Annual Groundwater Monitoring Report

Southwestern Electric Power Company

H. W. Pirkey Power Plant

East Bottom Ash Pond CCR Management Unit

Hallsville, Texas

January 2020

Prepared by:
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1 Riverside Plaza
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SOUTHWESTERN ELECTRIC POWER COMPANY℠

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Page

Table of Contents

I. Summary

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Pirkey 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, 2020.

In general, the following activities were completed:

- Groundwater samples were collected for AD-2, AD-4, AD-12, AD-18, AD-31, and AD-32 in February, May, and August 2019 and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.94 or 95 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Assessment Monitoring sampling was initiated on April 3, 2018;
- The unit was in Assessment monitoring at the beginning of 2019;
- Assessment of Corrective measure was initiated on March 26, 2019;
- Statistically significant level (SSLs) above the groundwater protection standard (GWPS) were determined for cobalt at wells AD-2, AD-31, and AD-32 and for lithium at AD-31 and AD-32 on December 26, 2018. An alternate source for cobalt was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on April 24, 2019. An alternate source for lithium was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on July 22, 2019. As result, assessment of corrective measure work stopped and the unit stayed in assessment monitoring.
- Statistically significant level (SSLs) above the groundwater protection standard (GWPS) were determined for cobalt at wells AD-2, AD-31, and AD-32 and for lithium at AD-31 and AD-32 on July 12, 2019. An alternate source was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on September 23, 2019.
- Statistically significant level (SSLs) above the groundwater protection standard (GWPS) were determined for cobalt at wells AD-2 and AD-32 and for lithium at AD-31 and AD-32 on January 3, 2020. An investigation will be conducted to see if an alternate source can be identified in a report.
- The unit was in Assessment monitoring at the end of the 2019;
- Groundwater Monitoring Statistical Evaluation Reports to evaluate groundwater data were prepared and certified in accordance with 40 CFR 257.93. The statistical process was

guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009).

The major components of this annual report, to the extent applicable at this time, are presented in sections that follow:

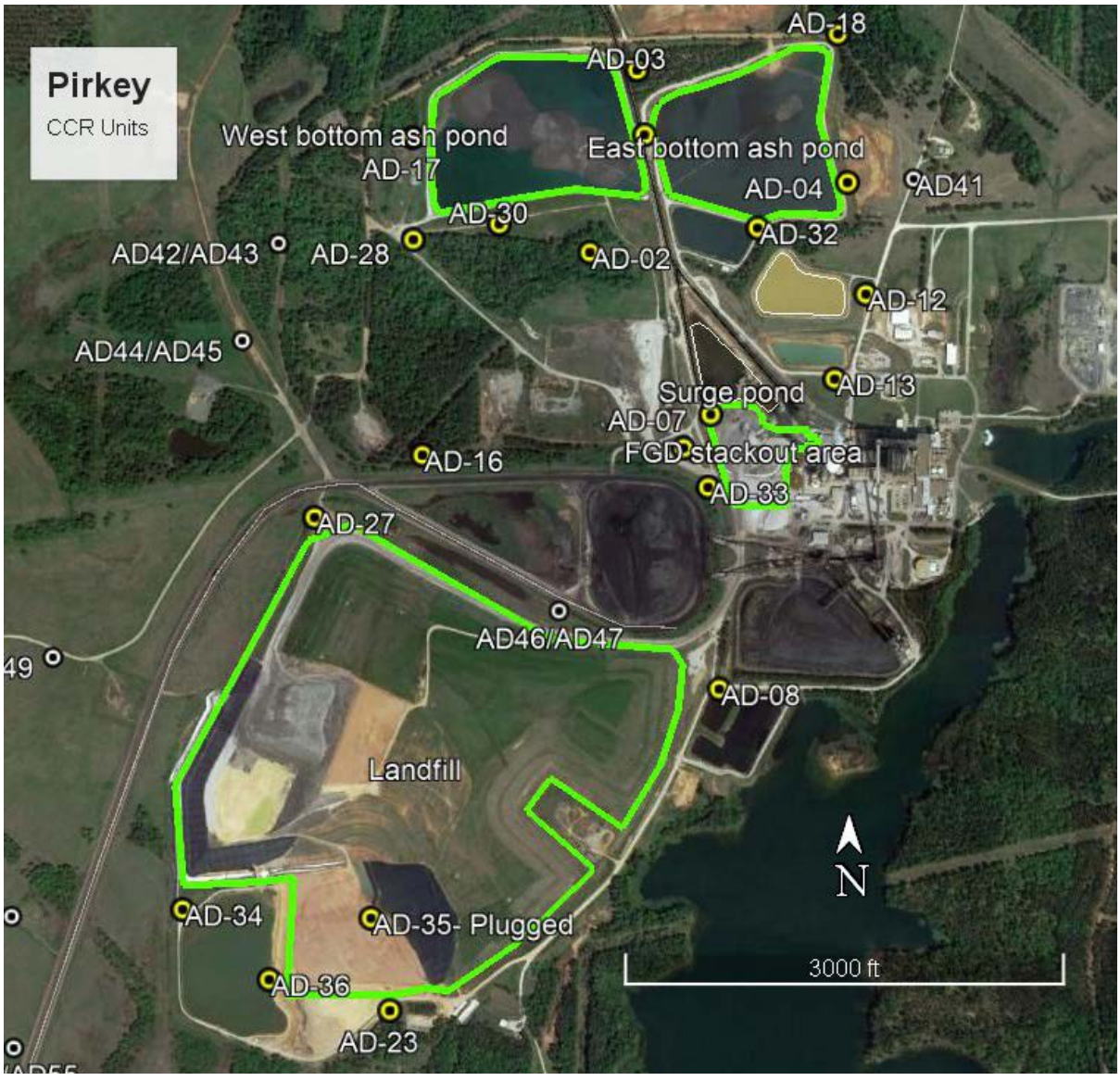
- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- 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 is included in Appendix I;
- 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 (Appendix IV).
- Other information required to be included in the annual report such as alternate source demonstration 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

The figure that follows depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers.

East BAP Monitoring Wells	
Up Gradient	Down Gradient
AD-4	AD-2
AD-12	AD-31
AD-18	AD-32



III. Monitoring Wells Installed or Decommissioned

Several monitoring wells were installed to better understand spatial variability of constituents across the site, groundwater flow, and groundwater chemistry in mine spoils. Please see the list below. Well installation reports can be found in Appendix V.

Soil Boring ID	Monitor Well ID
	AD-37
	AD-38
	AD-39
	AD-40
SB-01A	AD-41
SB-04	AD-42
SB-04	AD-43
SB-05	AD-44
SB-05	AD-45
SB-06	AD-46
SB-06	AD-47
SB-07	AD-48
SB-07	AD-49
SB-08	AD-50
SB-08	AD-52
SB-08	AD-53
SB-09	AD-54
SB-09	AD-55
SB-11	AD-56
SB-11	AD-57

Three additional soil borings were installed to better understand the spatial variability of constituents at the site up gradient of the plant. The borings logs can be found in Appendix III in *Alternative Source Demonstration Report Federal CCR Rule* dated July 22, 2019. Two monitor wells were installed at these boring locations B-2 and B-3. Well construction diagrams and well development logs for monitoring wells B-2 and B-3 can also be found in *Alternative Source Demonstration Report Federal CCR Rule* dated July 22, 2019. The well installation reports are included in this report in Appendix V.

IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction and Discussion

Appendix I contains tables showing the groundwater quality. Static water elevation data from each monitoring event are presented in Appendix I, along with the groundwater velocity, groundwater flow direction and potentiometric maps developed after each sampling event.

As required by the assessment monitoring rules, 40 CFR 257.95 et seq., a one round of sampling in February in accordance with 40 CFR 257.95(d)(1). A May sampling event was conducted in accordance with 40 CFR 257.95(b) including all Appendix III parameters and those Appendix IV constituents parameters followed by an August round of sampling in accordance with 40 CFR 257.95(d)(1). Assessment monitoring will continue in 2020.

V. Statistical Evaluation of 2019 Events

The two statistical analysis reports are included in Appendix II.

Statistically significant levels (SSLs) above the groundwater protection standard were identified for cobalt at wells AD-2, AD-31, and AD-32 and for lithium at AD-31 and AD-32 as summarized in *Statistical Analysis Summary East Bottom Ash Pond Report* (7/12/2019) in Appendix II.

Statistically significant level (SSLs) above the groundwater protection standard (GWPS) were determined for cobalt at wells AD-2 and AD-32 and for lithium at AD-31 and AD-32 on January 3, 2020. An investigation will be conducted to see if an alternate source can be identified in a report.

VI. Alternate Source Demonstration

An alternate source investigation was conducted for the east bottom ash pond SSLs above GWPSs. SSLs above the GWPS were determined for lithium and cobalt on December 26, 2018. An alternate source for cobalt was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on April 24, 2019. An alternate source for lithium was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on July 22, 2019.

SSLs above the GWPS were determined for cobalt at wells AD-2, AD-31, and AD-32 and for lithium at AD-31 and AD-32 on July 12, 2019. An alternate source was identified in a report (*Alternative Source Demonstration Report Federal CCR Rule*) on September 23, 2019.

Statistically significant level (SSLs) above the groundwater protection standard (GWPS) were determined for cobalt at wells AD-2 and AD-32 and for lithium at AD-31 and AD-32 on January 3, 2020. An alternate source investigation will be conducted for these SSLs.

The supporting information are found in Appendix III.

VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency

The unit transitioned from detection monitoring to assessment monitoring transition on April 3, 2018. The unit transitioned into assessment of corrective measures on March 26, 2019 since there

was no alternate source identified at that time. An alternate source was later identified for cobalt on April 24, 2019 and lithium on July 22, 2019. Assessment of corrective measures was discontinued and the unit remained in assessment monitoring.

Assessment monitoring will continue in 2020.

Regarding defining an alternate monitoring frequency, no modification of the twice-per-year detection monitoring effort is needed.

VIII. Other Information Required

No other information applies at this time.

IX. Description of Any Problems Encountered in 2019 and Actions Taken

No problems were encountered this year.

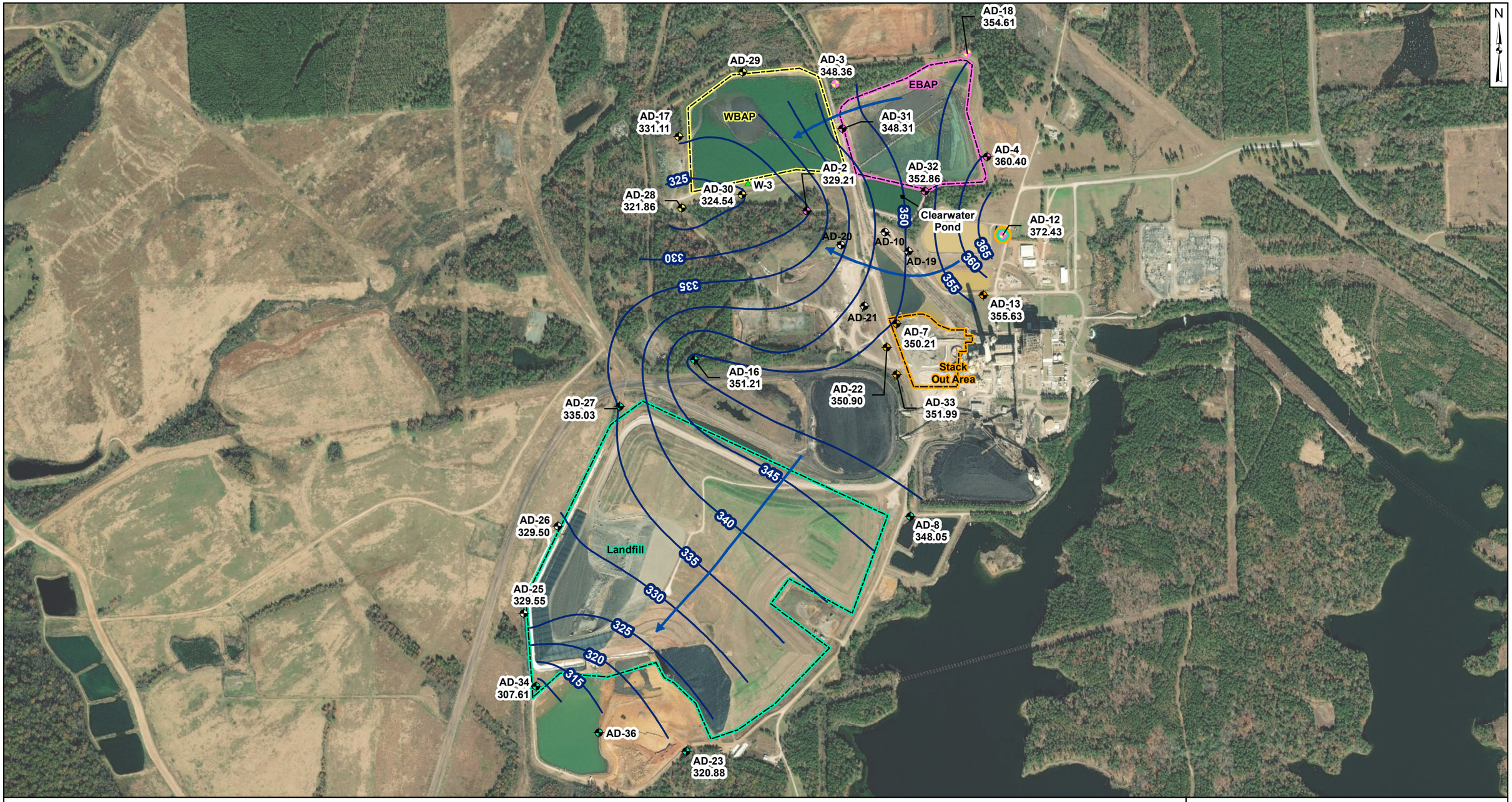
X. A Projection of Key Activities for the Upcoming Year

Key activities for next year include:

- Assessment monitoring sampling will be conducted;
- Evaluation of the assessment monitoring results from a statistical analysis viewpoint, looking for any SSLs above GWPS;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

APPENDIX I

Tables follow, showing the groundwater monitoring data collected, 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.



Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP

- All CCR Unit Networks
- Piezometer
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on February 23-28, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- W-3 was not gauged in February 2019.
- AD-35 was abandoned November 13, 2018. AD-36 was installed April 24, 2019.

1,000 500 0 1,000 Feet

Potentiometric Contours - Uppermost Aquifer
February 2019

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2020/01/16

Figure **1**

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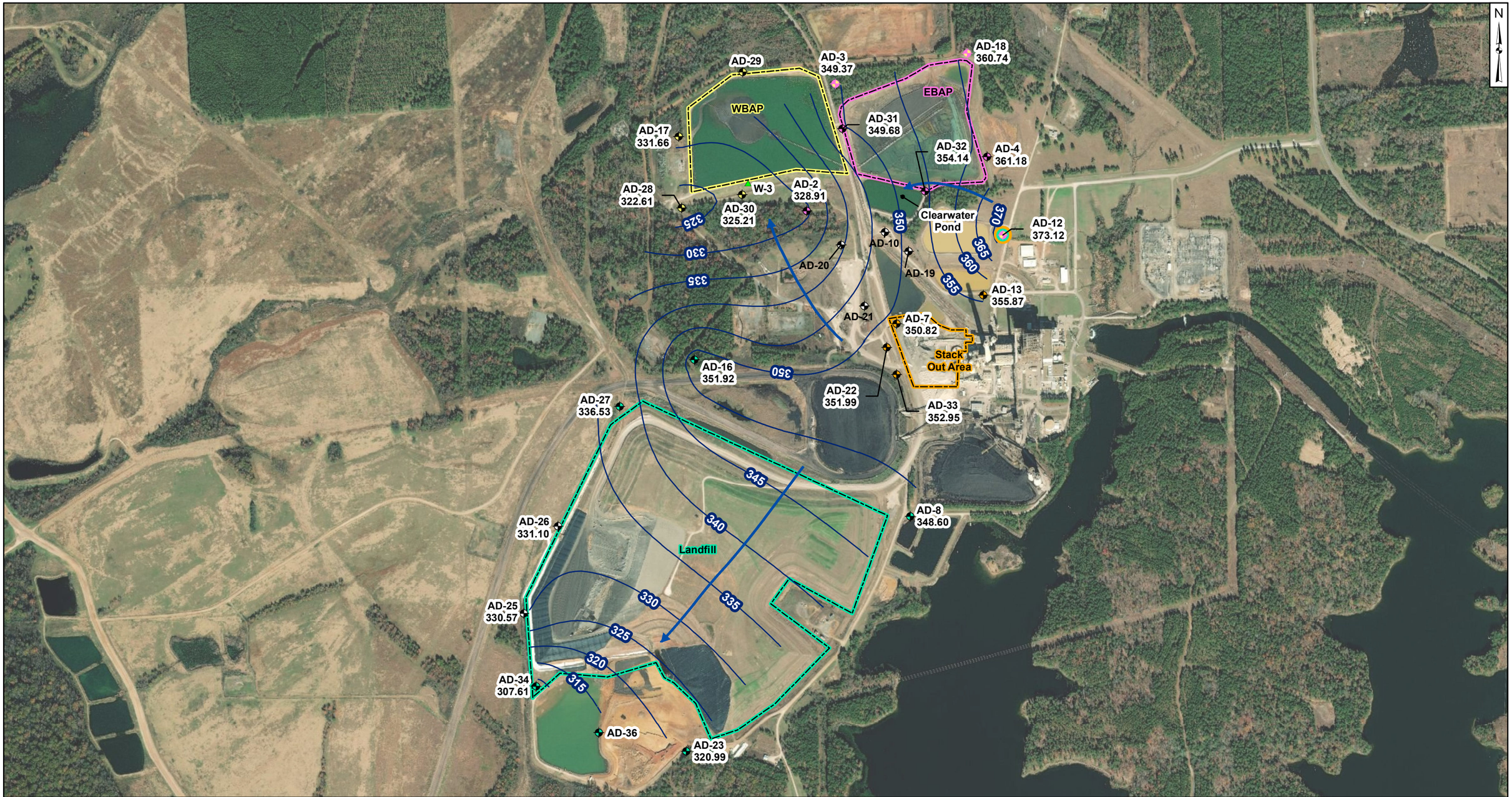

Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP
- All CCR Unit Networks
- Piezometer
- Groundwater Elevation Contour
- Approximate Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on May 21-23, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- W-3 was not gauged in May 2019.
- AD-35 was abandoned November 13, 2018. AD-36 was installed April 24, 2019.

1,000 500 0 1,000 Feet

Potentiometric Contours - Uppermost Aquifer May 2019

AEP Pirkey Power Plant
Hallsville, Texas

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Figure **2**

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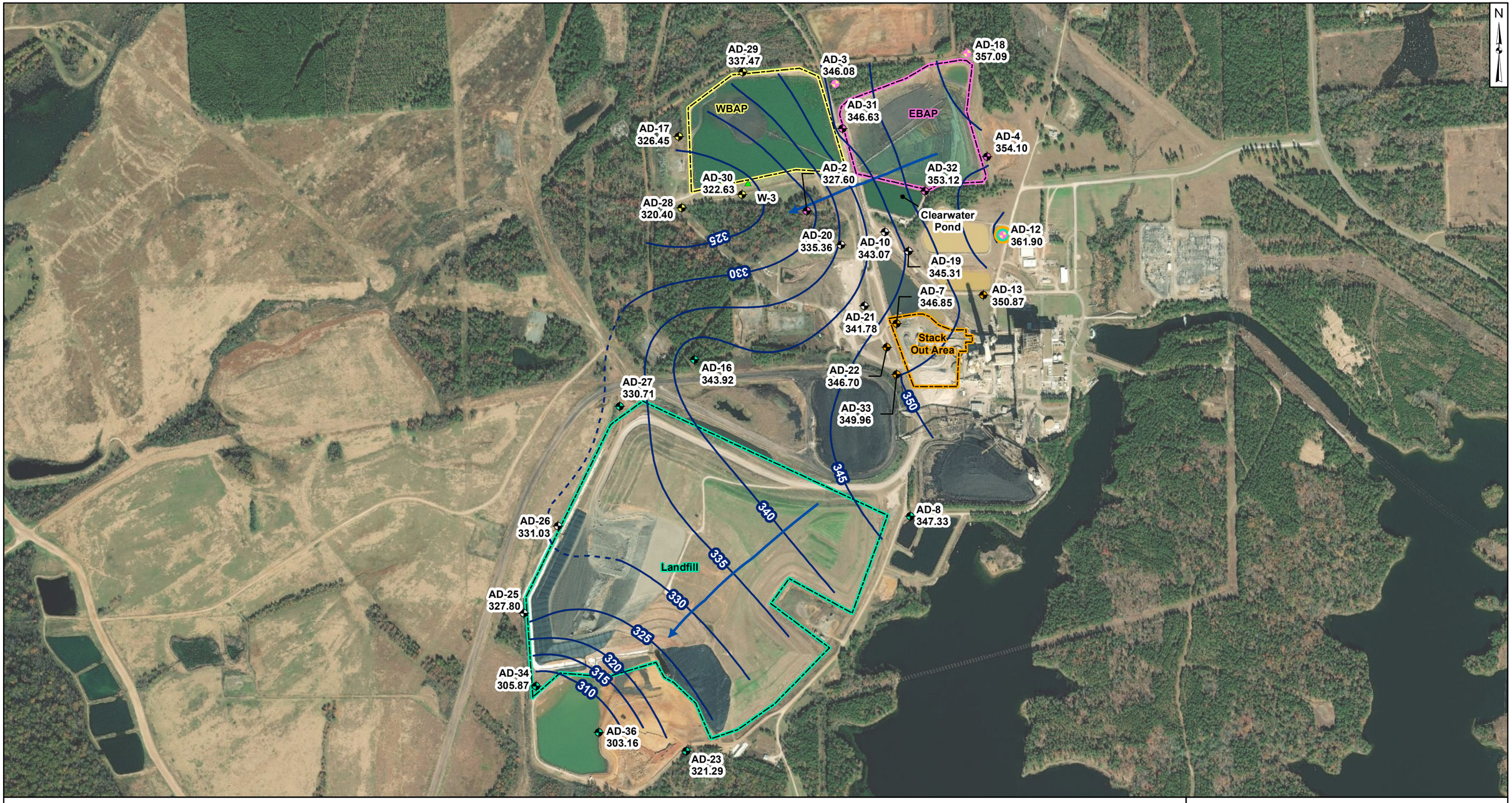

Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP

- All CCR Unit Networks
- Piezometer
- Approximate Groundwater Flow Direction
- Groundwater Elevation Contour
- Groundwater Elevation Contour (Inferred)

Notes

- Monitoring well coordinates and water level data (collected on August 12-16, 2019) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluations (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- W-3 was not gauged in August 2019.
- AD-35 was abandoned November 13, 2018. AD-36 was installed April 24, 2019.

1,000 500 0 1,000 Feet

Potentiometric Contours - Uppermost Aquifer August 2019

AEP Pirkey Power Plant
Hallsville, Texas

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Columbus, Ohio | 2020/01/16

Figure **3**

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Table 1: Residence Time Calculation Summary
Pirkey East Bottom Ash Pond

Geosyntec Consultants, Inc.

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2019-02		2019-05		2019-08	
			Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
East Bottom Ash Pond	AD-2 [2]	4.0	7.1	17.1	32.3	3.8	6.4	19.0
	AD-4 [1]	4.0	11.6	10.5	10.6	11.5	5.1	23.9
	AD-12 [1]	4.0	34.2	3.6	35.0	3.5	21.2	5.7
	AD-18 [1]	2.0	9.3	6.6	8.9	6.8	7.1	8.5
	AD-31 [2]	2.0	27.3	2.2	30.1	2.0	25.9	2.3
	AD-32 [2]	2.0	20.0	3.0	15.2	4.0	18.5	3.3

Notes:
[1] - Background Well
[2] - Downgradient Well

Table 1 - Groundwater Data Summary: AD-2
Pirkey - EBAP
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
5/11/2016	Background	1.27	1.43	28	<0.083 U	4.4	238	68
7/14/2016	Background	1.34	1.38	28	<0.083 U	4.2	216	71
9/7/2016	Background	1.3	2.65	20	<0.083 U	4.2	216	49
10/13/2016	Background	1.48	1.29	31	<0.083 U	3.6	230	67
11/14/2016	Background	1.36	1.44	28	<0.083 U	3.9	240	72
1/12/2017	Background	1.48	1.6	30	<0.083 U	3.9	244	94
3/1/2017	Background	1.62	1.28	28	<0.083 U	4.1	262	80
4/11/2017	Background	1.65	1.71	50	<0.083 U	4.0	254	88
8/24/2017	Detection	1.46	2.06	24	<0.083 U	4.3	200	64
12/21/2017	Detection	1.38	2.92	24	< 0.083 U	- -	206	64
3/22/2018	Assessment	1.99	1.97	30	<0.083 U	4.2	220	105
8/21/2018	Assessment	2.14	1.65	46	<0.083 U	4.7	312	130
2/28/2019	Assessment	2.25	1.96	31.8	0.1 J	3.5	384	129
5/22/2019	Assessment	2.17	2.19	29.6	0.1 J	4.0	316	137
8/12/2019	Assessment	2.16	3.30	28.4	0.1 J	4.6	306	128

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: AD-2
Pirkey - EBAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	<0.93 U	<1.05 U	38	0.514594 J	<0.07 U	<0.23 U	10	1.446	<0.083 U	<0.68 U	<0.00013 U	0.098	<0.29 U	2.08256 J	<0.86 U
7/14/2016	Background	<0.93 U	<1.05 U	38	0.46511 J	<0.07 U	0.401928 J	11	0.723	<0.083 U	<0.68 U	0.051	0.068	0.862706 J	<0.99 U	<0.86 U
9/7/2016	Background	<0.93 U	<1.05 U	39	0.439699 J	<0.07 U	0.493592 J	10	1.489	<0.083 U	<0.68 U	0.048	0.675	<0.29 U	<0.99 U	1.26444 J
10/13/2016	Background	<0.93 U	<1.05 U	39	0.40165 J	<0.07 U	0.885421 J	11	2.65	<0.083 U	<0.68 U	0.052	0.048	<0.29 U	1.3807 J	<0.86 U
11/14/2016	Background	<0.93 U	<1.05 U	34	0.367353 J	<0.07 U	<0.23 U	10	2.121	<0.083 U	<0.68 U	0.048	0.154	<0.29 U	1.23147 J	<0.86 U
1/12/2017	Background	<0.93 U	<1.05 U	37	0.376129 J	<0.07 U	<0.23 U	10	1.656	<0.083 U	<0.68 U	0.052	0.093	<0.29 U	<0.99 U	<0.86 U
3/1/2017	Background	<0.93 U	<1.05 U	37	0.413652 J	<0.07 U	<0.23 U	10	1.267	<0.083 U	<0.68 U	0.051	0.037	<0.29 U	<0.99 U	<0.86 U
4/11/2017	Background	<0.93 U	<1.05 U	37	0.435396 J	<0.07 U	0.243798 J	11	0.807	<0.083 U	<0.68 U	0.052	0.028	<0.29 U	<0.99 U	<0.86 U
3/22/2018	Assessment	<0.93 U	<1.05 U	33.28	0.45 J	<0.07 U	<0.23 U	12.43	1.053	<0.083 U	<0.68 U	0.05379	0.042	<0.29 U	1.61 J	<0.86 U
8/21/2018	Assessment	<0.01 U	0.52	29.0	0.428	0.06	0.406	13.6	1.059	<0.083 U	0.338	0.0479	0.02 J	0.06 J	1.1	0.096
2/28/2019	Assessment	0.02 J	0.53	26.1	0.5 J	0.06	0.1 J	13.9	1.261	0.1 J	0.355	0.0591	0.027	<0.4 U	1.5	<0.1 U
5/22/2019	Assessment	<0.4 U	<0.6 U	25.6	<0.4 U	<0.2 U	<0.8 U	15.5	0.832	0.1 J	<0.4 U	0.0542	0.063	<8 U	0.9 J	<0.1 U
8/12/2019	Assessment	<0.02 U	0.35	22.8	0.402	0.06	0.292	13.0	1.812	0.1 J	0.288	0.056	0.044	<0.4 U	0.8	0.1 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: AD-4
Pirkey - EBAP
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
5/11/2016	Background	0.02	1.63	4	<0.083 U	5.4	148	23
7/14/2016	Background	0.02	2.32	4	<0.083 U	4.9	157	20
9/8/2016	Background	0.02	2.37	5	<0.083 U	4.9	136	20
10/13/2016	Background	0.03	2.87	6	<0.083 U	4.1	164	19
11/15/2016	Background	0.04	2.71	5	<0.083 U	4.3	152	19
1/12/2017	Background	0.03	2.94	5	<0.083 U	4.8	148	18
3/1/2017	Background	0.03	2.86	4	<0.083 U	4.7	148	18
4/10/2017	Background	0.04	1.91	5	<0.083 U	4.4	140	21
8/24/2017	Detection	0.06229	2.04	5	<0.083 U	4.6	94	20
3/22/2018	Assessment	0.0331	1.41	3	<0.083 U	4.8	132	23
8/21/2018	Assessment	0.018	2.38	7	<0.083 U	4.8	158	21
2/28/2019	Assessment	0.021	1.57	3.56	0.11	4.9	192	22.9
5/23/2019	Assessment	0.021	1.71	3.31	0.15	5.0	150	24.6
8/14/2019	Assessment	<0.02 U	1.97	6.22	0.12	5.5	146	21.7

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: AD-4
Pirkey - EBAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	<0.93 U	3.95918 J	75	1	0.133362 J	0.396808 J	8	0.729	<0.083 U	<0.68 U	0.013	0.00891 J	<0.29 U	1.79183 J	<0.86 U
7/14/2016	Background	<0.93 U	8	127	1	<0.07 U	3	9	4.271	<0.083 U	<0.68 U	0.041	0.037	<0.29 U	1.73546 J	1.87362 J
9/8/2016	Background	<0.93 U	5	123	1	0.111076 J	2	8	0.193	<0.083 U	<0.68 U	0.04	0.01151 J	<0.29 U	<0.99 U	<0.86 U
10/13/2016	Background	<0.93 U	11	183	0.830588 J	<0.07 U	7	7	2.381	<0.083 U	<0.68 U	0.034	0.01005 J	<0.29 U	1.60451 J	0.868603 J
11/15/2016	Background	<0.93 U	<1.05 U	114	0.53145 J	<0.07 U	0.446412 J	6	1.072	<0.083 U	<0.68 U	0.035	0.01268 J	<0.29 U	<0.99 U	<0.86 U
1/12/2017	Background	<0.93 U	<1.05 U	149	0.406228 J	<0.07 U	0.305795 J	4.5062 J	2.599	<0.083 U	<0.68 U	0.03	0.01146 J	<0.29 U	<0.99 U	<0.86 U
3/1/2017	Background	<0.93 U	<1.05 U	131	0.354085 J	<0.07 U	<0.23 U	4.45689 J	1.089	<0.083 U	<0.68 U	0.033	0.01224 J	<0.29 U	<0.99 U	<0.86 U
4/10/2017	Background	<0.93 U	<1.05 U	94	0.915299 J	0.0796 J	0.240917 J	8	0.684	<0.083 U	<0.68 U	0.047	0.00554 J	<0.29 U	<0.99 U	<0.86 U
3/22/2018	Assessment	<0.93 U	<1.05 U	66.74	1.15	0.26 J	<0.23 U	9.39	1.283	<0.083 U	<0.68 U	0.05374	<0.005 U	<0.29 U	1.99 J	<0.86 U
8/21/2018	Assessment	<0.01 U	1.30	121	0.400	0.02 J	0.198	4.43	1.331	<0.083 U	0.098	0.0294	0.005 J	<0.02 U	0.04 J	0.096
2/28/2019	Assessment	<0.02 U	0.26	70.5	0.9 J	0.01 J	0.1 J	6.92	0.818	0.11	0.106	0.0513	<0.005 U	<0.4 U	0.03 J	<0.1 U
5/23/2019	Assessment	<0.4 U	<0.6 U	61.7	0.5 J	<0.2 U	1 J	7.86	0.5173	0.15	<0.4 U	0.0516	<0.005 U	<8 U	<0.6 U	<0.1 U
8/14/2019	Assessment	<0.02 U	0.17	73.5	1.04	<0.01 U	0.08 J	6.52	0.833	0.12	0.06 J	0.0484	<0.005 U	<0.4 U	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: AD-12
Pirkey - EBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	0.03	0.362	5	<0.083 U	4.4	94	4
7/13/2016	Background	0.03	0.26	6	<0.083 U	3.1	75	4
9/7/2016	Background	0.04	0.343	6	<0.083 U	3.9	63	7
10/12/2016	Background	0.03	0.271	7	< 1 U	3.4	92	8
11/14/2016	Background	0.04	0.331	8	<0.083 U	2.6	80	6
1/11/2017	Background	0.03	0.315	7	<0.083 U	4.8	76	6
2/28/2017	Background	0.04	0.434	5	<0.083 U	3.6	50	4
4/11/2017	Background	0.05	0.299	6	0.2565 J	4.7	72	7
8/23/2017	Detection	0.0495	0.245	6	0.213 J	4.8	52	6
3/21/2018	Assessment	0.01397	0.269	5	<0.083 U	4.2	<2 U	3
8/20/2018	Assessment	0.017	0.338	10	<0.083 U	4.4	94	4
2/27/2019	Assessment	0.03 J	0.4 J	6.08	0.09	5.2	36	3.6
5/21/2019	Assessment	0.020	0.3 J	6.30	0.09	4.1	80	4.0
8/12/2019	Assessment	<0.02 U	0.278	7.24	0.06 J	4.9	90	2.6

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: AD-12
Pirkey - EBAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	<0.93 U	<1.05 U	26	0.219521 J	<0.07 U	0.710981 J	1.58207 J	0.2073	<0.083 U	<0.68 U	<0.00013 U	<0.005 U	<0.29 U	1.73953 J	<0.86 U
7/13/2016	Background	<0.93 U	<1.05 U	23	0.190337 J	<0.07 U	0.68835 J	1.29444 J	2.909	<0.083 U	<0.68 U	0.008	<0.005 U	<0.29 U	<0.99 U	<0.86 U
9/7/2016	Background	<0.93 U	<1.05 U	30	0.232192 J	<0.07 U	0.353544 J	1.66591 J	0.881	<0.083 U	<0.68 U	0.01	<0.005 U	<0.29 U	<0.99 U	<0.86 U
10/12/2016	Background	<0.93 U	<1.05 U	27	0.149553 J	<0.07 U	0.529033 J	1.56632 J	0.257	< 1 U	<0.68 U	0.012	<0.005 U	<0.29 U	<0.99 U	<0.86 U
11/14/2016	Background	<0.93 U	<1.05 U	28	0.152375 J	<0.07 U	0.32826 J	1.47282 J	0.767	<0.083 U	<0.68 U	0.013	<0.005 U	<0.29 U	<0.99 U	<0.86 U
1/11/2017	Background	<0.93 U	<1.05 U	23	0.126621 J	<0.07 U	0.650158 J	1.09495 J	1.536	<0.083 U	<0.68 U	0.01	<0.005 U	<0.29 U	<0.99 U	<0.86 U
2/28/2017	Background	<0.93 U	<1.05 U	26	0.149219 J	<0.07 U	0.325811 J	1.29984 J	0.416	<0.083 U	<0.68 U	0.009	<0.005 U	<0.29 U	<0.99 U	0.994913 J
4/11/2017	Background	<0.93 U	<1.05 U	24	0.159412 J	<0.07 U	0.416007 J	1.33344 J	0.3895	0.2565 J	<0.68 U	0.008	0.01364 J	<0.29 U	<0.99 U	<0.86 U
3/21/2018	Assessment	<0.93 U	<1.05 U	25.82	0.16 J	<0.07 U	1.05	1.49 J	0.784	<0.083 U	<0.68 U	0.00722	<0.005 U	<0.29 U	<0.99 U	<0.86 U
8/20/2018	Assessment	<0.01 U	0.11	27.8	0.159	0.01 J	0.330	1.72	1.128	<0.083 U	0.089	0.0143	<0.005 U	0.04 J	0.1	0.04 J
2/27/2019	Assessment	<0.4 U	<0.6 U	22.5	<0.4 U	<0.2 U	<0.8 U	1.37	0.225	0.09	<0.4 U	0.00688	<0.005 U	<8 U	<0.6 U	<2 U
5/21/2019	Assessment	<0.4 U	<0.6 U	21.7	<0.4 U	<0.2 U	<0.8 U	1.15	0.201	0.09	<0.4 U	0.00576	<0.005 U	<8 U	<0.6 U	<0.1 U
8/12/2019	Assessment	<0.02 U	0.07 J	23.8	0.154	<0.01 U	0.204	1.3	0.237	0.06 J	0.08 J	0.00829	<0.005 U	<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: AD-18
Pirkey - EBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

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
5/10/2016	Background	0.01	0.548	8	<0.083 U	4.5	108	7
7/14/2016	Background	0.01	0.409	8	<0.083 U	4.7	116	7
9/8/2016	Background	0.01	0.343	8	<0.083 U	4.7	110	8
10/13/2016	Background	0.02	0.56	7	<0.083 U	4.1	124	10
11/15/2016	Background	0.02	0.59	7	<0.083 U	4.4	134	7
1/12/2017	Background	0.01	0.415	7	<0.083 U	4.7	128	10
3/1/2017	Background	0.01	0.224	6	<0.083 U	4.1	108	7
4/10/2017	Background	0.01	0.304	7	<0.083 U	4.1	102	8
8/24/2017	Detection	0.0278	0.435	8	<0.083 U	4.9	68	8
3/22/2018	Assessment	0.01642	0.292	6	<0.083 U	5.4	100	6
8/21/2018	Assessment	0.012	0.321	10	<0.083 U	5.1	118	8
2/28/2019	Assessment	<0.02 U	0.490	8.19	0.02 J	5.0	84	6.1
5/23/2019	Assessment	0.013	0.684	8.82	0.02 J	5.2	104	10.6
8/13/2019	Assessment	<0.02 U	0.647	8.49	0.01 J	5.2	90	6.6

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: AD-18
Pirkey - EBAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

