTIVE

This report was prepared by AEP- Geotechnical Engineering Services (GES) section to fulfill requirements of CFR 257 Subpart D for Inactive CCR Surface Impoundments.

2.0 NAME AND DESCRIPTION OF INACTIVE CCR SURFACE IMPOUNDMENT

The John E. Amos Power Plant is located near Winfield, Putnam County, West Virginia.
It is owned and operated by Appalachian Power Company (APCO). The facility owns an inactive CCR surface impoundment that was used for permanent disposal of fly ash, referenced as the John Amos Fly Ash Pond (FAP).

The Fly Ash Pond dam is a cross valley dam on Scary Creek, a tributary to the Kanawha River. The dam is 220 feet high and has side slopes of 2.5 to 3H:1V on the upstream slope, and 2.0 to 2.5H:1V on the downstream slope.

The dam is classified as a High Hazard Dam and is an unlined surface impoundment.

An operation of the CCR unit ceased in 2010 in accordance with the State requirements, and therefore was not operating as of October 14, 2015. The closure of the CCR unit started in 2011 with a site investigation and engineering report. The closure report was filed with applications to the State of West Virginia Department of Environmental Protection to close the fly ash pond.

Approval was obtained and construction activities started in September 2013. The construction was completed in the Fall of 2017. The closure of the CCR Unit was closure in place with a CCR compliant cap system, consisting of a geomembrane and two-feet thick cover soil and vegetation.

The closure report referenced above addressed all items related to Structural Integrity as per CFR 257.73, CFR 257.74 and CFR 257.82. As part of the closure design, a new discharge channel was constructed such that the dam no longer impounds any stormwater runoff from the watershed. The channel was designed to pass the peak discharge of the PMF design storm.

The text portion of the design report for the closure is in the attachment.

The facility is now in Post Closure Care period of 30 years.

ATTACHMENT

Design Basis Report

John E. Amos Plant
Fly Ash Pond Closure
Appalachian Power Company
Putnam County, West Virginia




AEP AMERICAN ELECTRIC POWER

Stantec

October 26, 2012

Design Basis Report

Stantec

John E. Amos Plant
Appalachian Power Company
Scary, West Virginia

JOHN MENNINGER
REGISTERED
19548
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER
10/26/12

October 25, 2012

Volume 1 of 2

Stantec Consulting Services Inc.
11687 Lebanon Road
Cincinnati OH 45241-2012
Tel: (513) 842-8200
Fax: (513) 842-8250

Stantec

October 26, 2012

Mr. John Massey-Norton
American Electric Power
1 Riverside Plaza, 22nd Floor
Columbus, Ohio 43215

Reference: **Design Basis Report**
Fly Ash Pond Closure
John E. Amos Plant
Putnam County, West Virginia

Dear Mr. Massey-Norton:

Stantec Consulting Services Inc. has prepared the attached Design Basis Report and Permit Drawings for the Fly Ash Pond Closure at the John E. Amos Plant. The documents were prepared in support of the application for a West Virginia Dam Modification Permit Certificate of Approval.

We appreciate the opportunity to assist the AEP team on this project. Please call if you have any questions or if we can be of further assistance.

Sincerely,

STANTEC CONSULTING SERVICES INC.

John R. Menninger, PE
Senior Project Engineer
Tel: (513) 842-8200
Fax: (513) 842-8250
john.menninger@stantec.com

Jeffrey S. Dingrando (JSH)
Jeffrey S. Dingrando, PE, PG
Geotechnical Engineer
Tel: (859) 422-3049
Fax: (859) 422-3100
jeff.dingrando@stantec.com

/lfb

Table of Contents

Appendices

1.0 Introduction

1.1 BACKGROUND

The John E. Amos power plant is located between Old US Route 35 (Winfield Road) and the Kanawha River in Putnam County, West Virginia. It is owned and operated by Appalachian Power Company, a subsidiary of American Electric Power (AEP). The plant consists of three coal-fired electric generating units and has been in operation since the early 1970's. Units 1 and 2 have a rated capacity of 816.3 MW each, and Unit 3 has a rated capacity of 1300 MW. Plant coal combustion residual (CCR) byproducts consist of fly ash, bottom ash and synthetic gypsum.

The fly ash pond complex was constructed and operated as a wet disposal facility for sluiced fly ash; however, it is no longer in use for CCR disposal. Currently gypsum is dewatered and dry landfilled at the newly constructed gypsum landfill. Bottom ash is managed at the ash pond located at the plant. Fly ash is dry landfilled at the older Quarrier site.

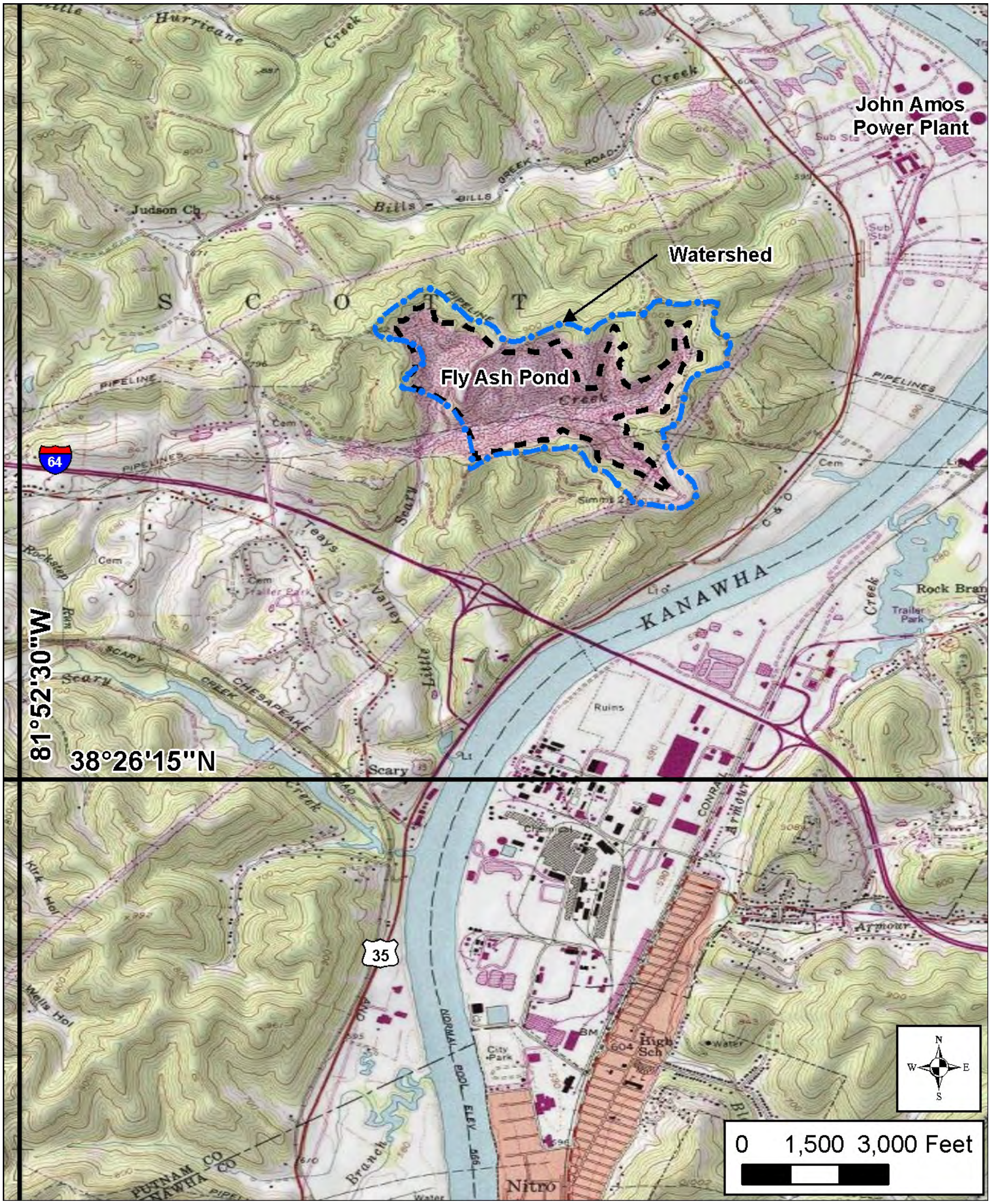
The fly ash pond complex is located approximately 1.5 miles southwest of the plant, north of Interstate-64 in the headwaters of Little Scary Creek (a tributary of the Kanawha River). The approximate surface area of the impoundment is 166 acres at normal pool (El. 860 feet). The current height of the dam as measured from the downstream toe is approximately 220 feet. The dam was originally constructed in the 1970's and subsequently raised via conventional downstream construction methodology in three stages: Stage 1 with crest elevation of 810 feet, Stage 2 with crest elevation of 845 feet, and Stage 3 with crest elevation of 875 feet. The dam was constructed as a zoned embankment with an inclined upstream impervious zone and downstream zones of earth and rockfill. Figure 1 shows the location of the fly ash dam in relation to roadways, streams and the nearest town.

The current crest of the dam at elevation 875 feet is approximately 30 feet wide and 2,000 feet long. The upstream slope of the dam ranges from roughly 2.5 to 3 horizontal to 1 vertical (H:V) and downstream slope ranges from 2 to 2.5:1 (H:V). The visible portion of the upstream slope is vegetated, while the downstream slope consists of large riprap.

The fly ash pond complex has a concrete principal spillway decant riser structure and discharge piping located in original ground off the northwest end of the dam. The decant piping corridor discharges through a tunnel in the hillside into an adjacent Little Scary Creek tributary. The dam also has an open channel emergency spillway excavated through bedrock along the northwest hillside.

The principal spillway riser is currently not used to control pool elevation. A reclaim water pump system was installed in 2010 to convey flows from the ash pond to the bottom ash pond at the plant.

Figure 1. Location Map



1.2 PROJECT DESCRIPTION

The Amos Fly Ash Pond Closure project will eliminate the permanent pool through the re-grading of the in-situ fly ash within the impoundment and excavation of a new outlet channel to the west of the facility. The re-graded ash will be overlain by a soil cover to prevent direct contact between stormwater runoff and CCRs.

1.3 DAM SAFETY CLASSIFICATION

The Amos Fly Ash Pond Dam is classified as a Class I structure per West Virginia Dam Safety Regulations. The previously developed Monitoring and Emergency Action Plan and Maintenance Plan revised January 24, 2008 by AEP are included in Appendix A-1. The Emergency Action Plan utilized results of a dam break analysis prepared by AEP in 1993. A copy of the dam break analysis is also provided in Appendix A-2. No updates to the plans or dam break analysis are proposed at this time. During closure operations, the normal pool and volume of sluiced ash / water impounded will not exceed the previous modeled conditions and will reduce potential breach consequences.

1.4 PURPOSE AND SCOPE OF REPORT

This engineering report is provided in support of the West Virginia Dam Safety permit modification application for the Amos Fly Ash Pond Closure project. The report presents the proposed design and supporting engineering analyses. Section 2.0 outlines the proposed construction elements, sequencing, costs and specifications. Section 3.0 discusses the analysis and design of stormwater management features including reservoir pool routings and channel design. Finally, Section 4.0 includes the review of the geotechnical design analyses performed including settlement, slope stability and liquefaction potential.

2.0 Site Development and Construction

2.1 PRIMARY DESIGN ELEMENTS

The Amos Fly Ash Pond Closure Permit Drawings provided with the application present the proposed closure design. The design is comprised of multiple key elements outlined below and detailed further in the project work plan and construction specifications.