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
5/10/2016	Background	<0.93 U	<1.05 U	157	0.262755 J	0.109247 J	1	1.82932 J	0.847	<0.083 U	<0.68 U	0.004	0.01536 J	<0.29 U	1.71074 J	<0.86 U
7/14/2016	Background	<0.93 U	3.77261 J	139	0.243326 J	<0.07 U	3	2.16037 J	3.264	<0.083 U	<0.68 U	0.02	0.064	0.41347 J	2.45009 J	<0.86 U
9/8/2016	Background	<0.93 U	<1.05 U	115	0.226343 J	<0.07 U	0.779959 J	1.09947 J	1.105	<0.083 U	<0.68 U	0.019	0.03	<0.29 U	<0.99 U	<0.86 U
10/13/2016	Background	<0.93 U	<1.05 U	112	0.192611 J	<0.07 U	0.631027 J	2.24885 J	1.161	<0.083 U	<0.68 U	0.026	0.01416 J	<0.29 U	<0.99 U	<0.86 U
11/15/2016	Background	<0.93 U	<1.05 U	94	0.107171 J	<0.07 U	0.724569 J	1.66054 J	1.486	<0.083 U	<0.68 U	0.017	0.029	<0.29 U	<0.99 U	<0.86 U
1/12/2017	Background	<0.93 U	<1.05 U	99	0.169196 J	<0.07 U	0.411433 J	1.62881 J	0.976	<0.083 U	<0.68 U	0.026	0.01887 J	<0.29 U	<0.99 U	<0.86 U
3/1/2017	Background	<0.93 U	<1.05 U	99	0.105337 J	<0.07 U	0.572874 J	0.976724 J	0.468	<0.083 U	<0.68 U	0.017	0.01086 J	<0.29 U	<0.99 U	<0.86 U
4/10/2017	Background	<0.93 U	<1.05 U	105	0.130316 J	<0.07 U	0.967681 J	0.98157 J	0.648	<0.083 U	<0.68 U	0.019	0.0096 J	<0.29 U	<0.99 U	<0.86 U
3/22/2018	Assessment	<0.93 U	<1.05 U	97.75	0.09 J	<0.07 U	<0.23 U	0.97 J	0.942	<0.083 U	<0.68 U	0.01647	0.006 J	<0.29 U	1.53 J	<0.86 U
8/21/2018	Assessment	0.02 J	1.01	99.8	0.129	0.02 J	0.809	1.18	1.108	<0.083 U	0.280	0.0175	0.014 J	0.08 J	0.2	0.060
2/28/2019	Assessment	<0.4 U	<0.6 U	106	<0.4 U	<0.2 U	<0.8 U	1.11	0.615	0.02 J	0.7 J	0.0177	0.009 J	<8 U	<0.6 U	<2 U
5/23/2019	Assessment	<0.4 U	<0.6 U	131	<0.4 U	<0.2 U	<0.8 U	1.47	0.492	0.02 J	<0.4 U	0.0209	0.009 J	<8 U	<0.6 U	<0.1 U
8/13/2019	Assessment	<0.02 U	0.45	100	0.118	0.02 J	0.212	1.25	0.473	0.01 J	0.2 J	0.0183	0.023 J	<0.4 U	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: AD-31
Pirkey - EBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	0.08	10.4	18	<0.083 U	4.5	286	63
7/13/2016	Background	0.03	4.27	18	<0.083 U	3.5	245	66
9/7/2016	Background	0.03	3.47	18	<0.083 U	3.7	260	60
10/12/2016	Background	0.04	4.41	18	<0.083 U	4.0	276	62
11/14/2016	Background	0.04	4.7	18	<0.083 U	3.2	266	66
1/11/2017	Background	0.03	4.43	19	<0.083 U	4.4	252	79
2/28/2017	Background	0.04	3.89	14	<0.083 U	3.6	212	68
4/11/2017	Background	0.04	3.64	16	<0.083 U	3.6	252	69
8/23/2017	Detection	0.01752	2.24	18	<0.083 U	4.5	228	52
12/21/2017	Detection	- -	- -	20	<0.083 U	- -	224	58
3/22/2018	Assessment	0.04078	3.11	16	<0.083 U	4.5	260	76
8/21/2018	Assessment	0.022	2.86	25	<0.083 U	4.9	274	72
2/28/2019	Assessment	0.03 J	2.77	18.8	0.1 J	5.0	74	74.8
5/23/2019	Assessment	0.021	3.29	18.7	0.13	5.1	240	79.9
8/12/2019	Assessment	<0.02 U	2.86	21.6	0.16	4.1	250	70.0

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: AD-31
Pirkey - EBAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	<0.93 U	93	712	10	0.858875 J	212	50	7.32	<0.083 U	57	0.077	1.797	0.893978 J	1.84045 J	<0.86 U
7/13/2016	Background	<0.93 U	3.41559 J	69	1	<0.07 U	10	11	3.38	<0.083 U	<0.68 U	0.096	0.32	0.316083 J	1.11301 J	<0.86 U
9/7/2016	Background	<0.93 U	4.34007 J	88	2	<0.07 U	15	11	2.345	<0.083 U	<0.68 U	0.094	0.284	<0.29 U	<0.99 U	<0.86 U
10/12/2016	Background	<0.93 U	6	76	1	<0.07 U	14	11	3.88	<0.083 U	1.54023 J	0.097	0.347	<0.29 U	<0.99 U	<0.86 U
11/14/2016	Background	<0.93 U	11	125	2	0.174662 J	30	14	3.202	<0.083 U	3.93298 J	0.096	0.523	0.401556 J	1.03392 J	<0.86 U
1/11/2017	Background	<0.93 U	3.92088 J	77	1	<0.07 U	12	10	2.725	<0.083 U	<0.68 U	0.093	0.384	<0.29 U	<0.99 U	1.01921 J
2/28/2017	Background	<0.93 U	<1.05 U	44	0.998308 J	<0.07 U	3	9	2.684	<0.083 U	<0.68 U	0.09	0.138	<0.29 U	<0.99 U	<0.86 U
4/11/2017	Background	<0.93 U	3.31744 J	73	1	0.0944 J	12	11	3.521	<0.083 U	<0.68 U	0.097	0.333	<0.29 U	<0.99 U	<0.86 U
3/22/2018	Assessment	<0.93 U	3.32 J	70.83	1.24	0.12 J	9.62	11.12	2.955	<0.083 U	<0.68 U	0.09732	1.389	<0.29 U	1.98 J	<0.86 U
8/21/2018	Assessment	0.02 J	1.92	57.7	0.729	0.06	2.39	9.29	4.13	<0.083 U	1.41	0.0556	1.112	0.24	2.5	0.113
2/28/2019	Assessment	<0.4 U	<0.6 U	33.1	1 J	<0.2 U	<0.8 U	9.38	3.156	0.1 J	<0.4 U	0.0864	0.01 J	<8 U	<0.6 U	<2 U
5/23/2019	Assessment	<0.4 U	<0.6 U	37.9	0.9 J	<0.2 U	<0.8 U	10.3	3.4	0.13	<0.4 U	0.0928	0.057	<8 U	<0.6 U	<0.1 U
8/12/2019	Assessment	<0.02 U	0.53	35.0	0.850	0.06	0.365	8.69	2.196	0.16	0.325	0.0875	1.027	<0.4 U	0.4	<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: AD-32
Pirkey - EBAP
Appendix III Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	0.708	7.41	12	<0.083 U	4.3	206	124
7/13/2016	Background	5.23	33.9	32	0.67 J	3.3	835	461
9/7/2016	Background	5.78	37.4	35	<0.083 U	3.1	884	479
10/12/2016	Background	4.26	27.1	29	0.8585 J	3.3	720	430
11/14/2016	Background	5.52	35.9	34	0.7468 J	3.0	922	621
1/11/2017	Background	5.05	40	35	<0.083 U	3.9	894	683
2/28/2017	Background	2.73	18.4	19	<0.083 U	3.1	490	285
4/11/2017	Background	1.46	11	15	0.4468 J	3.2	372	200
8/23/2017	Detection	0.716	7.15	14	1.962	4.3	288	115
12/21/2017	Detection	2.56	17.1	22	0.5932 J	- -	504	324
3/21/2018	Assessment	0.628	6.32	15	<0.083 U	4.1	288	113
8/21/2018	Assessment	2.45	17.8	28	<0.083 U	3.9	548	321
2/28/2019	Assessment	0.679	6.62	17.5	0.40	3.2	222	121
5/21/2019	Assessment	0.555	5.35	18.6	0.31	3.2	292	105
8/12/2019	Assessment	1.77	13.3	24.9	0.67	4.0	448	228

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: AD-32
Pirkey - EBAP
Appendix IV Constituents

Geosyntec Consultants, Inc.

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
5/11/2016	Background	<0.93 U	3.77019 J	35	3	0.293016 J	5	27	2.501	<0.083 U	<0.68 U	0.016	0.925	<0.29 U	<0.99 U	<0.86 U
7/13/2016	Background	<0.93 U	13	58	8	0.729634 J	18	74	6.41	0.67 J	<0.68 U	0.119	13.916	0.76212 J	3.88793 J	<0.86 U
9/7/2016	Background	<0.93 U	3.25886 J	35	8	0.601583 J	6	70	4.846	<0.083 U	<0.68 U	0.111	1.68	<0.29 U	<0.99 U	1.09263 J
10/12/2016	Background	<0.93 U	10	50	7	0.589066 J	15	65	17.32	0.8585 J	<0.68 U	0.972	7.285	<0.29 U	1.93488 J	<0.86 U
11/14/2016	Background	<0.93 U	6	37	9	0.78793 J	8	75	3.731	0.7468 J	<0.68 U	0.114	3.624	<0.29 U	<0.99 U	1.078 J
1/11/2017	Background	<0.93 U	6	37	7	0.602157 J	9	69	4.342	<0.083 U	<0.68 U	0.115	7.202	<0.29 U	<0.99 U	0.991051 J
2/28/2017	Background	<0.93 U	4.56273 J	30	5	0.389491 J	5	45	4.001	<0.083 U	<0.68 U	0.095	7.927	<0.29 U	2.53854 J	<0.86 U
4/11/2017	Background	<0.93 U	<1.05 U	26	4	0.440252 J	3	35	4.32	0.4468 J	<0.68 U	0.095	2.755	<0.29 U	<0.99 U	<0.86 U
3/21/2018	Assessment	<0.93 U	3.05 J	41.25	3.17	0.55 J	5.38	25.8	4.922	<0.083 U	<0.68 U	0.103	6.4	<0.29 U	2.18 J	<0.86 U
8/21/2018	Assessment	0.01 J	4.81	17.2	3.70	0.47	0.646	43.5	6.01	<0.083 U	0.714	0.0689	2.649	0.04 J	15.0	0.238
2/28/2019	Assessment	<0.4 U	2 J	28.9	3.34	0.2 J	2 J	25.0	4.67	0.40	<0.4 U	0.0919	1.135	<8 U	3 J	<2 U
5/21/2019	Assessment	<0.4 U	0.8 J	35.6	2.77	0.3 J	1 J	23.5	5.37	0.31	0.4 J	0.0897	1.371	<8 U	1 J	0.2 J
8/12/2019	Assessment	<0.02 U	3.43	38.5	3.65	0.40	1.7	33.7	5.70	0.67	0.996	0.0964	4.127	<0.4 U	7.3	0.2 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

APPENDIX II

Where applicable, show in this appendix the results from statistical analyses, and a description of the statistical analysis method chosen. These statistical analyses are to be conducted separately for each constituent in each monitoring well.

STATISTICAL ANALYSIS SUMMARY
EAST BOTTOM ASH POND
H.W. Pirkey Plant
Hallsville, Texas

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 12, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
EBAP	East Bottom Ash Pond
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 East Bottom Ash Pond (EBAP), an existing CCR unit at the H.W. Pirkey Power Plant located in Hallsville, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, calcium, chloride, total dissolved solids (TDS), and sulfate at the EBAP. An alternative source was not identified at the time, so two assessment monitoring events were conducted at the EBAP in 2018, in accordance with 40 CFR 257.95. SSLs were identified for cobalt at wells AD-2, AD-31, and AD-32 and for lithium at AD-31 and AD-32. An alternative source demonstration (ASD) was successfully completed for cobalt (Geosyntec, 2019).

A semi-annual assessment monitoring event was also completed in February 2019, with the results of the February 2019 event documented in this report. 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 February 2019 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. SSLs were identified for cobalt and lithium. Thus, either the unit will move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment 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). Although antimony, fluoride, lead, molybdenum, and thallium were not detected at any locations during the March 2018 screening event, samples from the February 2019 semi-annual sampling event were analyzed for all Appendix III and Appendix IV parameters. 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 EBAP 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(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, barium, beryllium, cadmium, cobalt, and selenium due to apparent non-normal distributions, for antimony, fluoride, lead, molybdenum, and thallium due to a high non-detect frequency, and for chromium and mercury due to both an apparent non-normal distribution and 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.

The following SSLs were identified at the Pirkey EBAP:

- LCLs for cobalt exceeded the GWPS of 0.0094 mg/L at AD-2 (0.0100 mg/L), AD-31 (0.00943 mg/L), and AD-32 (0.0333 mg/L).

- LCLs for lithium exceeded the GWPS of 0.052 mg/L at AD-31 (0.077 mg/L) and AD-32 (0.075 mg/L).

As a result, the Pirkey EBAP will either move to an assessment of corrective measures or an alternative source demonstration will be conducted to evaluate if the unit can remain in assessment monitoring

2.2.3 Evaluation of Potential Appendix III SSIs

While SSLs were identified, a review of the Appendix III results were also completed 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 pH, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, fluoride, sulfate, and TDS.

Prediction limits for the interwell tests were recalculated using data collected during the February 2019 assessment monitoring event. Three data points (i.e., one sample from three 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, fluoride, 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 pH.

Data collected during the February 2019 assessment monitoring event 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 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.047 mg/L at AD-2 (2.25 mg/L) and AD-32 (0.679 mg/L).
- The calcium concentration exceeded the interwell UPL of 2.94 mg/L at AD-32 (6.62 mg/L).
- Chloride concentrations exceeded the interwell UPL of 9.23 mg/L at AD-2 (31.8 mg/L), AD-31 (18.8 mg/L), and AD-32 (17.5 mg/L).
- The reported pH value exceeded the intrawell UPL of 4.9 SU at AD-31 (5.0 SU).
- Sulfate concentrations exceeded the interwell UPL of 23.0 mg/L at AD-2 (129 mg/L), AD-31 (74.8 mg/L), and AD-32 (121 mg/L).
- TDS concentrations exceeded the interwell UPL of 178 mg/L at AD-2 (384 mg/L) and AD-32 (222 mg/L).

While the prediction limits were calculated assuming a one-of-two testing procedure, it was conservatively assumed that an SSI was identified if the initial sample exceeded either the UPL based on previous results. Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Pirkey EBAP during 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 February 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. SSLs were identified for cobalt and lithium. Appendix III parameters were also evaluated, with exceedances identified for boron, calcium, chloride, pH, sulfate, and TDS.

Based on this evaluation, the Pirkey EBAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – Pirkey Plant. January 2017.

Geosyntec Consultants (Geosyntec). 2018. Statistical Analysis Summary – East Bottom Ash Pond, H.W. Pirkey Power Plant, Hallsville, Texas. January 3, 2018.

Geosyntec. 2019. Alternative Source Demonstration Report – Federal CCR Rule. H. W. Pirkey Plant, East Bottom Ash Pond. April.

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
Pirkey - East Bottom Ash Pond

Geosyntec Consultants

Parameter	Unit	AD-2	AD-4	AD-12	AD-18	AD-31	AD-32
		2/28/2019	2/28/2019	2/27/2019	2/28/2019	2/28/2019	2/28/2019
Antimony	µg/L	0.0200 J	0.100 U	2.00 U	2.00 U	2.00 U	2.00 U
Arsenic	µg/L	0.530	0.260	2.00 U	2.00 U	2.00 U	2.00 J
Barium	µg/L	26.1	70.5	22.5	106	33.1	28.9
Beryllium	µg/L	0.500 J	0.900 J	2.00 U	2.00 U	1.00 J	3.34
Boron	mg/L	2.25	0.0210	0.0300 J	0.100 U	0.0300 J	0.679
Cadmium	µg/L	0.0600	0.0100 J	1.00 U	1.00 U	1.00 U	0.200 J
Calcium	mg/L	1.96	1.57	0.400 J	0.490	2.77	6.62
Chloride	mg/L	31.8	3.56	6.08	8.19	18.8	17.5
Chromium	µg/L	0.100 J	0.100 J	4.00 U	4.00 U	4.00 U	2.00 J
Cobalt	µg/L	13.9	6.92	1.37	1.11	9.38	25.0
Combined Radium	pCi/L	1.26	0.818	0.225	0.615	3.16	4.67
Fluoride	mg/L	0.100 J	0.110	0.0900	0.0200 J	0.100 J	0.400
Lead	µg/L	0.355	0.106	2.00 U	0.700 J	2.00 U	2.00 U
Lithium	mg/L	0.0591	0.0513	0.00688	0.0177	0.0864	0.0919
Mercury	mg/L	0.0000270	0.0000250 U	0.0000250 U	0.00000900 J	0.0000100 J	0.00114
Molybdenum	µg/L	2.00 U	2.00 U	40.0 U	40.0 U	40.0 U	40.0 U
Selenium	µg/L	1.50	0.0300 J	4.00 U	4.00 U	4.00 U	3.00 J
Total Dissolved Solids	mg/L	384	192	36.0	84.0	74.0	222
Sulfate	mg/L	129	22.9	3.60	6.10	74.8	121
Thallium	µg/L	0.500 U	0.500 U	10.0 U	10.0 U	10.0 U	10.0 U
pH	SU	3.45	4.90	5.17	5.02	5.00	3.23

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 sampled

Table 2: Groundwater Protection Standards
Pirkey Plant - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule-Specified	Background Limit
Antimony, Total (mg/L)	0.006		0.002
Arsenic, Total (mg/L)	0.01		0.011
Barium, Total (mg/L)	2		0.18
Beryllium, Total (mg/L)	0.004		0.0012
Cadmium, Total (mg/L)	0.005		0.001
Chromium, Total (mg/L)	0.1		0.007
Cobalt, Total (mg/L)	n/a	0.006	0.0094
Combined Radium, Total (pCi/L)	5		3.64
Fluoride, Total (mg/L)	4		1
Lead, Total (mg/L)	n/a	0.015	0.005
Lithium, Total (mg/L)	n/a	0.04	0.052
Mercury, Total (mg/L)	0.002		0.000064
Molybdenum, Total (mg/L)	n/a	0.1	0.002
Selenium, Total (mg/L)	0.05		0.004
Thallium, Total (mg/L)	0.002		0.0019

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/Rule-Specified Level is used as the GWPS.

Table 3: Appendix III Data Summary
Pirkey Plant - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Units	Description	AD-2	AD-31	AD-32
			2/28/2019	2/27/2019	2/28/2019
Boron	mg/L	Interwell Background Value (UPL)	0.047		
		Detection Monitoring Result	**2.25**	0.030	**0.679**
Calcium	mg/L	Interwell Background Value (UPL)	2.94		
		Detection Monitoring Result	1.96	2.77	**6.62**
Chloride	mg/L	Interwell Background Value (UPL)	9.23		
		Detection Monitoring Result	**31.8**	**18.8**	**17.5**
Fluoride	mg/L	Interwell Background Value (UPL)	1.0		
		Detection Monitoring Result	0.1	0.1	0.4
pH	SU	Intrawell Background Value (UPL)	4.6	4.9	4.5
		Intrawell Background Value (LPL)	3.4	2.7	2.3
		Detection Monitoring Result	3.5	**5.0**	3.2
Sulfate	mg/L	Interwell Background Value (UPL)	23.0		
		Detection Monitoring Result	**129**	**74.8**	**121**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	178		
		Detection Monitoring Result	**384**	74.0	**222**

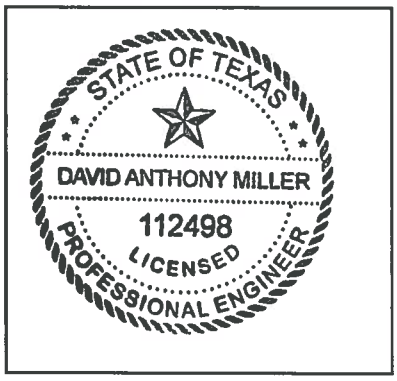
Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

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 Pirkey East 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

112498	TEXAS	07.12.19
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

July 10, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
150 E. Wilson Bridge Rd., #232
Worthington, OH 43085

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the evaluation of groundwater data from the February 2019 sample event for American Electric Power Company's Pirkey EBAP. 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 at each of the wells below began at Pirkey EBAP for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells AD-4, AD-12, and AD-18; and downgradient wells AD-2, AD-31, and AD-32A.

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; and

- **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. During the August 2019 event, a value of 0.015 mg/L was reported for selenium at well AD-32. That value was flagged as an outlier during this analysis since the reported value during the February 2019 event was significantly lower (0.003 mg/L) and similar to historical concentrations. A summary of flagged values follows this letter (Figure B).

Evaluation of Appendix III Parameters

Interwell prediction limits combined with a 1-of-2 resample plan were constructed for boron, calcium, chloride, fluoride, sulfate and TDS; and intrawell prediction limits combined with a 1-of-2 resample plan were constructed for pH (Figure 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; therefore, no further action is necessary. Prediction limits exceedances were noted for several 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 (Figure E). No statistically significant trends were noted, except for statistically significantly increasing trends for boron and sulfate in well AD-2. 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).

Note that the reporting limit during the February 2019 event for molybdenum at wells AD-12, AD-18, AD-31 and AD-32 was 0.04 mg/L compared to a historical reporting limit of 0.002 mg/L. Wells AD-2 and AD-4, however, had a reporting limit of 0.002 mg/L during this event. A substitution of 0.04 mg/L was used for all nondetects for molybdenum. This value is lower than the CCR Rule level of 0.1 mg/L.

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 ACL 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. A few confidence intervals exceedances were noted for cobalt and lithium. A summary of the confidence interval results follows this letter.

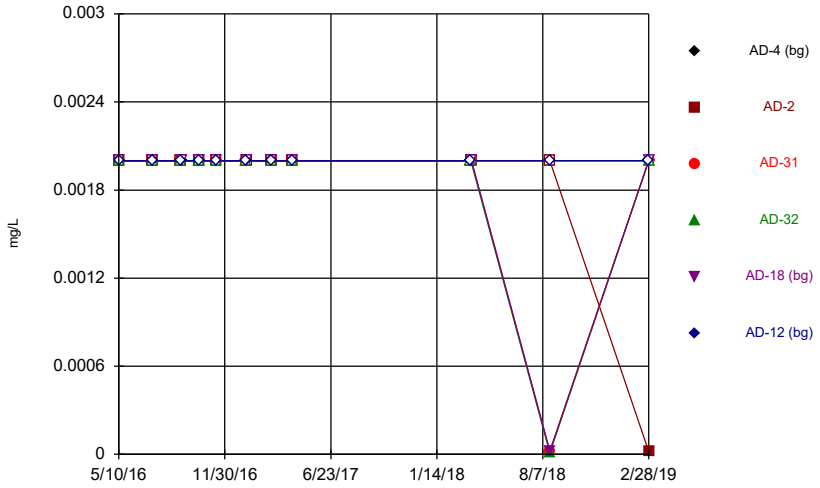
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Pirkey EBAP. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Antimony, total Analysis Run 7/7/2019 11:54 AM View: Time Series
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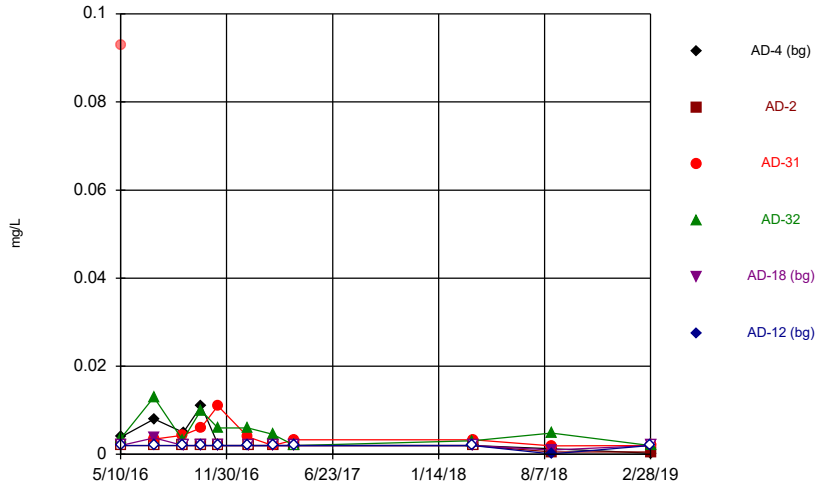
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Arsenic, total Analysis Run 7/7/2019 11:54 AM View: Time Series
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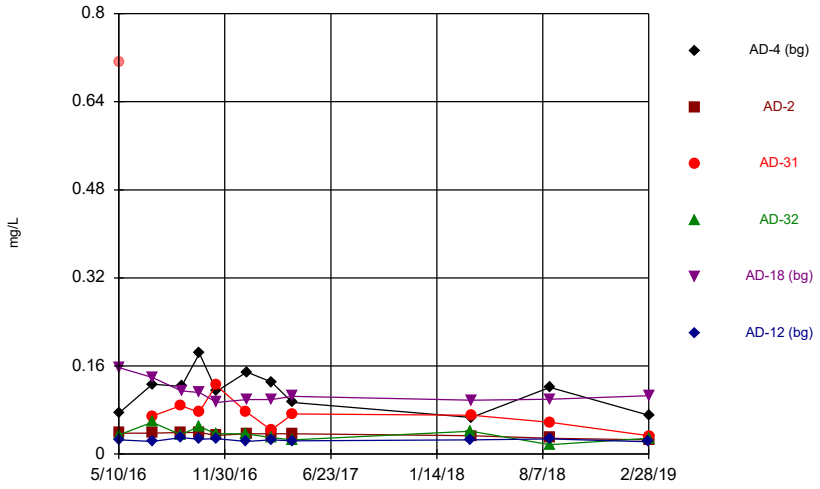
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Time Series



Constituent: Barium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
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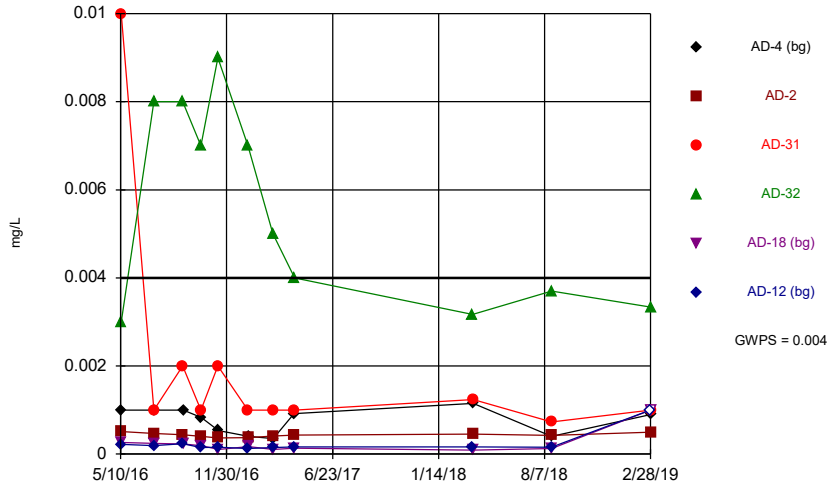
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

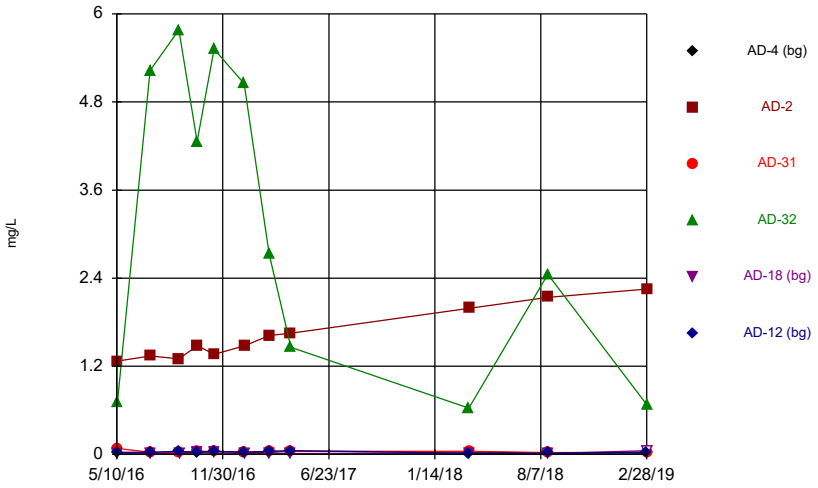
Time Series



Constituent: Beryllium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

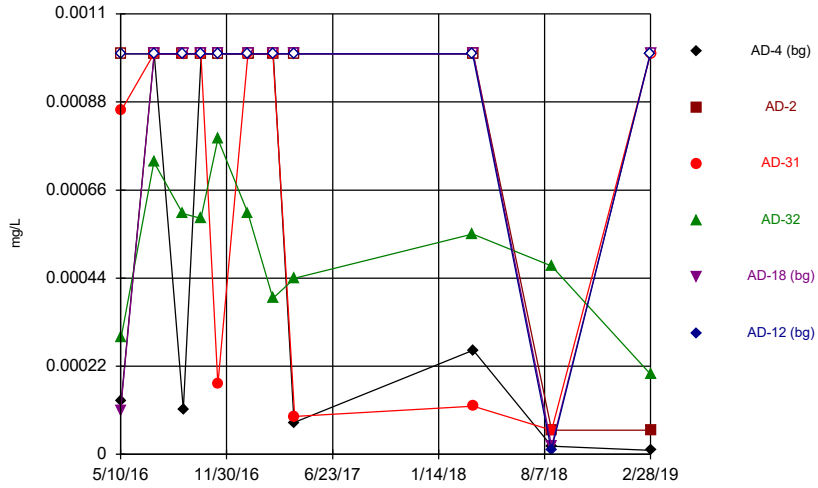
Time Series



Constituent: Boron, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

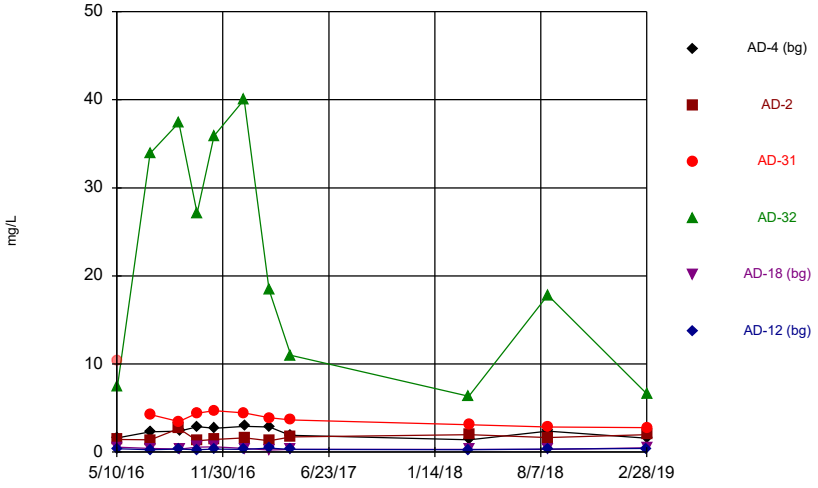
Time Series



Constituent: Cadmium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

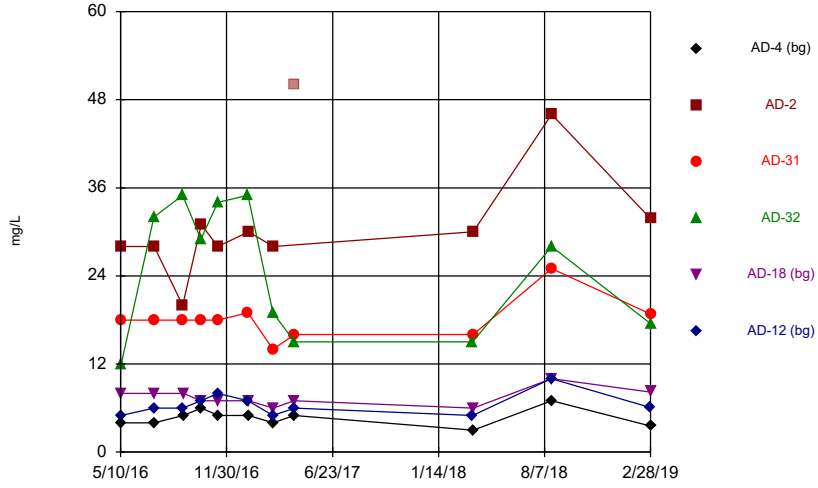
Time Series



Constituent: Calcium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

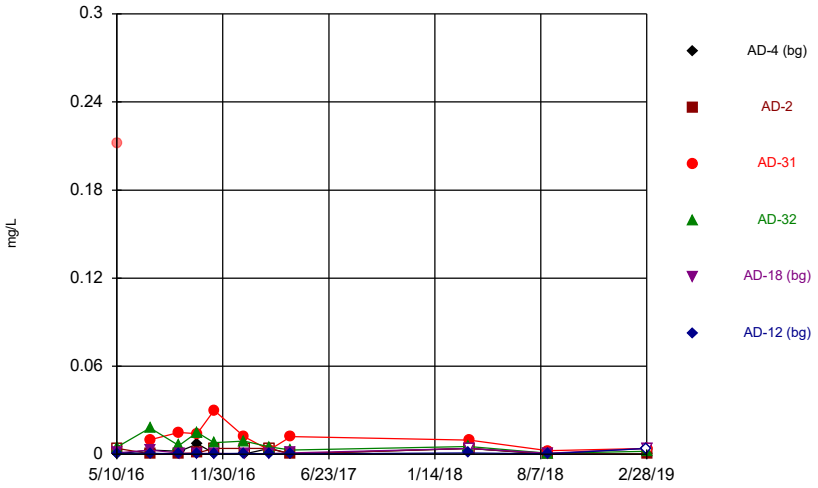
Time Series



Constituent: Chloride, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

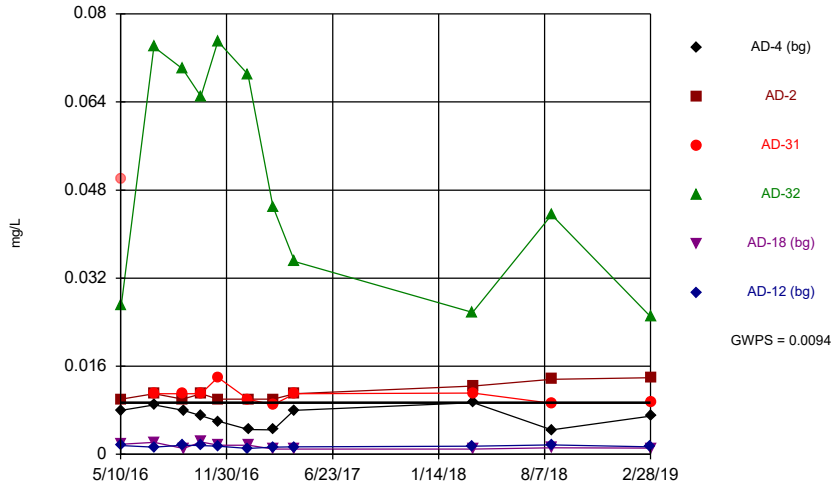
Time Series



Constituent: Chromium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

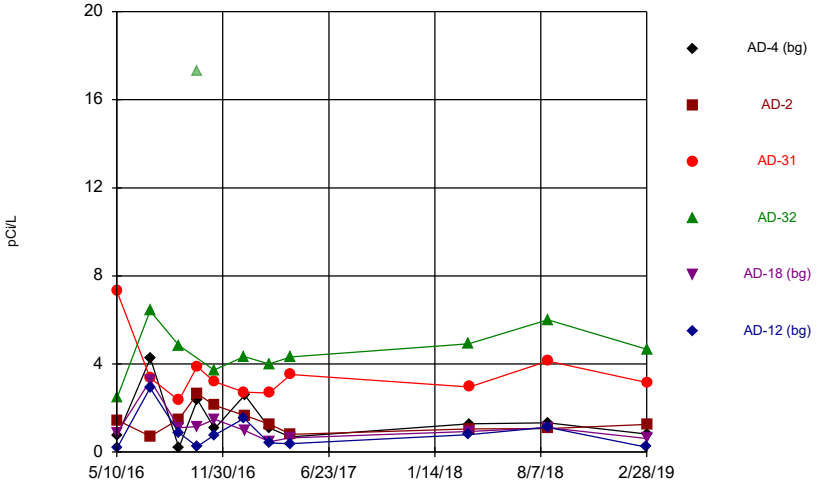
Time Series



Constituent: Cobalt, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

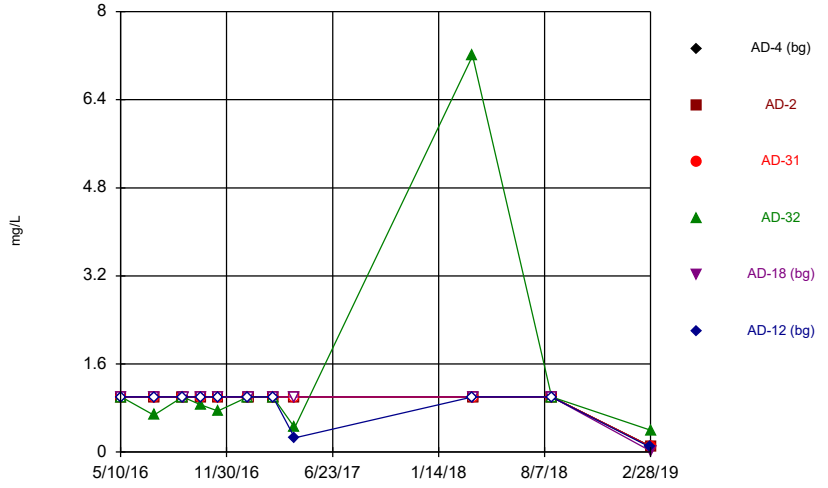
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

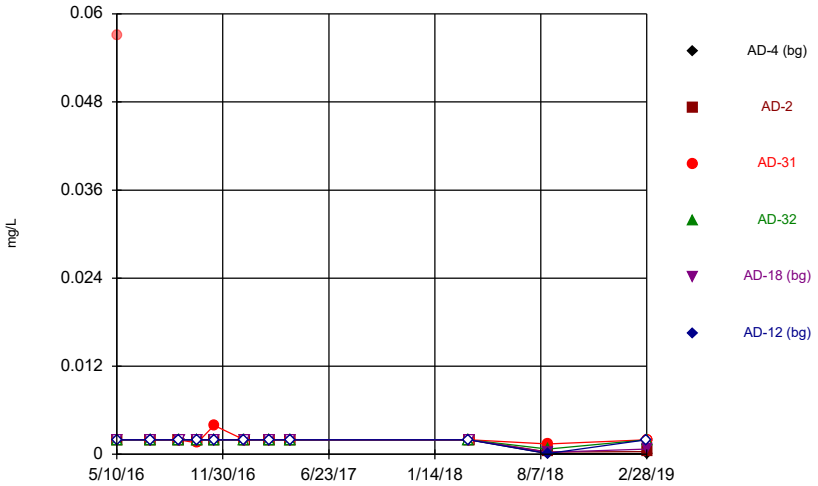
Time Series



Constituent: Fluoride, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

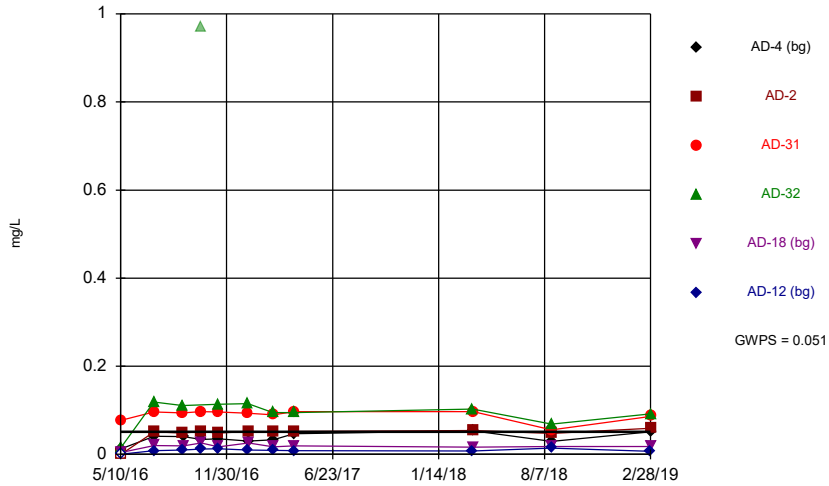
Time Series



Constituent: Lead, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

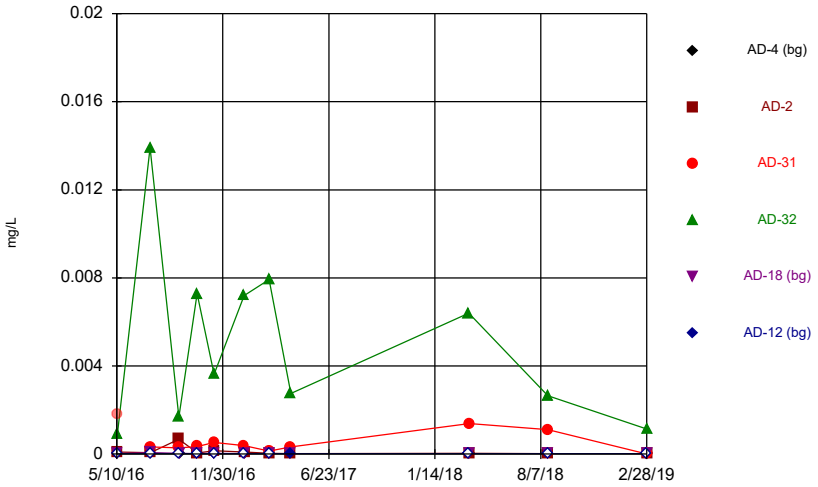
Time Series



Constituent: Lithium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

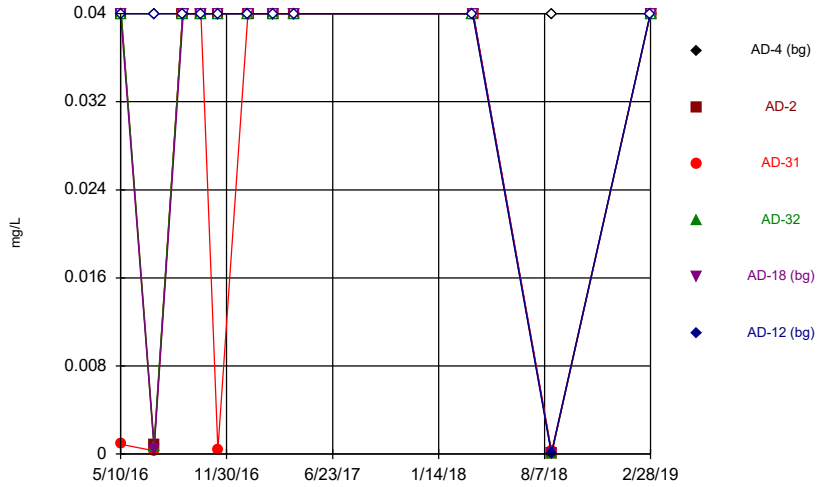
Time Series



Constituent: Mercury, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

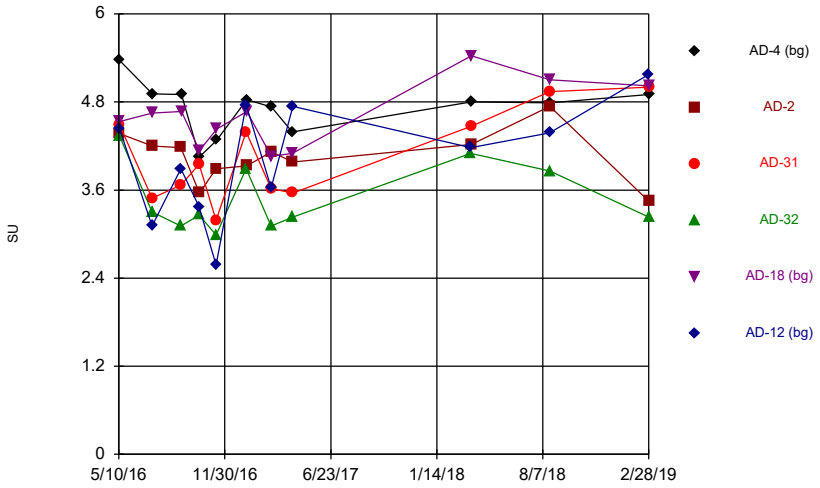
Time Series



Constituent: Molybdenum, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

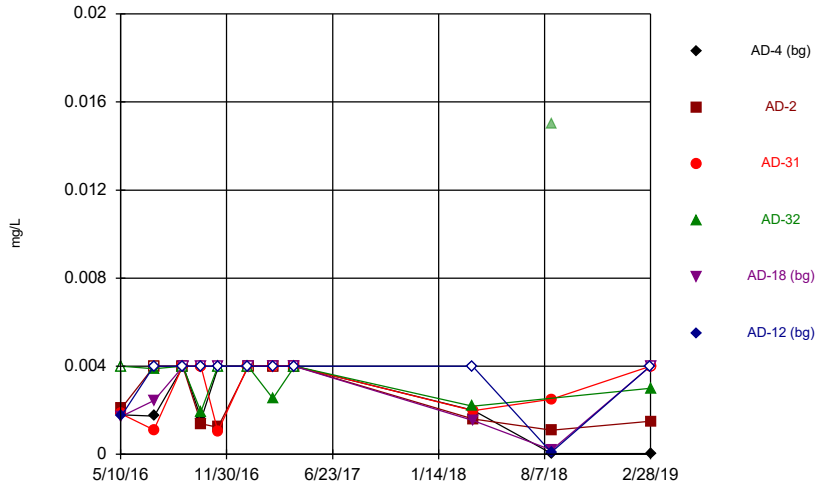
Time Series



Constituent: pH, field Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

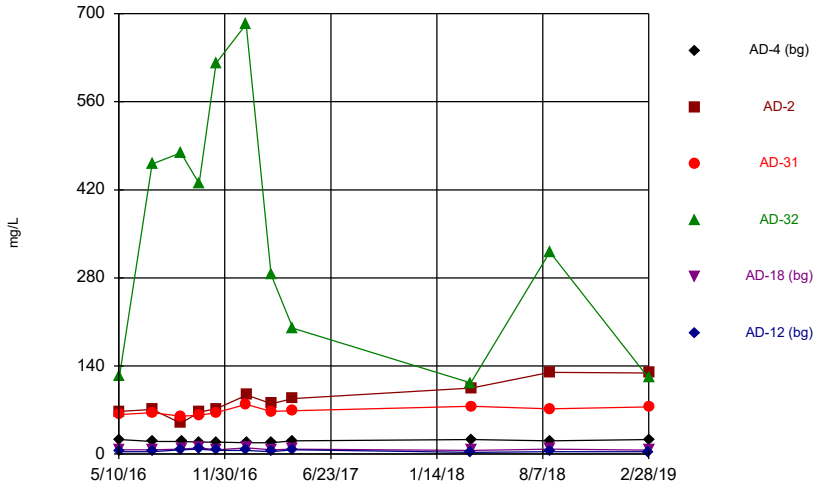
Time Series



Constituent: Selenium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

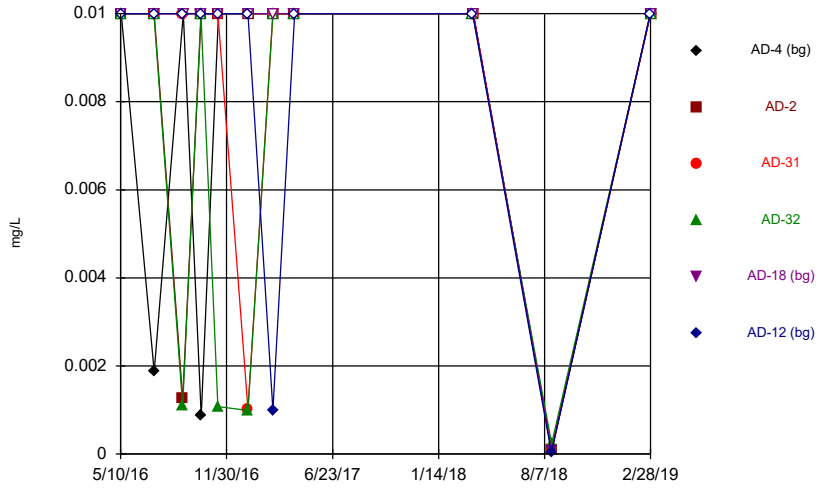
Time Series



Constituent: Sulfate, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

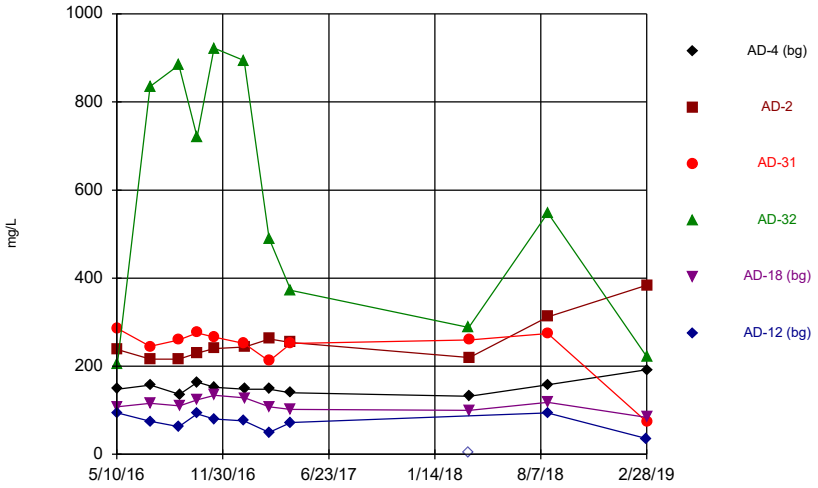
Time Series



Constituent: Thallium, total Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 7/7/2019 11:54 AM View: Time Series
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Outlier Summary

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 12:46 PM

	AD-31 Arsenic, total (mg/L)	AD-31 Barium, total (mg/L)	AD-31 Calcium, total (mg/L)	AD-2 Chloride, total (mg/L)	AD-31 Chromium, total (mg/L)	AD-31 Cobalt, total (mg/L)	AD-32 Combined Radium 226 + 228 (pCi/L)	AD-31 Lead, total (mg/L)	AD-32 Lithium, total (mg/L)	AD-31 Mercury, total (mg/L)
5/11/2016	0.093 (o)	0.712 (o)	10.4 (o)		0.212 (o)	0.05 (o)		0.057 (o)		0.001797 (o)
10/12/2016							17.32 (o)		0.972 (o)	
4/11/2017				50 (o)						
3/21/2018										
8/21/2018										

	AD-32 Selenium, total (mg/L)	AD-12 Total Dissolved Solids [TDS] (mg/L)
5/11/2016		
10/12/2016		
4/11/2017		
3/21/2018		<5 (o)
8/21/2018	0.015 (o)	

Interwell Prediction Limit Summary - Significant Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 12:37 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)	**AD-2**	**0.04655**	**n/a**	**2/28/2019**	**2.25**	**Yes**	**33**	**0.0252**	**0.012**	**3.03**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	**AD-32**	**0.04655**	**n/a**	**2/28/2019**	**0.679**	**Yes**	**33**	**0.0252**	**0.012**	**3.03**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Calcium, total (mg/L)	**AD-32**	**2.94**	**n/a**	**2/28/2019**	**6.62**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**AD-2**	**9.23**	**n/a**	**2/28/2019**	**31.8**	**Yes**	**33**	**6.207**	**1.699**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Chloride, total (mg/L)	**AD-31**	**9.23**	**n/a**	**2/28/2019**	**18.8**	**Yes**	**33**	**6.207**	**1.699**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Chloride, total (mg/L)	**AD-32**	**9.23**	**n/a**	**2/28/2019**	**17.5**	**Yes**	**33**	**6.207**	**1.699**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Sulfate, total (mg/L)	**AD-2**	**23**	**n/a**	**2/28/2019**	**129**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**AD-31**	**23**	**n/a**	**2/28/2019**	**74.8**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**AD-32**	**23**	**n/a**	**2/28/2019**	**121**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**AD-2**	**178.4**	**n/a**	**2/28/2019**	**384**	**Yes**	**32**	**113.7**	**36.26**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**AD-32**	**178.4**	**n/a**	**2/28/2019**	**222**	**Yes**	**32**	**113.7**	**36.26**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**

Interwell Prediction Limit Summary - All Results

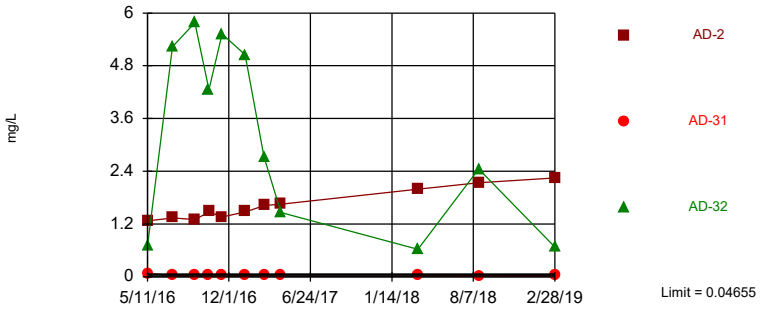
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 12:37 PM

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)	**AD-2**	**0.04655**	**n/a**	**2/28/2019**	**2.25**	**Yes**	**33**	**0.0252**	**0.012**	**3.03**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Boron, total (mg/L)	AD-31	0.04655	n/a	2/28/2019	0.03	No	33	0.0252	0.012	3.03	None	No	0.002505	Param Inter 1 of 2
Boron, total (mg/L)	**AD-32**	**0.04655**	**n/a**	**2/28/2019**	**0.679**	**Yes**	**33**	**0.0252**	**0.012**	**3.03**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Calcium, total (mg/L)	AD-2	2.94	n/a	2/28/2019	1.96	No	33	n/a	n/a	0	n/a	n/a	0.001673	NP Inter (normality) 1 of 2
Calcium, total (mg/L)	AD-31	2.94	n/a	2/28/2019	2.77	No	33	n/a	n/a	0	n/a	n/a	0.001673	NP Inter (normality) 1 of 2
Calcium, total (mg/L)	**AD-32**	**2.94**	**n/a**	**2/28/2019**	**6.62**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Chloride, total (mg/L)	**AD-2**	**9.23**	**n/a**	**2/28/2019**	**31.8**	**Yes**	**33**	**6.207**	**1.699**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Chloride, total (mg/L)	**AD-31**	**9.23**	**n/a**	**2/28/2019**	**18.8**	**Yes**	**33**	**6.207**	**1.699**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Chloride, total (mg/L)	**AD-32**	**9.23**	**n/a**	**2/28/2019**	**17.5**	**Yes**	**33**	**6.207**	**1.699**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Fluoride, total (mg/L)	AD-2	1	n/a	2/28/2019	0.1	No	33	n/a	n/a	87.88	n/a	n/a	0.001673	NP Inter (NDs) 1 of 2
Fluoride, total (mg/L)	AD-31	1	n/a	2/28/2019	0.1	No	33	n/a	n/a	87.88	n/a	n/a	0.001673	NP Inter (NDs) 1 of 2
Fluoride, total (mg/L)	AD-32	1	n/a	2/28/2019	0.4	No	33	n/a	n/a	87.88	n/a	n/a	0.001673	NP Inter (NDs) 1 of 2
Sulfate, total (mg/L)	**AD-2**	**23**	**n/a**	**2/28/2019**	**129**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**AD-31**	**23**	**n/a**	**2/28/2019**	**74.8**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Sulfate, total (mg/L)	**AD-32**	**23**	**n/a**	**2/28/2019**	**121**	**Yes**	**33**	**n/a**	**n/a**	**0**	**n/a**	**n/a**	**0.001673**	**NP Inter (normality) 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	**AD-2**	**178.4**	**n/a**	**2/28/2019**	**384**	**Yes**	**32**	**113.7**	**36.26**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**
Total Dissolved Solids [TDS] (mg/L)	AD-31	178.4	n/a	2/28/2019	74	No	32	113.7	36.26	0	None	No	0.002505	Param Inter 1 of 2
Total Dissolved Solids [TDS] (mg/L)	**AD-32**	**178.4**	**n/a**	**2/28/2019**	**222**	**Yes**	**32**	**113.7**	**36.26**	**0**	**None**	**No**	**0.002505**	**Param Inter 1 of 2**

Exceeds Limit: AD-2, AD-32

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=0.0252, Std. Dev.=0.012, n=33, 3.03% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9111, critical = 0.906. Kappa = 1.78 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

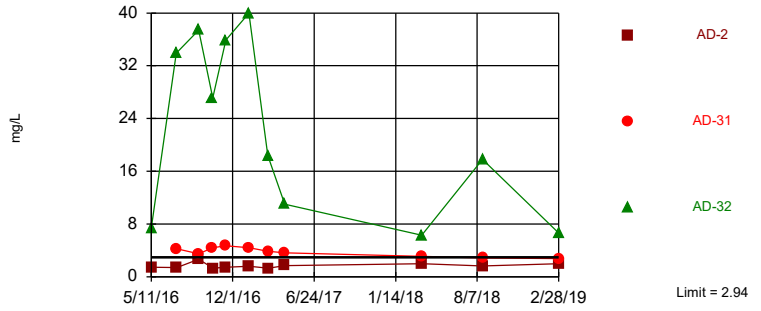
Constituent: Boron, total Analysis Run 7/5/2019 12:28 PM View: PL's Interwell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: AD-32

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 33 background values. Annual per-constituent alpha = 0.009997. Individual comparison alpha = 0.001673 (1 of 2). Comparing 3 points to limit.

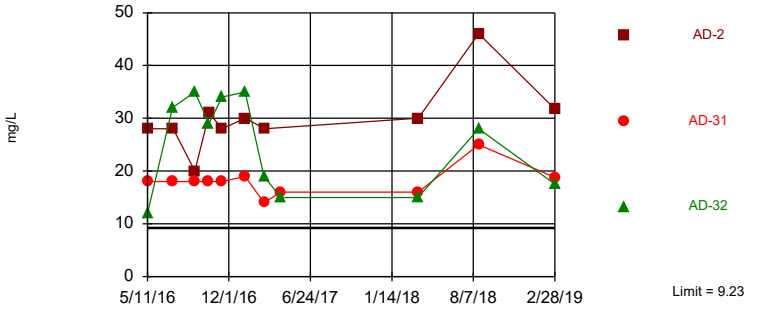
Constituent: Calcium, total Analysis Run 7/5/2019 12:28 PM View: PL's Interwell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: AD-2, AD-31, AD-32

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=6.207, Std. Dev.=1.699, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9559, critical = 0.906. Kappa = 1.78 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

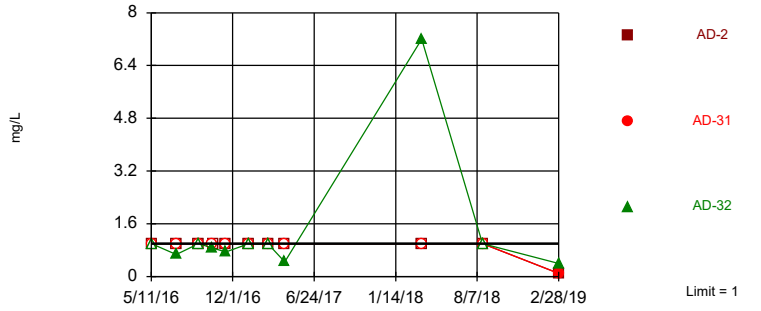
Constituent: Chloride, total Analysis Run 7/5/2019 12:28 PM View: PL's Interwell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

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



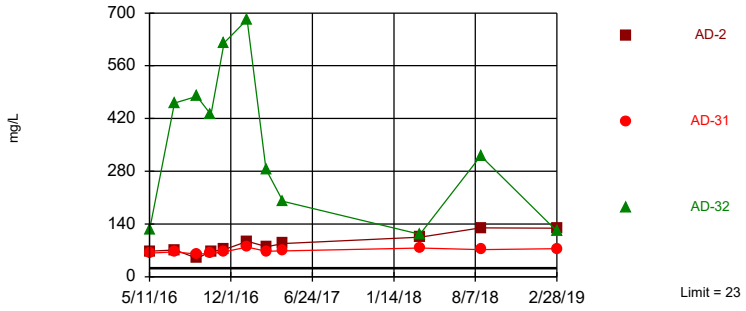
Non-parametric test used in lieu of parametric prediction limit because censored data exceeded 50%. Limit is highest of 33 background values. 87.88% NDs. Annual per-constituent alpha = 0.009997. Individual comparison alpha = 0.001673 (1 of 2). Comparing 3 points to limit.

Constituent: Fluoride, total Analysis Run 7/5/2019 12:28 PM View: PL's Interwell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Exceeds Limit: AD-2, AD-31, AD-32

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 33 background values. Annual per-constituent alpha = 0.009997. Individual comparison alpha = 0.001673 (1 of 2). Comparing 3 points to limit.

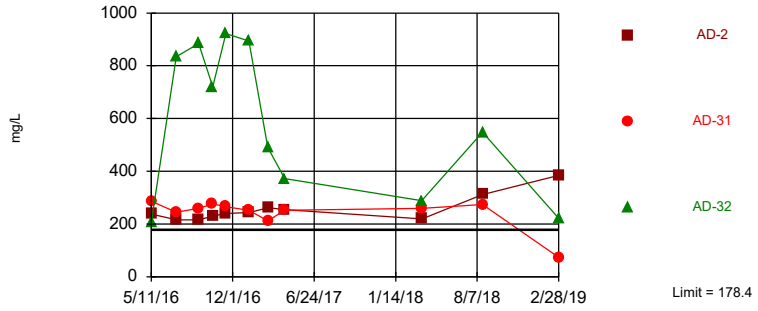
Constituent: Sulfate, total Analysis Run 7/5/2019 12:28 PM View: PL's Interwell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limit: AD-2, AD-32

Prediction Limit

Interwell Parametric



Background Data Summary: Mean=113.7, Std. Dev.=36.26, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9872, critical = 0.904. Kappa = 1.784 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.007498. Individual comparison alpha = 0.002505. Comparing 3 points to limit.

Constituent: Total Dissolved Solids [TDS] Analysis Run 7/5/2019 12:28 PM View: PL's Interwell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Intrawell Prediction Limit Summary - Significant Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 12:39 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
pH, field (SU)	**AD-31**	**4.903**	**2.687**	**2/28/2019**	**5**	**Yes**	**8**	**3.795**	**0.4507**	**0**	**None**	**No**	**0.001253**	Param 1 of 2

Intrawell Prediction Limit Summary - All Results

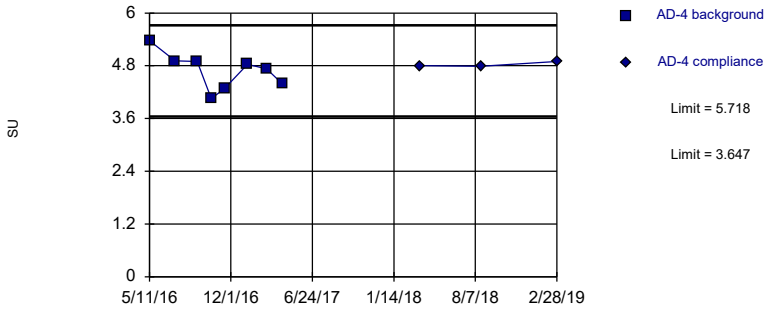
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 12:39 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
pH, field (SU)	AD-4	5.718	3.647	2/28/2019	4.9	No	8	4.683	0.4215	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	AD-2	4.637	3.421	2/28/2019	3.45	No	8	4.029	0.2473	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	**AD-31**	**4.903**	**2.687**	**2/28/2019**	**5**	**Yes**	**8**	**3.795**	**0.4507**	**0**	**None**	**No**	**0.001253**	Param 1 of 2
pH, field (SU)	AD-32	4.549	2.259	2/28/2019	3.23	No	8	3.404	0.4657	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	AD-18	5.063	3.75	2/28/2019	5.02	No	8	4.406	0.267	0	None	No	0.001253	Param 1 of 2
pH, field (SU)	AD-12	5.764	1.866	2/27/2019	5.17	No	8	3.815	0.7928	0	None	No	0.001253	Param 1 of 2

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.683, Std. Dev.=0.4215, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9603, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: pH, field Analysis Run 7/5/2019 12:37 PM View: PL's Intrawell

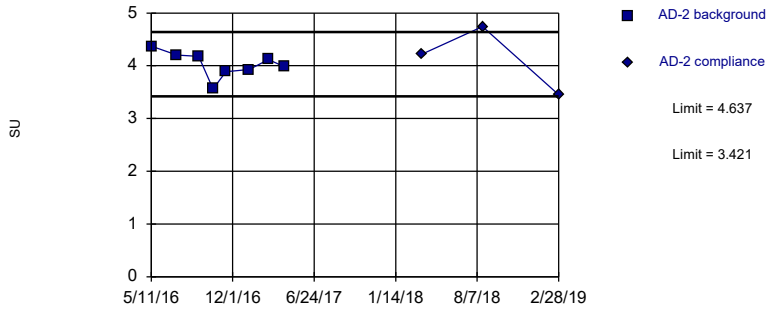
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.029, Std. Dev.=0.2473, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.956, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: pH, field Analysis Run 7/5/2019 12:37 PM View: PL's Intrawell

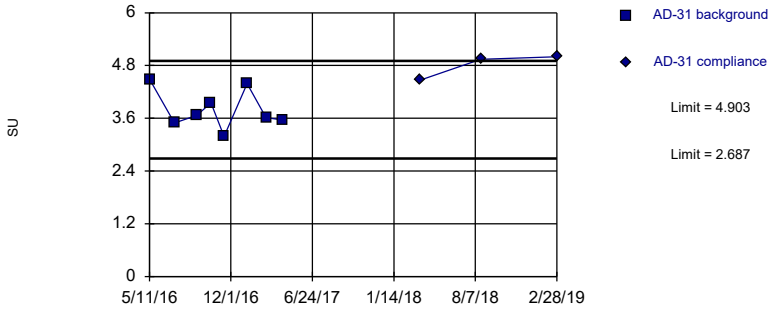
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Exceeds Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=3.795, Std. Dev.=0.4507, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9179, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: pH, field Analysis Run 7/5/2019 12:37 PM View: PL's Intrawell

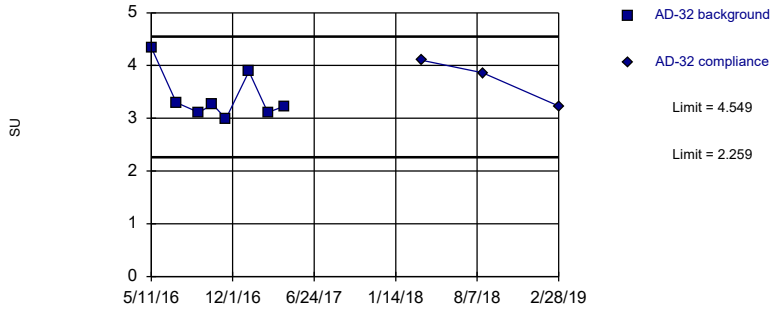
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=3.404, Std. Dev.=0.4657, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7949, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

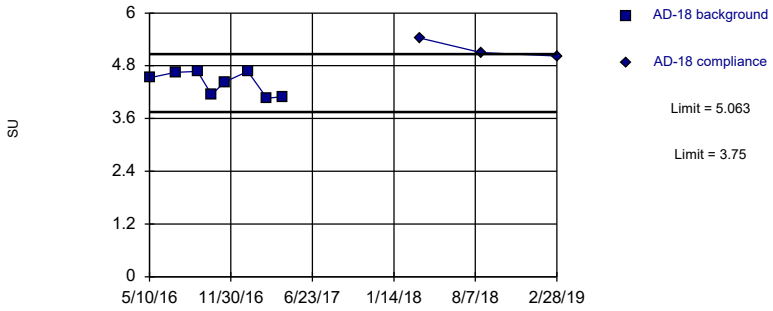
Constituent: pH, field Analysis Run 7/5/2019 12:37 PM View: PL's Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=4.406, Std. Dev.=0.267, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8312, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: pH, field Analysis Run 7/5/2019 12:37 PM View: PL's Intrawell

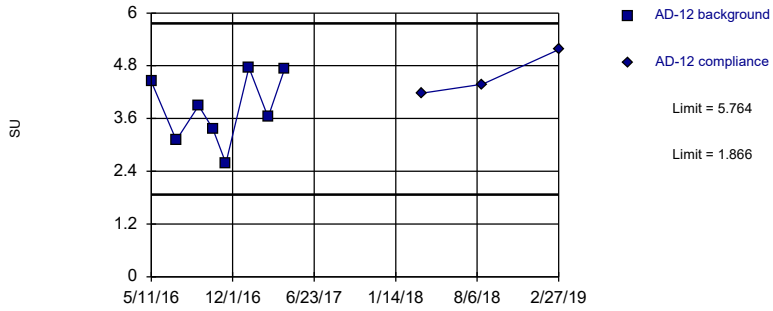
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Within Limits

Prediction Limit

Intrawell Parametric



Background Data Summary: Mean=3.815, Std. Dev.=0.7928, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9424, critical = 0.749. Kappa = 2.458 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505.

Constituent: pH, field Analysis Run 7/5/2019 12:37 PM View: PL's Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Trend Test Summary Table - Significant Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 1:08 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	**AD-2**	**0.3802**	**50**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	**AD-2**	**25.54**	**41**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**

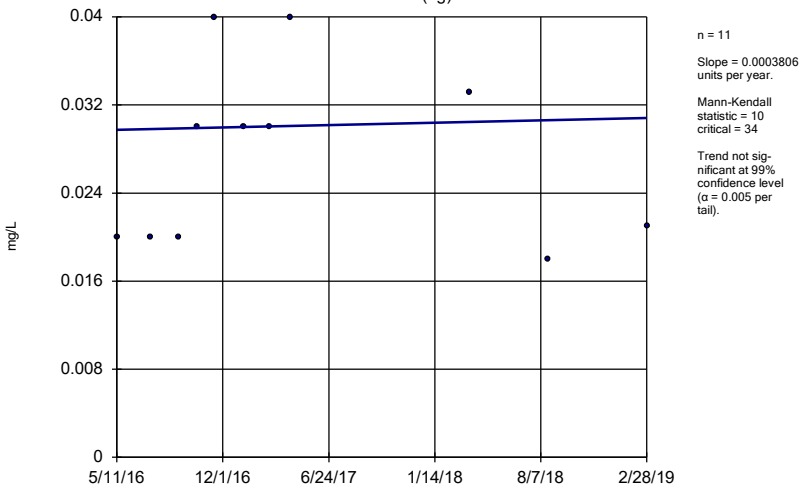
Trend Test Summary Table - All Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 1:08 PM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-4 (bg)	0.0003806	10	34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	**AD-2**	**0.3802**	**50**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Boron, total (mg/L)	AD-32	-1.705	-25	-34	No	11	0	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-18 (bg)	0.0008764	17	34	No	11	9.091	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-12 (bg)	0	-4	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-4 (bg)	-0.1181	-5	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-32	-8.602	-19	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-18 (bg)	-0.04371	-13	-34	No	11	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-12 (bg)	0.01357	5	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-4 (bg)	0	-2	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-2	1.659	22	30	No	10	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-31	0	4	34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-32	-3.583	-11	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-18 (bg)	0	-7	-34	No	11	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-12 (bg)	0.03234	10	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-4 (bg)	-0.05639	-10	-34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-31	0.441	19	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-18 (bg)	0.1747	12	34	No	11	0	n/a	n/a	0.01	NP
pH, field (SU)	AD-12 (bg)	0.5174	19	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-4 (bg)	0	4	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	**AD-2**	**25.54**	**41**	**34**	**Yes**	**11**	**0**	**n/a**	**n/a**	**0.01**	**NP**
Sulfate, total (mg/L)	AD-31	5.856	32	34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-32	-92.31	-15	-34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-18 (bg)	0	-7	-34	No	11	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-12 (bg)	-0.5376	-15	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AD-4 (bg)	0	2	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AD-2	48.67	34	34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AD-32	-176.2	-15	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AD-18 (bg)	-7.565	-16	-34	No	11	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (mg/L)	AD-12 (bg)	-18.79	-14	-30	No	10	0	n/a	n/a	0.01	NP

Sen's Slope Estimator

AD-4 (bg)



n = 11

Slope = 0.0003806 units per year.

Mann-Kendall statistic = 10 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

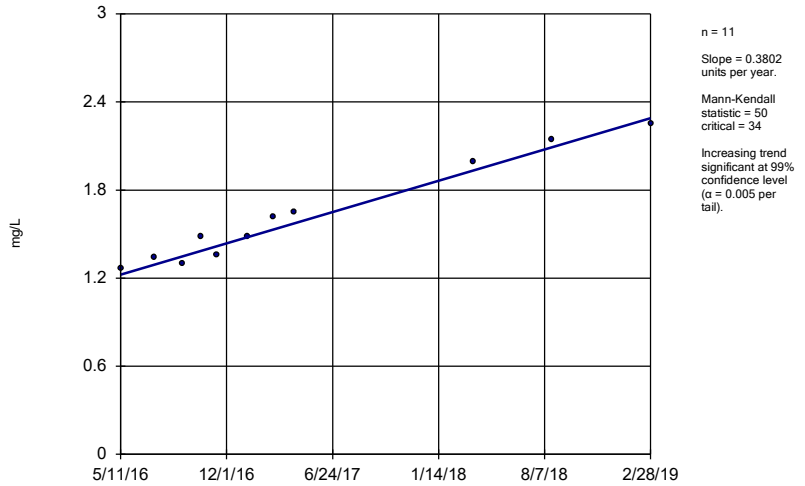
Constituent: Boron, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-2



n = 11

Slope = 0.3802 units per year.

Mann-Kendall statistic = 50 critical = 34

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

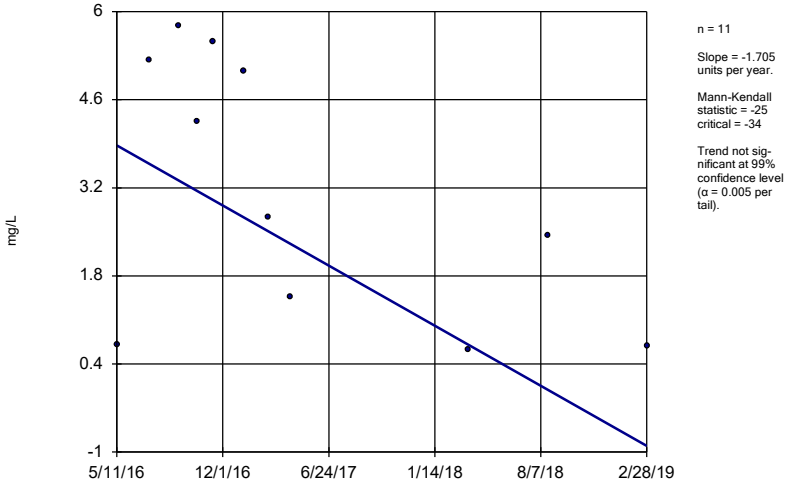
Constituent: Boron, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-32



n = 11

Slope = -1.705 units per year.

Mann-Kendall statistic = -25 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

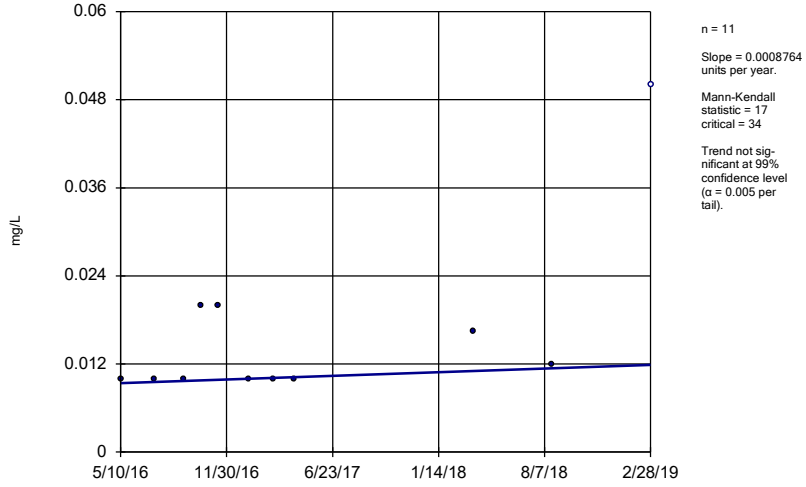
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-18 (bg)



n = 11

Slope = 0.0008764 units per year.

Mann-Kendall statistic = 17 critical = 34

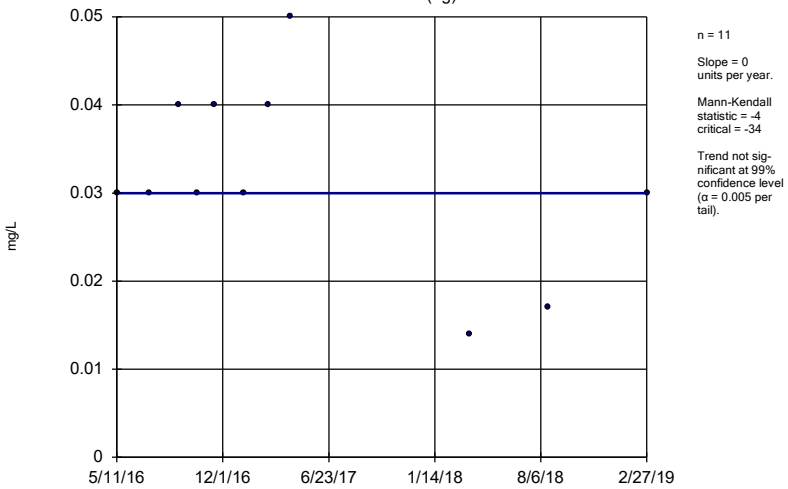
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-12 (bg)



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = -4 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

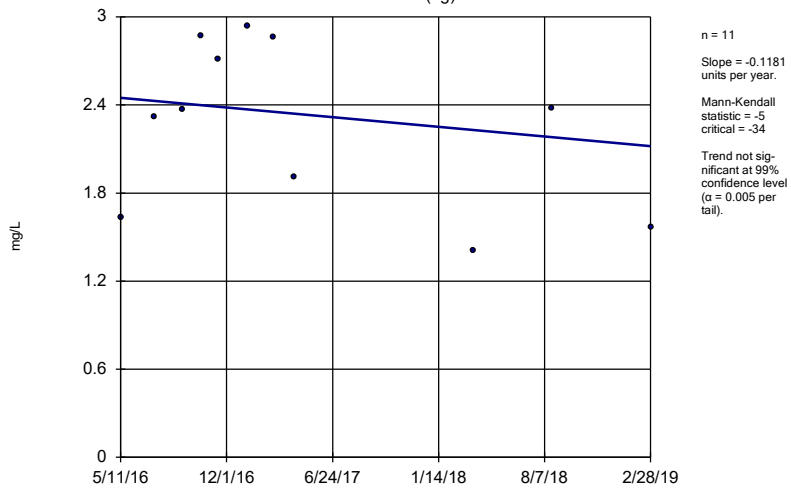
Constituent: Boron, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-4 (bg)



n = 11

Slope = -0.1181 units per year.