2.1.1 Mass Grading

The proposed closure design includes the re-grading of in-situ fly ash within the fly ash pond impoundment to facilitate drainage across the site and eliminate a permanent pool. Initial grading will be performed through excavation of fly ash in the central and western portions of the pond and placement in the eastern areas of the pond. The grading is anticipated to occur via one or a combination of the following methods: 1) hydraulic dredging of fly ash and placement in upstream dredge containment areas and/or 2) conventional excavation and fill placement utilizing low ground pressure construction equipment. Proposed grading plans for the final grade and interim phasing are presented in Drawings 13-30705 to 30714.

A typical dredge containment dike detail is presented in Drawing 13-30727. The typical dike design includes a homogenous soil embankment with a compatible chimney filter and drainage blanket. The upstream and downstream slopes are protected from erosion with a soil/rock cover. The pool elevation will be controlled by a fixed trapezoidal spillway with an invert two feet below the dam crest.

Dredge containment dike heights will vary based on their location and the proposed final grades. The dikes will be restricted to a maximum height of 24 feet and the open impounded volume less than 50-acre feet. Dredge containment areas may not be operated in series. Once a cell is filled to capacity, the free water shall be drained and final grade established prior to construction of the next downstream cell.

As an alternative to dredging, the contractor may elect to utilize conventional grading methods based on either ease of construction or economic factors. Areas not filled via hydraulic dredging shall be constructed with fly ash or soil / rock borrow from designated borrow sites within the impoundment watershed.

For purposes of the construction work plan and cost opinion, it is currently assumed that the majority of grading in the eastern and central portions of the pond identified in the Phase 1 drawings will be constructed with hydraulic dredging. The remaining grading operations in the western areas will completed via conventional methods.

2.1.2 Borrow Sites

Soil and rock borrow for use in the pond closure will be sourced from one of four borrow sites located adjacent to the pond. The borrow sites are identified on Drawings 13-30714 to 30720. Maximum extents for the borrow sites are identified on the drawings. Borrow materials are anticipated to include clay overburden soils and bedrock including claystone, shales, siltstone and sandstone. Additional information regarding the composition and uses of borrow material is provided in Section 4.1, Borrow Area Analysis.

2.1.3 Soil Cover

Soil cover will be placed atop the ash subgrade surface to protect the placed fill from erosion. The soil will be sourced from the adjacent borrow areas. Cover soils will be sloped from 2-10 percent. The top six inches will be suitable to sustain vegetation.

2.1.4 Interim Stormwater Management

The existing water reclaim system consists of the pump station located adjacent to the emergency spillway and twin eight-inch HDPE reclaim water lines that run along the crest of the dam and along a floating roadway east toward the plant. Stormwater that falls within the pond watershed is stored in the pond and pumped via the reclaim system to the plant. During construction, the reclaim system will be utilized to manage construction runoff and ash contact water.

Modifications to the system will be required as the proposed grading will impact the existing discharge pipes and require water levels in the pond lower than the allowable operating range of the existing pump system estimated as elevation 850 feet. The new reclaim water lines will be constructed outside of the proposed excavation limits. Details for the water lines are provided on Drawing 13-30707.

Additionally, the contractor will modify the existing pump intake lines to accommodate attachment of a secondary pumping system. The secondary system will pump water through two temporary units at the current pump station capacity (675 gpm) each from elevations below 850 feet to the existing pump station. The existing station will then pump flows back to the plant.

2.1.5 Drainage Channel Network

Following establishment of final grades, stormwater runoff from the soil cover and surrounding hillsides will be conveyed across the final surface, via a network of drainage channels, through a newly excavated spillway adjacent to the existing emergency spillway and into a tributary of Little Scary Creek. Channel details are shown on Drawing 13-30728. Details on the design of each channel are provided in Section 3.4.

2.2 CONSTRUCTION SEQUENCING

The proposed construction sequencing was developed to review constructability concerns and allow for review of potential interim conditions. The actual construction sequencing of the proposed closure may differ from that displayed on Drawings 13-30708 to 30713 and will be determined by the selected contractor.

The construction phases presented are described below. A more detailed outline of the construction sequencing is provided in Appendix B-1.

- Phase 1 – Initial Mass Grading: In-situ ash will be hydraulically dredged and placed in upstream dredge containment areas. The operating pool of the ash pond will be maintained at an approximate elevation of 860 feet to allow for dredge equipment access to the excavation areas. The dredge containment dikes would maintain a permanent pool to allow for solids to settle and decanted water to flow back to the larger impoundment. The containment areas would be constructed from upstream to downstream and dewatered as necessary. Constructed dredge containment dikes will maintain storage capacity and dike height metrics below dam classification thresholds.

- Phase 2 – Close Dredge Containment Areas and Grade Dredged Areas: At the conclusion of dredging operations, the pool level will be drawn down and the dredge containment areas will be constructed to final grade, covered, mulched and seeded. Areas within the pond that were dredged will be graded to prepare for final cap and the pond water level will be lowered by the contractor using the existing reclaim water pump system and the secondary pumping system.

- Phase 3 – Continue Closure: During Phase 3, the prepared subgrade in Phase 2 will be covered, mulched and seeded. Additional subgrade development will occur with stormwater being directed to a smaller pool in the northwest corner of the pond.

- Phase 4 - Completion of Diversion Network: Phase 4 will include the cover, mulch and seeding of the Phase 3 area and completion of the diversion network. This will include construction of the proposed spillway rock cut and connection to the receiving tributary. Stormwater will continue to be maintained in the northwest pool.

- Phase 5 – Final Closure Operations: During Phase 5, the majority of stormwater runoff within the pond watershed will be diverted through the proposed spillway following establishment of vegetation of the Phase 4 final cover. A small water quality basin will remain to provide for erosion control and contact water containment of the area not yet completed. The remaining pond will be filled in and closed from the perimeter working towards the pond. Finally, once vegetation has been established, the small remaining pond will be closed and all runoff directed to the diversion channel. At this time, the existing principal spillway will be abandoned.

2.3 OPINION OF PROBABLE CONSTRUCTION COSTS

A construction cost opinion has been developed as part of the permit design package. The total construction costs are estimated at $26,819,000. A detailed breakdown of the construction cost opinion is provided in Appendix B-2.

2.4 CONSTRUCTION SPECIFICATIONS

Specifications have been developed for the construction of the proposed improvements. The specifications include the following:

- CE-002 - Specification for Clearing and Grubbing
- CE-003 - Specification for Stripping
- CE-004 - Specification for Excavation
- CE-004A - Specification for Rock Blasting
- CE-005 - Specification for Foundation Preparation
- CE-006 - Specification for Fill
- CE-006A - Earthwork (Backfill) Testing
- CE-007 - Specification for Erosion and Sediment Control
- CE-008 - Specification for Surface Drainage Systems
- CE-009 - Specification for Roads and Parking Areas
- CE-009A - Specification for Road Mix Fly Ash-Aggregate Base Course
- CE-013 - Specification for Geotextile
- CE-013A - Nonwoven Geotextile
- CE-017 - Specification for Hydraulic Dredging
- CE-022 - Specification for Surface Settlement Monuments and Settlement Gages
- CE-025 - Specification for Pressure Relief, Horizontal, and French Drains
- CE-033 - Specification for Loading, Excavating, Hauling, Placing, and Compacting of Coal Combustion By-Products
- CE-036 - Demolition Removals and Alterations
- CE-037 - Excavation and Backfill for Underground Utilities
- CE-040 - Materials for Underground Piping and Sewers

These are included in Appendix B-3.

3.0 Stormwater Management

Stantec performed stormwater calculations to evaluate the hydrologic and hydraulic performance of the drainage facilities for the proposed closure design. This analysis included routing of storm runoff through the impoundment for existing, interim and closed conditions. In addition, peak flow rates were estimated for the closed condition to develop the stormwater conveyance and diversion structure designs.

Current pond operations maintain a normal pool elevation of approximately 860 feet utilizing the reclaim water pump system with a total rated capacity of 1350 gallons per minute (3 cubic feet per second). The pump system was designed to prevent the discharge of water through the primary decant structure (current discharge elevation 867 feet) for storm events equal to or less than back-to-back 25-year, 24-hour storms. These storm inflows are stored in the pond and pumped back to the bottom ash pond at the plant.

As outlined in Section 2.0, the ash pond will be closed through the progressive phasing of excavation and fill within the impoundment. Throughout construction, the existing operation guidelines will be maintained. Contact water (i.e. rainfall that falls on or passes over exposed ash) will be stored within the pond footprint and pumped back to the bottom ash pond for storm events equal to or less than back-to-back 25-year, 24-hour events. In addition, the proposed interim grading and pond elevations will provide sufficient storage and spillway capacity to pass the Probable Maximum Precipitation (PMP) event without overtopping the dam crest.

Final closure conditions will result in elimination of the permanent pool and a direct connection to a downstream tributary of Little Scary Creek through a deepening of the existing emergency spillway cut. The primary decant structure will be abandoned and new drainage channels constructed atop the closed pond surface. The proposed drainage channels are designed to convey the 100-year, 6-hour storm event.

3.1 HYDROLOGY

Stantec computed runoff hydrographs for the drainage area of the impoundment using the U.S. Army Corps of Engineers (USACE) Hydrologic Modeling System (HEC-HMS) Version 3.4 (USACE, 2010). Twelve design subbasins were delineated based on topographic information provided by AEP and the proposed closure geometry. The base mapping was derived from AEP aerial and hydrographic surveys dated early 1996, March 29, 2002, April 5, 2005 and September 8, 2010. Topographic data was formatted into 2-foot contours referenced to the North American Vertical Datum of 1988. Figure C-1 in Appendix C.1 displays the subbasin delineations and key drainage features.

Hydrologic calculations were performed using the methodology outlined in the U.S. Department of Agriculture (USDA) Technical Release 55: Urban Hydrology for Small Watersheds (TR-55) (USDA, 1986). Design storm rainfall depths were determined using the National Oceanic and

Atmospheric Administration (NOAA) Atlas 14: Point Precipitation Frequency Estimates (NOAA, 2011) and Hydrometeorological Report No. 51 (NOAA, 1978). Design storm information is summarized in Table 1. The SCS Type B six hour rainfall hyetograph was utilized for each 6-hour event (Chow, 1988), and a modified SCS Type II hyetograph was utilized for the back-to-back 24-hour events.

Table 1. Design Storms

Recurrence Interval (year)	Duration (hour)	Rainfall Depth (inches)	Design Basis
2	6	1.81	Low Flow (Bankfull) Channel Design
Back-to-Back 25	48	8.31	Contact Water Containment Pool Routing
100	6	3.84	Channel Design
PMP	6	27.80	Dam Safety Pool Routing

Stantec analyzed the performance of the pond and drainage network for the existing, interim and closed conditions. Subbasin runoff properties, including curve numbers and lag times, were calculated for each of the modeled scenarios using TR-55 methodology. Appendix C.1 includes a summary of the hydrologic parameters for each model scenario.

3.2 RESERVOIR POOL ROUTING

The existing fly ash pond complex must continue to meet dam safety regulations outlined in the State of West Virginia's "Title 47, Legislative Rule, Department of Environmental Protection, Water Resources Series 34, Dam Safety Rule" (State of West Virginia, 2009) throughout pond closure construction. As a high hazard facility, the pond must maintain the capacity to store and pass the 6-hour PMP event without overtopping the dam crest. To assess the impacts of the proposed closure design on the reservoir performance during a PMP event, Stantec analyzed each interim phase of construction and the final proposed closure geometry.

3.2.1 Stage – Storage – Discharge Relationships

A unique stage storage curve was developed for each modeled scenario using existing aerial and hydrographic survey data and proposed grading plans. Figures C.2 and C.3 in Appendix C.2 show the estimated stage storage curves for each of these scenarios.