Mann-Kendall statistic = -5 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

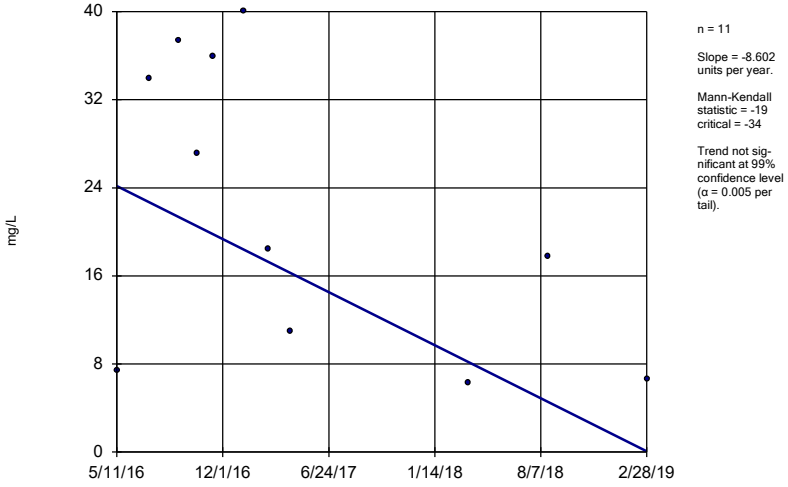
Constituent: Calcium, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-32



n = 11

Slope = -8.602 units per year.

Mann-Kendall statistic = -19 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

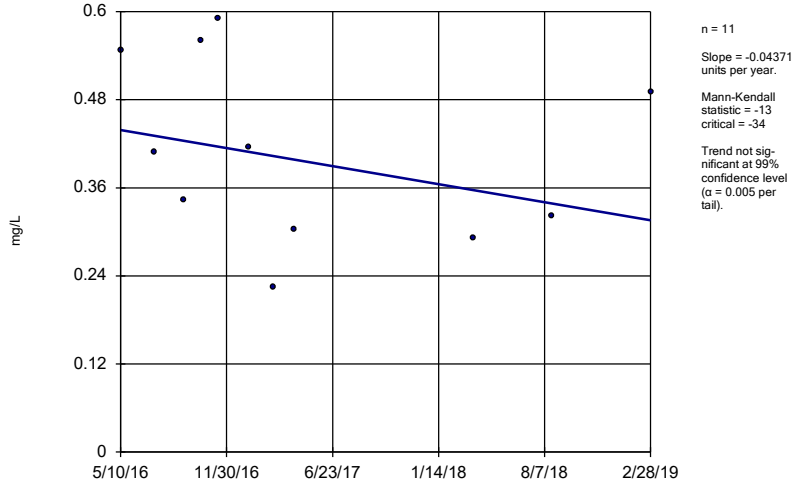
Constituent: Calcium, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-18 (bg)



n = 11

Slope = -0.04371 units per year.

Mann-Kendall statistic = -13 critical = -34

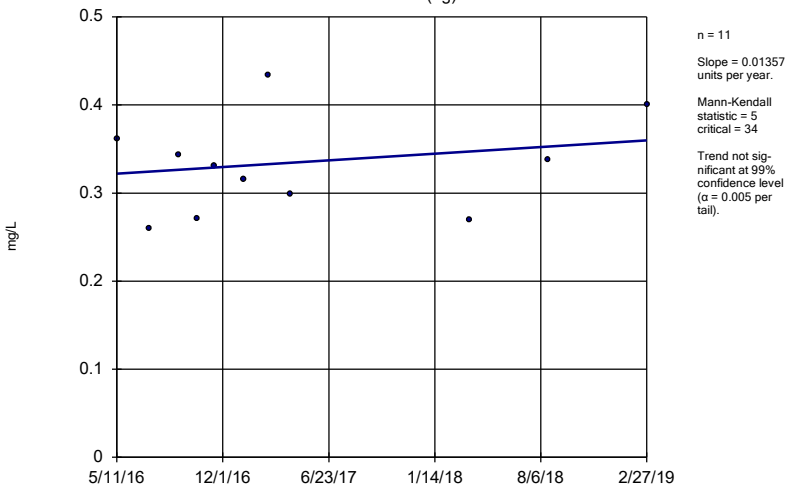
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium, total Analysis Run 7/5/2019 1:05 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-12 (bg)



n = 11

Slope = 0.01357 units per year.

Mann-Kendall statistic = 5 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

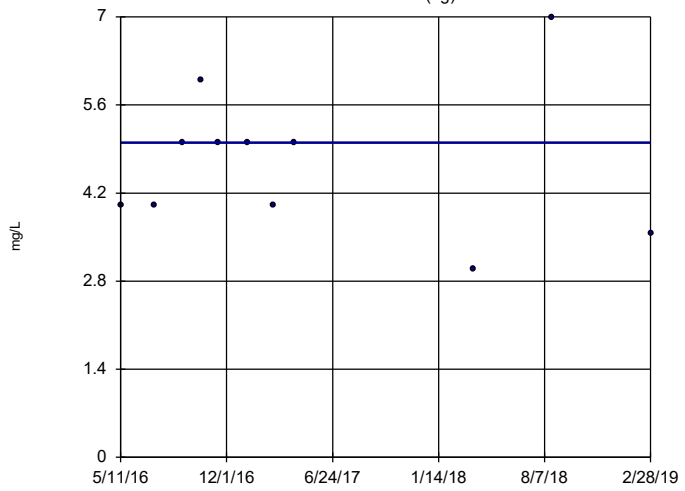
Constituent: Calcium, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-4 (bg)



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = -2 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

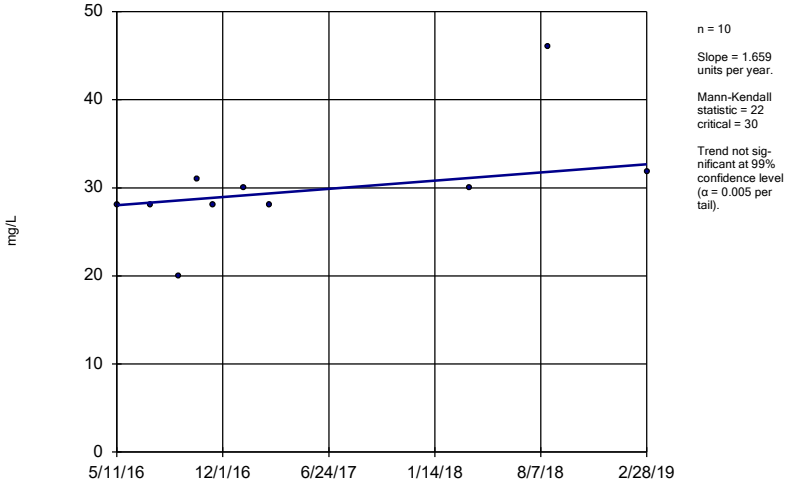
Constituent: Chloride, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-2



n = 10

Slope = 1.659 units per year.

Mann-Kendall statistic = 22 critical = 30

Trend not significant at 99% confidence level (α = 0.005 per tail).

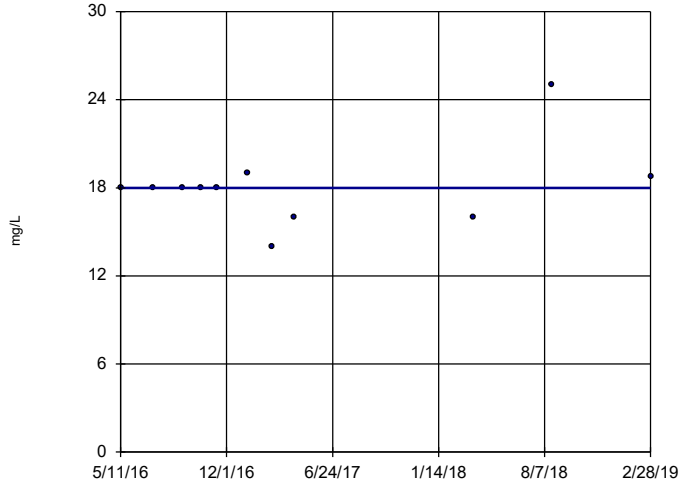
Constituent: Chloride, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-31



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = 4 critical = 34

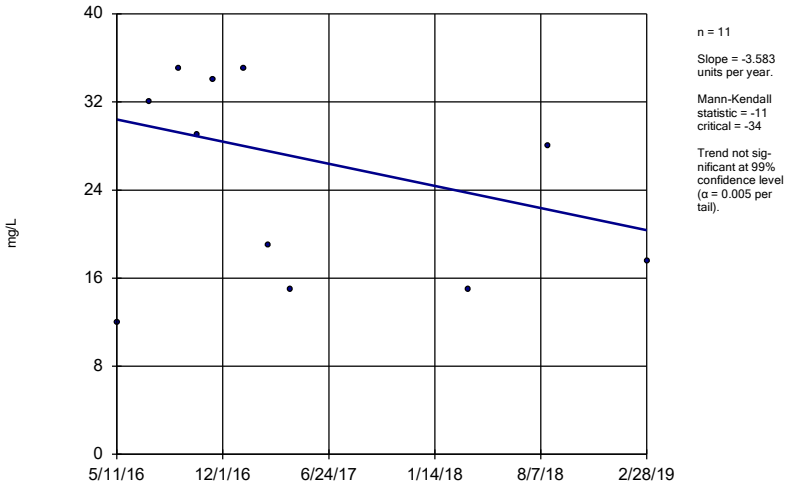
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-32



n = 11

Slope = -3.583 units per year.

Mann-Kendall statistic = -11 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

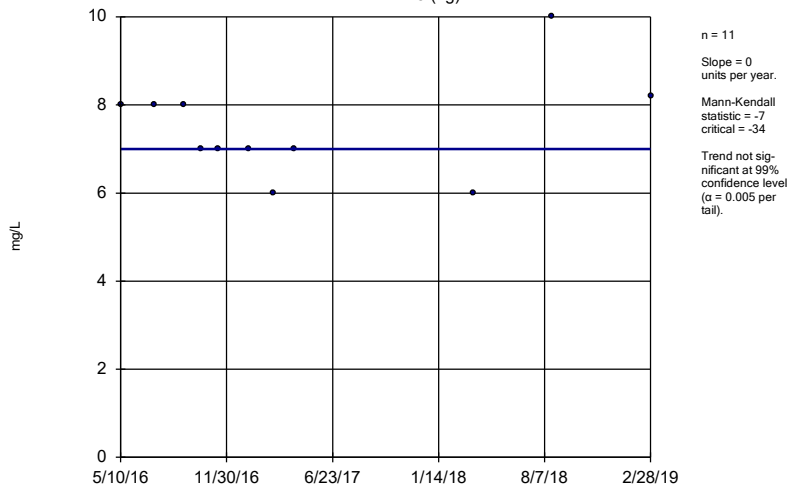
Constituent: Chloride, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-18 (bg)



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = -7 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

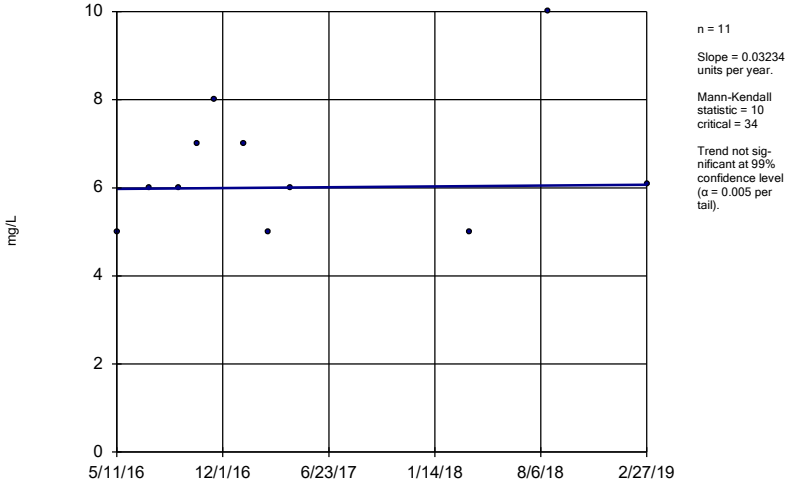
Constituent: Chloride, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-12 (bg)



n = 11

Slope = 0.03234 units per year.

Mann-Kendall statistic = 10 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

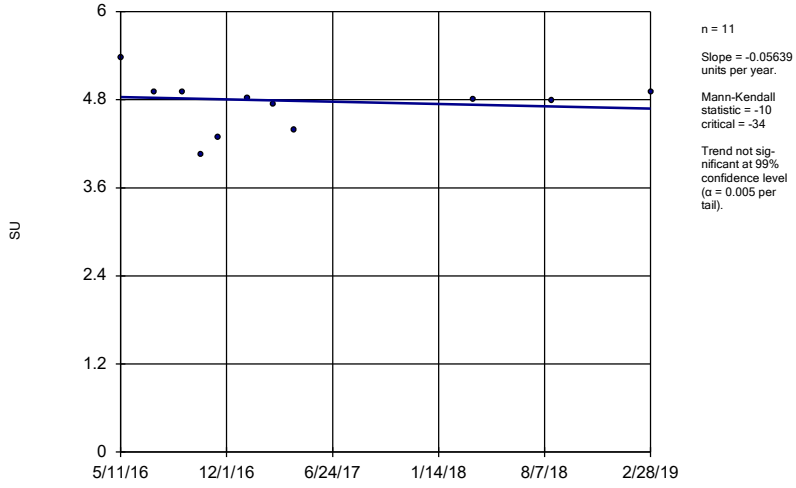
Constituent: Chloride, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-4 (bg)



n = 11

Slope = -0.05639 units per year.

Mann-Kendall statistic = -10 critical = -34

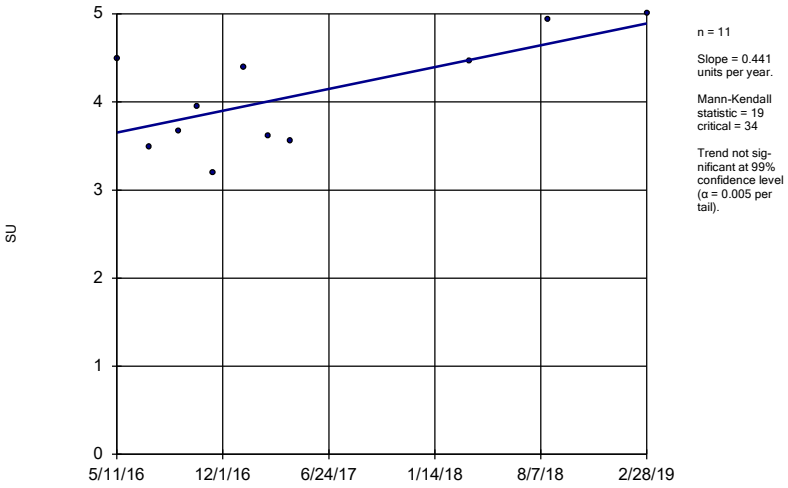
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: pH, field Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-31



n = 11

Slope = 0.441 units per year.

Mann-Kendall statistic = 19 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

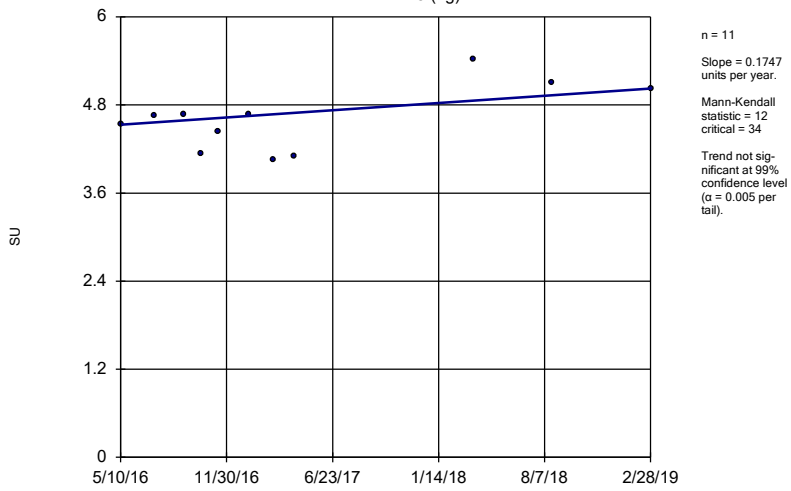
Constituent: pH, field Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-18 (bg)



n = 11

Slope = 0.1747 units per year.

Mann-Kendall statistic = 12 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

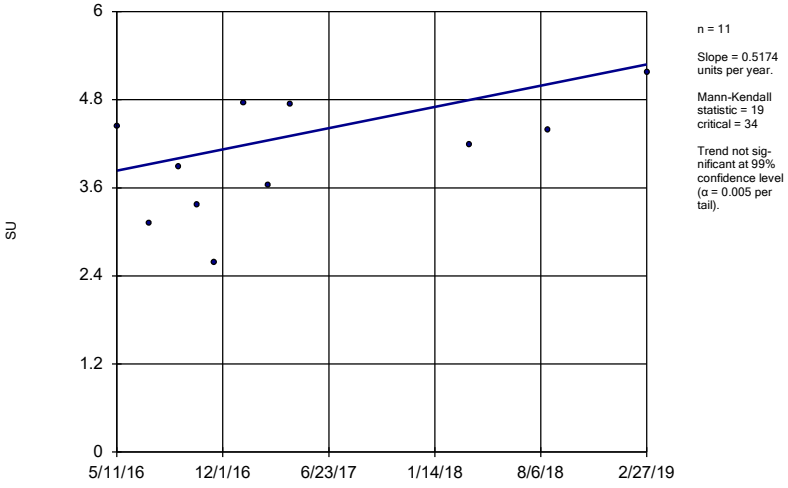
Constituent: pH, field Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-12 (bg)



n = 11

Slope = 0.5174 units per year.

Mann-Kendall statistic = 19 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

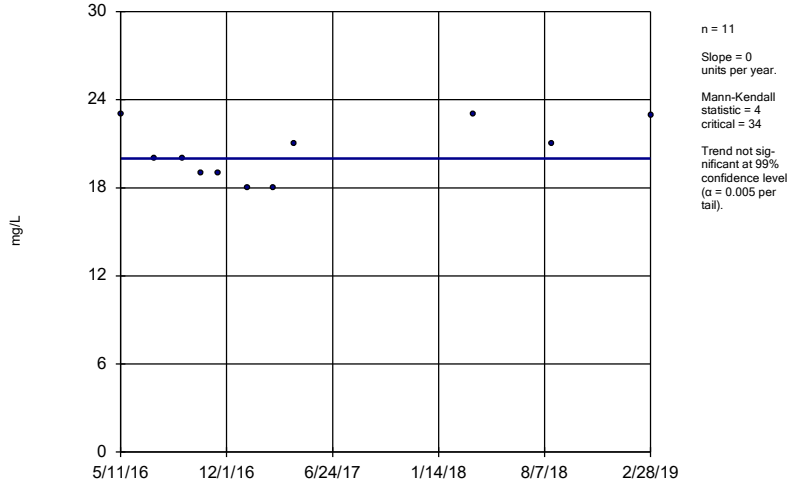
Constituent: pH, field Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-4 (bg)



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = 4 critical = 34

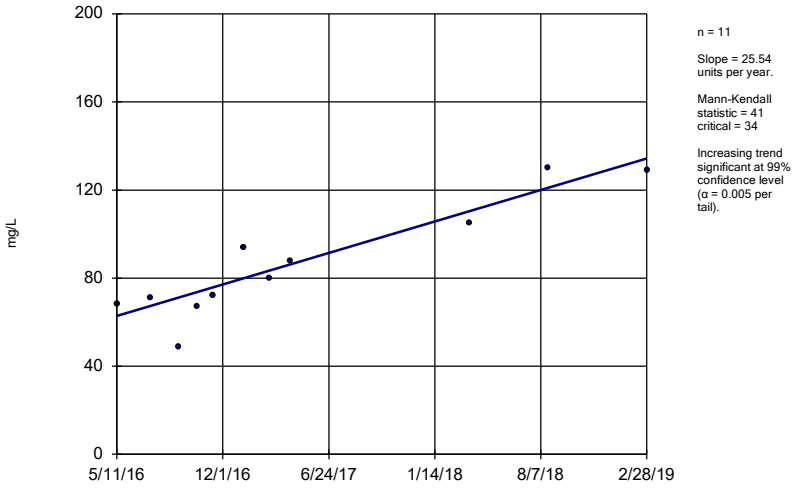
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-2



n = 11

Slope = 25.54 units per year.

Mann-Kendall statistic = 41 critical = 34

Increasing trend significant at 99% confidence level (α = 0.005 per tail).

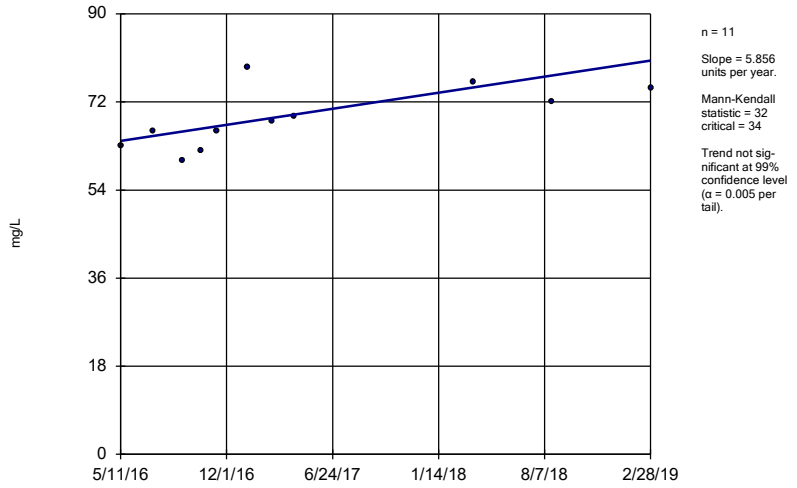
Constituent: Sulfate, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-31



n = 11

Slope = 5.856 units per year.

Mann-Kendall statistic = 32 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

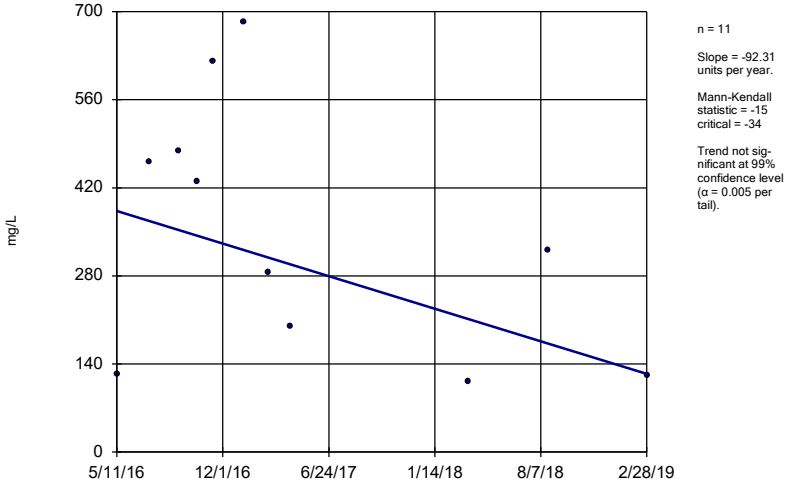
Constituent: Sulfate, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-32



n = 11

Slope = -92.31 units per year.

Mann-Kendall statistic = -15 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

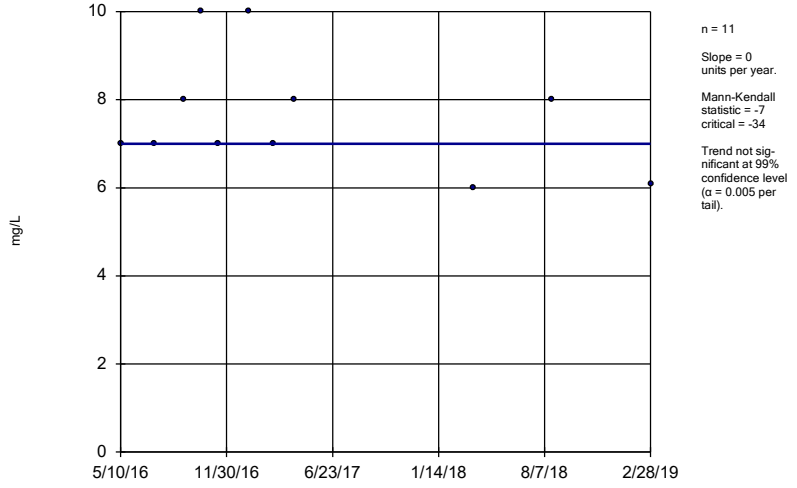
Constituent: Sulfate, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-18 (bg)



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = -7 critical = -34

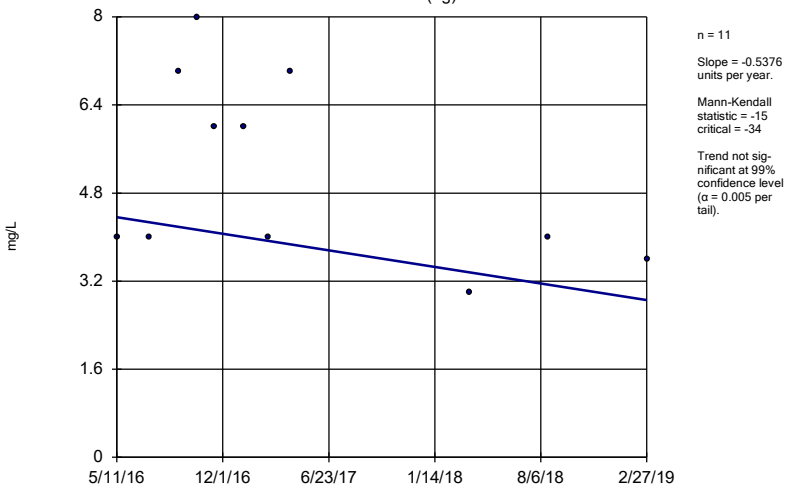
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-12 (bg)



n = 11

Slope = -0.5376 units per year.

Mann-Kendall statistic = -15 critical = -34

Trend not significant at 99% confidence level (α = 0.005 per tail).

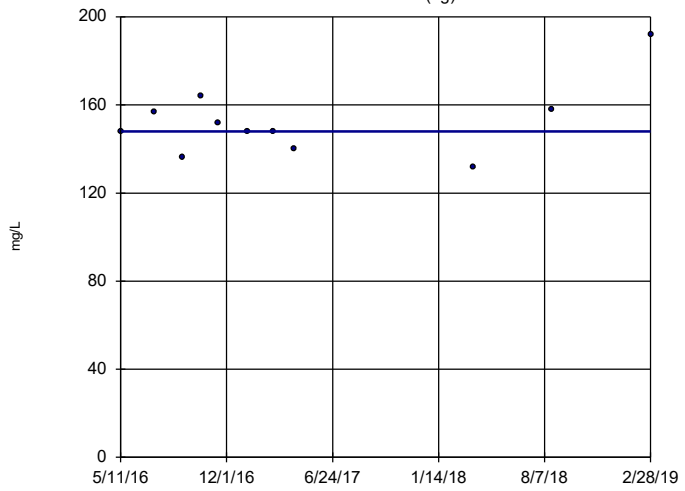
Constituent: Sulfate, total Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-4 (bg)



n = 11

Slope = 0 units per year.

Mann-Kendall statistic = 2 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

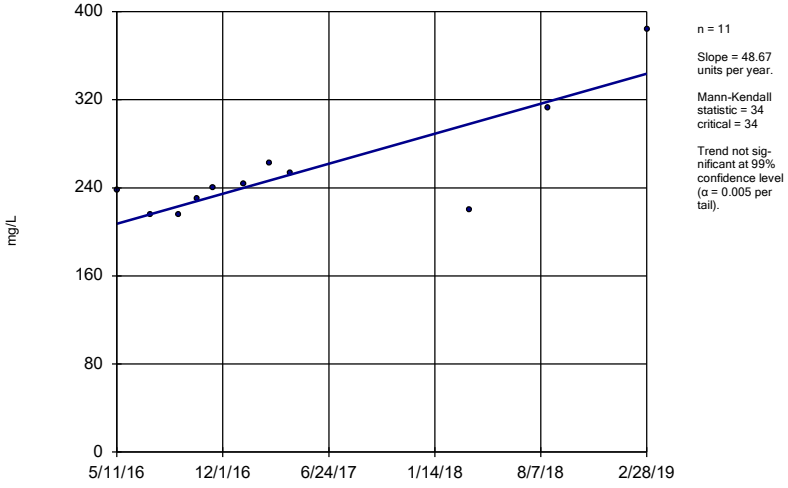
Constituent: Total Dissolved Solids [TDS] Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-2



n = 11

Slope = 48.67 units per year.

Mann-Kendall statistic = 34 critical = 34

Trend not significant at 99% confidence level (α = 0.005 per tail).

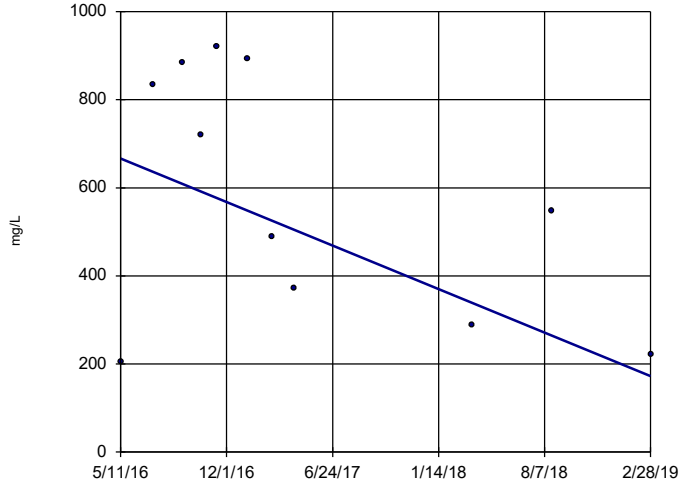
Constituent: Total Dissolved Solids [TDS] Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-32



n = 11

Slope = -176.2 units per year.

Mann-Kendall statistic = -15 critical = -34

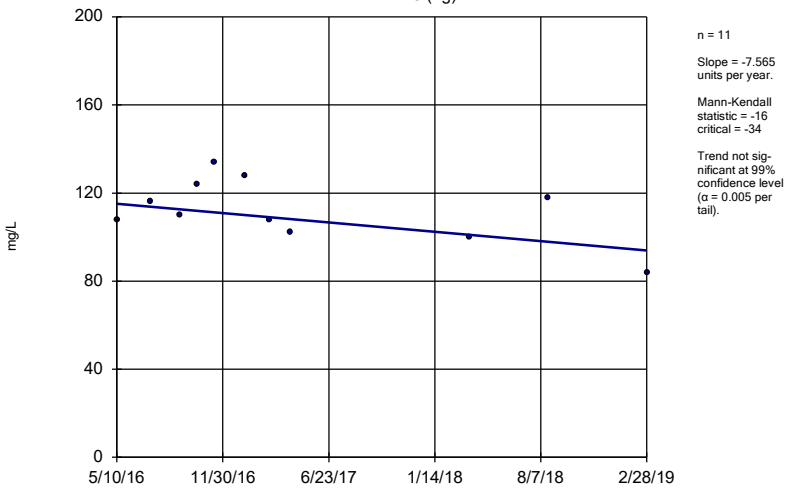
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 7/5/2019 1:06 PM View: Trend Tests

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-18 (bg)



n = 11

Slope = -7.565 units per year.

Mann-Kendall statistic = -16
critical = -34

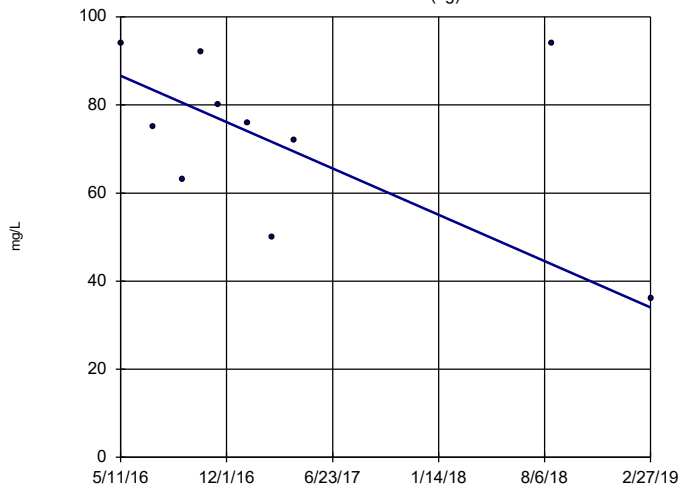
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 7/5/2019 1:06 PM View: Trend Tests
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Sen's Slope Estimator

AD-12 (bg)



n = 10

Slope = -18.79 units per year.