Additionally, two separate rating curves were developed for the analysis. Rating Curve # 1 represents the existing pond operations including the principal spillway set at El. 867 feet and the emergency spillway at El. 868 feet. Rating Curve #2 represents the final spillway configuration with the proposed channel cut through the ridge on the west side of the pond. Due to the varied geometry and slope of the spillway cut, a HEC-RAS model was developed to calculate water surface elevations at multiple locations for a range of flow rates. Figures C.4 and C.5 in Appendix C.3 provide a graphical representation of Rating Curves 1 and 2, respectively.

3.2.2 Design Storm Routing Results

The results of the analysis are presented in Table 2. Additional model results output is provided in Appendix C.4.

Table 2. PMP Reservoir Routing Results

Phase	Spillway Elevation (feet)	Max Normal Pool Elevation (feet)	Peak Pool Elevation (feet)
Existing	867.0	860.0	864.4
1 / 2	867.0	860.0	865.5
3	867.0	832.0	851.9
4	867.0	824.0	852.6
Final	825.2	825.2	836.7

Based on the results of the analyses, none of the existing or proposed conditions will result in pool elevations greater than the top of the existing primary spillway (El. 867’), emergency spillway (El. 868’) or within 9 feet of the dam crest (El. 875’). The highest pool elevation would occur during the initial stages of Phase 2 when fill has been placed in the eastern sections of the pond and the pool is still raised for dredging operations. Subsequent phases lower the normal pool elevation and result in additional storage capacity and freeboard.

Following completion of construction, the permanent pool will be eliminated; however, during extreme events, such as the PMP, water may pond on the graded surface for less than 24-hours.

3.3 CONTACT WATER CONTAINMENT

In addition to the PMP reservoir pool routings, Stantec also reviewed the performance of the proposed contact water containment ponds during Phases 3, 4 and 5 of construction. During these phases, excavation of some or all of the Borrow Site 3 / Spillway Cut will occur. With excavation of this area, a potential release of contact water could occur without proper containment procedures.

Using the results of the HEC-HMS rainfall-runoff analysis, Stantec performed pool routings for each phase to determine the required containment elevation for back-to-back 25-year, 24-hour storm events. The results of the routings, as well as the containment elevations specified on the drawings, are provided in Table 3 below.

Table 3. Containment Pond Routing Results (Back-to-Back 25-Year, 24-Hour Storms)

Phase	Normal Pool Elevation (feet)	Peak Pool Elevation	Containment Elevation (feet)
3	832.0	839.2	840.0
4	824.0	838.7	840.0
5	830.0	838.4	840.0

During back-to-back 25-year events, containment elevations provide at least 0.8 feet of freeboard above the calculated maximum pool elevations.

3.4 CHANNEL DESIGN

Each of the proposed permanent drainage channels was designed to convey the 100-year 6-hour storm event, which meets the West Virginia Dam Safety Regulations for diversion channels and exceeds the requirements for supplemental drainage features. The permit modification drawings include details for three channel configurations. Each of the configurations is a two-staged channel with a small "bankfull" channel and a broader shallow floodplain.

The channel geometries were designed to contain a 2-year storm event within the "bankfull" channel and a 100-year storm event within the floodplain area. Table 4 below, provides a list of peak flow rates at key locations developed from the HEC-HMS rainfall-runoff analysis. The location of each studied discharge point is shown on Figure C.1 in Appendix C.1.

Table 4. Drainage Channel Peak Flow Rates

Discharge Point	Peak Flows (cfs)	
	2-Year	100-Year
A	93	478
B	91	456
C	86	432
D	8	43
E	10	40
F	9	41
G	8	71
H	8	41
I	15	82

The required channel depth and erosion protection were determined based on methods outlined in the West Virginia Division of Highways Drainage Manual (WVDOT, 2007). Normal depth for each channel was calculated based on Manning's equation. The maximum anticipated shear stress was calculated using Tractive Force Theory. Example calculations and channel design results are provided in Appendix C.5.

4.0 Geotechnical Design

4.1 BORROW AREA ANALYSIS

Construction of the final closure system will require significant quantities of soil that is suitable for supporting vegetation. In addition, significant borrow material will be needed to adjust grades within the pond footprint prior to placing the final cover. Stantec's geotechnical exploration, performed in February and March of 2012, focused on potential borrow areas within the ash pond watershed, as well as within the vicinity of the proposed spillway cut.

Four areas were identified as potential borrow sites during the exploration and are shown in planview and profile on the permit modification drawings. Borrow Sites 1, 2 and 4 are located around the eastern perimeter of the ash pond, and Borrow Site 3 is located on north side of the existing emergency spillway cut. Both soil and rock excavation is expected within these areas, with rock excavation being performed using mechanical excavation and/or blasting. Certain weaker rock strata can be broken down into clay-like materials as needed.

These borrow sites will provide material for three primary needs:

- Soil Cover – final cover
- Durable Rock Fill – channel lining, slope protection stone, etc.
- Bulk Fill – subgrade fill (in areas where dredged fly ash is not used), other areas where random fill is suitable.

Although dredged fly ash will be used extensively as subgrade fill, it is not discussed further herein because it is not being imported from outside the pond footprint.

In conjunction with the geotechnical exploration performed by Stantec, several historical references were used to define the subsurface stratigraphy for each site. These sources were also used to determine the available materials and quantities. The references included Acres American Incorporated (1974, 1975a, 1975b) reports for the main dam construction and expansion (including quarries that were to provide soil and rock borrow), along with the H. C. Nutting (2008) geotechnical report and AEP (1995) boring and monitoring well logs. Geotechnical reports provided by Stantec to support this design project are included in Appendix D. This includes Stantec (2012d) and Stantec (2012e).

Conceptual cut slope designs were developed for each borrow site, and can be found in the permit drawings. With the exception of Borrow Site 3, the slopes shown represent the steepest allowable slopes and the greatest lateral extent of development. The contractor may choose the degree of development for each borrow site based on their preferred approach. The lateral extent of the excavation is constrained by a minimum setback distance from gas lines located around the facility perimeter. Currently, the setback distance (100 feet) shown herein has been assumed. The actual minimum distance will be determined during preparation of final construction drawings, in coordination with AEP and the gas utilities.

The development of Borrow Site 3 is also needed for the new spillway cut. On the south side of the new drainage channel, the geometry shown on the design drawings represents the required cut. On the north side, the minimum cut is shown but the contractor may propose to expand this cut farther to the north to generate additional borrow.

4.1.1 Material Needs

Based on the proposed grading, the required borrow quantities are estimated as follows:

- Soil Cover = 541,000 cubic yards
- Durable Rock Fill = small quantity in comparison to available (Section 4.1.2)
- Bulk Fill = 432,000 cubic yards

Quantities are presented in terms of “in-place, after-compaction” volumes. No adjustment or assumptions have been made regarding the volume of borrow material that would be required to produce these in-place, after-compaction volumes.

4.1.2 Available Materials

Based upon Stantec’s exploration and the historical data, the materials available onsite consist of clayey overburden soil, durable and nondurable sandstone, siltstone, shale, and claystone. Using the designed cut slopes shown on the drawings, volume calculations were performed using AutoCAD Civil3D 2009, and the available in-situ quantities of each material are presented in Table 5. The quantities provided are estimates based upon the limited subsurface data from Stantec’s test pits and the available historical exploration data. Subsurface conditions between borings and test pits are unknown.

Table 5. Estimated Borrow Site Materials

Borrow Site	ESTIMATED AVAILABLE MATERIAL VOLUMES		
	Sandstone/Siltstone (cy)	Shale/Claystone (cy)	Clayey Soil (cy
Site 1	182,000	171,000	129,000
Site 2	173,000	8,500	55,000
Site 3	391,000	20,000	72,000
Site 4	248,000	89,000	71,000
Total	**994,000**	**288,500**	**327,000**

The durable rock fill could consist of the relatively hard sandstone and siltstone encountered in the area. Bulk fill could consist of nondurable sandstone, siltstone, and shale, along with overburden soil unsuitable for the final cover and liner. Coal, if encountered during excavation, should be separated from the borrow material and not be used as fill for this site. The soil cover should consist of clayey overburden material, similar to that encountered during the test pit exploration conducted by Stantec.

Weaker claystone and clay shale strata could be processed until suitable for use as clay for the final cover and liner. Processing may include mechanically breaking down the rock and wetting the rock to accelerate the slaking process, until the material becomes soil-like and suitable for placement and compaction. This process has been successfully utilized at the Amos Plant in the past to construct the impervious zone of the fly ash dam, and is currently ongoing to generate clay material for construction of the Amos Flue Gas Desulfurization (FGD) landfill.

The level of effort necessary to excavate the borrow sites (e.g., mechanical excavation versus blasting) has not been quantified and is beyond the current scope of study. Similarly, the level of effort necessary to process certain rock strata into soil-like materials is beyond the current scope of study. Prospective contractors should evaluate these issues during the bidding process for this project. The rock excavation is discussed in more detail in Section 4.3.4.2, Rock Excavation, and in the specifications (Appendix B-3).

4.2 SETTLEMENT ANALYSIS

Consolidation analyses were performed to evaluate the total anticipated vertical settlement of the final cap. Total settlement is a function of the thickness and stress history of underlying ash and soil, additional load imposed by closure construction (new sluiced ash and final cap), and the assumed time period over which the new load is imposed. Multiple points along several profiles were evaluated and then compared in order to consider planned overbuild and potential areas of differential settlement. A plan view showing the selected alignments can be found in Appendix E-1.

The closure geometry and sequence is such that the most significant settlement will occur within the existing sluiced ash, due to the placement of new sluiced ash in the upstream portions of the pond footprint. Another area of larger settlements is near the existing principal spillway riser, where the pond is still deep and will require a large amount of fill during closure. The rate of consolidation has been considered herein to evaluate whether a waiting period can be incorporated to allow some percentage of this settlement to occur prior to construction of the final cap. After establishing a reasonable waiting period, the total anticipated settlement is then calculated. The grading design was then modified (i.e., overbuilt) to compensate for settlements, such that post-closure grades were within acceptable bounds.

4.2.1 Methodology and Assumptions

The settlement magnitude was calculated along the main project baseline at approximate 100-foot spacing and at 200- to 300-foot spacing along selected secondary alignments. A plan view showing the alignments is included in Appendix E-1. At each selected station, two components of settlement were estimated:

- Settlement due to Grading: caused by placement of fill (dredged ash or bulk fill) to achieve the subgrade elevation.
- Settlement due to Cap: caused by placement of the final soil cover to achieve final grade.

Settlement due to grading (dredge and fill) and due to cap (final soil cover) were calculated separately. The soil profile at each station was divided into separate horizons, consisting of residual soil, sluiced fly ash, dredged fly ash, and the final soil cover. Each soil horizon was assumed to be homogeneous, using the soil properties in Appendix E-1 estimated from the lab and field testing performed during the geotechnical exploration.

Several assumptions were made to simplify the analysis:

- All settlement is due to primary consolidation, which can be modeled assuming a one-dimensional soil profile.
- Existing sluiced ash is normally consolidated.
- Based upon the exploration findings, the sluiced fly ash and residual soil were assumed to be saturated. Further, the additional dredged fly ash is assumed to be saturated at the time of final cover placement.
- After dredging portions of the pond footprint, sufficient time passes to allow complete rebound of the existing sluiced ash prior to placing the cap. Therefore, the ash in the dredge area will be over consolidated at the beginning of cap placement.
- Post-construction settlement within the final cover is assumed to be negligible.

4.2.2 Time Rate of Consolidation

In order to determine the total settlement magnitude at each station, it was assumed that the final soil cover would not be placed until 30 days after completion of ash grading. This is judged to be a reasonable assumption, given that the ash grading will take place over an extended period of time and that the conversion from dredging to final cover construction cannot occur instantaneously. In reality, consolidation due to placement of dredged fly ash will occur continuously as material is placed, not instantaneously as is assumed.

Using the pore pressure dissipation tests performed as part of the CPT exploration on the site, estimated time to 50% consolidation (t_{50}) values were calculated. As shown in the calculations in Appendix E-1, using lab data and published correlations, a coefficient of consolidation (c_v)

value was calculated for the fly ash. A c_v value was also estimated for the residual soil based upon lab test results and published correlations for clayey soil. These values were used to estimate the percent of consolidation that will occur in the first 30 days. Any settlement occurring after those 30 days was added to the settlement caused by the final soil cover to determine the total settlement magnitude at each station. This 30-day waiting period reduced the settlement magnitude due to fly ash grading by 40 to 90 percent, thus reducing the total settlement by as much as 0.3 feet within the pond footprint.

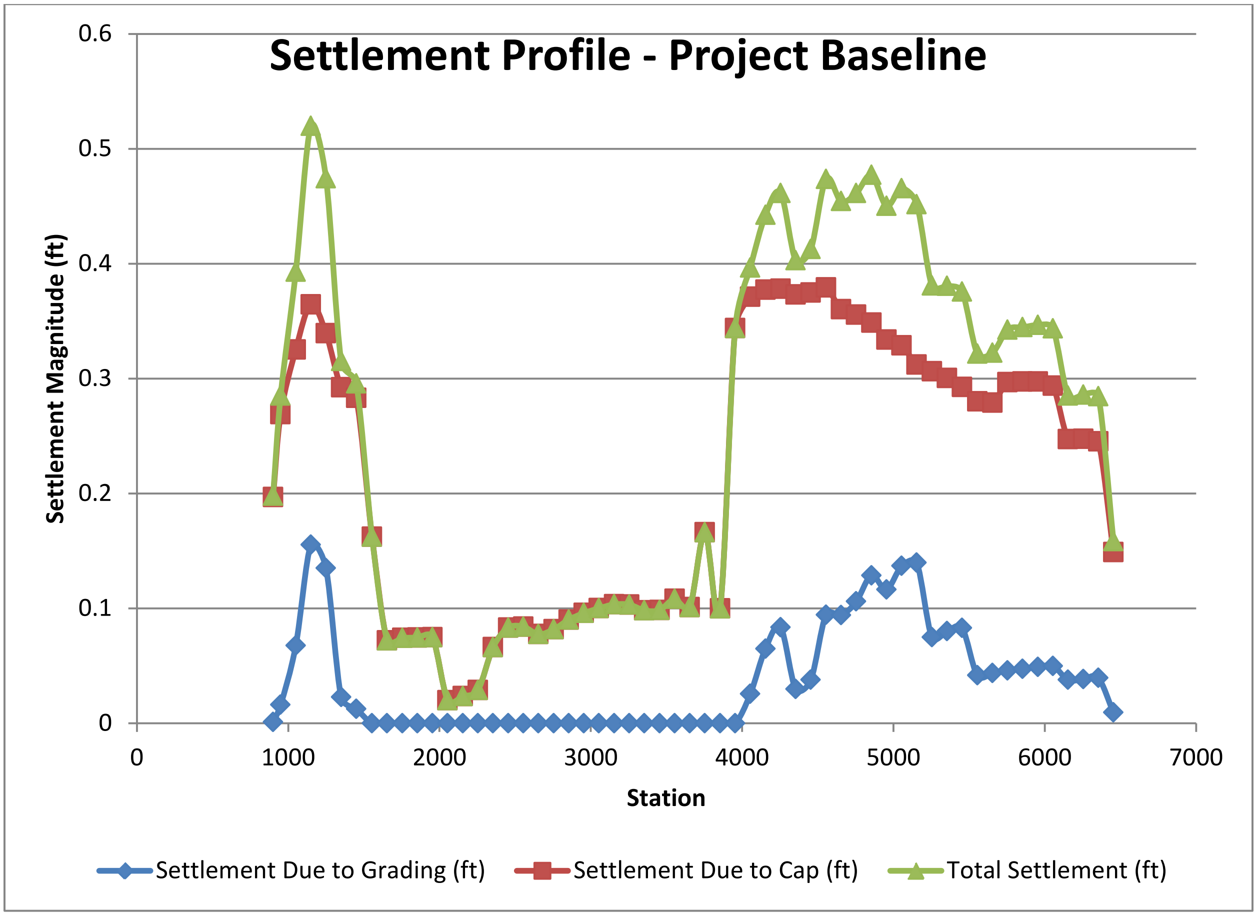
4.2.3 Settlement Magnitude and Differential Settlement

The general settlement profile for the baseline consists of a relatively large amount of settlement near the spillway, peaking at Station 111+50 with a magnitude of 0.52 feet, and decreasing to as low as 0.02 feet near Station 120+54. The region of higher settlement is where the pond is currently deep and requires significant filling, while the region of lower settlement corresponds to an area of dredging where the only settlement is due to placement of the 2-foot thick cover.

Towards the eastern (upper) end of the baseline, the calculated settlement increases again due to the amount of dredged ash fill. The maximum settlement calculated in this area is approximately 0.48 feet near Station 148+54. It was anticipated that the buried quarry bench (Stations 120+00 to 122+00 along the baseline) within the footprint of the pond would create substantial differential settlement. However, because of favorable grading in this region, the quarry bench is now almost completely in the dredging area and is not a major concern for differential settlement.

The settlement values calculated for the secondary alignments were found to be less than the maximum values along the main project baseline alignment. Shown below, and in Appendix E-1, is a plot of the settlement profile along the project baseline, assuming a 30-day wait period before placing the final soil cover.

Figure 2. Settlement Profile along Main Project Baseline



As shown in the above graph, the area with zero settlement due to grading is the dredged area of the pond. The areas of high settlement are caused by a combination of relatively large amounts of fill and thick layers of existing sluiced ash. The maximum settlement locations do not necessarily coincide with the locations of maximum fill because the thickness of the compressible layers decreases as the fill increases near the upper end of the project baseline.

4.2.4 Overbuild Design

As incorporated in the permit drawings, an overbuild amount was determined for the site based upon the settlement analysis. By comparing the station-to-station differential settlement and calculating the segment slopes for each station, it was determined that there were two areas that had undesirable post-settlement slopes caused by differential settlement. The first area is near the proposed spillway, and the second is near the transition from subgrade cut to fill near the middle of the ash pond. In order to counteract the differential settlement, an overbuild amount was added to the ash fill quantity that increased the post-settlement segment slopes to an acceptable value (1% ± approximately 0.1%). Beginning at the spillway, ash fill 0.2 feet thick was added and carried along the alignment until Station 139+54, after which an additional 0.4 feet of ash fill was added.

The secondary alignments did not show significant differential settlement, thus they did not require additional overbuild beyond that necessary to match up at the confluence with the overbuilt primary alignment.

4.3 POST-CLOSURE STABILITY

Stability analyses were performed at several locations of the impoundment to determine the stability of the closure design. Several scenarios were analyzed for the various cross-sections, including short-term, long-term, and seismic stability.

4.3.1 Design Criteria and Methodology

Consistent with engineering practice and governing dam safety regulations (State of West Virginia, 2009), the target factors of safety for short-term (i.e., during construction and end of construction) slope stability are as follows:

- Drained Stability (FS_d) $FS_d \geq 1.5$
- Undrained Stability (FS_u) $FS_u \geq 1.3$ (per §47-34-7.4.b.1.D.1(b))

The following factors of safety against static slope stability will be maintained in the long term, following project completion:

- Drained Stability (FS_d) $FS_d \geq 1.5$ (per §47-34-7.4.b.1.D.1(a))
- Veneer Sliding (FS_v) $FS_v \geq 1.1$
- Dynamic Stability (FS_{EQ}) $FS_{EQ} \geq 1.2$ (per §47-34-7.4.b.1.D.1(d))
- Post-Earthquake Static Stability ($FS_{POST\text{-}EQ}$) $FS_{POST\text{-}EQ} \geq 1.0$

The material properties used in the analyses were derived from lab and field testing performed during the geotechnical exploration, historical data from the site, and correlated values with published data when necessary. Refer to summary tables in Appendix E-2 for material properties.

The strength values for the residual soil were based upon strength values given in Acres American Incorporated (1974) dam raising report and other historical information for the clay in the area. For the final soil cover, a similar value was used based upon the type of soil recovered during the excavation of the test pits. The material consisted of stiff to very stiff sandy clay and clayey sand.

As described in Stantec (2012d), several triaxial tests were performed on the sluiced fly ash. From the consolidated-undrained (CU) tests, it was shown that, under the range of pressures that the samples were tested, the material has higher undrained strength than drained strength, which can only occur if negative pore pressures are generated and lead to additional strength via suction pressures. Typically, sluiced ash is assumed to be deposited in such a loose state that it will contract upon shearing, even at low confining pressures. However, most of the CU triaxial test results show that the sluiced ash demonstrates classic dilative behavior, illustrated by the shape of the stress path and the pore pressure response. The pore pressure response is particularly indicative of dilation during shear, in which negative pore pressures are generated as the sample attempts to expand.

Stress-strain behavior is also generally dilative, indicated by a lack of significant post-peak drop in strength. However, as confining pressures increase, the behavior of this same material should change to contractive. In a small number of tests at the highest confining pressures (representative of the ash near the bottom of the deepest portions of the pond), this transition can be seen in terms of slightly positive pore pressures during shearing.

During design, the increase in undrained shear strength due to negative pore pressures is often neglected, because such suction pressures cannot be sustained. This may be particularly true for the relatively pervious sluiced ash, which will dissipate excess pore pressures rather quickly during and after shearing. In such cases, it is common to assume that the lower drained strength will control design during otherwise undrained loading scenarios. Because of this, the material exhibits higher undrained strengths than drained strengths. Therefore, the drained friction angle was used in the analyses for both short and long-term stability.

A copy of Stantec (2012d) is included in Appendix D-1.

4.3.2 Dam Stability

The existing fly ash deposits along the upstream face of the dam will be regraded and capped for closure. In general, a modest amount of additional fill (sluiced ash and cover materials) will be placed against the dam near the left (south) abutment, while existing fill (sluiced ash) will be removed moving towards the right (north) abutment. The removed thickness will increase moving towards the right abutment in the direction of the new spillway cut. The most significant change to the loading on the dam might be the removal of the permanent pool from the upstream side and the resulting decrease in pore water pressures in the embankment.

Based on previous reports and the known regulatory requirements, the existing dam is assumed to meet all necessary stability criteria for short-term and long-term load scenarios for the range of conditions that existed during construction and operation of the fly ash pond. To demonstrate (graphically) how the closure geometry interacts with that of the dam and to show that stability criteria are met for long-term conditions, two cross sections were evaluated using drained strength parameters and steady-state (post-closure) conditions. Two ash elevations were used, the highest (Elevation 861.8 feet) and lowest (Elevation 838.7 feet) proposed ash fill heights behind the dam. Material properties for the dam were derived from historical data (Acres

American Incorporated, 1974, 1975a; H.C. Nutting 2008) and published correlations. The piezometric line was estimated to be at the fly ash-soil cover interface and then travel through the dam to the drainage layer to the toe of the dam. The results of the long-term, drained analyses are shown in Table 6.