Mann-Kendall statistic = -14
critical = -30

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 7/5/2019 1:06 PM View: Trend Tests
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tolerance Limit Summary Table - Appendix IV Parameters

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 12:55 PM

Constituent	Well	Upper Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.002	33	n/a	n/a	96.97	n/a	n/a	0.184	NP Inter(NDs)
Arsenic, total (mg/L)	n/a	0.011	33	n/a	n/a	72.73	n/a	n/a	0.184	NP Inter(normality)
Barium, total (mg/L)	n/a	0.183	33	n/a	n/a	0	n/a	n/a	0.184	NP Inter(normality)
Beryllium, total (mg/L)	n/a	0.00115	33	n/a	n/a	6.061	n/a	n/a	0.184	NP Inter(normality)
Cadmium, total (mg/L)	n/a	0.001	33	n/a	n/a	72.73	n/a	n/a	0.184	NP Inter(normality)
Chromium, total (mg/L)	n/a	0.007	33	n/a	n/a	15.15	n/a	n/a	0.184	NP Inter(Cohens/xform)
Cobalt, total (mg/L)	n/a	0.00939	33	n/a	n/a	0	n/a	n/a	0.184	NP Inter(normality)
Combined Radium 226 + 228 (pCi/L)	n/a	3.455	33	1.012	0.3872	0	None	sqrt(x)	0.05	Inter
Fluoride, total (mg/L)	n/a	1	33	n/a	n/a	87.88	n/a	n/a	0.184	NP Inter(NDs)
Lead, total (mg/L)	n/a	0.002	33	n/a	n/a	84.85	n/a	n/a	0.184	NP Inter(NDs)
Lithium, total (mg/L)	n/a	0.05207	33	0.02139	0.01402	3.03	None	No	0.05	Inter
Mercury, total (mg/L)	n/a	0.000064	33	n/a	n/a	36.36	n/a	n/a	0.184	NP Inter(Cohens/xform)
Molybdenum, total (mg/L)	n/a	0.002	33	n/a	n/a	90.91	n/a	n/a	0.184	NP Inter(NDs)
Selenium, total (mg/L)	n/a	0.004	33	n/a	n/a	63.64	n/a	n/a	0.184	NP Inter(normality)
Thallium, total (mg/L)	n/a	0.001874	33	n/a	n/a	81.82	n/a	n/a	0.184	NP Inter(NDs)

Confidence Interval Summary Table - Significant Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 1:02 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Cobalt, total (mg/L)	**AD-2**	**0.0136**	**0.01**	**0.0094**	**n/a**	**Yes**	**11**	**0**	**No**	**0.006**	**NP (normality)**
Cobalt, total (mg/L)	**AD-31**	**0.01192**	**0.009429**	**0.0094**	**n/a**	**Yes**	**10**	**0**	**sqrt(x)**	**0.01**	**Param.**
Cobalt, total (mg/L)	**AD-32**	**0.0675**	**0.03328**	**0.0094**	**n/a**	**Yes**	**11**	**0**	**No**	**0.01**	**Param.**
Lithium, total (mg/L)	**AD-31**	**0.097**	**0.077**	**0.052**	**n/a**	**Yes**	**11**	**0**	**No**	**0.006**	**NP (normality)**
Lithium, total (mg/L)	**AD-32**	**0.1154**	**0.07511**	**0.052**	**n/a**	**Yes**	**10**	**0**	**x^2**	**0.01**	**Param.**

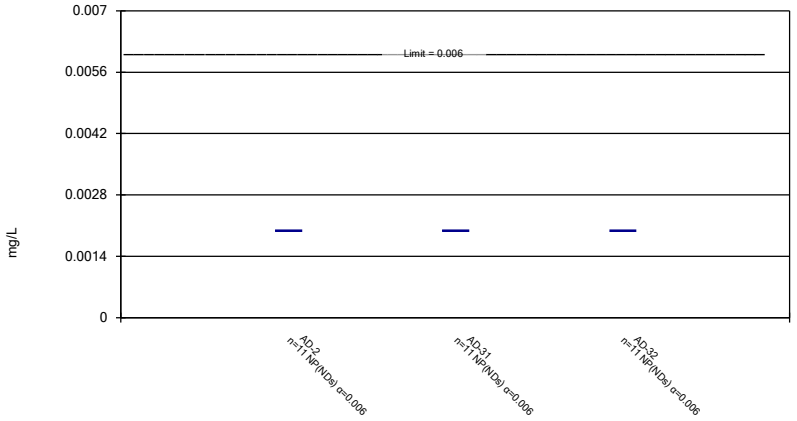
Confidence Interval Summary Table - All Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 7/5/2019, 1:02 PM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Lower Compl.	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-2	0.002	0.002	0.006	n/a	No	11	90.91	No	0.006	NP (NDs)
Antimony, total (mg/L)	AD-31	0.002	0.002	0.006	n/a	No	11	90.91	No	0.006	NP (NDs)
Antimony, total (mg/L)	AD-32	0.002	0.002	0.006	n/a	No	11	90.91	No	0.006	NP (NDs)
Arsenic, total (mg/L)	AD-2	0.002	0.00053	0.011	n/a	No	11	81.82	No	0.006	NP (NDs)
Arsenic, total (mg/L)	AD-31	0.006	0.002	0.011	n/a	No	10	20	No	0.011	NP (Cohens/xfrm)
Arsenic, total (mg/L)	AD-32	0.007737	0.002689	0.011	n/a	No	11	9.091	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-2	0.03849	0.03229	2	n/a	No	11	0	x^3	0.01	Param.
Barium, total (mg/L)	AD-31	0.09365	0.04907	2	n/a	No	10	0	No	0.01	Param.
Barium, total (mg/L)	AD-32	0.04527	0.02662	2	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	AD-2	0.0004741	0.0003971	0.004	n/a	No	11	0	No	0.01	Param.
Beryllium, total (mg/L)	AD-31	0.002	0.0009983	0.004	n/a	No	11	0	No	0.006	NP (normality)
Beryllium, total (mg/L)	AD-32	0.007452	0.003677	0.004	n/a	No	11	0	No	0.01	Param.
Cadmium, total (mg/L)	AD-2	0.001	0.00006	0.005	n/a	No	11	81.82	No	0.006	NP (NDs)
Cadmium, total (mg/L)	AD-31	0.001	0.0000944	0.005	n/a	No	11	54.55	No	0.006	NP (normality)
Cadmium, total (mg/L)	AD-32	0.0006616	0.0003662	0.005	n/a	No	11	0	No	0.01	Param.
Chromium, total (mg/L)	AD-2	0.004	0.0002438	0.1	n/a	No	11	45.45	No	0.006	NP (normality)
Chromium, total (mg/L)	AD-31	0.01835	0.004053	0.1	n/a	No	10	10	No	0.01	Param.
Chromium, total (mg/L)	AD-32	0.01144	0.002569	0.1	n/a	No	11	0	No	0.01	Param.
Cobalt, total (mg/L)	**AD-2**	**0.0136**	**0.01**	**0.0094**	**n/a**	**Yes**	**11**	**0**	**No**	**0.006**	**NP (normality)**
Cobalt, total (mg/L)	**AD-31**	**0.01192**	**0.009429**	**0.0094**	**n/a**	**Yes**	**10**	**0**	**sqrt(x)**	**0.01**	**Param.**
Cobalt, total (mg/L)	**AD-32**	**0.0675**	**0.03328**	**0.0094**	**n/a**	**Yes**	**11**	**0**	**No**	**0.01**	**Param.**
Combined Radium 226 + 228 (pCi/L)	AD-2	1.886	0.9373	5	n/a	No	11	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-31	4.384	2.647	5	n/a	No	11	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-32	5.566	3.585	5	n/a	No	10	0	No	0.01	Param.
Fluoride, total (mg/L)	AD-2	1	1	4	n/a	No	11	90.91	No	0.006	NP (NDs)
Fluoride, total (mg/L)	AD-31	1	1	4	n/a	No	11	90.91	No	0.006	NP (NDs)
Fluoride, total (mg/L)	AD-32	1	0.4468	4	n/a	No	11	45.45	No	0.006	NP (normality)
Lead, total (mg/L)	AD-2	0.002	0.000355	0.015	n/a	No	11	81.82	No	0.006	NP (NDs)
Lead, total (mg/L)	AD-31	0.002	0.00154	0.015	n/a	No	10	70	No	0.011	NP (normality)
Lead, total (mg/L)	AD-32	0.002	0.002	0.015	n/a	No	11	90.91	No	0.006	NP (NDs)
Lithium, total (mg/L)	AD-2	0.05472	0.04503	0.052	n/a	No	11	9.091	x^4	0.01	Param.
Lithium, total (mg/L)	**AD-31**	**0.097**	**0.077**	**0.052**	**n/a**	**Yes**	**11**	**0**	**No**	**0.006**	**NP (normality)**
Lithium, total (mg/L)	**AD-32**	**0.1154**	**0.07511**	**0.052**	**n/a**	**Yes**	**10**	**0**	**x^2**	**0.01**	**Param.**
Mercury, total (mg/L)	AD-2	0.000147	0.00002779	0.002	n/a	No	11	0	ln(x)	0.01	Param.
Mercury, total (mg/L)	AD-31	0.0008212	0.0001268	0.002	n/a	No	10	0	sqrt(x)	0.01	Param.
Mercury, total (mg/L)	AD-32	0.008327	0.001765	0.002	n/a	No	11	0	No	0.01	Param.
Molybdenum, total (mg/L)	AD-2	0.002	0.0008627	0.1	n/a	No	11	81.82	No	0.006	NP (NDs)
Molybdenum, total (mg/L)	AD-31	0.002	0.0003161	0.1	n/a	No	11	63.64	No	0.006	NP (normality)
Molybdenum, total (mg/L)	AD-32	0.002	0.0007621	0.1	n/a	No	11	81.82	No	0.006	NP (NDs)
Selenium, total (mg/L)	AD-2	0.004	0.001231	0.05	n/a	No	11	45.45	No	0.006	NP (normality)
Selenium, total (mg/L)	AD-31	0.004	0.001113	0.05	n/a	No	11	54.55	No	0.006	NP (normality)
Selenium, total (mg/L)	AD-32	0.004	0.00218	0.05	n/a	No	10	50	No	0.011	NP (normality)
Thallium, total (mg/L)	AD-2	0.01	0.001264	0.002	n/a	No	11	81.82	No	0.006	NP (NDs)
Thallium, total (mg/L)	AD-31	0.01	0.001019	0.002	n/a	No	11	81.82	No	0.006	NP (NDs)
Thallium, total (mg/L)	AD-32	0.01	0.0009911	0.002	n/a	No	11	63.64	No	0.006	NP (normality)

Non-Parametric Confidence Interval

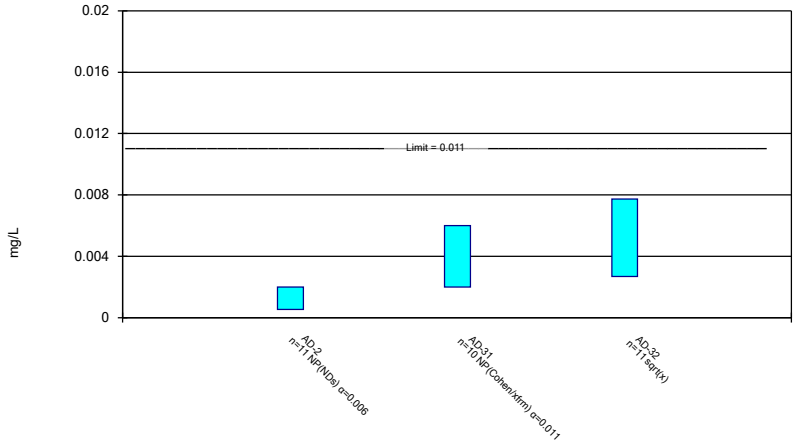
Compliance Limit is not exceeded.



Constituent: Antimony, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Parametric and Non-Parametric (NP) Confidence Interval

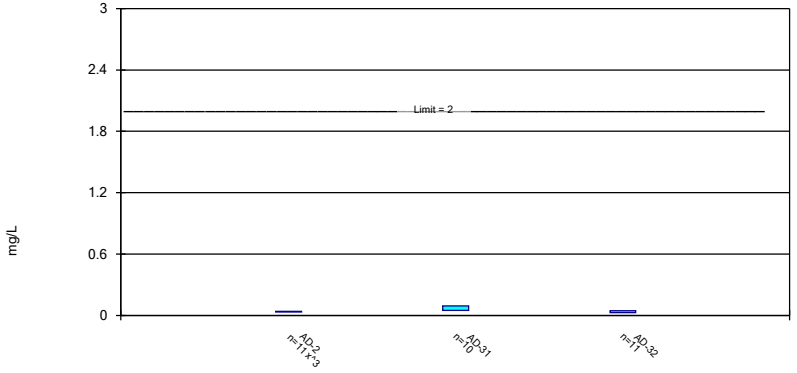
Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Arsenic, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Parametric Confidence Interval

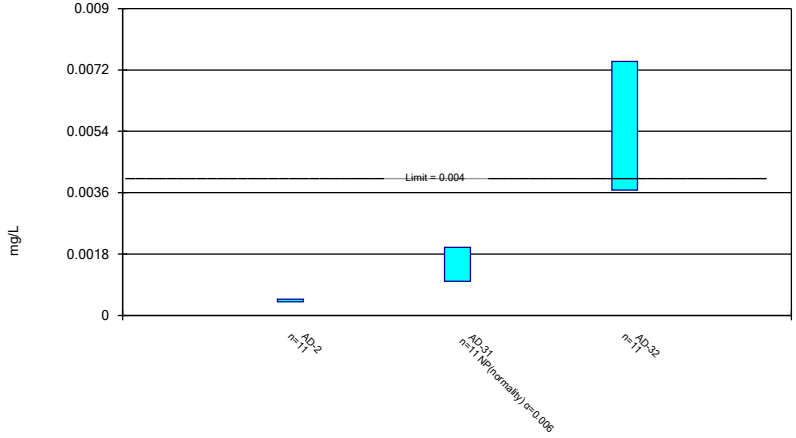
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Barium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Parametric and Non-Parametric (NP) Confidence Interval

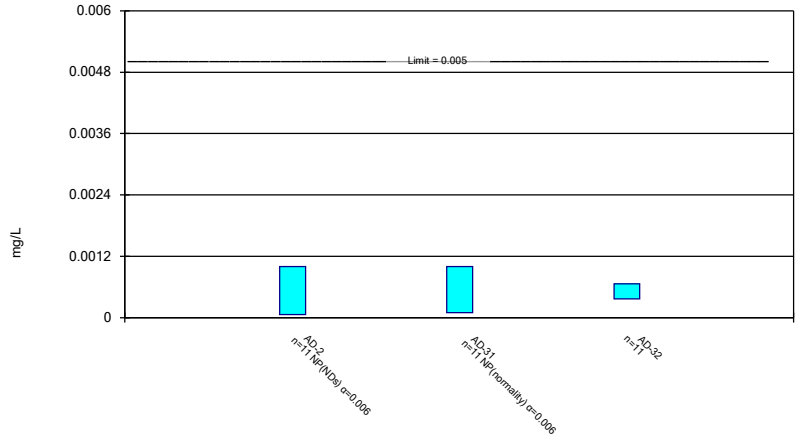
Compliance Limit is not exceeded. Per-well alpha = 0.01 except as noted. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Beryllium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

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.

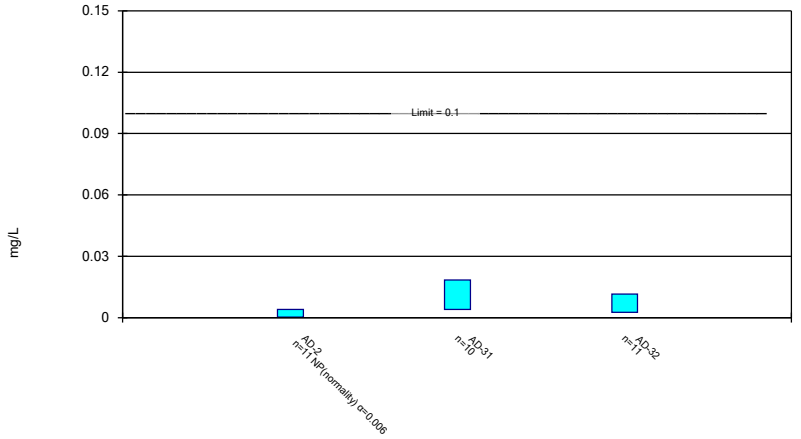


Constituent: Cadmium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 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.

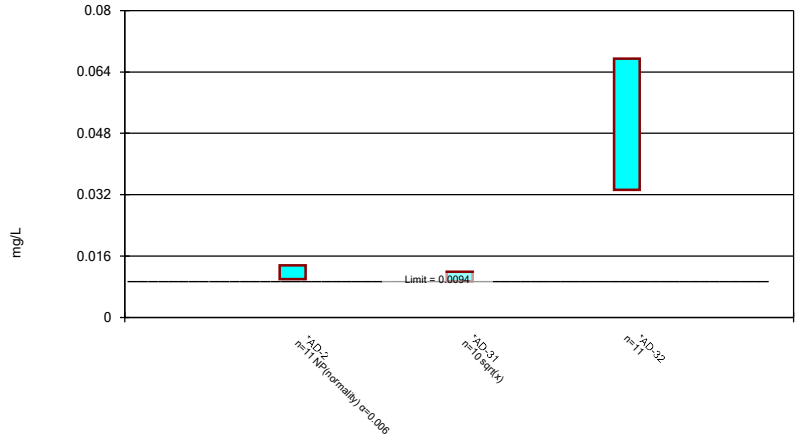


Constituent: Chromium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 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.

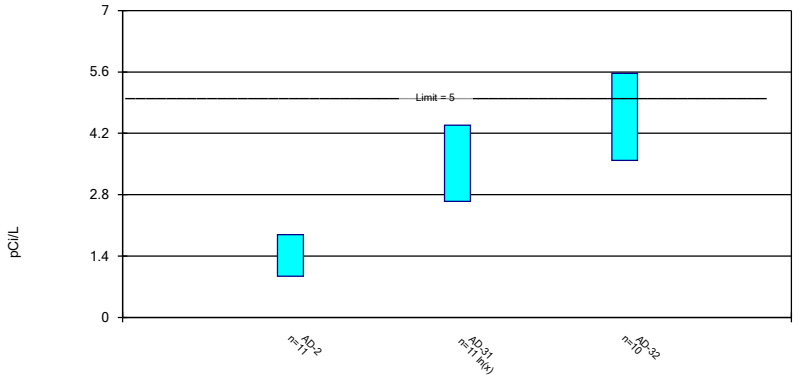


Constituent: Cobalt, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

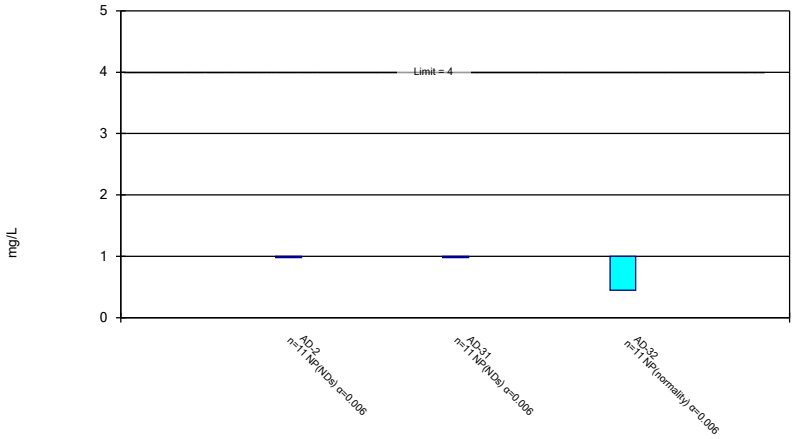
Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Combined Radium 226 + 228 Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - A
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

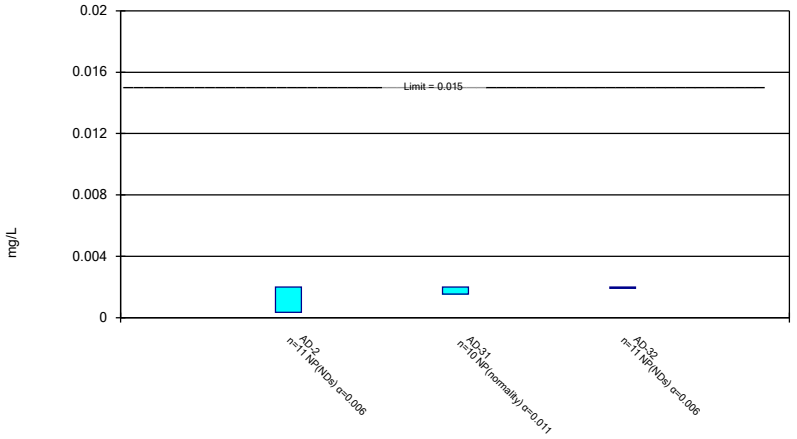


Constituent: Fluoride, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

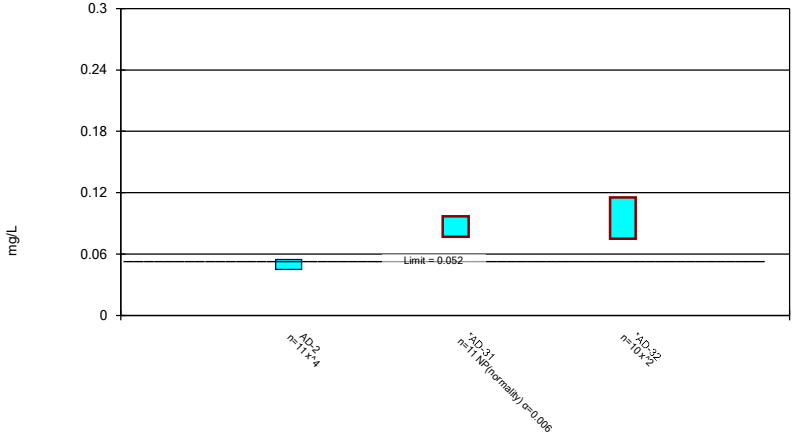


Constituent: Lead, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 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.

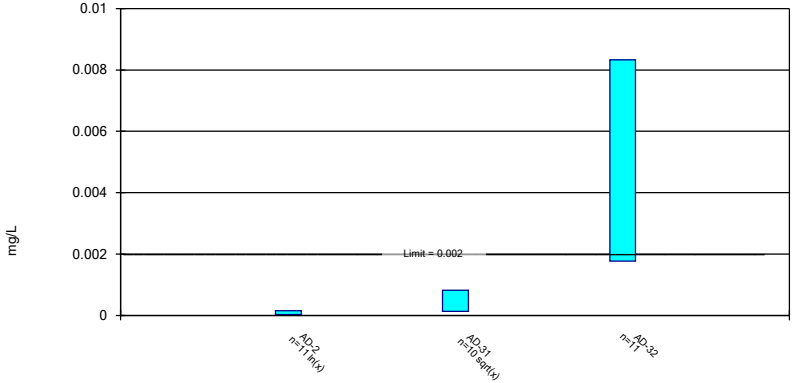


Constituent: Lithium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

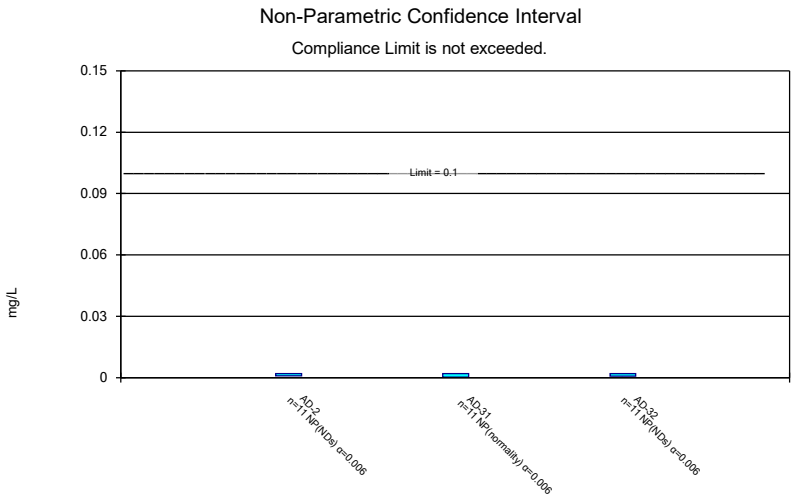
Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

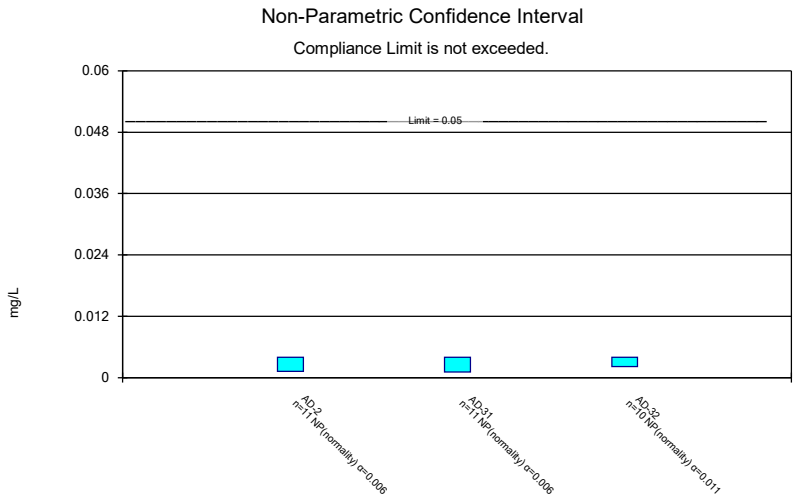


Constituent: Mercury, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP



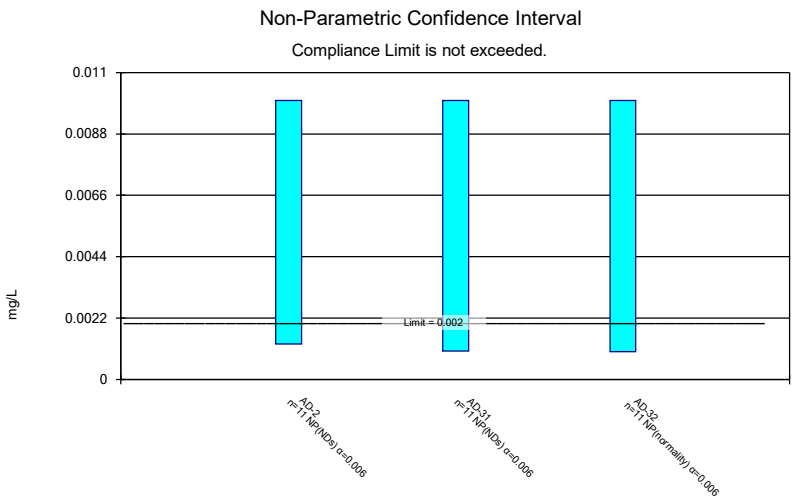
Constituent: Molybdenum, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Selenium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.18 Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Thallium, total Analysis Run 7/5/2019 1:00 PM View: Confidence Intervals - App IV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

STATISTICAL ANALYSIS SUMMARY
EAST BOTTOM ASH POND
H.W. Pirkey Plant
Hallsville, Texas

Submitted to

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
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Columbus, Ohio 43221

December 26, 2019

CHA8473

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
EBAP	East Bottom Ash Pond
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 East Bottom Ash Pond (EBAP), an existing CCR unit at the Pirkey Power Plant located in Hallsville, Texas.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for boron, calcium, chloride, total dissolved solids (TDS), and sulfate at the EBAP. An alternative source was not identified at the time, so the EBAP has been in assessment monitoring since. During the most recent assessment monitoring event, completed in July 2019, SSLs were identified for cobalt at wells AD-2, AD-31, and AD-32 and for lithium at wells AD-31 and AD-31. An alternative source demonstration (ASD) was successfully completed for cobalt and lithium (Geosyntec, 2019); thus, the unit remained in assessment monitoring. Two assessment monitoring events were conducted at the EBAP in May and August 2019, in accordance with 40 CFR 257.95. The results of these events are 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. SSLs were identified for cobalt and lithium. Thus, either the unit will move to an assessment of corrective measures or an alternative source demonstration (ASD) will be conducted to evaluate if the unit can remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

EAST 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) (May 2019) and 257.95(d)(1) (August 2019). Samples from both sampling events were analyzed for the Appendix III and Appendix IV parameters. 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 EBAP 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 during the May and August 2019 sampling events were screened for potential outliers. While possible outliers were identified for beryllium at wells AD-2 and AD-31 and for molybdenum at well AD-32, these values were not removed from the dataset as they were either non-detects or were similar to concentrations in adjacent wells.

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 barium, beryllium, cobalt, and mercury due to apparent non-normal distributions, for antimony, arsenic, cadmium, fluoride, lead, molybdenum, selenium, and thallium due to a high non-detect frequency, and for chromium due to both an apparent non-normal distribution and 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.

The following SSLs were identified at the Pirkey EBAP:

- LCLs for cobalt exceeded the GWPS of 0.0094 mg/L at AD-2 (0.0100 mg/L) and AD-32 (0.0310 mg/L).
- LCLs for lithium exceeded the GWPS of 0.0616 mg/L at AD-31 (0.0859 mg/L) and AD-32 (0.0878 mg/L).

As a result, the Pirkey EBAP will either move to an assessment of corrective measures or an alternative source demonstration will be conducted to evaluate if the unit can remain in assessment monitoring.

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 pH, whereas interwell tests were used to evaluate potential SSIs for boron, calcium, chloride, fluoride, 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 EBAP. 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 (May 2016-April 2017) to the new compliance samples (August 2017- February 2019) for 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 continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B. A statistically significant difference was identified for pH in well AD-18. However, because this is an upgradient well and limited data are available, the background data were updated to include all data through February 2019.

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 February 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 pH, whereas interwell tests continued to be used to evaluate potential SSIs for boron, calcium, chloride, fluoride, sulfate, and TDS. The intrawell 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

While SSLs were identified, a review of the Appendix III results were also completed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations.

Data collected during the May and August 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. The following exceedances of the upper prediction limits (UPLs) were noted:

- Boron concentrations exceeded the interwell UPL of 0.0510 mg/L at AD-2 (2.17 mg/L and 2.16 mg/L) and AD-32 (0.555 mg/L and 1.77 mg/L).

- Calcium concentrations exceeded the interwell UPL of 2.94 mg/L at AD-2 (3.30 mg/L), AD-31 (3.29 mg/L), and AD-32 (5.35 mg/L and 13.3 mg/L).

- Chloride concentrations exceeded the interwell UPL of 9.16 mg/L at AD-2 (29.6 mg/L and 28.4 mg/L), AD-31 (18.7 mg/L and 21.6 mg/L), and AD-32 (18.6 mg/L and 24.9 mg/L).

- Sulfate concentrations exceeded the interwell UPL of 23.0 mg/L at AD-2 (137 mg/L and 128 mg/L), AD-31 (79.9 mg/L and 70.0 mg/L), and AD-32 (105 mg/L and 228 mg/L).

- TDS concentrations exceeded the interwell UPL of 178 mg/L at AD-2 (316 mg/L and 306 mg/L), AD-31 (240 mg/L and 250 mg/L), and AD-32 (292 mg/L and 448 mg/L).

While the prediction limits were calculated assuming a 1-of-2 testing procedure, it was conservatively assumed that an SSI was identified if the initial sample exceeded either the UPL based on previous results. Based on these results, concentrations of Appendix III parameters exceeded background levels at compliance wells at the Pirkey EBAP during 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. While potential outliers for beryllium and lithium were identified in the May and August 2019 data, no values were removed from the dataset. 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. SSLs were identified for cobalt and lithium. Appendix III parameters were compared to recalculated prediction limits, with exceedances identified for boron, calcium, chloride, sulfate, and TDS.

Based on this evaluation, the Pirkey EBAP CCR unit will either move to an assessment of corrective measures or an ASD will be conducted to evaluate if the unit can remain in assessment monitoring.

SECTION 3

REFERENCES

American Electric Power (AEP). 2017. Statistical Analysis Plan – H.W. Pirkey Plant. January 2017.

Geosyntec Consultants. 2018. Statistical Analysis Summary – East Bottom Ash Pond, H.W. Pirkey Plant, Hallsville, Texas. January 15, 2018.

Geosyntec Consultants. 2019. Alternative Source Demonstration Report – Federal CCR Rule. H. W. Pirkey Plant, East Bottom Ash Pond. September.

TABLES

Table 1 - Groundwater Data Summary
Pirkey - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Component	Unit	AD-2		AD-4		AD-12		AD-18		AD-31		AD-32	
		5/22/2019	8/12/2019	5/23/2019	8/14/2019	5/21/2019	8/12/2019	5/23/2019	8/13/2019	5/23/2019	8/12/2019	5/21/2019	8/12/2019
Antimony	µg/L	2.00 U	0.100 U	2.00 U	0.100 U	2.00 U	0.100 U	2.00 U	0.100 U	2.00 U	0.100 U	2.00 U	0.100 U
Arsenic	µg/L	2.00 U	0.350	2.00 U	0.170	2.00 U	0.0700 J	2.00 U	0.450	2.00 U	0.530	0.800 J	3.43
Barium	µg/L	25.6	22.8	61.7	73.5	21.7	23.8	131	100	37.9	35.0	35.6	38.5
Beryllium	µg/L	2.00 U	0.402	0.500 J	1.04	2.00 U	0.154	2.00 U	0.118	0.900 J	0.850	2.77	3.65
Boron	mg/L	2.17	2.16	0.0210	0.0500 U	0.0200	0.0500 U	0.0130	0.0500 U	0.0210	0.0500 U	0.555	1.77
Cadmium	µg/L	1.00 U	0.0600	1.00 U	0.0500 U	1.00 U	0.0500 U	1.00 U	0.0200 J	1.00 U	0.0600	0.300 J	0.400
Calcium	mg/L	2.19	3.30	1.71	1.97	0.300 J	0.278	0.684	0.647	3.29	2.86	5.35	13.3
Chloride	mg/L	29.6	28.4	3.31	6.22	6.30	7.24	8.82	8.49	18.7	21.6	18.6	24.9
Chromium	µg/L	4.00 U	0.292	1.00 J	0.0800 J	4.00 U	0.204	4.00 U	0.212	4.00 U	0.365	1.00 J	1.70
Cobalt	µg/L	15.5	13.0	7.86	6.52	1.15	1.30	1.47	1.25	10.3	8.69	23.5	33.7
Combined Radium	pCi/L	0.832	1.81	0.517	0.833	0.201	0.237	0.492	0.473	3.40	2.20	5.37	5.70
Fluoride	mg/L	0.100 J	0.100 J	0.150	0.120	0.0900	0.0600 J	0.0200 J	0.0100 J	0.130	0.160	0.310	0.670
Lead	µg/L	2.00 U	0.288	2.00 U	0.0600 J	2.00 U	0.0800 J	2.00 U	0.200 J	2.00 U	0.325	0.400 J	0.996
Lithium	mg/L	0.0542	0.0560	0.0516	0.0484	0.00576	0.00829	0.0209	0.0183	0.0928	0.0875	0.0897	0.0964
Mercury	mg/L	0.0000630	0.0000440	0.0000250 U	0.0000250 U	0.0000250 U	0.0000250 U	0.00000900 J	0.0000230 J	0.0000570	0.00103	0.00137	0.00413
Molybdenum	µg/L	40.0 U	2.00 U	40.0 U	2.00 U	40.0 U	2.00 U	40.0 U	2.00 U	40.0 U	2.00 U	40.0 U	2.00 U
Selenium	µg/L	0.900 J	0.800	4.00 U	0.0400 J	4.00 U	0.200 J	4.00 U	0.0900 J	4.00 U	0.400	1.00 J	7.30
Total Dissolved Solids	mg/L	316	306	150	146	80.0	90.0	104	90.0	240	250	292	448
Sulfate	mg/L	137	128	24.6	21.7	4.00	2.60	10.6	6.60	79.9	70.0	105	228
Thallium	µg/L	0.500 U	0.100 J	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.500 U	0.200 J	0.200 J
pH	SU	4.04	4.55	4.97	5.49	4.09	4.94	5.20	5.22	5.14	4.06	3.21	4.01

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

Table 2: Groundwater Protection Standards
Pirkey Plant - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.0025
Arsenic, Total (mg/L)	0.01		0.011
Barium, Total (mg/L)	2		0.18
Beryllium, Total (mg/L)	0.004		0.0012
Cadmium, Total (mg/L)	0.005		0.0005
Chromium, Total (mg/L)	0.1		0.007
Cobalt, Total (mg/L)	n/a	0.006	0.0094
Combined Radium, Total (pCi/L)	5		3.33
Fluoride, Total (mg/L)	4		0.5
Lead, Total (mg/L)	0.015		0.0025
Lithium, Total (mg/L)	n/a	0.04	0.062
Mercury, Total (mg/L)	0.002		0.000064
Molybdenum, Total (mg/L)	n/a	0.1	0.020
Selenium, Total (mg/L)	0.05		0.0025
Thallium, Total (mg/L)	0.002		0.0019

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
Pirkey - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	Description	AD-2	AD-31	AD-32
Boron	mg/L	Interwell Background Value (UPL)	0.0510		
Calcium	mg/L	Interwell Background Value (UPL)	2.94		
Chloride	mg/L	Interwell Background Value (UPL)	9.16		
Fluoride	mg/L	Interwell Background Value (UPL)	1.00		
pH	SU	Intrawell Background Value (UPL)	4.8	5.4	4.6
		Intrawell Background Value (LPL)	3.3	2.8	2.5
Sulfate	mg/L	Interwell Background Value (UPL)	23.0		
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	176		

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit

Table 4: Appendix III Data Summary
Pirkey - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	Description	AD-2		AD-31		AD-32	
			5/22/2019	8/12/2019	5/23/2019	8/12/2019	5/21/2019	8/12/2019
Boron	mg/L	Interwell Background Value (UPL)	0.0510					
		Detection Monitoring Result	**2.17**	**2.16**	0.0210	0.0200	**0.555**	**1.77**
Calcium	mg/L	Interwell Background Value (UPL)	2.94					
		Detection Monitoring Result	2.19	**3.30**	**3.29**	2.86	**5.35**	**13.3**
Chloride	mg/L	Interwell Background Value (UPL)	9.16					
		Detection Monitoring Result	**29.6**	**28.4**	**18.7**	**21.6**	**18.6**	**24.9**
Fluoride	mg/L	Interwell Background Value (UPL)	1.00					
		Detection Monitoring Result	0.100	0.100	0.130	0.160	0.310	0.670
pH	SU	Intrawell Background Value (UPL)	4.8		5.4		4.6	
		Intrawell Background Value (LPL)	3.3		2.8		2.5	
		Detection Monitoring Result	4.0	4.6	5.1	4.1	3.2	4.0
Sulfate	mg/L	Interwell Background Value (UPL)	23.0					
		Detection Monitoring Result	**137**	**128**	**79.9**	**70.0**	**105**	**228**
Total Dissolved Solids	mg/L	Interwell Background Value (UPL)	176					
		Detection Monitoring Result	**316**	**306**	**240**	**250**	**292**	**448**

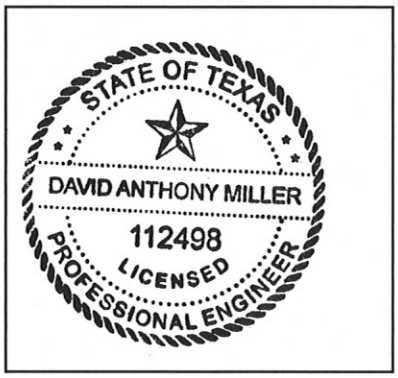
Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.

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 Pirkey East 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

112498	TEXAS	01.03.20
License Number	Licensing State	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: Pirkey EBAP - Assessment Monitoring Event & Background Update 2019

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the evaluation of groundwater data and the background update for American Electric Power Company's Pirkey EBAP. 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 at each of the wells below began at Pirkey EBAP for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient wells AD-4, AD-12, and AD-18; and downgradient wells AD-2, AD-31, and AD-32.

Data were sent electronically, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to GSC. The analysis was conducted according to the Statistical Analysis Plan and initial screening evaluation prepared in November 2017 by GSC and approved by Dr. Kirk Cameron.

The CCR program consists of the following constituents:

- **Appendix III** (Detection Monitoring) **-** boron, calcium, chloride, fluoride, pH, sulfate, and TDS; and

- **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 been flagged as outliers may be seen in a lighter font and disconnected symbol on the graphs. During the August 2018 event, a value of 0.015 mg/L was reported for selenium at well AD-32. That value was flagged as an outlier since the reported value during the February 2019 event was significantly lower (0.003 mg/L) and similar to historical concentrations.

Background data at all wells were initially evaluated during the background screening conducted in December 2017 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. A summary of that screening is provided below. Data are evaluated in this report for inclusion of more recent data into background to update the prediction limits. Power curves were provided during the initial background screening 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-2 resample plan for pH.
2) Interwell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, fluoride, 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 may be 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.

Summary of 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. The reports were submitted with the background screening.

Tukey's outlier test noted several outliers which were flagged in the database. Any values flagged as outliers are plotted in a lighter font on the time series graph. While the test identified a couple low outliers for chloride, lead and lithium in downgradient wells, these values were not flagged because they were similar in concentration to surrounding wells. It was noted that the first background sample in well AD-31 for several constituents was higher than all subsequent samples. This could be representative of well drilling processes, or an indication of sampling or analytical error. Therefore, these values were flagged as outliers since they do not appear to represent the population of groundwater at this well. In some cases, the test could not identify suspect outliers due to the upper and lower quartiles being equal. When extreme values were present in background, however, they were flagged as outliers, such as fluoride in upgradient well AD-12. 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 were submitted with the background screening report and showed a couple statistically significant increasing and decreasing trends. These trends were relatively low in magnitude when compared to average concentrations; 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. 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 no variation for fluoride, making this constituent suitable for interwell analyses. Variation was identified in groundwater upgradient of the site for all other Appendix III parameters. Therefore, these 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 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 recommended for intrawell analyses. 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 parameters exhibiting spatial variation. 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 pH, while the confidence intervals for all other Appendix III parameters evaluated were above the background standards for parameters exhibiting spatial variation. Therefore, intrawell methods were recommended for pH, and interwell methods were recommended for all other Appendix III parameters. As mentioned earlier, if a demonstration supports natural variation in groundwater, intrawell methods will be considered for all parameters.

All available data through April 2017 at each well were used to establish intrawell background limits 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 the Appendix III parameters discussed above. 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 carefully screened during each event for new outliers or extreme trending data. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points from each well 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 Summary – November 2019

Prior to updating background data sets, all Appendix III and data through February 2019 were re-evaluated using Tukey's outlier test and visual screening (Figure C). Tukey's Outlier test identified an outlier for fluoride in well AD-32 which was flagged in the database. Additionally, the reported nondetect value of <5.0 mg/L for TDS in upgradient well AD-12 was flagged as it is not consistent with remaining measurements within this well. 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.

The Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through April 2017 to the new compliance samples at each well through February 2019 to evaluate whether the groups are significantly different at the 99% confidence level. When no differences are noted, background data may be updated with more recent compliance data (Figure D). 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 statistically significant difference was identified for pH in well AD-18. However, because this is an upgradient well and limited data are available, the background data were updated to include all data through February 2019. These data will be re-evaluated during the next background update. If earlier measurements no longer represent present-day conditions, the earlier portion of the record will be deselected prior to construction of statistical limits. 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 February 2019 combined with a 1-of-2 resample plan, were constructed for pH and a summary of the updated limits follows this letter (Figure E). Future compliance observations at each well will be compared to these background limits during each subsequent semi-annual sampling event.

The Sen's Slope/Mann Kendall trend test was used to evaluate data at upgradient wells for boron, calcium, chloride, fluoride, sulfate and TDS, which are tested using interwell prediction limits, to identify statistically significant increasing or decreasing trends. The results of the trend analyses showed all data are consistent over time with no statistically significant increasing or decreasing trends (Figure F).

Interwell prediction limits, combined with a 1-of-2 resample plan, were updated using all available data from upgradient wells for the same time period for the parameters listed above (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

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. The test identified a few outliers such as: beryllium in wells AD-2 and AD-31 and molybdenum in well AD-32 (which were reported nondetects). The value identified for beryllium in well AD-2 was not flagged due to the low concentrations within this well and all values being similar to neighboring wells, indicating natural variability. The nondetect values were not flagged as outliers for molybdenum in well AD-32, but it was noted these limits are higher than historical limits and have been reported at these levels for two events. A nondetect adjustment may be required depending on what the future reporting limit is set at for nondetects. Additionally, several other values that were not identified by Tukey's test (often due to the natural log transformation) were flagged as they were significantly different from the other reported measurements within the same well. 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 either the MCL, CCR-Rule specified levels or ACL 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. When a GWPS is exceeded, if an Alternate Source Demonstration cannot be made, corrective action would be initiated. The following confidence interval exceedances were noted: cobalt in wells AD-2 and AD-32, and lithium in wells AD-31 and AD-32. A summary of the confidence interval results follows this letter.

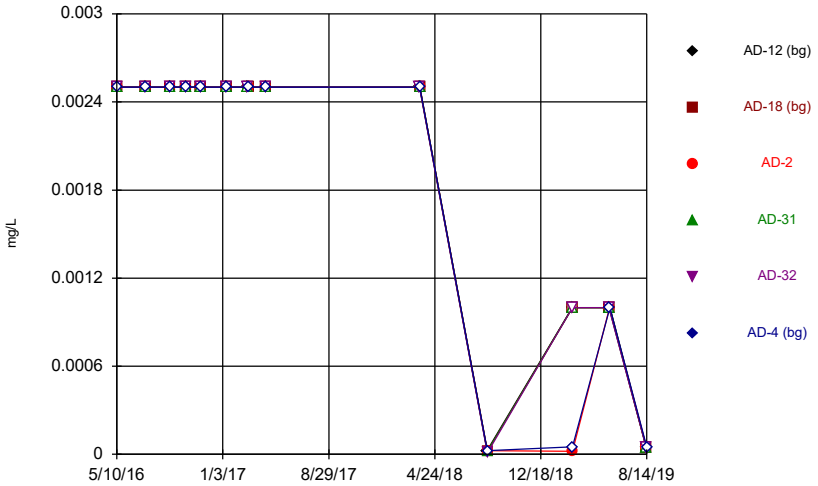
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Pirkey EBAP. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

Time Series



Constituent: Antimony, total Analysis Run 11/25/2019 11:32 AM View: All Data
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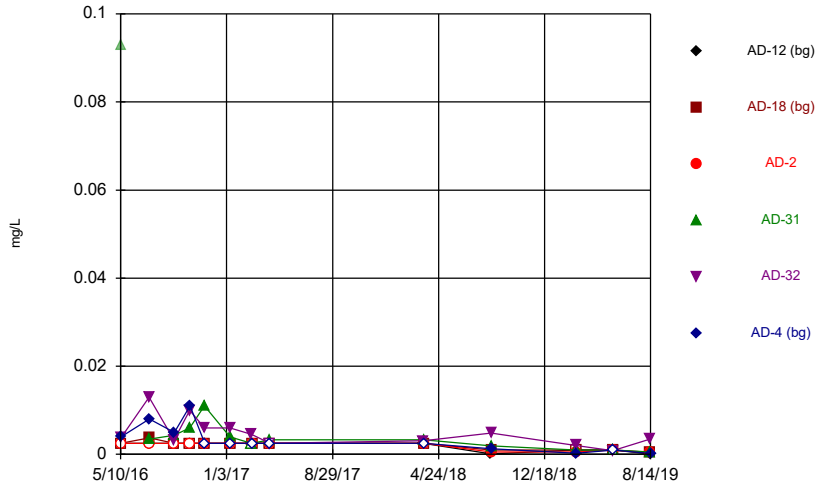
Hollow symbols indicate censored values.

Time Series



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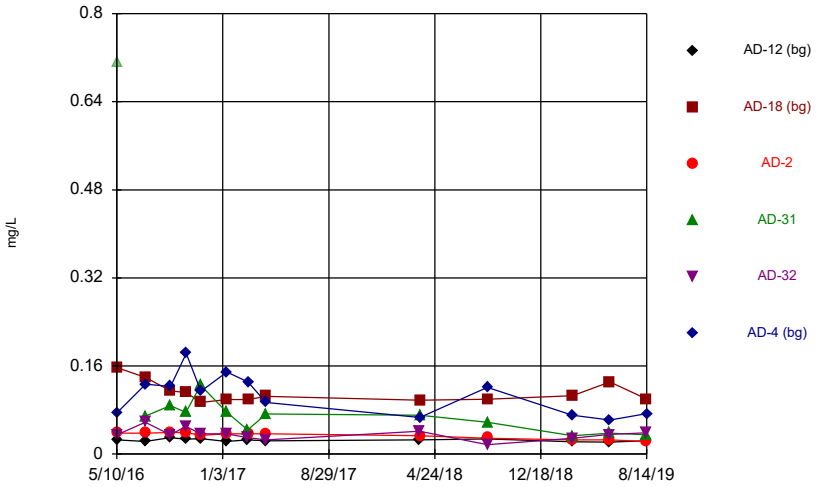
Time Series



Constituent: Barium, total Analysis Run 11/25/2019 11:32 AM View: All Data
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Hollow symbols indicate censored values.

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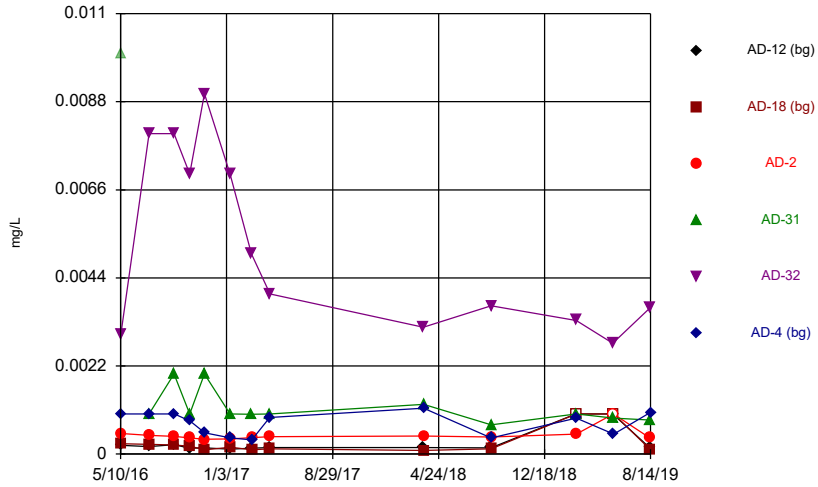

Constituent: Beryllium, total Analysis Run 11/25/2019 11:32 AM View: All Data
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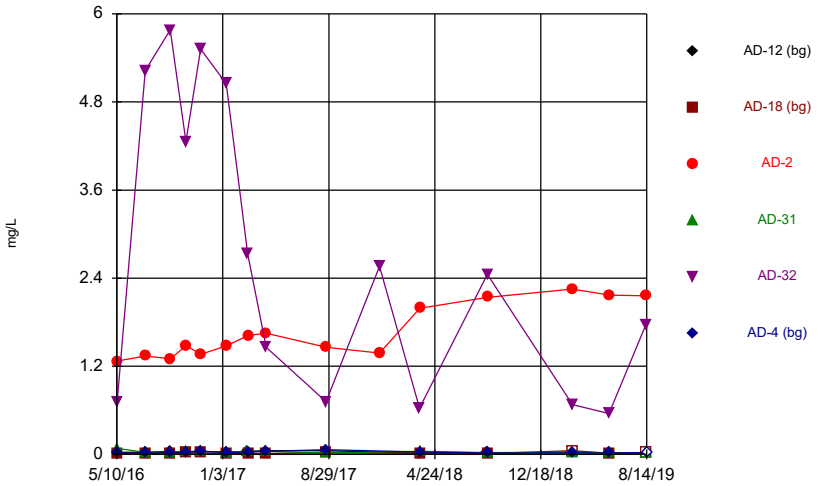
Hollow symbols indicate censored values.

Time Series



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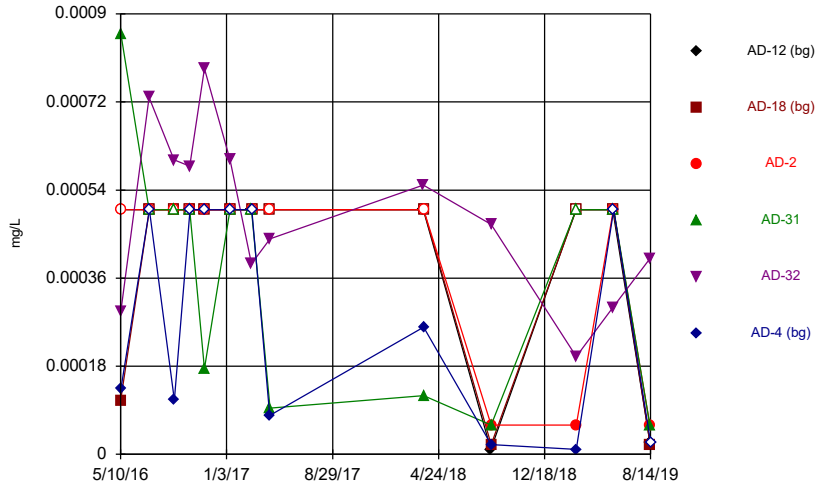
Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

Time Series



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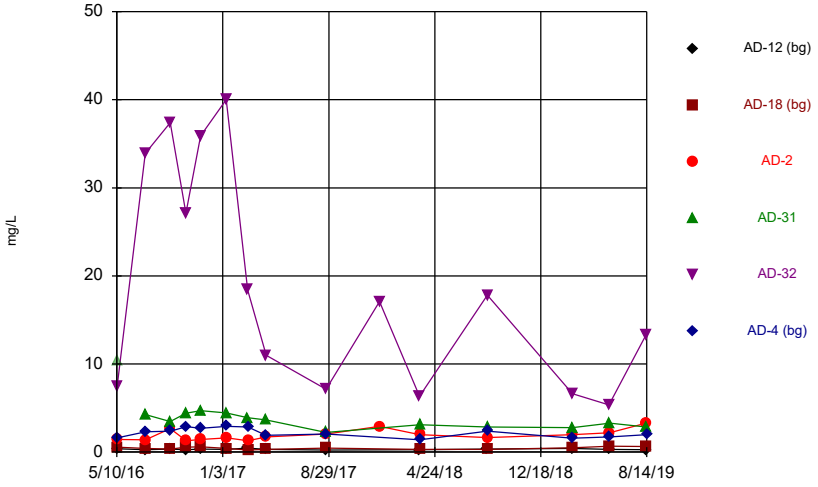
Sanitas™ v.9.6.23 . EPA

Time Series



Constituent: Calcium, total Analysis Run 11/25/2019 11:32 AM View: All Data
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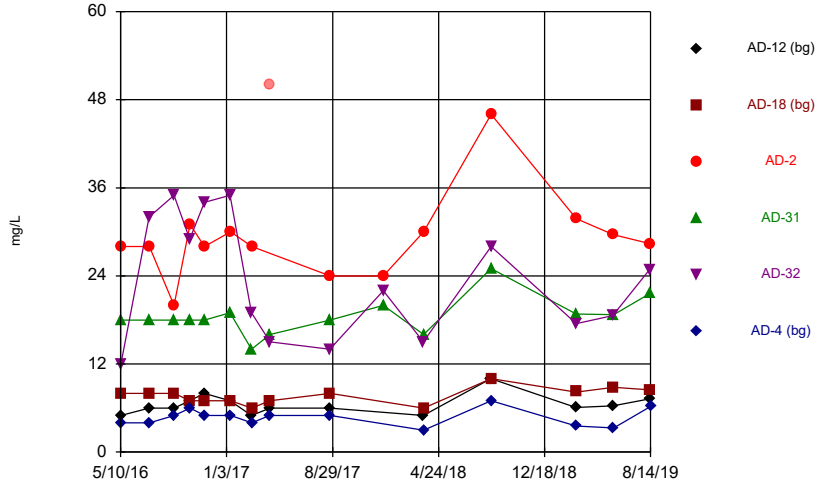
Sanitas™ v.9.6.23 . EPA

Time Series



Constituent: Chloride, total Analysis Run 11/25/2019 11:32 AM View: All Data
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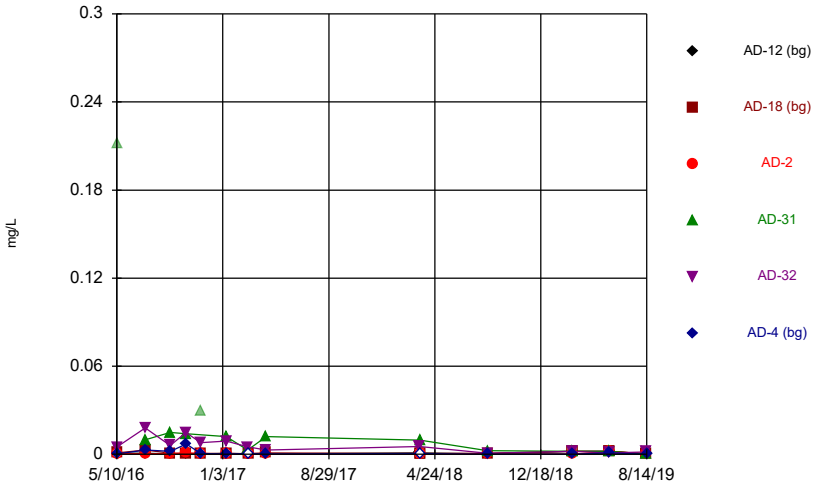
Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

Time Series



Constituent: Chromium, total Analysis Run 11/25/2019 11:32 AM View: All Data
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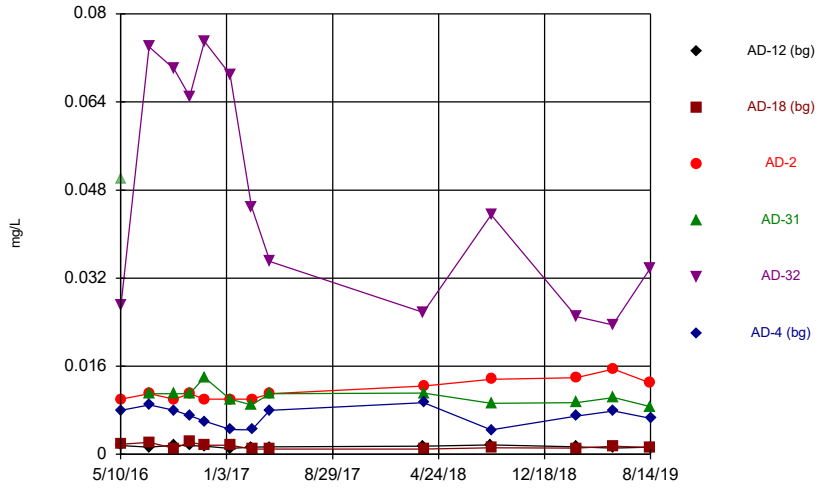
Sanitas™ v.9.6.23 . EPA

Time Series



Constituent: Cobalt, total Analysis Run 11/25/2019 11:32 AM View: All Data
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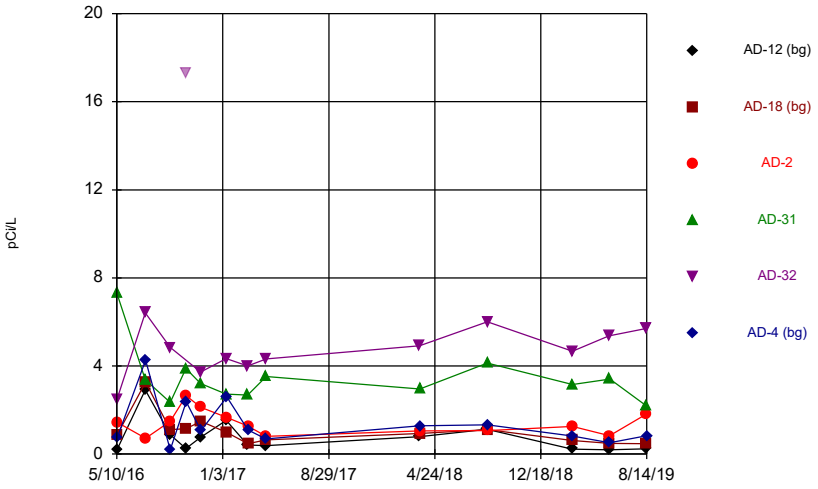
Sanitas™ v.9.6.23 . EPA

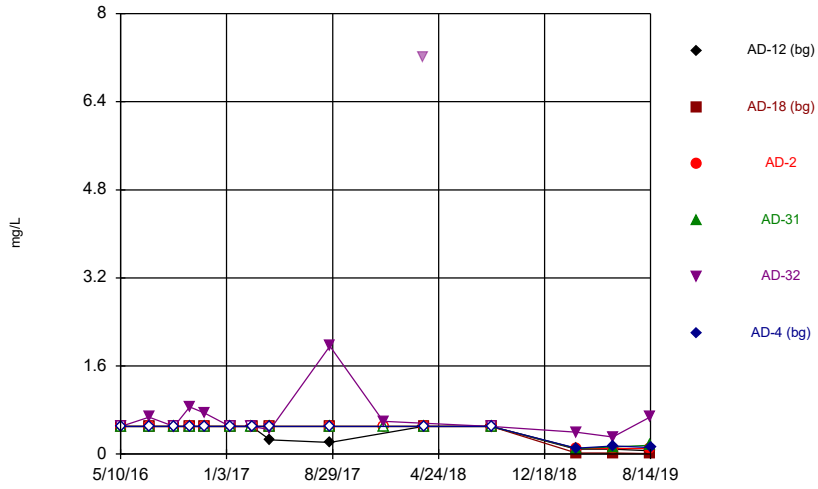
Time Series



Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 11:32 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

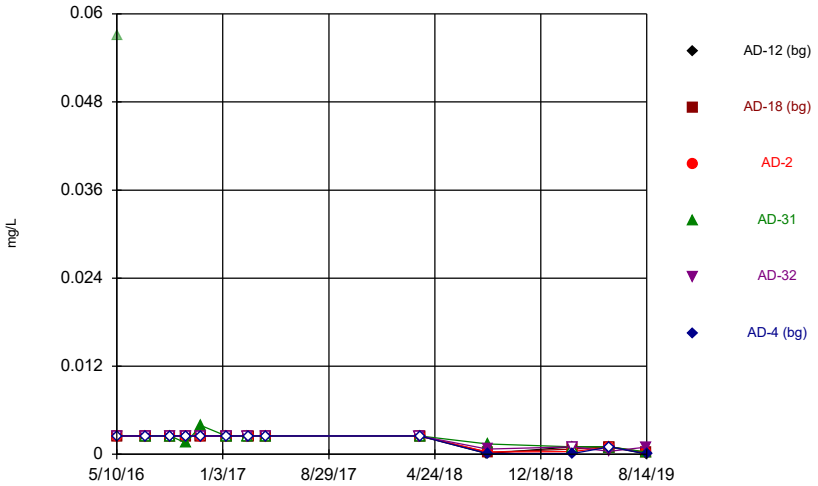
Time Series



Constituent: Fluoride, total Analysis Run 11/25/2019 11:32 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

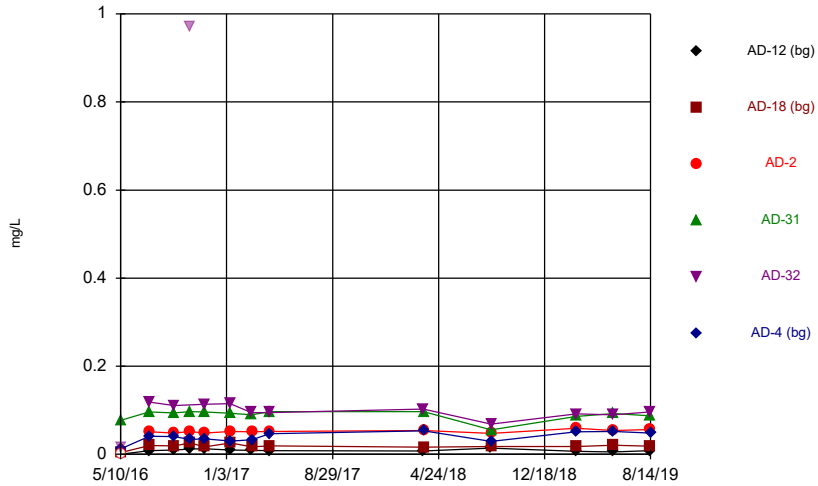
Time Series



Constituent: Lead, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

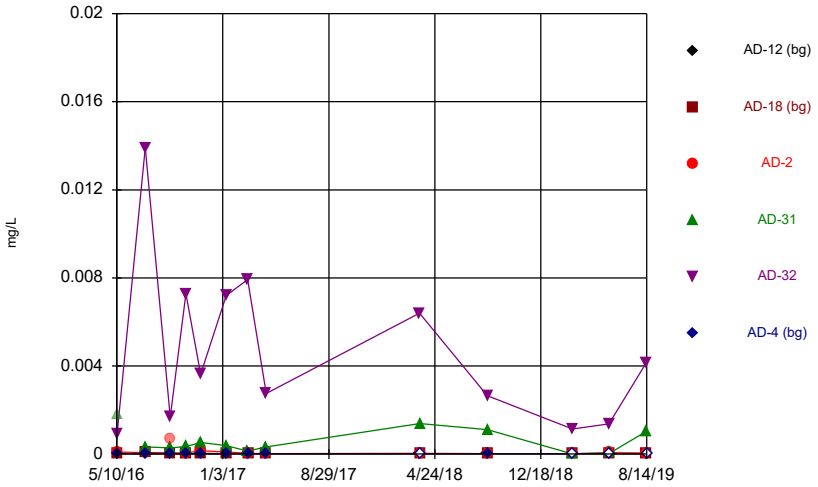
Time Series



Constituent: Lithium, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

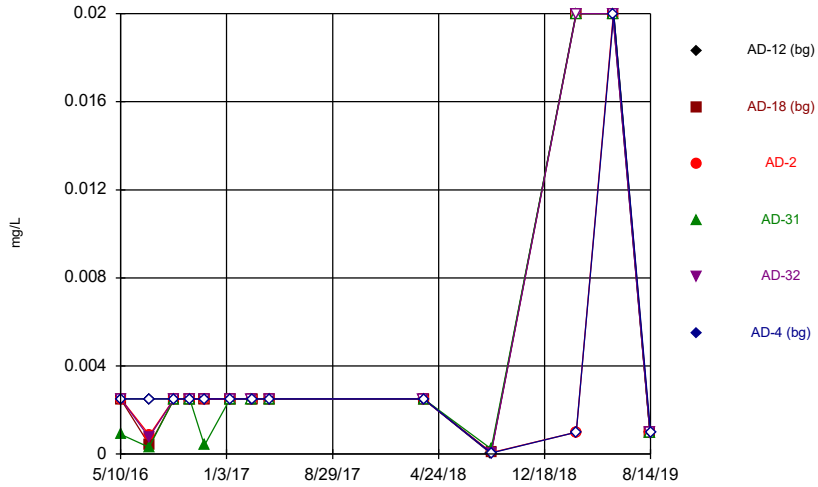
Time Series



Constituent: Mercury, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

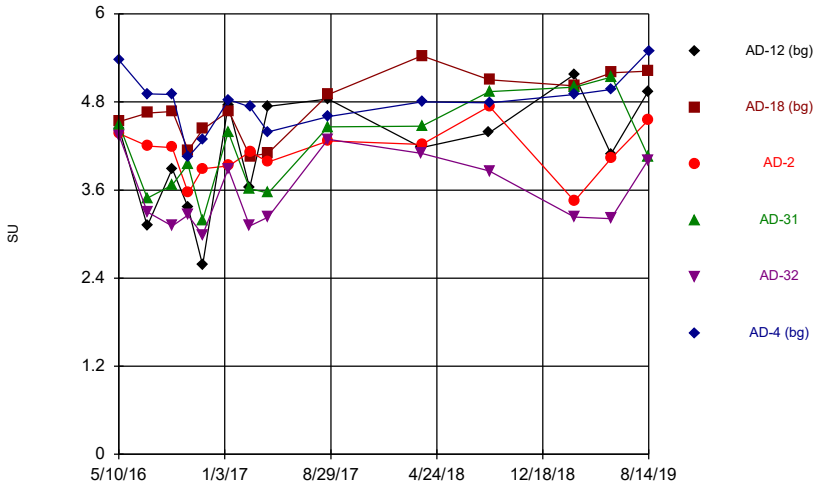
Time Series



Constituent: Molybdenum, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

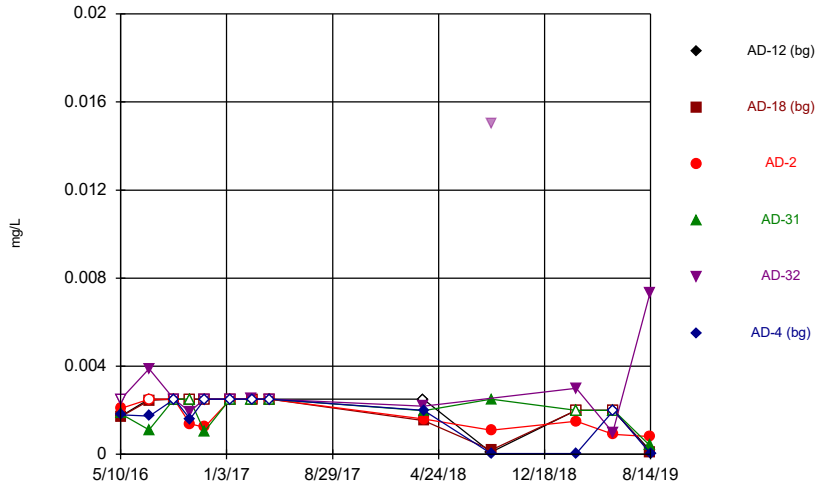
Time Series



Constituent: pH, field Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

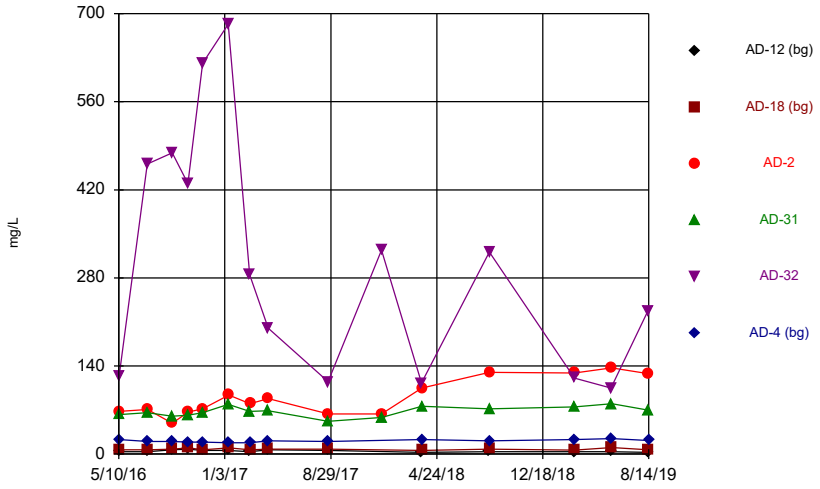
Time Series



Constituent: Selenium, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

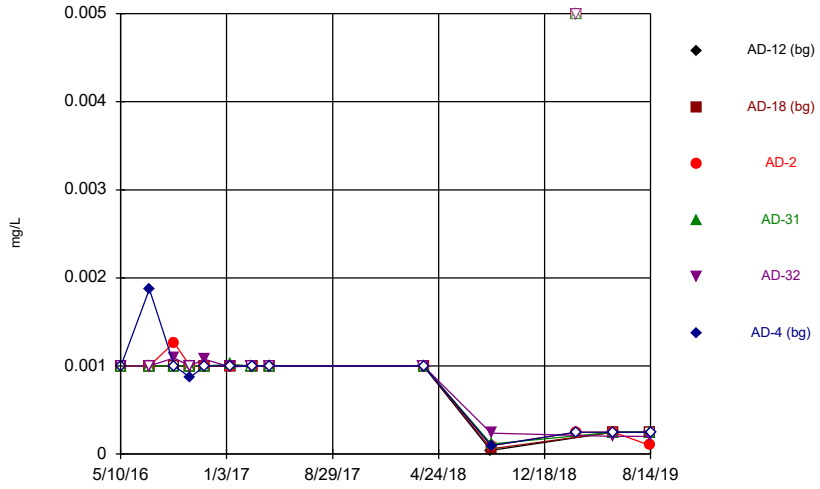
Time Series



Constituent: Sulfate, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

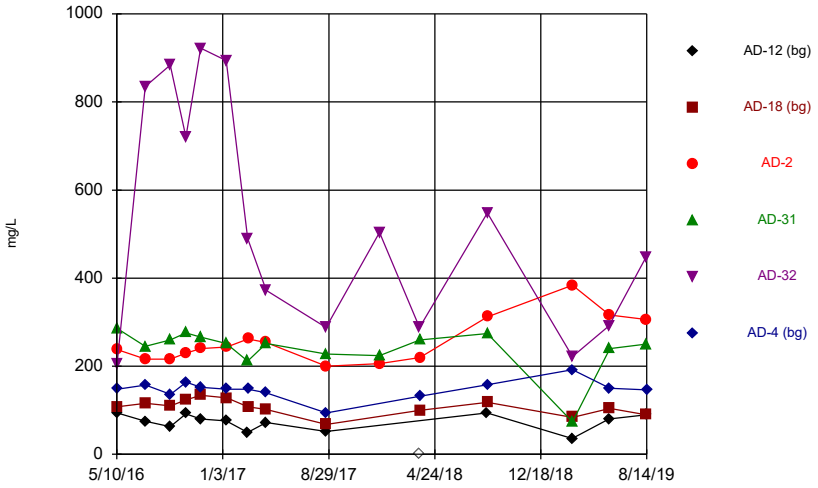
Time Series



Constituent: Thallium, total Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA
Hollow symbols indicate censored values.

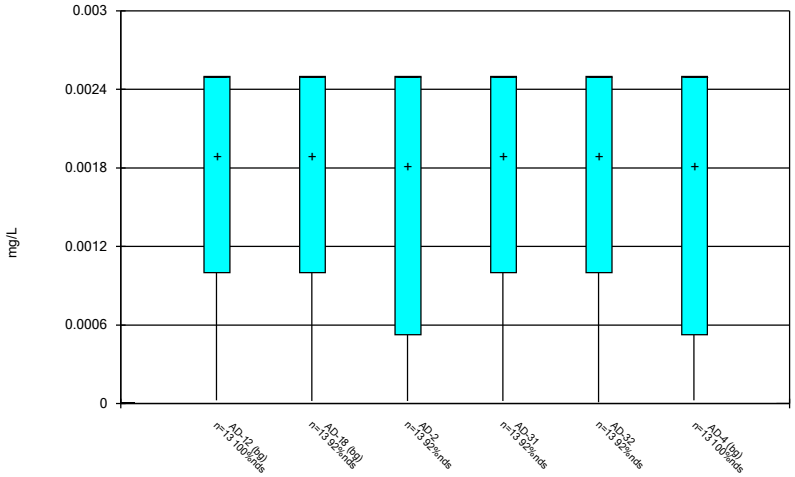
Time Series



Constituent: Total Dissolved Solids [TDS] Analysis Run 11/25/2019 11:33 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

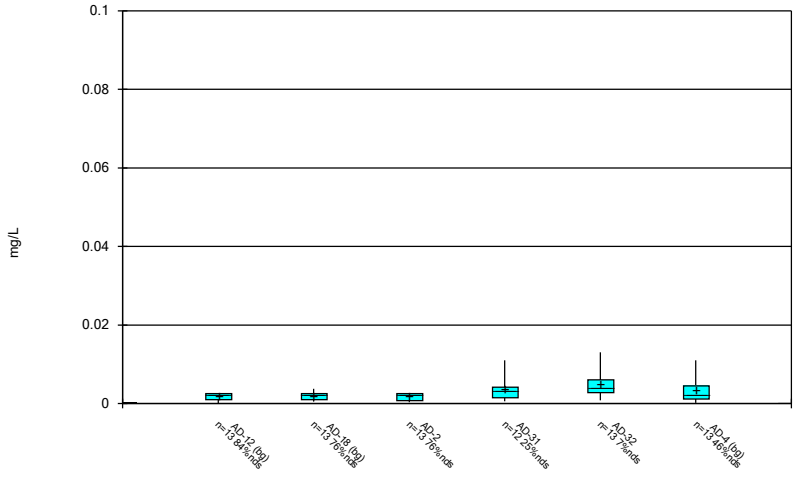
Box & Whiskers Plot



Constituent: Antimony, total Analysis Run 11/25/2019 11:36 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