Table 6. Global Slope Stability Results, Existing Dam after Closure

Scenario	Calculated Factor of Safety	Minimum Target Factor of Safety
High Ash Elevation, Downstream Face	1.65	1.5
High Ash Elevation, Upstream Face	1.60	1.5
Low Ash Elevation, Downstream Face	2.03	1.5
Low Ash Elevation, Upstream Face	1.51	1.5

4.3.3 Closed Impoundment

Three cross sections, shown in planview in Appendix E-2, were chosen within the closed pond footprint to evaluate for global slope stability. The sections were chosen because they were either long continuous slopes or steeper slopes. Each section was evaluated under three scenarios: short term, long term, and dynamic.

The dynamic scenario applied a 0.022g horizontal seismic coefficient (k_h) to the section and was evaluated under undrained conditions. For the dynamic case, the static, undrained shear strengths of each material were reduced by 20 percent to account for a modest loss of strength due to generation of excess pore water pressure. The horizontal seismic coefficient was selected as 50 percent of the peak ground acceleration on rock (PGA_{rock}) for the design earthquake. The use of 50 percent of PGA_{rock} is based on research from the U.S. Army Corps of Engineers (USACE) regarding seismic stability of embankments (Hynes-Griffin and Franklin 1984). They conclude that permanent deformations will be tolerable if a slope stability analysis shows at least marginal stability (factor of safety greater than or equal to 1) using k_h and reduced strengths as outlined above.

The depth of the failure surface was not restricted; therefore, the failure surface generally extended to the residual soil or to the estimated top of bedrock. A summary of the results are presented in Table 7, and a graphical representation of the analyses and summary of material parameters can be found in Appendix E-2. Because no liquefaction is anticipated (Section 4.4), the post-earthquake case would utilize the same strengths as the dynamic case, but with no horizontal seismic coefficient (k_h=0). Thus, no additional analysis is needed to show that this case exceeds the minimum target factor of safety.

Table 7. Global Slope Stability Results, Closed Impoundment

Cross-Section	Factor of Safety		
	Long-Term, Drained Conditions	Short-Term, Undrained Conditions	Long-Term, Undrained Conditions, Dynamic Loading (k_h=0.022g)
Minimum Target FS	1.5	1.3	1.2
Cross-Section 1	7.92	12.07	5.54
Cross-Section 2	11.13	7.52	2.86
Cross-Section 3	10.70	7.78	2.99

Veneer stability is often highly dependent on the interface shear strength between specific components of the cover layer. An additional analysis was performed to determine if sufficient shear strength was provided within the soil cover and between its interface with the fly ash fill. As shown in Appendix E-3, the veneer stability spreadsheet was used to analyze two sections: one with the longest straight-line continuous slope and another with the steepest final grade slope. Each section was analyzed under drained, saturated, seismic, and static residual stability conditions. The relevant material properties used in the analyses were the same as those used in the global stability calculations.

For the seismic veneer stabilizing case, the results of ground response analyses (Section 4.4.2.2) were used to estimate the ground surface accelerations at the top of the soil cover. The range of ground surface accelerations was found to be between 0.05g and 0.1g. Therefore, a value of 0.1g was used in the veneer stability analyses. The spreadsheet calculates the factor of safety against sliding for a range of interface friction angles for each scenario. Results and plots of the minimal necessary strength “envelopes” (combinations of friction angle and adhesion) and are included in Appendix E-3, as are derivations of the veneer stability equations. From this spreadsheet, due in large part to the gentle slopes of the final surface, it is determined that stability of the closed facility under the conditions analyzed is acceptable.

4.3.4 Spillway Cut and Borrow Sites

Because construction of the spillway cut and borrow sites will require rock excavations that are to become permanent site features, the slopes must be designed to meet appropriate criteria. Also, because blasting is likely near site features that need to be protected, a discussion is included on how such work can be governed and monitored during construction.

4.3.4.1 Rock Slope Design

Rock slopes have been designed for the four potential borrow sites at the project. Borrow Sites 1, 2, and 4 (refer to the permit drawings for a plan view and profiles of all borrow sites) may be developed to varying degrees, at the contractor’s discretion. Slopes shown for these borrow sites represent the greatest extent that the contractor could elect to develop; that is, they represent the steepest slopes that could remain and the greatest lateral extent of development (often constrained by a buffer zone away from gas lines around the facility perimeter). As part of developing efficient means and methods to construct the project, the contractor may choose not to develop certain borrow sites or to only partially develop certain sites.

The development of Borrow Site 3, near the existing emergency spillway cut, is required to allow the main drainage channel to exit the pond footprint. The cut slope geometry also incorporates a road that was requested by AEP to allow access to monitoring wells and gas lines. The southern side of this “new spillway cut” must be built as shown on the drawings, while the northern side represents a minimum required cut. The contractor could propose expanding this cut to the north (within limits dictated by gas lines farther to the north) to generate more borrow material from this site. Such a modification could be considered by AEP and the design engineer during construction through a submittal by the contractor for an alternate geometry.

The design of proposed rock cut slopes was performed in accordance with guidance from the West Virginia Department of Transportation (WVDOT), Division of Highways. The design directive is entitled “DD-403, Guide for Design in Cut Sections through Bedrock” (WVDOT 2006). Although this guidance is not mandatory for this type of project, it was judged to be an appropriate resource to serve as a design basis for rock slopes at the project. The guidance attempts to balance construction costs (i.e., minimizing the amount of excavation) with long-term maintenance (i.e., minimizing cleanup costs related to rockfalls). It is also written to allow a certain degree of flexibility to account for unique site geology, geometric, and/or construction issues.

WVDOT provides design guidance based on four bedrock types. The four types are not based purely on geology, instead they are based on slope angles that are considered appropriate based on experience and historical performance. The types are described in general terms (see Table 8) by geology, unconfined compressive strength (UCS), and slake durability index (SDI). Based on the rock type, guidance is then provided regarding maximum slope, bench width, and backslope height. Guidance is also provided regarding slopes in the overburden zone.

Table 8. WVDOT Rock Types for Cut Slope Design (WVDOT, 2006)

Rock Category	Typical Maximum Slope	Typical Geology	UCS (psi)	SDI (for shales)	Other Remarks
Type 1	1/6H:1V	Hard and medium-hard limestone and sandstone, hard shale	8,000+	95+	N/A
Type 2	1/2H:1V	Soft limestones and sandstones, medium-hard shale and siltstone or interbedded combinations	4,000-8,000	51-94	N/A
Type 3	3/4H:1V	Soft shale interbedded with siltstone, sandstone, or limestone	1,000-4,000	0-50	Without the interbedded materials, these shales would be Type 4.
Type 4	1H:1V	Soft and very soft shale	1,000	0-50	N/A

At Borrow Sites 1, 2, and 4, rock coring was not within the scope of Stantec's geotechnical exploration. However, historical borings and/or geologic profiles provided by AEP were available for Sites 1 and 4, and monitoring well logs were available for the lower portion of rock within Site 2. No UCS or SDI data were available for Sites 1, 2, or 4, and limited information was recorded on the boring logs regarding rock quality (e.g., percent core recovery, rock quality designation (RQD)). Generally, the rock at these sites consisted of layers of clay shale upwards of 20 feet thick and layers of interbedded siltstone, sandstone, and clay shale approaching 30 feet thick. Due to the presence of the clay shale and the limited degree of available data, these materials were classified as Type 4. Based on the range of allowable parameters for Type 4 rock, the design includes 3H:1V slopes in soft, erodible soils and 1H:1V slopes in competent rock with a 10-foot bench width.

At Borrow Site 3, Stantec performed 4 borings that included soil sampling and rock coring. The field engineer photographed the rock core and recorded the percent recovery and RQD. Stantec performed UCS and SDI testing on the predominant strata encountered in the borings. In addition, AEP provided several historical borings and a geologic profile in the vicinity of Site 3. The rock at these sites consisted of layers of interbedded shale and sandstone upwards of 30 feet thick, claystone up to 5 feet thick, shale up to 9 feet thick, and sandstone up to 30 feet thick. The sandstone was classified as Type 2, while all other materials were classified as Type 4. Based on the range of allowable parameters for Type 2 rock, the design included 1H:1V slopes (the allowable 1/2H:1V slopes were not necessary). No benches were required within the sandstone, due to the limited height exposed. For the Type 4 rock, the design includes 1H:1V slopes and 10-foot bench widths for the competent rock with 2H:1V slopes in the soft, erodible soils.

For comparison, historical drawings show that the existing rock slopes in the emergency spillway are 1H:1V in strata similar to that expected at the four borrow sites. Recent observations of these cut slopes show that the slopes are in good condition, and plant personnel reported little need for maintenance with regard to rockfall.

It should be noted that the designs described herein and depicted on the drawings are approximate and are based on geologic information from limited subsurface information, laboratory testing, and historical records. Boring logs and related information depict approximate subsurface conditions at discrete locations and at the time of drilling. Conditions at other locations may differ from those at the boring locations. Also, the passage of time may result in a change in the subsurface conditions at any boring location. Actual conditions between borings are unknown and may differ from those shown. Benches that are positioned at specific elevations on the drawings are often based upon encountering certain weaker strata. During construction, if weaker strata are found at different locations (vertically and/or laterally), the slope design may need to be adjusted to suit actual field conditions. If AEP or the contractor proposes alternate rock slope geometry during construction based on actual field conditions, the design engineer should be engaged to evaluate the proposed changes.

4.3.4.2 Rock Excavation

Rock excavation will be required to construct the cut near the existing emergency spillway, where the new drainage channel will exit the pond footprint. In addition, the contractor may elect to develop one or more of the other designated borrow sites to generate additional material for use as fill. It is likely that rock excavation will be performed using blasting; therefore, to protect structures of interest both on- and off-site, it will be important for AEP to control this work through appropriate construction specifications.

Protection of nearby dwellings, buildings, utilities, or other sensitive structures is typically regulated by establishing certain controls on the blasting, coupled with monitoring to verify compliance. Three phenomena that can damage nearby structures are ground vibration, air-overpressure (airblast), and flyrock. Specification CE-04A Rock Blasting provided in Appendix B-3 defines project requirements for blasting including procedures to minimize impacts from these hazards.

4.3.5 Stability During Construction

4.3.5.1 Concept

During construction, temporary slopes will be generated during the excavation (dredging) and filling processes. Due to the nature of the dredging process, it is assumed that slopes of significant grade will be temporary and below water level. Similarly, due to the nature of the sluicing and sedimentation process, it is assumed that no fill slopes of significant grade will be created.

The existing dam is assumed to remain stable during construction, as it is not being modified by the closure, other than removing some sluiced ash along a portion of the upstream face.

However, the rate of decrease in the pond elevation must be properly regulated to avoid a slope failure (due to rapid drawdown) along the upstream face of the dam.

The primary items of concern for interim stability during construction are the dredge containment dikes that will be constructed in upstream areas to impound the sluiced material as it is deposited. These containment dikes have flexibility in the design based on the materials available and the construction elevation height needs.

The dikes have been designed using a 30-foot minimum crest width, 4 horizontal to 1 vertical (4:1) sideslopes, and a maximum height of 24 feet. They have slope protection along the sideslopes and a graded stone surface for an access road along the crest. To address seepage and piping concerns during initial analyses, a chimney drain, blanket drain, and a seepage blanket have been designed. It will be the contractor's responsibility to establish a stable subgrade for construction of the dike.

Target factors of safety for short-term (i.e., during construction and end of construction) slope stability are as shown in Section 4.3.1. The potential for piping was evaluated because upward seepage toward the ground surface is anticipated during dredging activities. The toe of the dredge containment dike was evaluated in areas of high upward gradient and within a few feet of the phreatic surface near the embankment toe. For this design, we used the factor of safety against piping (FS_{piping}) as defined by the U. S. Army Corps of Engineers (USACE) for the design and assessment of dams (USACE, 1993). The current USACE design criteria (EM 1110-2-1901) generally requires:

- Downstream toe of dam $FS_{piping} \geq 3.0$
- Toe of a downstream seepage berm $FS_{piping} \geq 1.5$

The material properties used in the seepage and stability analyses were derived from the lab and field testing performed during the geotechnical exploration, historical data from the site, and correlated values with published data when necessary. Material properties used for these analyses are summarized in Appendix E-4.

4.3.5.2 Dike Design

The dimensions and construction of the design dredge dike are shown on the details of the design drawings. The models use a 30-foot crest width, 4H:1V sideslopes, and a 25-foot dike height. The 25-foot height exceeds the maximum allowable height and provides for another factor of safety in the analysis. Slope protection is modeled along the dike crest and slopes to protect against erosion.

Material parameters were based upon laboratory testing data (Stantec, 2012d) and historical design shear strengths (H. C. Nutting, 2008; Acres American Incorporated, 1974). The embankment model assumes compacted fly ash composes the embankment. The slope protection and seepage blanket were modeled using the random rock fill properties from Acres American Incorporated (1974). This should be representative of the durable rock available from the proposed borrow sites for this project. For the chimney and blanket drains, a filter design was performed to determine an appropriate drainage material within the fly ash dike. AASHTO

Type A sand was selected for the design. Alternative filter materials might be available for construction activities and should be checked against the design requirements. Sluiced and compacted fly ash material parameters were based upon laboratory testing of Shelby tubes taken during Stantec's 2012 field exploration. Dredged fly ash properties were assumed to be similar to the sluiced ash results with the exception of the selected anisotropy ratio.

For purposes of stability analysis, it was assumed that the compacted fly ash dikes will be constructed directly on the existing sluiced fly ash surface of the pond. No foundation improvements, bridging layers, or geosynthetic reinforcement were modeled, although the contractor should consider constructability issues related to localized soft zones on the ash surface.

The phreatic surface was defined using a seepage model (analyzed using GeoStudio 2007 SEEP/W). Boundary conditions for the seepage model were based on the spillway designs of the dredge dikes. The design storm event allows a short-term, one-foot freeboard upstream of the dredge dike. The model was run assuming dredged ash at the principal spillway elevation with the design storm event raising the pool level to a one-foot freeboard upstream of the dike. A second model was run assuming no dredged ash is present and water has risen upstream to a one-foot freeboard.

The chimney drain was designed at approximately half of the dredge dike height, in line with the downstream edge of the dike crest. It is modeled at a thickness of three feet. The seepage blanket extends 18 feet beyond the downstream toe of the dredge dike. It is three feet thick with a 3H:1V downstream toe.

4.3.5.3 Results

The laboratory test results for the consolidated undrained (CU) triaxial testing suggests that drained strength within the sluiced ash controls over the undrained strength properties due to the fly ash's dilative nature at low confining pressures. The stability analyses were run using the selected drained strengths as a more conservative estimate of slope stability. In reality, excess pore water pressures are created during sluiced ash placement and dike construction; however, it will begin to dissipate immediately. It is unclear how quickly the fly ash transitions from undrained to drained behavior.

Stability cross sections, material parameters, and results are shown in Appendix E-4. Results are also summarized in the following table (Table 9). The runs all assume a 25-foot tall dike constructed of compacted fly ash with a chimney drain, seepage blanket, and stone slope protection.

Table 9. Design Slope Stability Results – Dredge Containment Dike

Stability Case (Short-Term Conditions)	Calculated Factor of Safety (1.3 target)	FS_{piping}	
		Dike Toe (3.0 target)	Blanket Toe (1.5 target)
Downstream (ash impounded, with storm event)	2.1	3.8	1.5
Downstream (water only impounded)	3.2	3.5	1.5
Upstream (water only impounded)	2.0		

The results show that the assumed dimensions and materials for the dredge containment dikes are capable of meeting target factors of safety for stability and seepage. It is possible that a greater number of shorter dikes, or dikes raised in multiple stages, may be preferred by the contractor due to constructability concerns and/or operational and sequencing issues. The above analyses for the more conservative cases demonstrate that properly designed shorter dikes should also be capable of meeting stability criteria.

It is recommended that appropriate construction observation methods be employed to monitor actual performance of the dike and foundation materials during loading. The rate of fill placement, development of excess pore water pressures (using piezometers), and potential slope deformations (using survey markers or inclinometers) should be monitored and analyzed throughout construction. Refer to Section 4.5 regarding recommended instrumentation during construction.

4.4 LIQUEFACTION POTENTIAL

4.4.1 Seismic Liquefaction

Because sluiced fly ash is typically a saturated, loose, cohesionless material, it is susceptible to liquefaction if subjected to a sufficiently large earthquake. Strength loss due to liquefaction can lead to settlement and/or slope deformations, depending on material parameters and site geometry. The NCEER method compares the liquefaction resistance of a soil, expressed in terms of a cyclic resistance ratio (CRR), to the cyclic stress ratio (CSR) induced by the design earthquake. Both the CRR and CSR represent a shear stress normalized with respect to the vertical effective stress in the soil. The factor of safety against liquefaction (FS_{liq}) is computed by taking the ratio of CRR and CSR:

$$FS_{liq} = \frac{CRR}{CSR}$$

Seismic loads were estimated using the site-specific design earthquake ground motions and a site-specific ground response analysis (using ProShake software). Liquefaction resistance was estimated based on laboratory data (cyclic triaxial testing) for fly ash from the Amos Plant.

4.4.2 Site-Specific Seismic Study

4.4.2.1 Definition of Design Seismic Event

The design earthquake event has been defined probabilistically on the basis of a site-specific seismic hazards study. The legislative rule (refer to Department of Environmental Protection, Water Resources, Dam Safety Rule, §47-34-7.4.b.1.D.1(d)) does not specify an appropriate design earthquake recurrence interval (i.e., return period). Consistent with engineering practice and AEP direction, the design earthquake event corresponds to a 2% probability of exceedance in 50 years (recurrence interval = 2,475 years).

4.4.2.2 Site-Specific Design Seismic Events and Ground Motions

Stantec coordinated with its seismology subconsultant, Pacific Engineering and Analysis (Pacific), to perform site-specific seismic study and develop the design seismic events and associated ground motions (i.e., time histories). Pacific's report (Pacific Engineering and Analysis, 2011), which describes their methodology and results, is provided as an appendix in our Geotechnical Data Report (2012d). Stantec (2012d) is included in Appendix D.

Uniform hazard spectra (UHS) were developed using probabilistic methods. Dominant individual design events were then selected by deaggregating the hazard and identifying primary contributors in terms of magnitude and epicentral distance. Two design earthquake scenarios were identified for development of ground motion time histories. The first scenario is a M5.5 event relatively close to the project site (epicentral distance in the range of 10-50 km). The second scenario is a M7.5 event at a greater distance from the project site (epicentral distance in the range of 75-200 km). Pacific used deterministic methods to derive design spectra and ground motion parameters that are consistent with both the UHS and the two design event scenarios. Key ground motion parameters for the design events used in this study are summarized in Table 10.

The design event acceleration time histories represent the expected subsurface ground motions at the top of bedrock and not a free-surface or outcrop motion. Stantec supplied Pacific with basic geologic parameters for the site, such as soil type, rock type, approximate depth to bedrock ("soft rock"), and depth to "hard rock" (the fundamental seismic hazard model for central and eastern United States assumes "hard rock" geology). Pacific estimated a range of reasonable shear wave velocities for overburden (i.e., alluvium) and soft rock and estimated average unit weights for the overburden and soft rock. These parameters were based on existing site information and regional geologic information, some of which was supplied by AEP. The design ground motions, which were derived from historic acceleration records, were spectrally matched to the deterministic design spectra, in accordance with the standard of practice. The peak acceleration and duration of shaking at the top of bedrock for each earthquake scenario is listed in Table 10. Note that, while the peak horizontal accelerations for the two scenarios are rather similar, the duration of the larger magnitude event is significantly greater than that of the smaller magnitude event.

Table 10. Bedrock Ground Motion Parameters for Seismic Evaluation of AEP Amos Fly Ash Pond Closure[1]

Parameter	Scenario 1	Scenario 2
Moment Magnitude (M_w)	5.5	7.5
Peak Horizontal Acceleration	0.043 g	0.034 g
Time History Duration (5 to 75%) – Horizontal Component of Motion	Approx. 3-4 sec	Approx. 21 sec
Time History Duration (5 to 95%) – Horizontal Component of Motion	Approx. 7-8 sec	Approx. 26-27 sec

[1]Parameters shown are at top of soft rock/base of soil.

4.4.3 Cyclic Triaxial Testing

AEP provided results from cyclic triaxial testing that was performed on fly ash from Amos at The Ohio State University (OSU) (OSU, 2012). As part of our Supplemental Scope of Work, Stantec collaborated with the University of Kentucky to perform additional cyclic triaxial tests on Amos fly ash (Stantec, 2012e).

4.4.3.1 The Ohio State University Data

AEP provided Stantec the report prepared by OSU for the fly ash liquefaction potential at Amos Fossil Plant (OSU, 2012). OSU prepared 10 specimens from the Amos fly ash by pluviating the material in water to a range of initial densities. The specimens were then tested at confining stresses ranging from 10 to 40 pounds per square inch (psi) and cyclic stress ratios (CSR) ranging from 0.1 to 0.4 as shown in Table 11. After testing, OSU reviewed the data and number of cycles to liquefaction (N_{liq}) was determined as the first occurrence of either:

- Axial stress reported was less than 95% of the programmed loading, or
- Effective confining stress reached a minimum value of zero (i.e., r_u=1) (OSU, 2012).

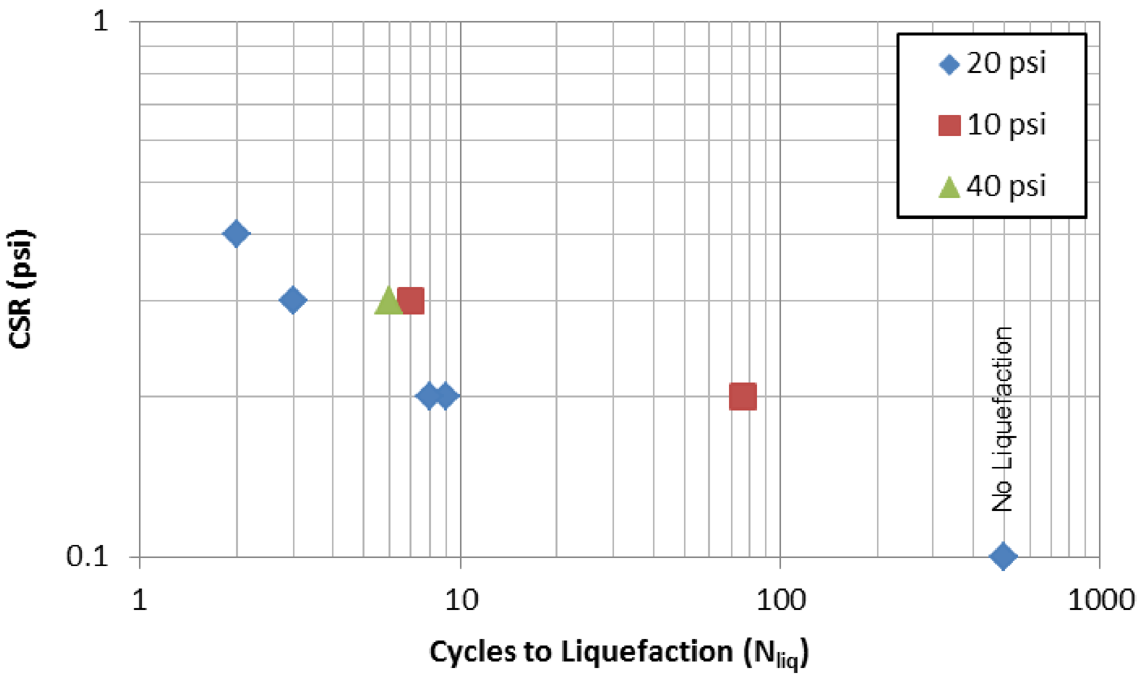
Table 11. Ohio State University – Cyclic Triaxial Laboratory Data for Amos Fly Ash

Test No.	CSR	Confining Stress (psi)	Dry Density (pcf)	Cycles to Liquefaction (N_{liq})
1	0.1	20	101.1	500[1]
2	0.2	20	97.6	9
3	0.3	20	94.9	3
4	0.4	20	94.1	2
5	0.1	20	96.9	500[1]
6	0.2	20	100.4	8
7	0.3	20	97.0	3
8	0.3	10	101.0	7
9	0.2	10	111.0	76
10	0.3	40	102.1	6

[1] Samples that did not liquefy were tested for 500 cycles before ending the test.