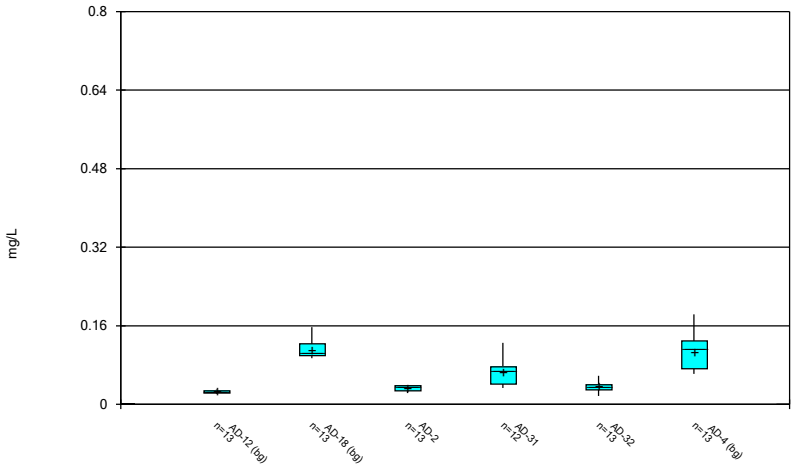
Box & Whiskers Plot



Constituent: Arsenic, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

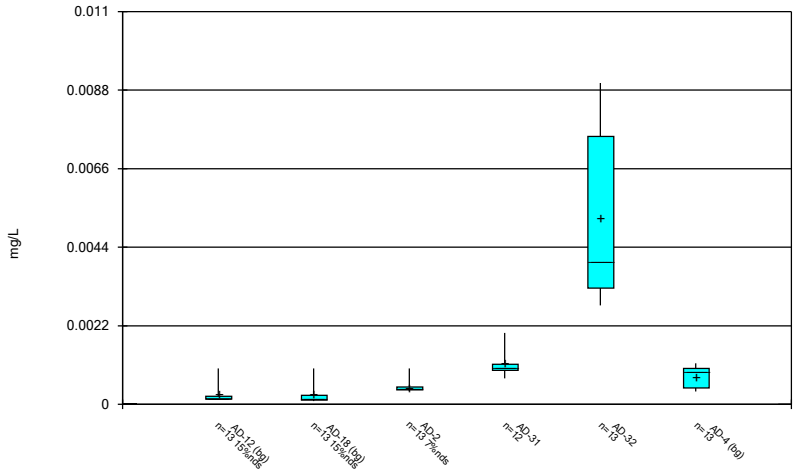
Box & Whiskers Plot



Constituent: Barium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

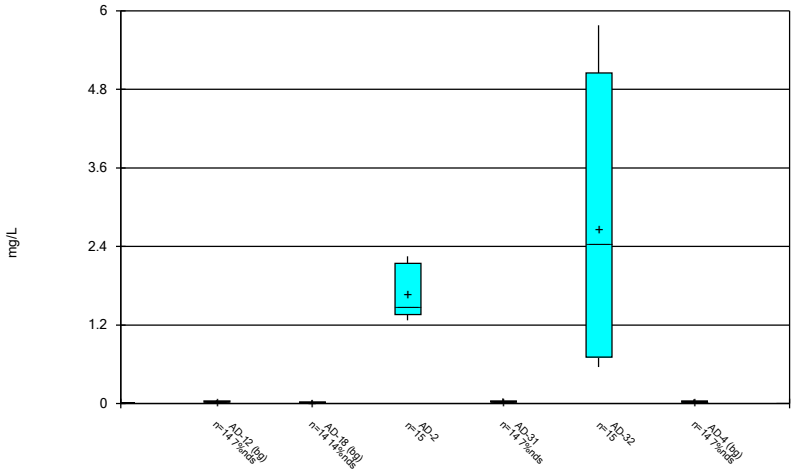
Box & Whiskers Plot



Constituent: Beryllium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

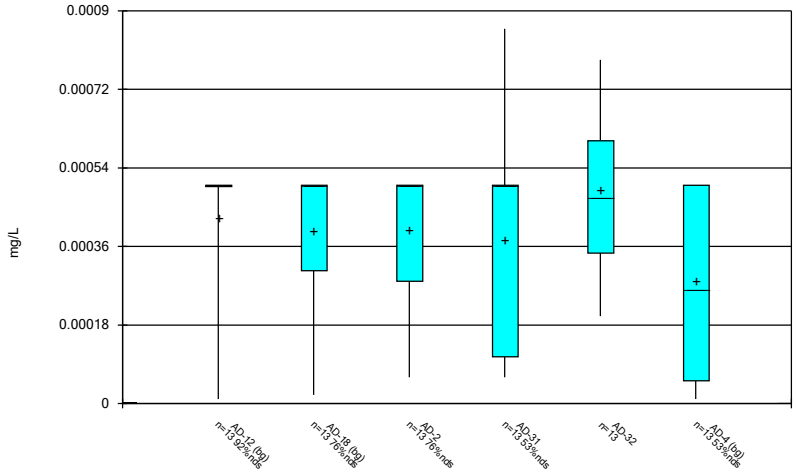
Box & Whiskers Plot



Constituent: Boron, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

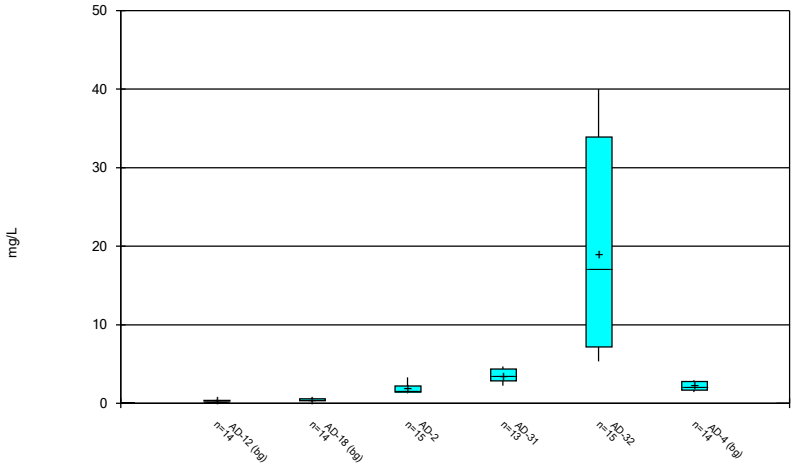
Box & Whiskers Plot



Constituent: Cadmium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

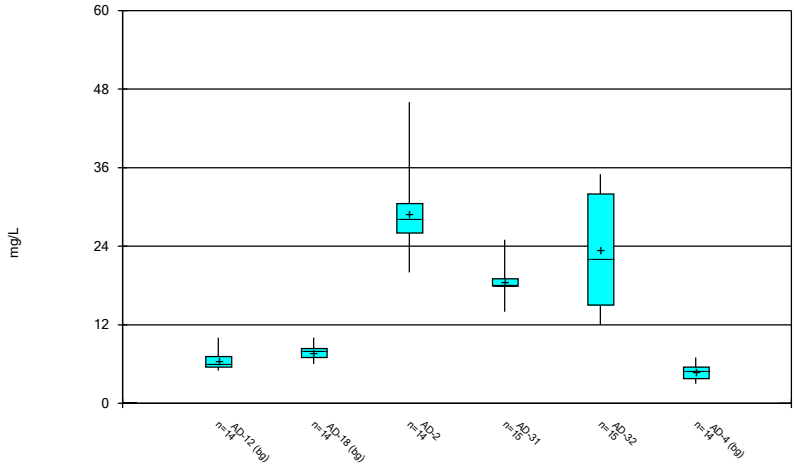
Box & Whiskers Plot



Constituent: Calcium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

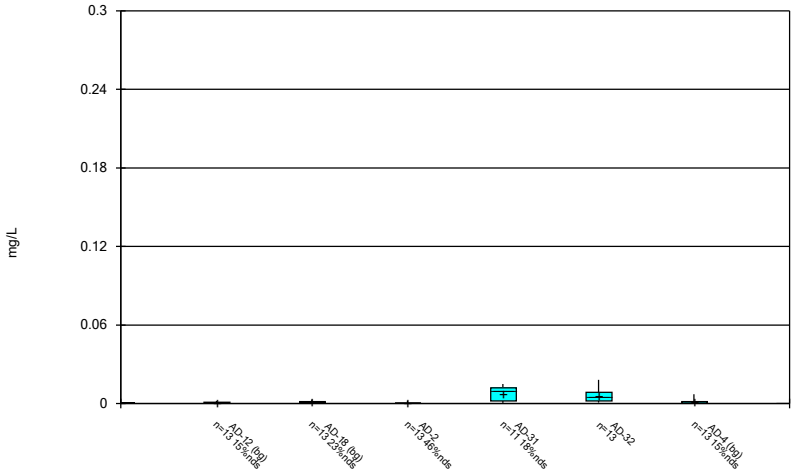
Box & Whiskers Plot



Constituent: Chloride, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

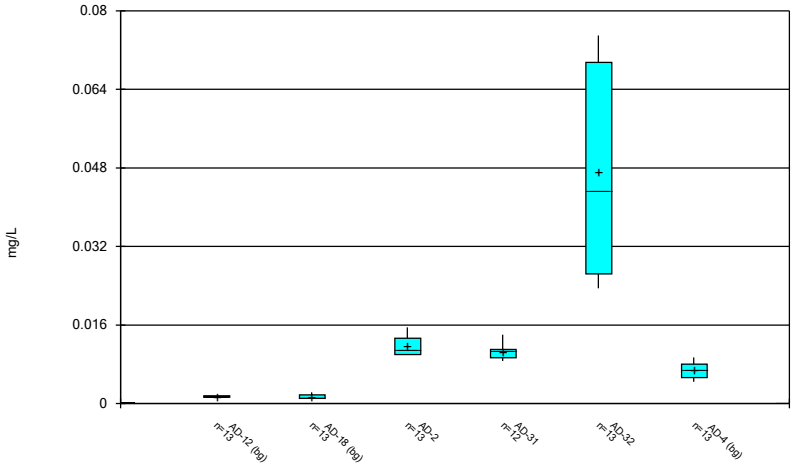
Box & Whiskers Plot



Constituent: Chromium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

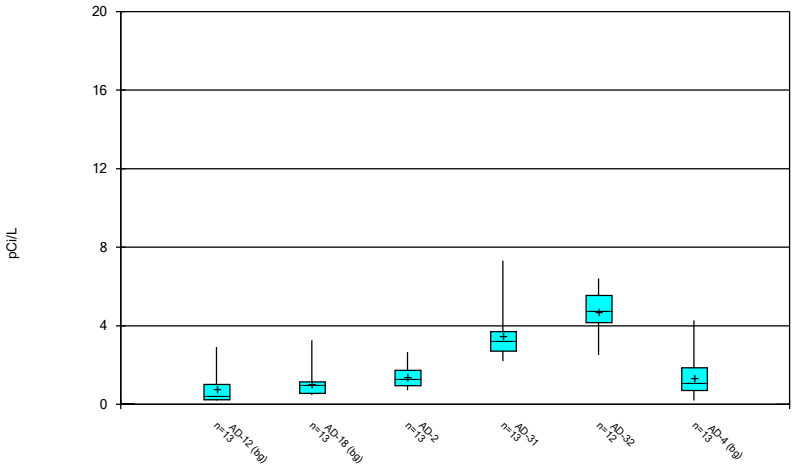
Box & Whiskers Plot



Constituent: Cobalt, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

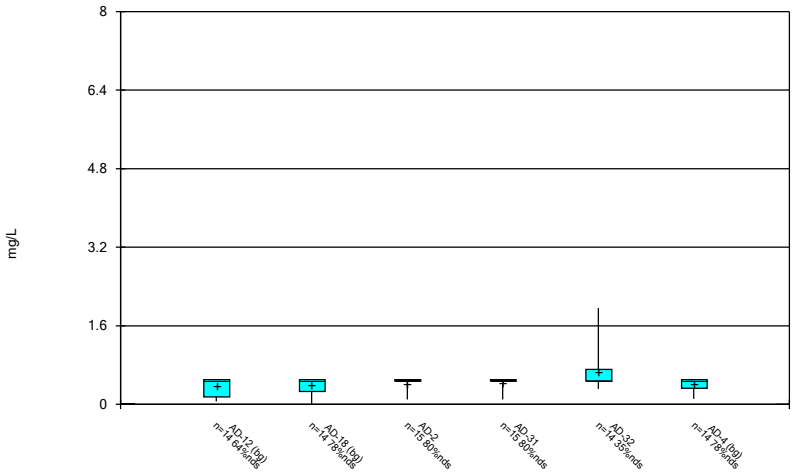
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

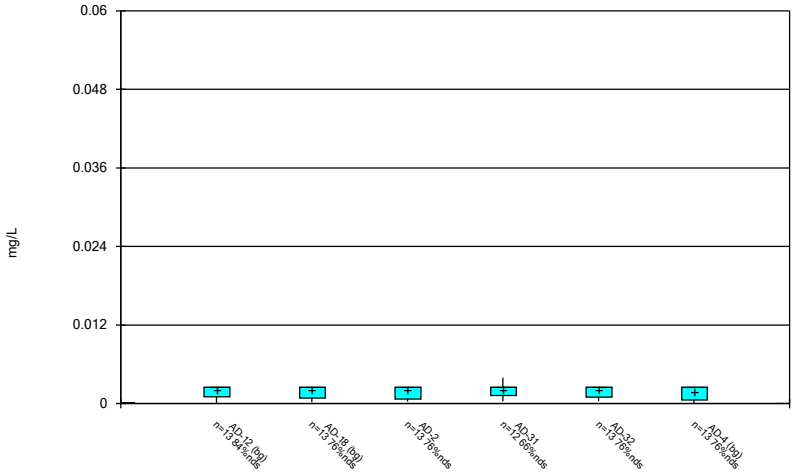
Box & Whiskers Plot



Constituent: Fluoride, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

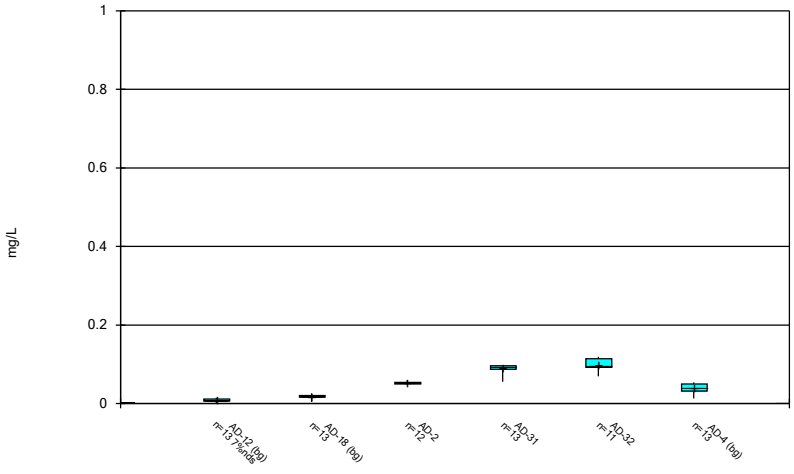
Box & Whiskers Plot



Constituent: Lead, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

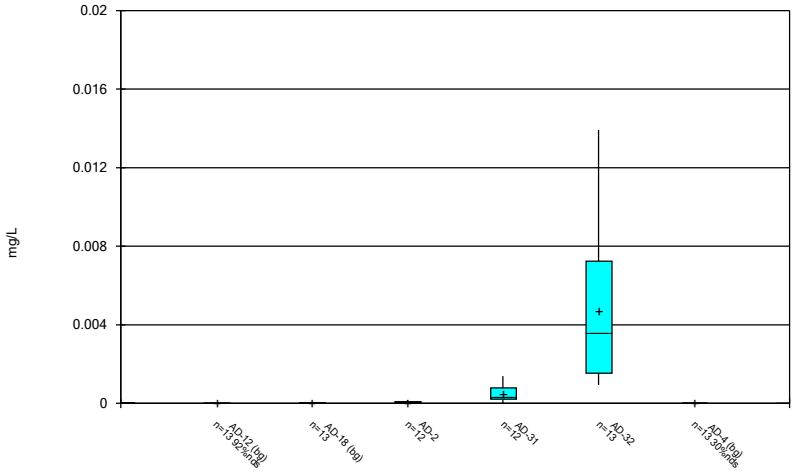
Box & Whiskers Plot



Constituent: Lithium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

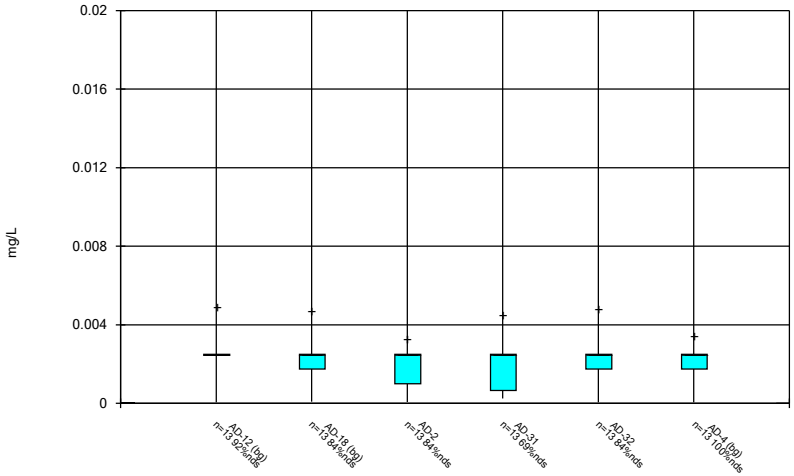
Box & Whiskers Plot



Constituent: Mercury, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

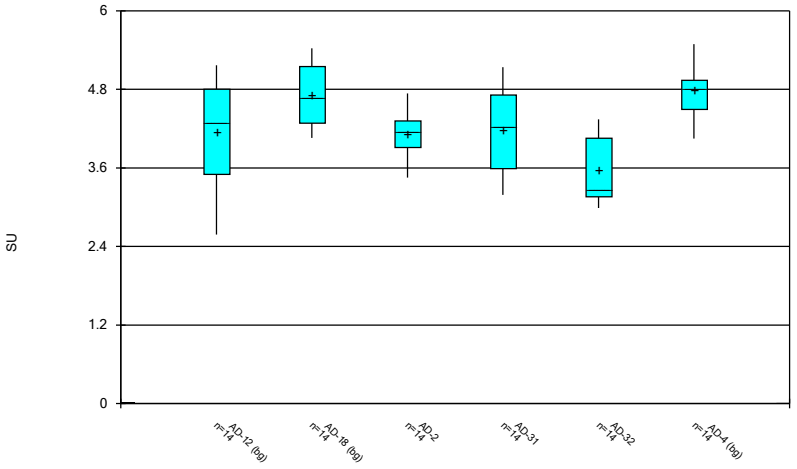
Box & Whiskers Plot



Constituent: Molybdenum, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

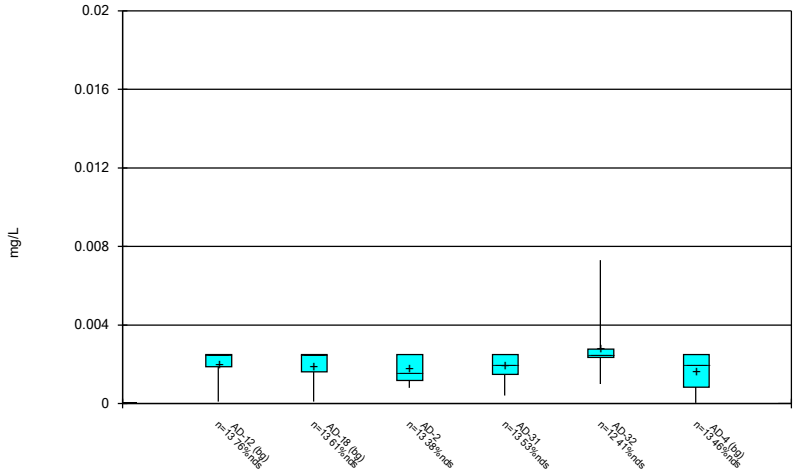
Box & Whiskers Plot



Constituent: pH, field Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

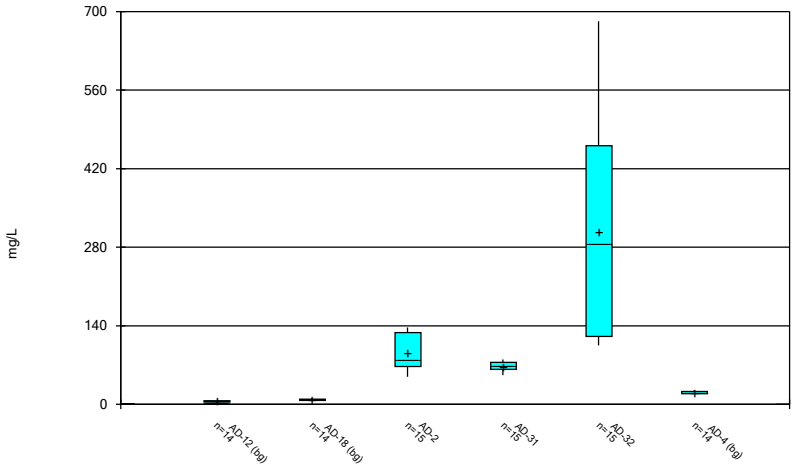
Box & Whiskers Plot



Constituent: Selenium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

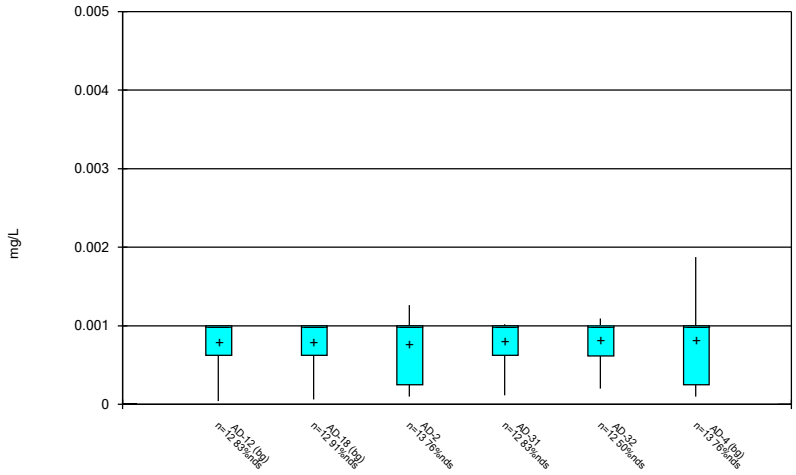
Box & Whiskers Plot



Constituent: Sulfate, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

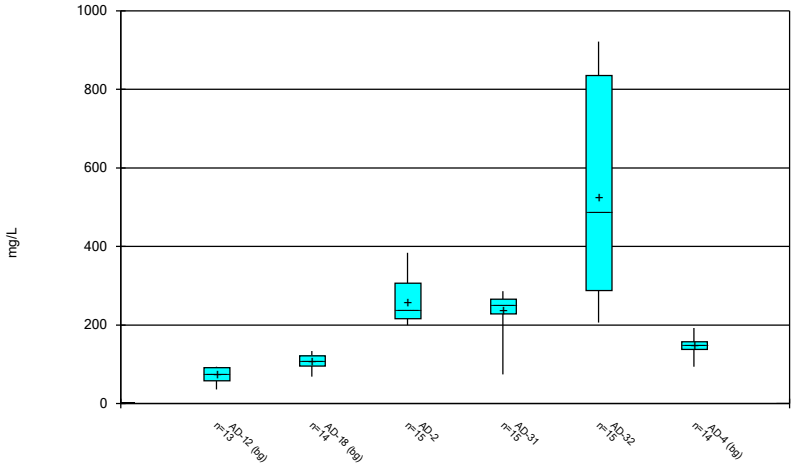
Sanitas™ v.9.6.23 . EPA

Box & Whiskers Plot



Constituent: Thallium, total Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Box & Whiskers Plot



Constituent: Total Dissolved Solids [TDS] Analysis Run 11/25/2019 11:37 AM View: All Data
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Outlier Summary

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 11:50 AM

	AD-31 Arsenic, total (mg/L)	AD-31 Barium, total (mg/L)	AD-31 Beryllium, total (mg/L)	AD-31 Calcium, total (mg/L)	AD-2 Chloride, total (mg/L)	AD-31 Chromium, total (mg/L)	AD-31 Cobalt, total (mg/L)	AD-32 Combined Radium 226 + 228 (pCi/L)	AD-32 Fluoride, total (mg/L)	AD-31 Lead, total (mg/L)
5/11/2016	0.093 (o)	0.712 (o)	0.01 (o)	10.4 (o)		0.212 (o)	0.05 (o)			0.057 (o)
9/7/2016										
10/12/2016								17.32 (o)		
11/14/2016						0.03 (o)				
4/11/2017					50 (o)					
3/21/2018									7.2 (o)	
8/21/2018										
2/27/2019										
2/28/2019										

	AD-2 Lithium, total (mg/L)	AD-32 Lithium, total (mg/L)	AD-2 Mercury, total (mg/L)	AD-31 Mercury, total (mg/L)	AD-32 Selenium, total (mg/L)	AD-12 Thallium, total (mg/L)	AD-18 Thallium, total (mg/L)	AD-31 Thallium, total (mg/L)	AD-32 Thallium, total (mg/L)	AD-12 Total Dissolved Solids [TDS] (mg/L)
5/11/2016	<0.001 (o)	0.016 (o)		0.001797 (o)						
9/7/2016			0.000675 (o)							
10/12/2016		0.972 (o)								
11/14/2016										
4/11/2017										
3/21/2018										<5 (o)
8/21/2018					0.015 (o)					
2/27/2019						<0.01 (o)				
2/28/2019							<0.01 (o)	<0.01 (o)	<0.01 (o)	

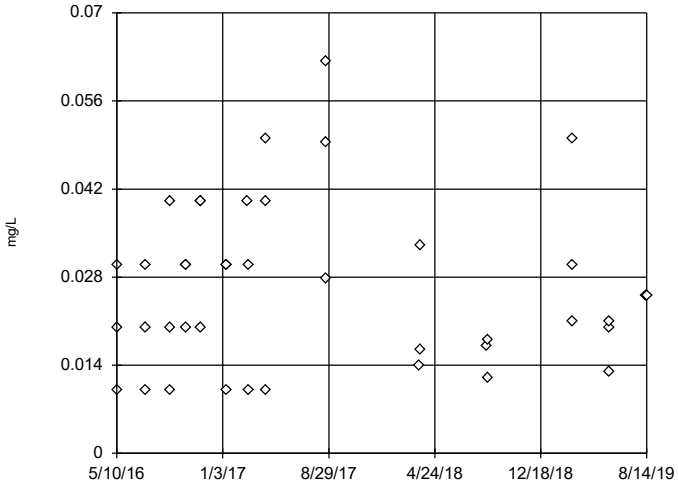
Interwell Outlier Analysis - All Results (No Significant)

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 10:07 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	AD-12,AD-...	No	n/a	n/a w/com...	NP	NaN	42	0.02619	0.01281	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	AD-12,AD-...	No	n/a	n/a w/com...	NP	NaN	42	0.9856	0.9174	ln(x)	ShapiroWilk
Chloride, total (mg/L)	AD-12,AD-...	No	n/a	n/a w/com...	NP	NaN	42	6.291	1.698	sqrt(x)	ShapiroWilk
Fluoride, total (mg/L)	AD-12,AD-...	No	n/a	n/a w/com...	NP	NaN	42	0.7652	0.4008	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	AD-12,AD-...	No	n/a	n/a w/com...	NP	NaN	42	11.18	7.187	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (m...	AD-12,AD-...	No	n/a	n/a w/com...	NP	NaN	41	110.1	35.78	normal	ShapiroWilk

Tukey's Outlier Screening, Pooled Background

AD-12,AD-18,AD-4



n = 42

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 = 0.1226, low cutoff = 0.0004167, based on IQR multiplier of 3.

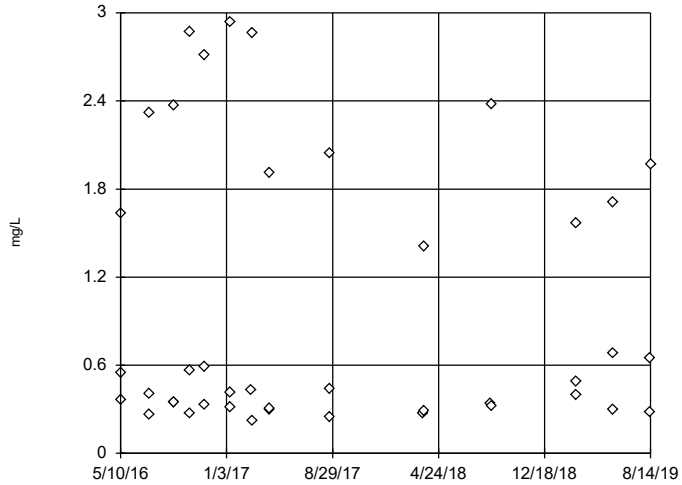
Constituent: Boron, total Analysis Run 11/25/2019 10:05 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-12,AD-18,AD-4



n = 42

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 = 360, low cutoff = 0.001554, based on IQR multiplier of 3.

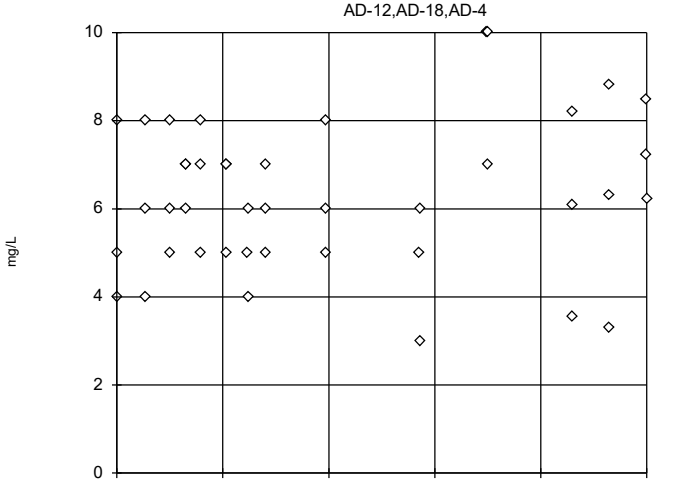
Constituent: Calcium, total Analysis Run 11/25/2019 10:05 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-12,AD-18,AD-4



n = 42

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 = 18.75, low cutoff = 0.4429, based on IQR multiplier of 3.

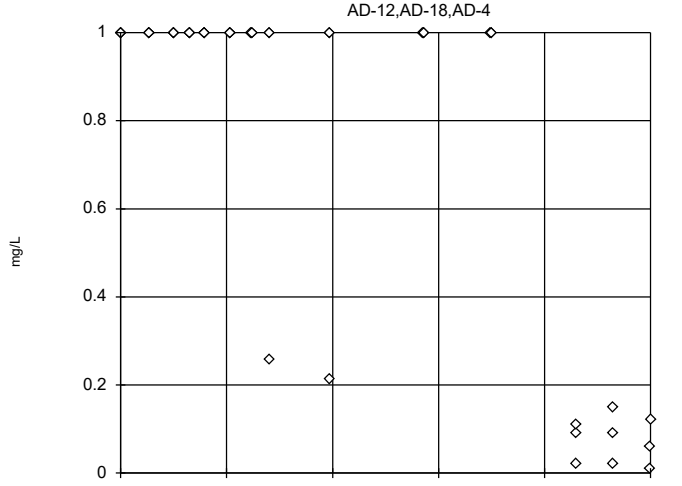
Constituent: Chloride, total Analysis Run 11/25/2019 10:05 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-12,AD-18,AD-4



n = 42

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

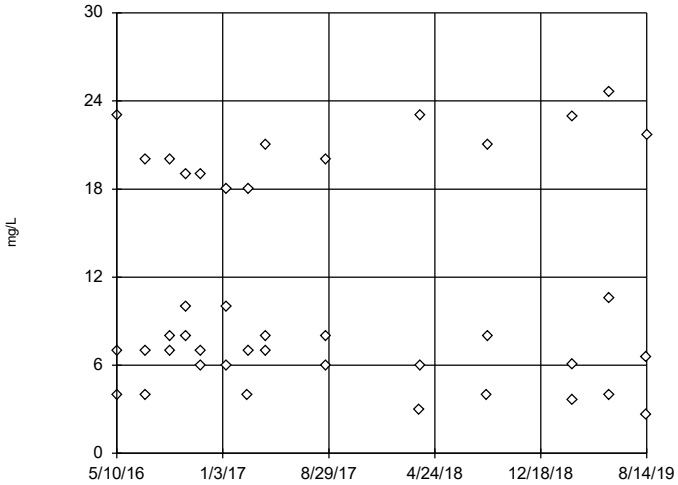
High cutoff = 78.31, low cutoff = 0.002985, based on IQR multiplier of 3.

Constituent: Fluoride, total Analysis Run 11/25/2019 10:06 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening, Pooled Background

AD-12,AD-18,AD-4



n = 42

No outliers found. Tukey's method selected by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

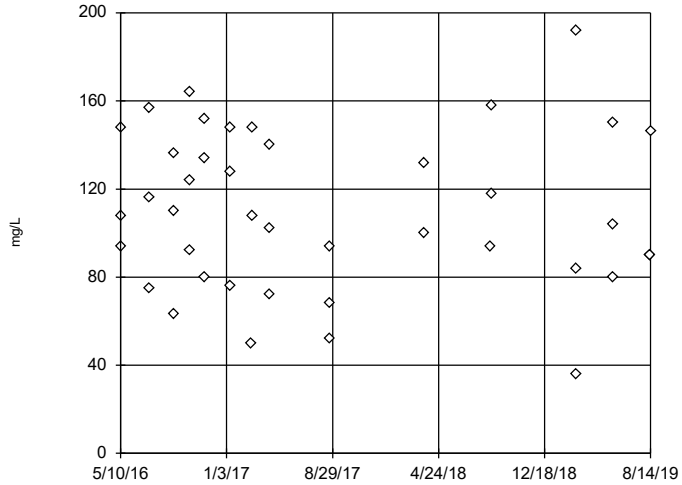
High cutoff = 668.5, low cutoff = 0.175, based on IQR multiplier of 3.

Constituent: Sulfate, total Analysis Run 11/25/2019 10:06 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening, Pooled Background

AD-12,AD-18,AD-4



n = 41

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 326, low cutoff = -101, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/25/2019 10:06 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Intrawell Outlier Analysis - All Results (No Significant)

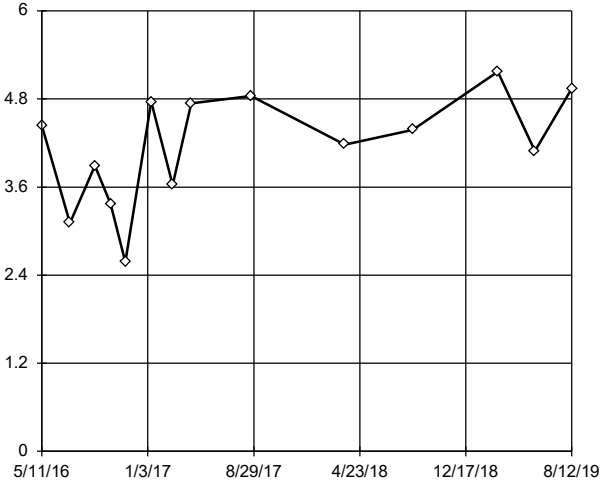
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 10:08 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
pH, field (SU)	AD-12 (bg)	No	n/a	n/a	NP	NaN	14	4.151	0.7593	x^3	ShapiroWilk
pH, field (SU)	AD-18 (bg)	No	n/a	n/a	NP	NaN	14	4.723	0.4418	x^2	ShapiroWilk
pH, field (SU)	AD-2	No	n/a	n/a	NP	NaN	14	4.107	0.3452	x^2	ShapiroWilk
pH, field (SU)	AD-31	No	n/a	n/a	NP	NaN	14	4.174	0.6174	x^(1/3)	ShapiroWilk
pH, field (SU)	AD-32	No	n/a	n/a	NP	NaN	14	3.566	0.4853	ln(x)	ShapiroWilk
pH, field (SU)	AD-4 (bg)	No	n/a	n/a	NP	NaN	14	4.786	0.3829	normal	ShapiroWilk

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-12 (bg)



n = 14

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 = 6.792, low cutoff = -5.425, based on IQR multiplier of 3.

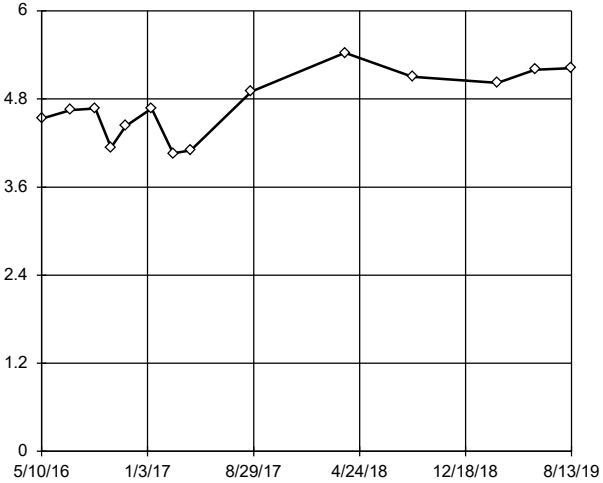
Constituent: pH, field Analysis Run 11/25/2019 10:08 AM View: Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-18 (bg)



n = 14

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 = 7.138, low cutoff = -2.459, based on IQR multiplier of 3.

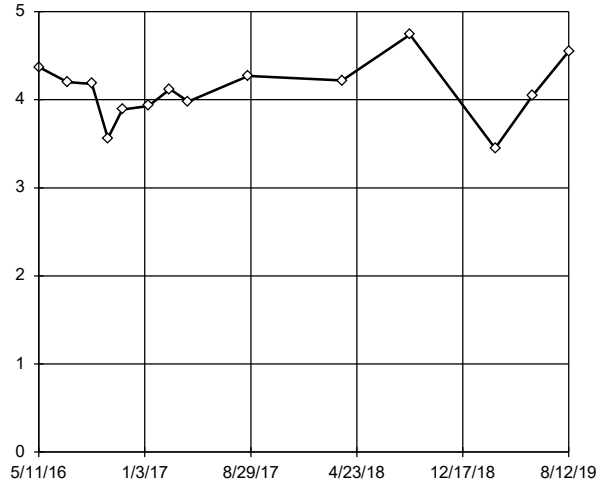
Constituent: pH, field Analysis Run 11/25/2019 10:08 AM View: Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



n = 14

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 = 5.366, low cutoff = 2.271, based on IQR multiplier of 3.

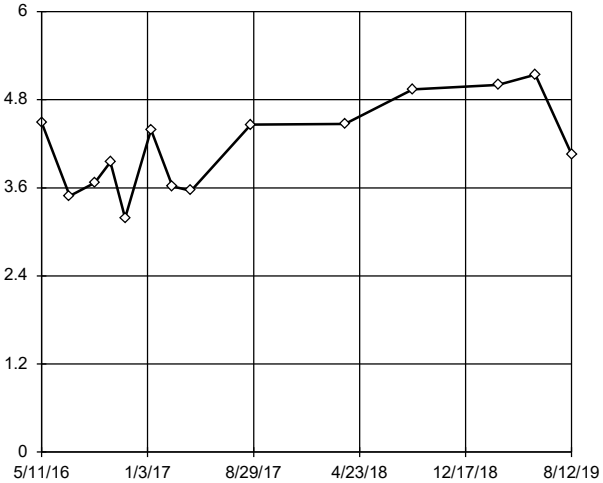
Constituent: pH, field Analysis Run 11/25/2019 10:08 AM View: Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



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).

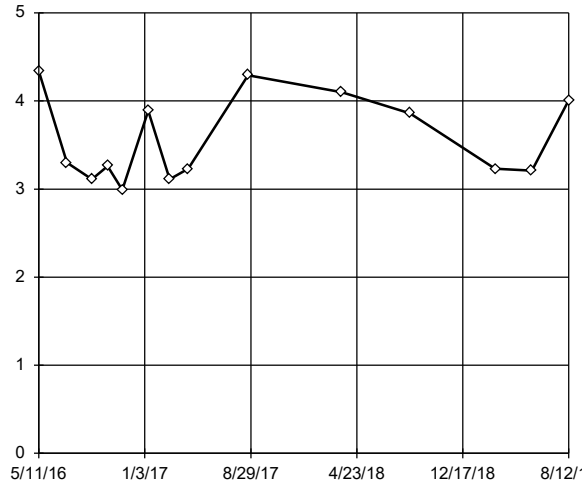
High cutoff = 9.423, low cutoff = 1.315, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/25/2019 10:08 AM View: Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-32



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).

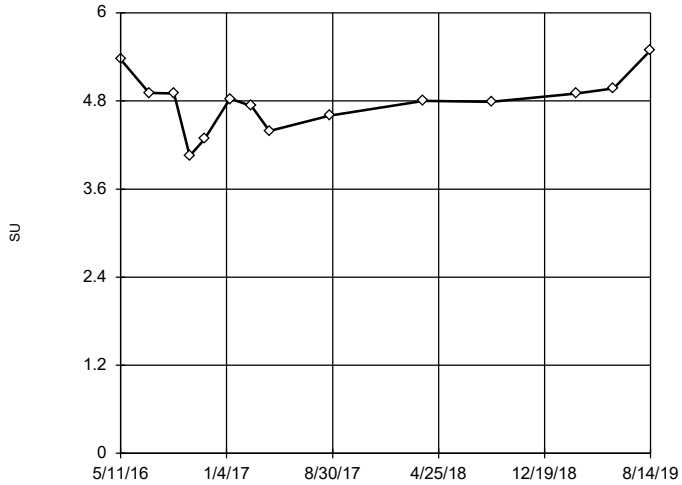
High cutoff = 8.57, low cutoff = 1.495, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/25/2019 10:08 AM View: Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-4 (bg)



n = 14

No outliers found. Tukey's method selected by user.

Ladder of Powers transformations did not improve normality; analysis run on raw data.

High cutoff = 6.275, low cutoff = 3.16, based on IQR multiplier of 3.