Figure presents the number of cycles required for each sample to liquefy using the above liquefaction criteria. Typically, it is expected that the number of cycles of liquefaction increases as the confining pressure increases (all else equal). However, data would indicate that the samples tested at 10 psi are more resistant to liquefaction than those tested at 20 psi and 40 psi. This could be correct if samples at 10 psi are dilative while samples at 20 psi and 40 psi are more contractive. The results for the 20 psi generally provide a lower bound for the available data.

Figure 3. Results from the OSU Cyclic Triaxial Testing for the Amos Fly Ash Specimens



4.4.3.2 University of Kentucky Data

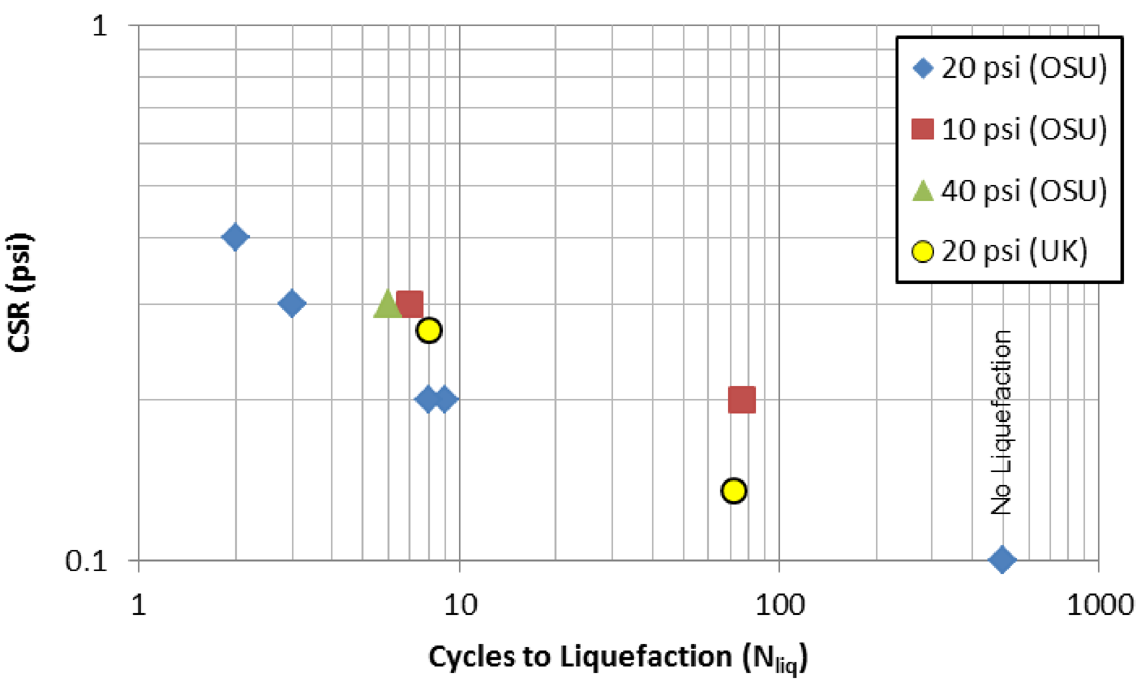
To supplement the OSU data, Stantec and the University of Kentucky (UK) performed two additional cyclic triaxial tests on the Amos fly ash, as documented in our Supplemental Geotechnical Data Report (Stantec, 2012e). UK prepared two specimens from the Amos fly ash by pluviating the material in water to a range of initial densities. UK tested the samples with CSR values of 0.135 and 0.269, and both samples had a 20-psi confining pressure applied. Using the same definition of liquefaction as OSU, Stantec estimated the number of cycles to liquefaction for the UK data as shown in Table . The number of cycles to liquefaction of Test No. 1 was governed by the axial stress criteria, while Test No. 2 was governed by the excess pore pressure ratio criteria.

Table 12. University of Kentucky – Cyclic Triaxial Laboratory Data for Amos Fly Ash

Test No.	CSR	Confining Stress (psi)	Dry Density (pcf)	Cycles to Liquefaction (N_{liq})
1	0.135	20	79.4	72
2	0.269	20	76.3	8

Figure presents the number of cycles required for each sample to liquefy using the above liquefaction criteria for both the OSU and UK data. The UK data provided additional data in the 0.1 to 0.2 CSR range, which was previously undefined by the OSU data. The UK data reaffirms the trend shown by the OSU data for a confining pressure of 20 psi; therefore, the 20-psi cyclic triaxial data was used to estimate the cyclic resistance ratio of the Amos ash.

Figure 4. Results from the OSU and UK Cyclic Triaxial Testing for the Amos Fly Ash Specimens



4.4.3.3 Cyclic Resistance Ratio (CRR)

For samples of similar initial density, relationships between the imposed cyclic stress and the number of cycles to liquefaction failure are observed. These relationships define the cyclic resistance ratio (CRR) for the material, which can then be compared against the cyclic stress ratio (CSR) imposed by any design earthquake of interest. Methodology outlined by Idriss and Boulanger (2008) was used to adjust the laboratory CRR to an appropriate field CRR for the site conditions and design earthquake (geometry, in situ stresses, earthquake magnitude, etc.). The primary benefit of this approach is the use of site-specific materials and development of a CRR relationship for the specific material. This is particularly relevant for fly ash, as many of the published relationships and correlations are based on testing of sands and may not be as appropriate for fly ash. The primary drawback of such a method is that fly ash samples must be reconstituted in the lab and may not be representative of the undisturbed, in-situ materials.

The approach used site-specific ground response analysis to estimate the load (CSR) imposed by the design earthquake. Because the cyclic triaxial results are not specific to a particular location within the fly ash pond, three generic soil columns were derived for the site and were used in a ground response analysis and to estimate the CSR. Shear wave velocities for the sluiced ash were based on CPT testing performed during the geotechnical exploration, while shear wave velocities for other soils were estimated based on published correlations that are typically related to effective stress and soil type.

The methodologies outlined above, along with the results, are summarized in a series of example calculations in Appendix E. Both the M7.5 and M5.5 earthquakes were evaluated. Considering the CRR derived from laboratory testing of Amos fly ash, the M7.5 event controlled for all three generic profiles. The larger magnitude event controlled because its longer duration (more cycles of shaking) results in a lower CRR compared to the shorter duration, smaller magnitude event. The CSR for the M7.5 event was higher than that of the M5.5 event for two of the three profiles, but the greater difference in CRR was such that the resulting factor of safety (FS_{liq}) was lower for the M7.5 event for all three profiles. For both events and all three profiles, FS_{liq} was shown to be above the typical threshold value of 1.4 (values less than 1.1 indicate fully liquefied conditions, while values of 1.1 to 1.4 are partially liquefied), meaning that no liquefaction would be anticipated.

4.4.3.4 Static Liquefaction

Static liquefaction is a phenomenon that can occur when a soil experiences significant strain softening (i.e., strength loss beyond the peak strength) due to static loading or creep, often resulting in a flow failure. Contractive soils, which can include hydraulic fill (including some types of sluiced fly ash), can be particularly susceptible to static liquefaction during undrained shearing. The potential for static liquefaction is related to two key material parameters: (1) the strain level at peak strength and (2) the decrease in strength from peak to residual (often expressed as a sensitivity ratio) as strain increases. If peak strength is realized at very small strains, there exists a greater probability that static loads and/or creep could surpass the peak. If the material is highly sensitive, yet a slope or facility was designed based on peak strength, there exists a greater probability that any exceedance of the peak strain will lead to a flow failure.

Laboratory results (15 consolidated-undrained triaxial tests) of Amos fly ash indicate that in general, the material behavior is dilative or near a transition from dilative to slightly contractive (see Appendix E). Dilative behavior is typically observed at lower confining pressures and a transition towards slightly contractive behavior is observed at higher confining pressures, as would be expected. Dilative materials do not exhibit distinct peak strength in undrained shear, as the strength continues to climb as the specimen attempts to dilate. It should be noted that several of the laboratory specimens showed signs of air bubbles in the testing apparatus used to measure pore water pressure. This is indicated by non-responsive pore water pressure readings as the values become more negative during shear. The impact on the data is that the deviator stress does not continue to go upward as it should if the negative pore water pressures could be correctly measured. This could lead to underestimating the undrained shear strength of such dilative materials.

To account for static liquefaction potential during design, two approaches could be used: (1) avoid undrained loading scenarios that could mobilize the peak strength/strain or (2) design based on residual strengths. For weak, contractive materials, it is typically not feasible to design based on residual strengths. Therefore, the preferred approach is to design with adequate safety margins for undrained conditions, to avoid approaching the peak strength/strain. Meeting the regulatory defined minimum factors of safety for short-term, undrained conditions is only a first step in this process.

The current design considers the stress-strain behavior and sensitivity of the sluiced fly ash. Because the Amos fly ash is judged to be dilative, and thus stronger when sheared in undrained conditions, the design is actually based on the lower, drained strengths. Further, the dilative behavior makes it unlikely that a flow failure due to static liquefaction would occur (i.e., no significant strain softening). The gentle slopes of the proposed closure provide ample safety margins, given the drained and undrained strength of the fly ash. The more critical case is the undrained loading of the ash due to the temporary dredge containment dikes, which have somewhat steeper side slopes and thus lower safety factors. Because the dikes will be relatively short, the areas of concern within the foundation would be relatively shallow. Shallow areas correspond to low confining pressures; thus, dilative behavior would be more likely. Regardless, construction observation and instrumentation should be used during construction (Section 4.5) to check for signs of elevated pore pressures and/or slope movement that could lead to an undrained failure.

4.5 INSTRUMENTATION

During construction, the use of field instrumentation is recommended to monitor actual conditions and compare with those assumed during design. Post-closure monitoring using instrumentation is also recommended to monitor long-term performance of the facility and to meet any regulatory permitting requirements. A detailed discussion of the instruments and proposed locations can be found in the following sections.

The construction instrumentation and monitoring program recommended below is a baseline for the initial dredge containment dike(s) constructed during the project. However, it is likely that the Contractor’s approach, including construction methods and their operation of the dredge containment cells will influence how the monitoring program can be best utilized. The instrumentation and monitoring program for subsequent dikes should be reviewed and potentially adapted based on analysis of data and observed performance of the initial dikes.

4.5.1 Piezometers

The primary geotechnical issue during construction is the stability of temporary/interim dredge containment dikes. With respect to both slope stability and piping failure modes, there is a need to monitor pore pressures in the sluiced fly ash foundation in the vicinity of the dikes. We recommend installation of standpipe piezometers that can be read manually or vibrating wire piezometers that can be read using an automated data acquisition system (ADAS), along with routine monitoring and timely analysis of the resulting data throughout construction. General recommendations for the piezometers are given below. More specific requirements will be developed as part of the construction documents.

- Within each dike there should be a minimum of six piezometers installed. These piezometers will be arranged along three separate cross sections of the dike. The cross-sections (upstream to downstream) will have a piezometer at each critical area of interest (i.e., crest and downstream toe). One cross-section should be located through the center (lengthwise) of the dike, and the maximum allowable distance between cross-sections (in plan) is 100 feet.

- Instruments should be installed prior to construction of each dredge containment dike. Special considerations will have to be made to protect installed instruments during construction. The elevation of the standpipe including additional riser lengths will have to be closely monitored and documented during construction so that water level elevations can be accurately referenced.

- Monitoring thresholds will be established to link observed readings with field actions such as slowing or accelerating the rate of fill placement, decreasing pool levels, or other risk reduction measures.

- If desired, piezometers could utilize electronic pressure transducers with ADAS to allow frequent monitoring and observations of fluctuations and trends in pore pressure. Automation may not be needed during construction if staff will be on site to take daily measurements. The ADAS option could also be implemented post-construction by installing pressure transducers within the open standpipe piezometers to monitor the site for an extended period afterward.

- Instruments must be designed and protected against construction activities (excavations, traffic) and the elements (standing water, lightning).

- Piezometers can be installed in open boreholes using the fully grouted method, in which the transducer and data cable are surrounded by a grout mixture instead of a filter sand zone. Fully grouted piezometers are becoming more common, particularly for short-term projects, due to the simplified backfilling method, quicker response time (i.e., more compliant in lower permeability soils), and ability to easily install multiple instruments in a single borehole if desired. However, the data could not be manually verified by a water level indicator as could be done for a transducer in an open standpipe.

- Data from unvented transducers must be corrected for site-specific fluctuations in barometric pressure. This is simply addressed by installing a barometer onsite that can be used to correct all of the piezometer data during post processing. Although vented piezometers, which do not require barometric correction, could be used, they can be prone to problems with the vent clogging (air bubbles or other problems). Vented piezometers are also not as suitable for the fully grouted installation method.

- In order to correlate piezometer readings with potential influencing factors, we recommend periodic monitoring of the pond elevation, dredge area pool elevations, and daily precipitation. Such readings could be performed manually (staff gauge, rain gauge, etc.) or they could also be automated.

- If the system is automated, the use of transducers, as opposed to open standpipes, would allow data cables from multiple instruments to be routed to one or more centralized locations for data collection. Such location(s) could be selected to avoid high-traffic areas during construction. If warranted, telemetry systems (wired or wireless) could be added to allow remote data transfer and monitoring, although this increases the costs and complexity of the system.

- Data should be collected weekly at a minimum when no sluicing or stacking is occurring and daily during the ash sluicing or stacking process. If excessive pore pressures are generated, additional measurements may be warranted to assess stability.

4.5.2 Vertical Slope Inclinometers

Vertical slope inclinometers (SI) can be installed within or near slopes to detect small initial movements that may alert the user to the potential for larger slope failures and allow time for risk reduction measures to be implemented. Inclinometers will be considered for use near the downstream toe of dredge containment dikes during construction, but are probably not warranted for use after closure due to the gentle final slopes. General recommendations are provided below. More specific requirements will be developed as part of the construction documents.

- Slope inclinometers (SIs) should be located at the critical area of interest (i.e., downstream toe of dike). A minimum of one inclinometer should be placed within a given temporary/interim dredge containment dike. The inclinometer should be located next to the piezometer at the downstream toe of the center (lengthwise) cross-section (see Section 4.5.1). If additional inclinometers are warranted they should be placed at the downstream toe at the same cross section(s) as other piezometers.

- Instruments should be installed prior to construction of each dredge containment dike. Special considerations will have to be made to protect installed instruments during construction. The initial elevation of the casing will have to be well documented, and additions to the casing will have to be well documented to accurately reference slope inclinometer readings.

- Monitoring thresholds could be established to link observed readings with field actions such as slowing the rate of fill placement or other risk reduction measures.

- The bottom of the SI casing must be a fixed reference point. Thus, it must be installed in stable rock (preferred, if depth to rock is reasonable) or soil that is known to be well below any reasonable failure surface.
- In an overall program that involves both SIs and fully grouted piezometers, some cost efficiency can be realized by installing the piezometers on the outside of the SI casing, thus eliminating an extra borehole.
- Data should be collected weekly at a minimum when no sluicing or stacking is occurring and daily during the sluicing or stacking process. If excessive movements are observed, additional measurements may be warranted to assess stability.

4.5.3 Existing Instrumentation

AEP maintains a network of piezometers and surface deformation monuments across the crest and downstream face of the existing dam. They currently have one pneumatic piezometer in the sluiced fly ash (installed in 2008 - B-17). As part of Stantec's geotechnical exploration, two open standpipe piezometers (with pressure transducers and ADAS) and one multilevel groundwater sampling system were installed within the sluiced fly ash. We recommend that all of these instruments be protected and periodically monitored during construction. The value of data from specific instruments may depend on their proximity to active areas of construction (excavation, fill, fluctuating pools, etc.).

4.5.4 Post Closure

The Dam Safety Rule (W. Va. Code §22-14-4 and §22-14-19) establishes the guidelines required to operate and abandon a dam in the state of West Virginia. Within the Dam Safety Rule, guidelines are presented regarding instrumentation and monitoring of said instruments. Given that the pond closure will be addressed through a modification of the existing permit (as opposed to the dam abandonment process), existing monitoring wells and any other instrumentation should continue to be monitored as required under existing permits and regulations. If abandonment of the dam becomes an option in the future, the proposed construction instrumentation could be used to support compliance with the abandonment guidelines.

Instrumentation installed during closure activities could be monitored (at AEP's discretion) to measure the phreatic surface and saturation levels of the ash over time. The cap will reduce the infiltration into the impoundment, but seasonal changes will likely have an impact on the ash saturation levels, therefore, data could be collected at a minimum monthly. If personnel will not be on-site frequently, the automation of data collection may be the most efficient method to take routine, periodic measurements. Pressure transducers can be installed within open standpipe piezometers to record hourly, daily, or weekly measurements. The data from the transducers would be retained on the instrument until personnel downloads the data during a site visit.

5.0 References

- Acres American Incorporated (1974). “Draft, Preliminary Design Report, John E. Amos Plant, Fly Ash Retention Dam, Stage 2.” Prepared for Appalachian Power Company, November.

- Acres American Incorporated (1975a). “Geotechnical Data for Bidders, Volume 2 (Phases 1 and 2 Investigations), John E. Amos Plant, Fly Ash Retention Dam, Stage 2.” Prepared for Appalachian Power Company.

- Acres American Incorporated (1975b). Various Stage 2 construction drawings, John E. Amos Plant, Fly Ash Retention Dam, Stage 2. Prepared for Appalachian Power Company.

- American Electric Power (1995). “EPRI Ground Water Study – Amos” (partial), Boring Logs and Monitoring Well Construction Logs. Unit 3 – Fly Ash Pond Monitoring Program. August.

- American Electric Power Service Corporation (AEPSC) (1993). “Dam Break Analysis”. Appalachian Power Company. John Amos Fly Ash Dam, West Virginia ID #03911. Civil Engineering Division. November.

- American Electric Power Service Corporation (AEPSC) (2008b). “Monitoring and Emergency Action Plan and Maintenance Plan”. For the John E. Amos Plant Fly Ash Dam, WV ID #07911. Winfield, Putnam County, West Virginia. Prepared for Appalachian Power Company. January 28.

- Chow V., D. R. Maidment, and L. W. Mays. (1988). Applied Hydrology. McGraw Hill, Singapore, 461.

- H. C. Nutting (2008). “Geotechnical Data Collection Report, Amos U3 Fly Ash Dam Raising Study” Prepared for American Electric Power. February.

- Hynes-Griffin, M. E., and Franklin, A. G. (1984). “Rationalizing the seismic coefficient method.” Miscellaneous Paper GL-84-13, U.S. Army Engineer Waterways Experiment Station, July, 37 pages.

- Idriss, I.M. and Boulanger, R.W. (2008). “Soil Liquefaction During Earthquakes.” Monograph, Earthquake Engineering Research Institute, Oakland, California.

- Konya, C. J., and Walter, E. J. (1990). Surface Blast Design. Second Edition, Prentice Hall Publishing, Englewood, New Jersey.

- National Oceanic and Atmospheric Administration (NOAA) (2011). NOAA Atlas 14: Precipitation-Frequency Atlas of the United States. National Weather Service, Silver Spring, Maryland.

- National Oceanic and Atmospheric Administration (NOAA) (1978). Hydrometeorological Report No. 51. Probable Maximum Precipitation Estimates, United States, East of 105th Meridian. Washington, D.C. June.

- Pacific Engineering and Analysis (2011). "Development of Design Ground Motions for the John E. Amos Plant Fly Ash Pond Closure, Draft Report." Prepared for Stantec Consulting Services Inc., December.

- Stantec Consulting Services Inc. (2011a). "Work Plan, Fly Ash Dam Complex Closure, John E. Amos Plant" Prepared for American Electric Power, August.

- Stantec Consulting Services Inc. (2012a). "Data Gaps Memorandum, Fly Ash Dam Complex Closure, AEP John E. Amos Plant; Data Gap Analysis and Phase 2 Exploration Recommendations – Rev. 1" Prepared for American Electric Power, January.

- Stantec Consulting Services Inc. (2012b). Amos Ash Pond Complex Closure, Conceptual Design Report. John E. Amos Power Plants. Putnam County, West Virginia. February.

- Stantec Consulting Services Inc. (2012c). 30-Percent Design Drawings, Fly Ash Dam Closure. John E. Amos Power Plant. Scary, West Virginia. Prepared for American Electric Power. April.

- Stantec Consulting Services Inc. (2012d). "Geotechnical Data Report (Revision 2), Fly Ash Dam Complex" Prepared for American Electric Power, October.

- Stantec Consulting Services Inc. (2012e). "Revised Supplemental Geotechnical Data Report, Fly Ash Dam Complex" Prepared for American Electric Power, October.

- State of West Virginia (2009). "Title 47, Legislative Rule, Department of Environmental Protection, Water Resources; Series 34, Dam Safety Rule." West Virginia Code of State Rules.

- State of West Virginia (2010). "Title 33, Legislative Rule, Department of Environmental Protection, Waste Management; Series 1, Solid Waste Management Rule." West Virginia Code of State Rules.

- State of West Virginia (2011). "Chapter 22. Environmental Resources, Article 14. Dam Control Act." West Virginia Code.

- The Ohio State University (OSU) (2012). “Evaluation of Liquefaction Potential of Impounded Fly Ash: John E. Amos Power Plant, Final Report.” Prepared for American Electric Power, June.
- U. S. Army Corps of Engineers (USACE) (1993). Engineering and Design, Seepage Analysis and Control of Dams. EM 1110-2-1901. April 30th.
- US Army Corps of Engineers (USACE). (2010). Hydrologic Modeling System, HEC-HMS Version 3.4. Hydrologic Engineering Center, Davis, California.
- US Department of Agriculture (USDA). (1986). Technical Release 55: Urban Hydrology for Small Watersheds. Natural Resources Conservation Service, Urbandale, Iowa.
- West Virginia Department of Transportation (WVDOT) (2006). “DD-403, Guide for Design in Cut Sections through Bedrock.” Division of Highways, July.
- West Virginia Department of Transportation (WVDOT) (2007). Drainage Manual – 3rd Edition. Division of Highways. December.