Constituent: pH, field Analysis Run 11/25/2019 10:08 AM View: Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Downgradient Appendix IV Outlier Analysis - Significant Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 10:18 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Beryllium, total (mg/L)	**AD-2**	**Yes**	**0.001**	**5/22/2019**	**NP**	**NaN**	**13**	**0.000...**	**0.0001631**	**ln(x)**	**ShapiroWilk**
Beryllium, total (mg/L)	**AD-31**	**Yes**	**0.01**	**5/11/2016**	**NP**	**NaN**	**13**	**0.001824**	**0.002489**	**ln(x)**	**ShapiroWilk**
Fluoride, total (mg/L)	**AD-32**	**Yes**	**7.2**	**3/21/2018**	**NP**	**NaN**	**15**	**1.257**	**1.69**	**ln(x)**	**ShapiroWilk**
Molybdenum, total (mg/L)	**AD-32**	**Yes**	**0.00004,0...**	**8/21/2018...**	**NP**	**NaN**	**13**	**0.009446**	**0.01368**	**x^(1/3)**	**ShapiroWilk**

Downgradient Appendix IV Outlier Analysis - All Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 10:18 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Antimony, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.003628	0.002196	sqrt(x)	ShapiroWilk
Antimony, total (mg/L)	AD-31	n/a	n/a	n/a	NP	NaN	13	0.003778	0.001988	unknown	ShapiroWilk
Antimony, total (mg/L)	AD-32	n/a	n/a	n/a	NP	NaN	13	0.003778	0.001989	unknown	ShapiroWilk
Arsenic, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.003723	0.002031	x^(1/3)	ShapiroWilk
Arsenic, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	12	0.003897	0.002691	x^(1/3)	ShapiroWilk
Arsenic, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.005052	0.003274	x^(1/3)	ShapiroWilk
Barium, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.03352	0.0057	x^6	ShapiroWilk
Barium, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	12	0.06554	0.02637	x^(1/3)	ShapiroWilk
Barium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.03612	0.01024	sqrt(x)	ShapiroWilk
Beryllium, total (mg/L)	**AD-2**	**Yes**	**0.001**	**5/22/2019**	**NP**	**NaN**	**13**	**0.000...**	**0.0001631**	**ln(x)**	**ShapiroWilk**
Beryllium, total (mg/L)	**AD-31**	**Yes**	**0.01**	**5/11/2016**	**NP**	**NaN**	**13**	**0.001824**	**0.002489**	**ln(x)**	**ShapiroWilk**
Beryllium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.005202	0.002256	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.000...	0.0004122	sqrt(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	13	0.000...	0.0004484	ln(x)	ShapiroWilk
Cadmium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.000...	0.0001743	normal	ShapiroWilk
Chromium, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.000...	0.0009898	ln(x)	ShapiroWilk
Chromium, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	12	0.009698	0.008089	x^(1/3)	ShapiroWilk
Chromium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.006133	0.005302	x^(1/3)	ShapiroWilk
Cobalt, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.01165	0.001847	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	12	0.01048	0.001419	ln(x)	ShapiroWilk
Cobalt, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.04704	0.02056	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-2	No	n/a	n/a	NP	NaN	13	1.398	0.5579	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-31	No	n/a	n/a	NP	NaN	13	3.454	1.289	ln(x)	ShapiroWilk
Combined Radium 226 + 228 (pCi/L)	AD-32	No	n/a	n/a	NP	NaN	12	4.735	1.074	x^2	ShapiroWilk
Fluoride, total (mg/L)	AD-2	n/a	n/a	n/a	NP	NaN	15	0.82	0.3726	unknown	ShapiroWilk
Fluoride, total (mg/L)	AD-31	n/a	n/a	n/a	NP	NaN	15	0.826	0.3604	unknown	ShapiroWilk
Fluoride, total (mg/L)	**AD-32**	**Yes**	**7.2**	**3/21/2018**	**NP**	**NaN**	**15**	**1.257**	**1.69**	**ln(x)**	**ShapiroWilk**
Lead, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.003691	0.002086	sqrt(x)	ShapiroWilk
Lead, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	12	0.003434	0.00182	sqrt(x)	ShapiroWilk
Lead, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.003778	0.001939	ln(x)	ShapiroWilk
Lithium, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.04812	0.01467	x^6	ShapiroWilk
Lithium, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	13	0.0892	0.01162	x^6	ShapiroWilk
Lithium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	12	0.09291	0.02791	x^4	ShapiroWilk
Mercury, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.000...	0.0001745	ln(x)	ShapiroWilk
Mercury, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	12	0.000...	0.0004424	x^(1/3)	ShapiroWilk
Mercury, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.004692	0.003739	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	AD-2	n/a	n/a	n/a	NP	NaN	13	0.006533	0.01022	unknown	ShapiroWilk
Molybdenum, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	13	0.008758	0.01402	ln(x)	ShapiroWilk
Molybdenum, total (mg/L)	**AD-32**	**Yes**	**0.00004,0...**	**8/21/2018...**	**NP**	**NaN**	**13**	**0.009446**	**0.01368**	**x^(1/3)**	**ShapiroWilk**
Selenium, total (mg/L)	AD-2	No	n/a	n/a	NP	NaN	13	0.002739	0.001887	ln(x)	ShapiroWilk
Selenium, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	13	0.003221	0.001784	sqrt(x)	ShapiroWilk
Selenium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	12	0.003903	0.001797	sqrt(x)	ShapiroWilk
Thallium, total (mg/L)	AD-2	n/a	n/a	n/a	NP	NaN	13	0.00142	0.0008116	unknown	ShapiroWilk
Thallium, total (mg/L)	AD-31	No	n/a	n/a	NP	NaN	13	0.002164	0.002461	ln(x)	ShapiroWilk
Thallium, total (mg/L)	AD-32	No	n/a	n/a	NP	NaN	13	0.001985	0.002521	ln(x)	ShapiroWilk

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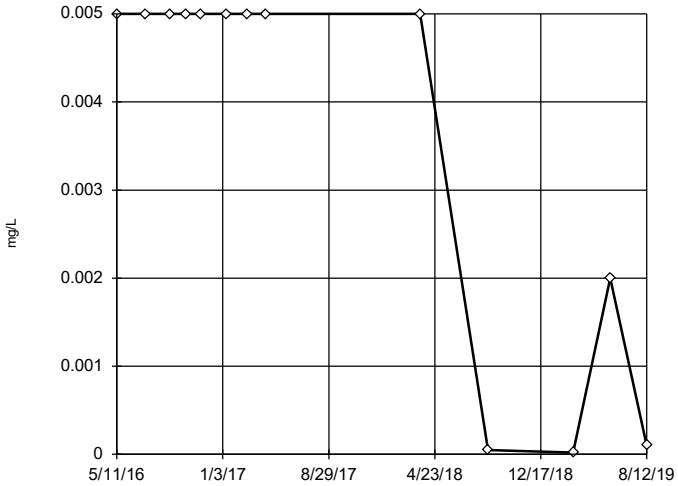
Tukey's Outlier Screening

AD-2



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 = 0.0403, low cutoff = -0.01055, based on IQR multiplier of 3.

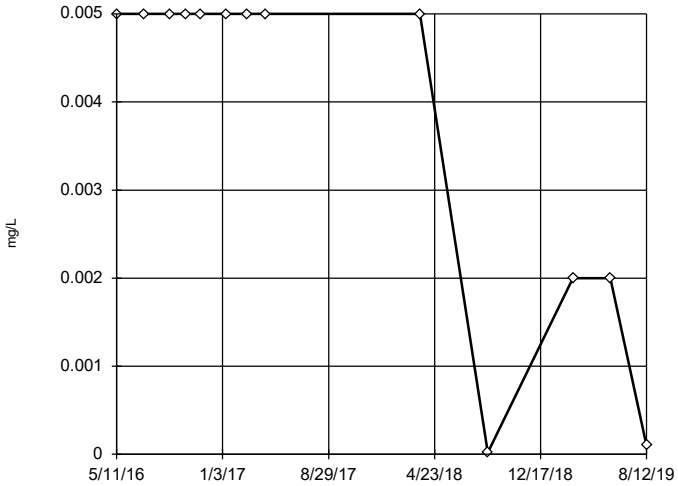
Constituent: Antimony, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



n = 13

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 both the lower and upper quartiles represent reporting limits.

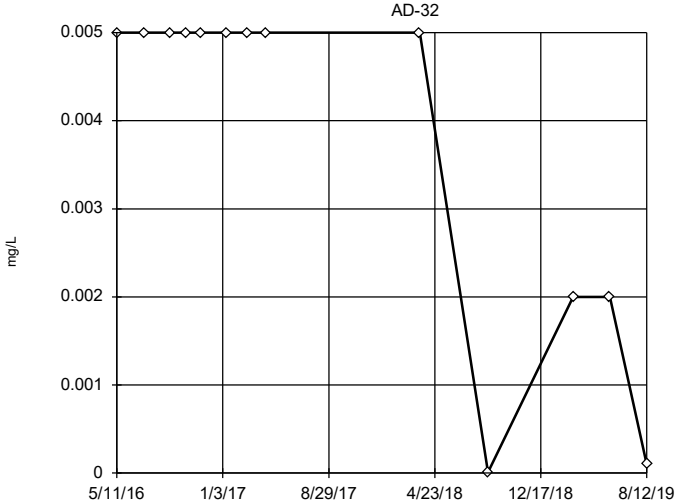
Constituent: Antimony, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



n = 13

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 both the lower and upper quartiles represent reporting limits.

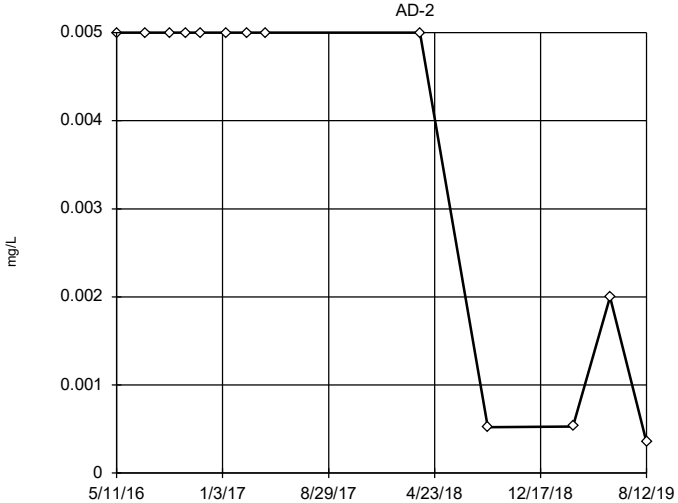
Constituent: Antimony, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

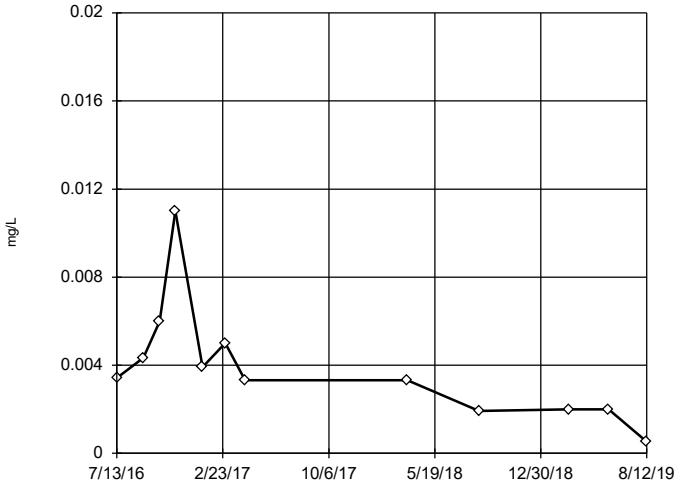
High cutoff = 0.05215, low cutoff = -0.0009749, based on IQR multiplier of 3.

Constituent: Arsenic, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-31



n = 12

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 = 0.02445, low cutoff = 2.2e-8, based on IQR multiplier of 3.

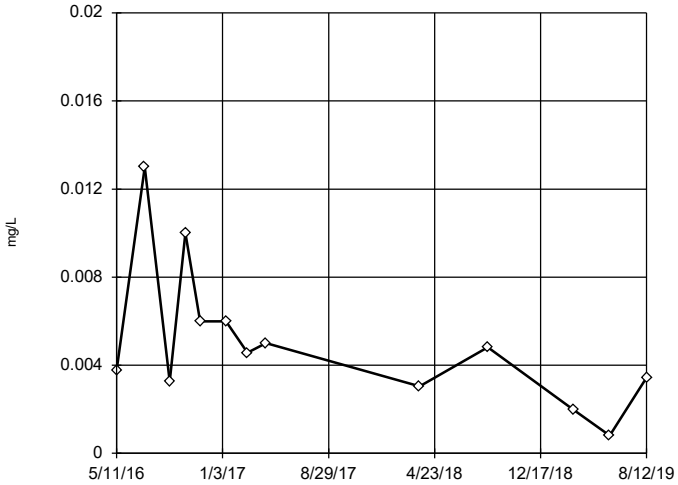
Constituent: Arsenic, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



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 = 0.02362, low cutoff = 0.00007109, based on IQR multiplier of 3.

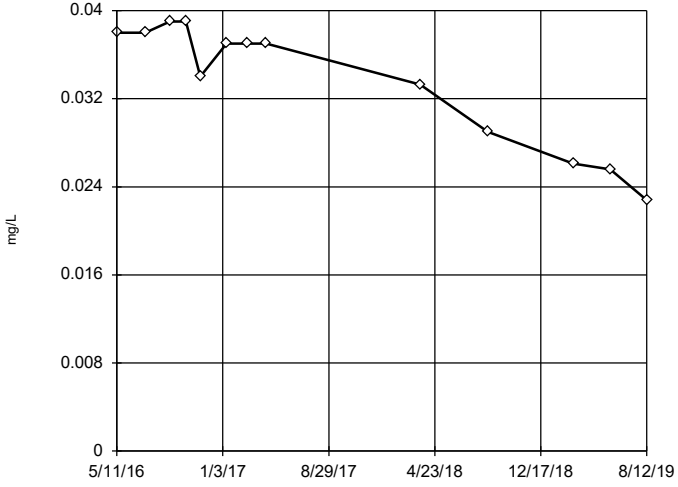
Constituent: Arsenic, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



n = 13

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 = 0.04693, low cutoff = -0.04395, based on IQR multiplier of 3.

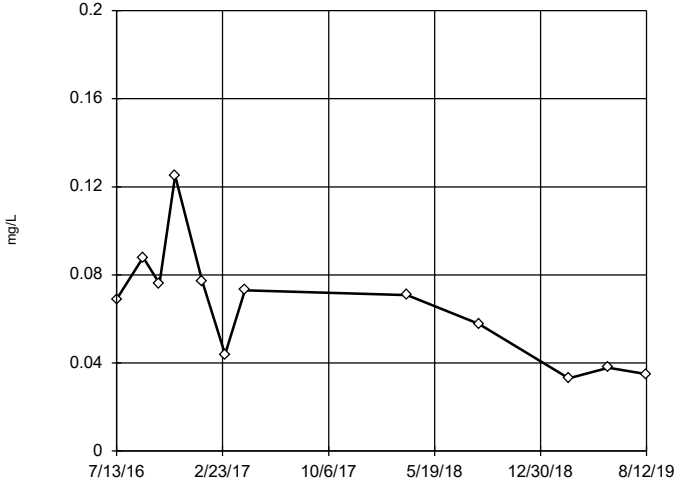
Constituent: Barium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



n = 12

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

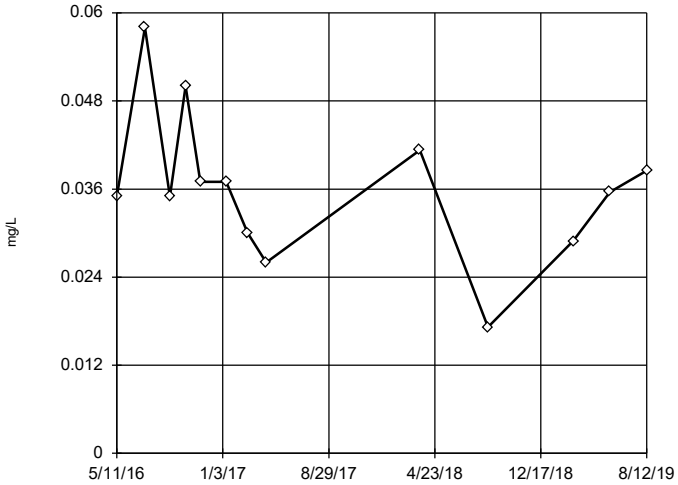
High cutoff = 0.2936, low cutoff = 0.001136, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-32



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).

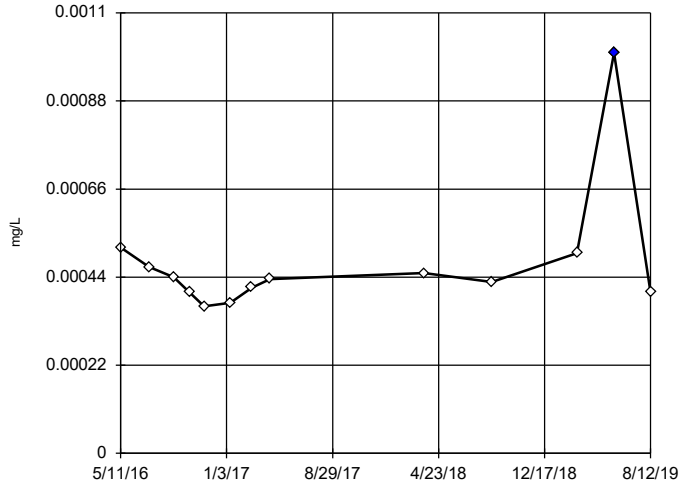
High cutoff = 0.0807, low cutoff = 0.007613, based on IQR multiplier of 3.

Constituent: Barium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

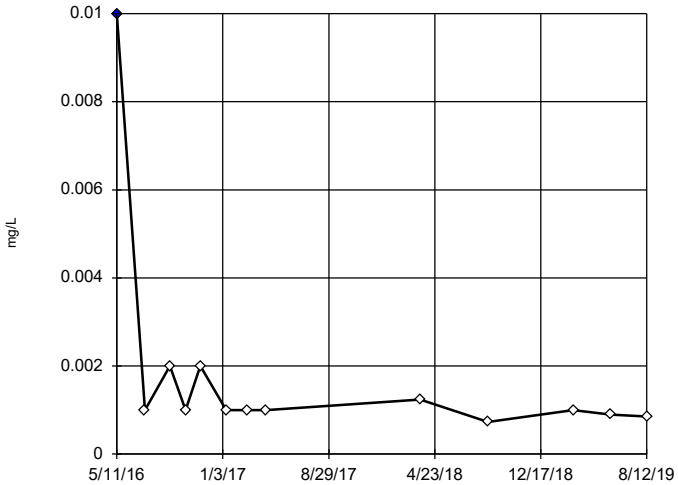
High cutoff = 0.0008336, low cutoff = 0.0002325, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



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).

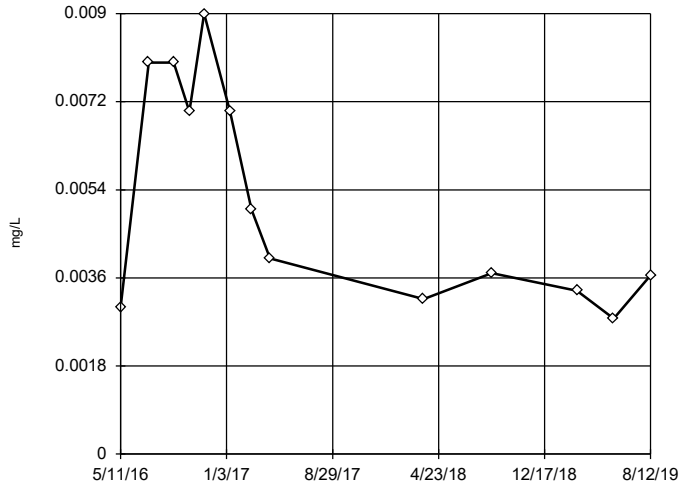
High cutoff = 0.007222, low cutoff = 0.0002067, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



n = 13

No outliers found. Tukey's method selected by user.

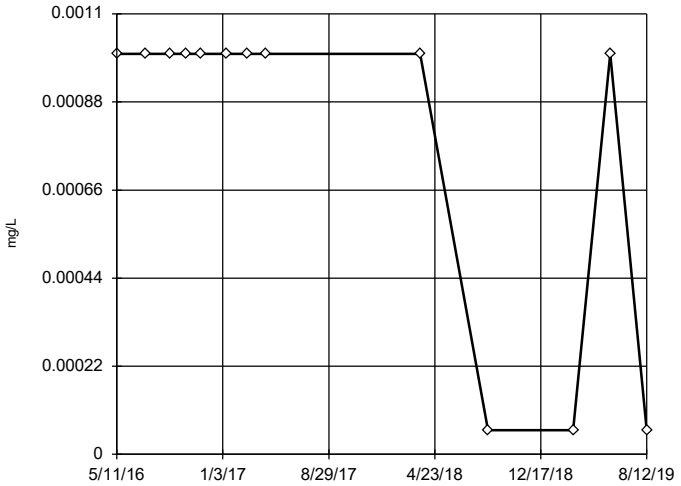
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.09103, low cutoff = 0.0002675, based on IQR multiplier of 3.

Constituent: Beryllium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-2



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 = 0.004548, low cutoff = -0.0002602, based on IQR multiplier of 3.

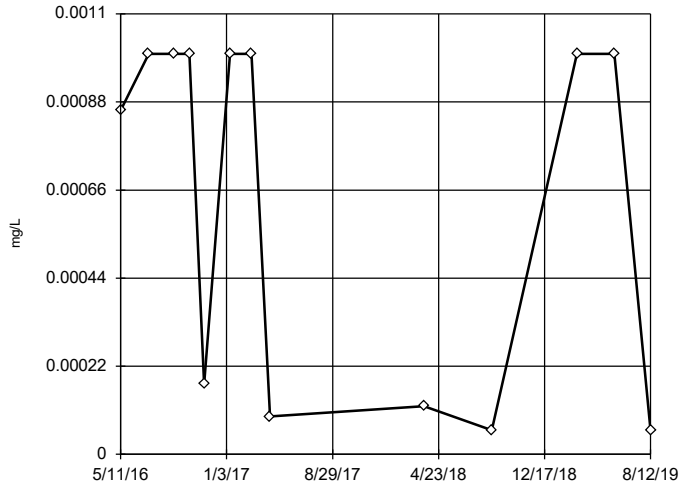
Constituent: Cadmium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



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 = 0.8294, low cutoff = 1.3e-7, based on IQR multiplier of 3.

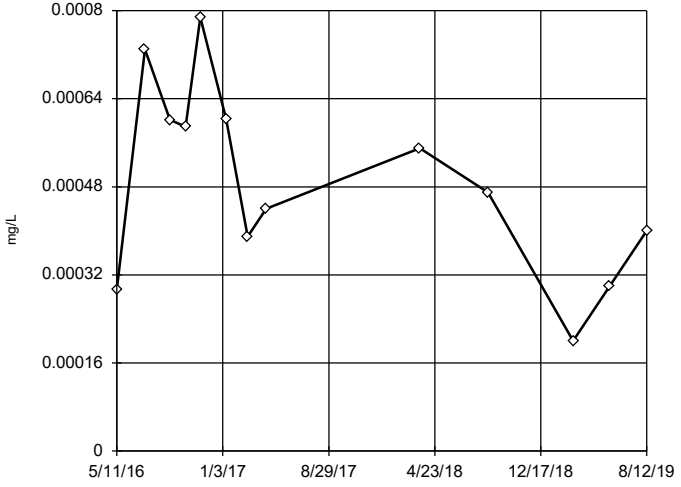
Constituent: Cadmium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



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 = 0.001373, low cutoff = -0.0004266, based on IQR multiplier of 3.

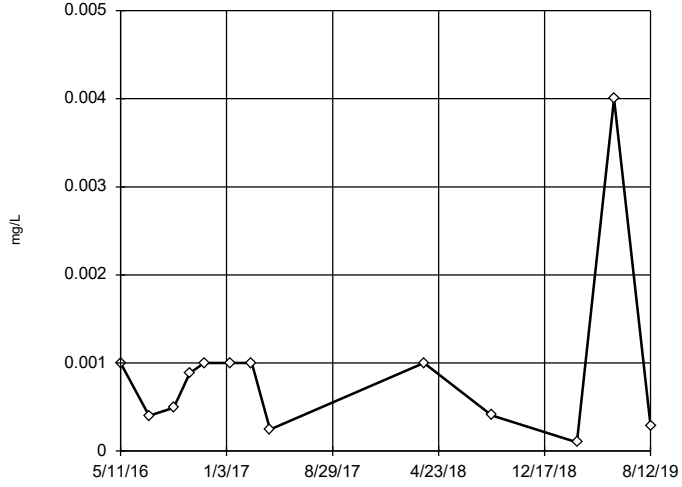
Constituent: Cadmium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

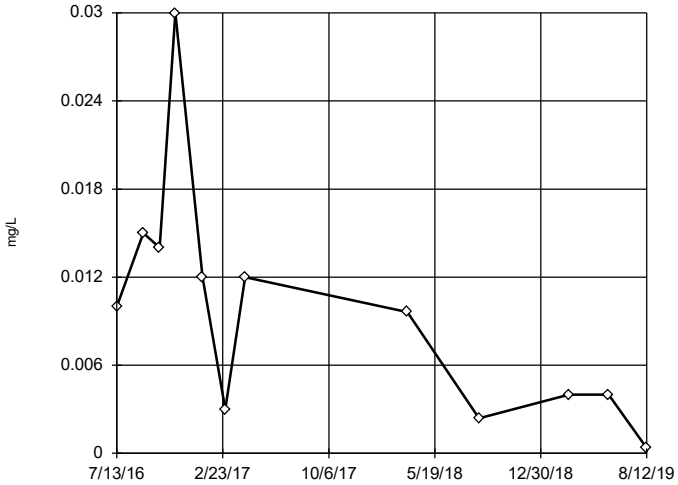
High cutoff = 0.02487, low cutoff = 0.00001377, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-31



n = 12

No outliers found. Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

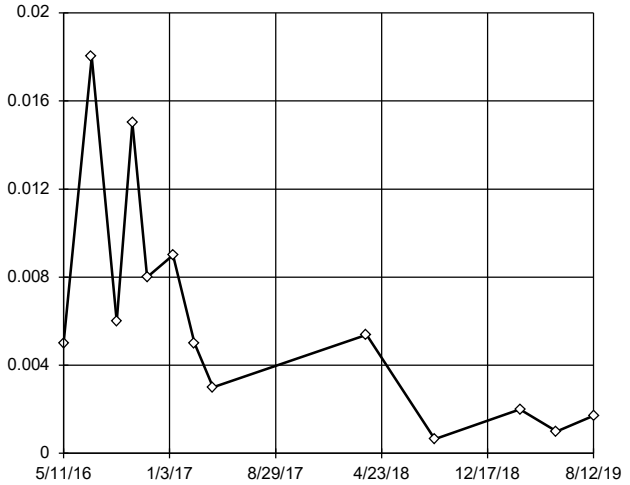
High cutoff = 0.1144, low cutoff = -0.0009705, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



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).

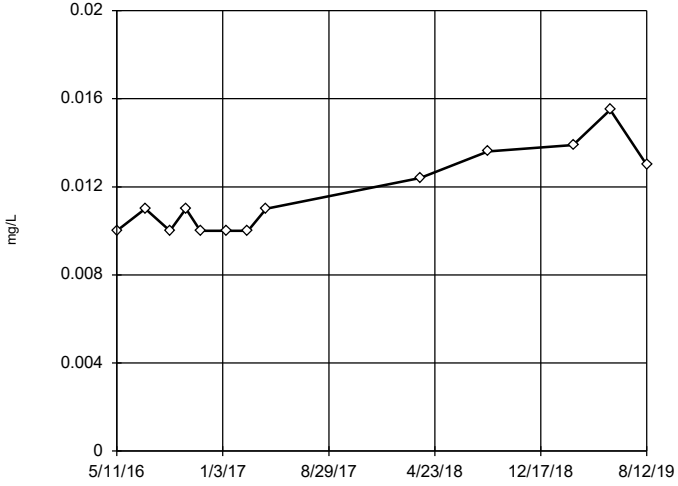
High cutoff = 0.08992, low cutoff = -0.001786, based on IQR multiplier of 3.

Constituent: Chromium, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

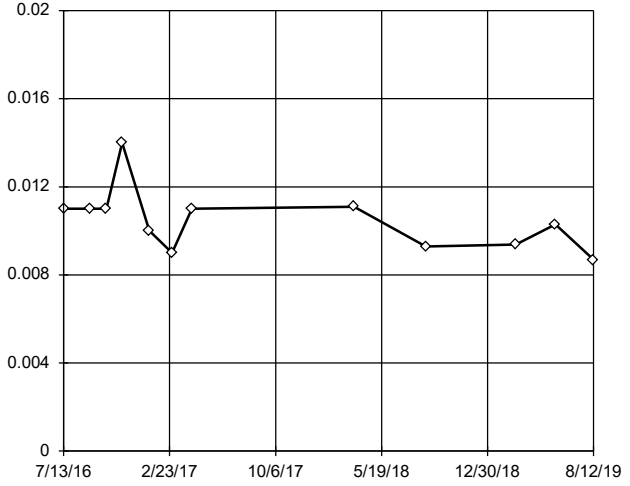
High cutoff = 0.03126, low cutoff = 0.004254, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



n = 12

No outliers found. Tukey's method selected by user.

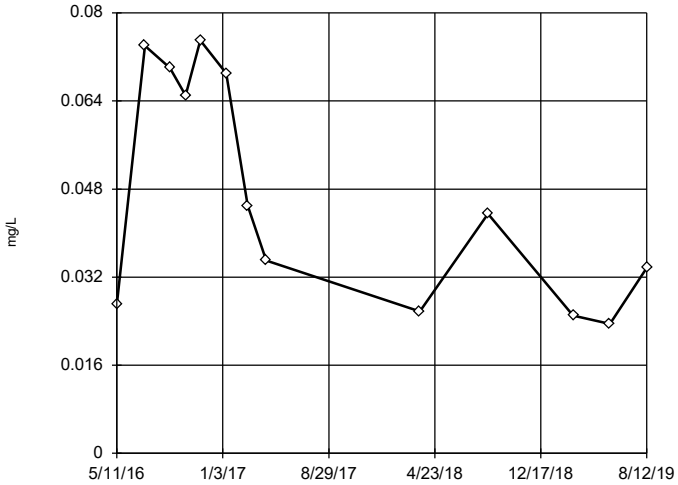
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.018, low cutoff = 0.005705, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-32



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).

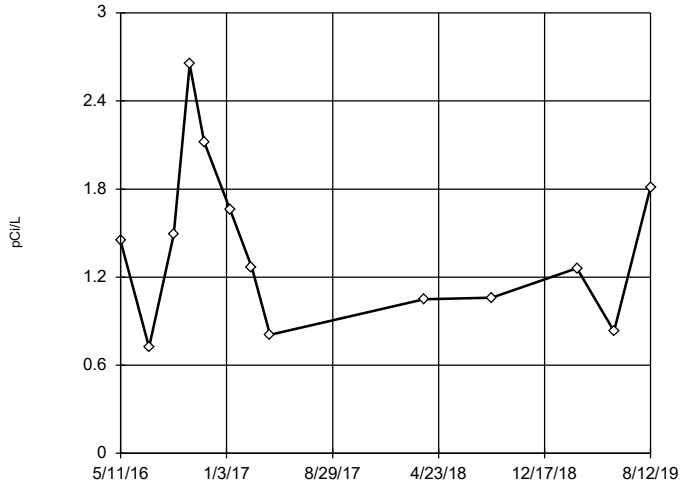
High cutoff = 1.269, low cutoff = 0.001446, based on IQR multiplier of 3.

Constituent: Cobalt, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

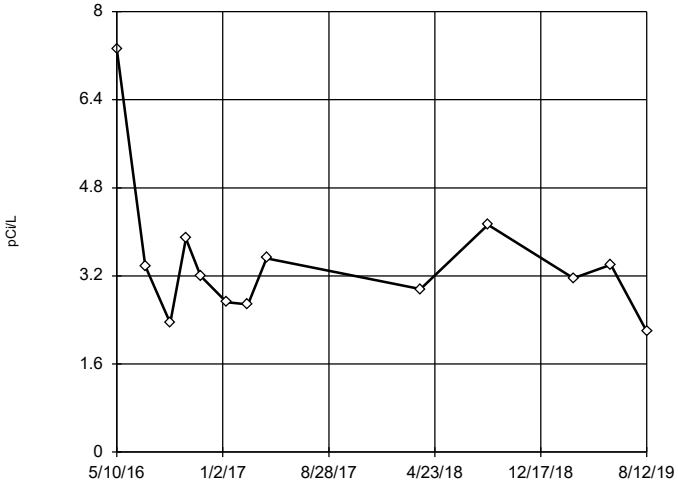
High cutoff = 11.03, low cutoff = 0.1468, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



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).

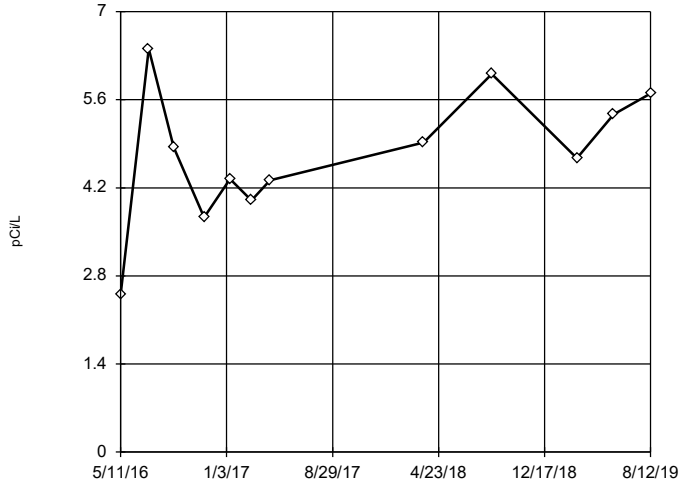
High cutoff = 9.436, low cutoff = 1.059, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



n = 12

No outliers found. Tukey's method selected by user.

Data were square transformed to achieve best W statistic (graph shown in original units).

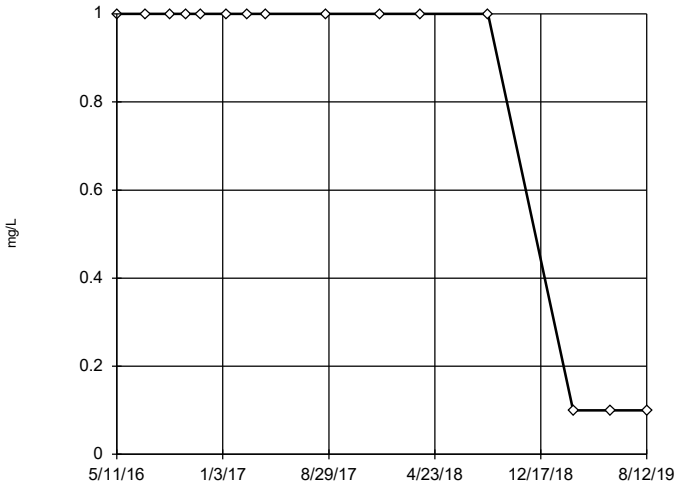
High cutoff = 8.405, low cutoff = -4.759, based on IQR multiplier of 3.

Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



n = 15

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.

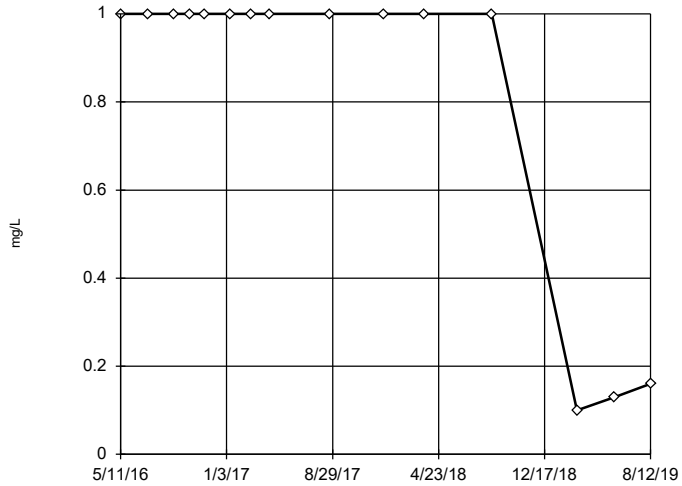
Constituent: Fluoride, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



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).

The results were invalidated, because the lower and upper quartiles are equal.

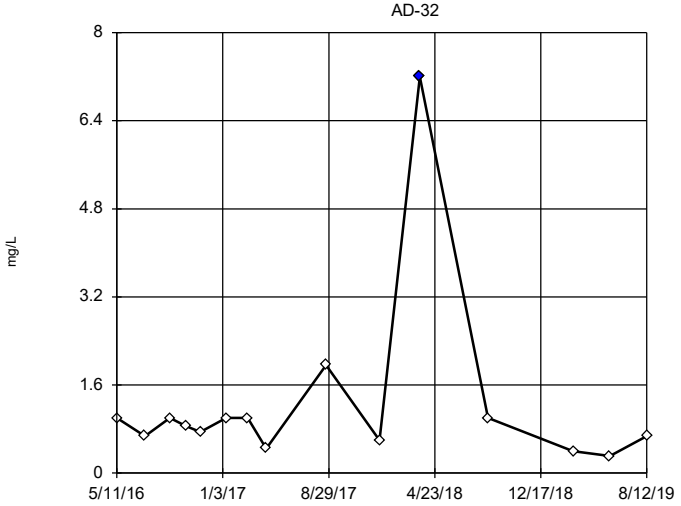
Constituent: Fluoride, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



n = 15

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 = 4.791, low cutoff = 0.1238, based on IQR multiplier of 3.

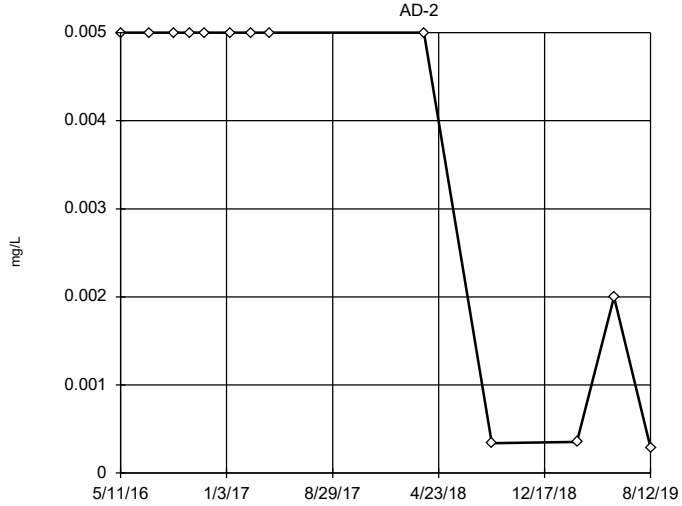
Constituent: Fluoride, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

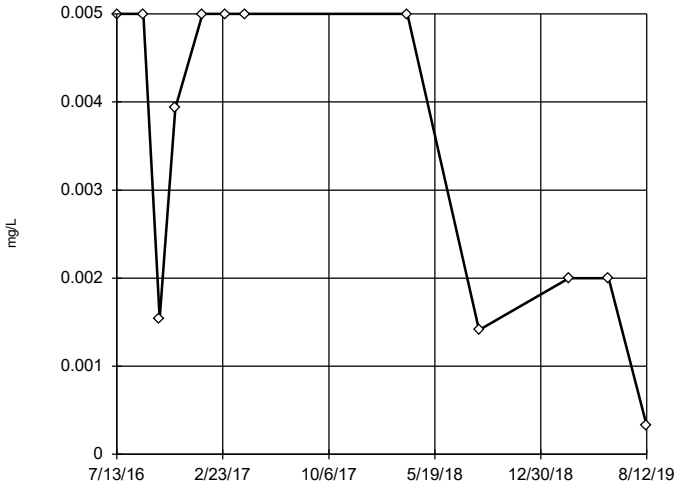
High cutoff = 0.03516, low cutoff = -0.007226, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-31



n = 12

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

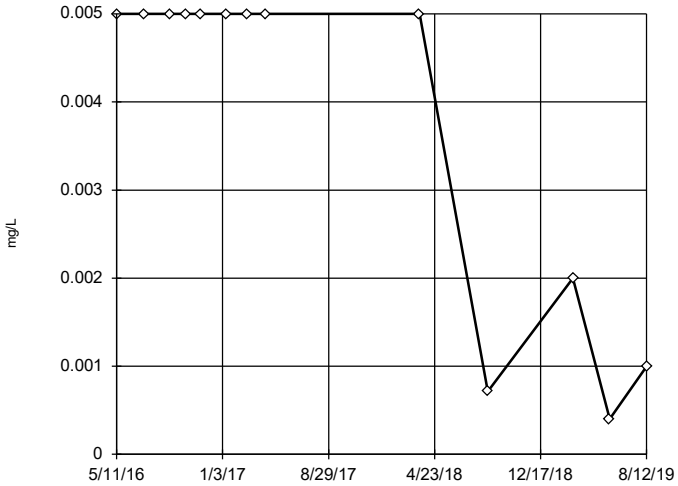
High cutoff = 0.02462, low cutoff = -0.001953, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



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).

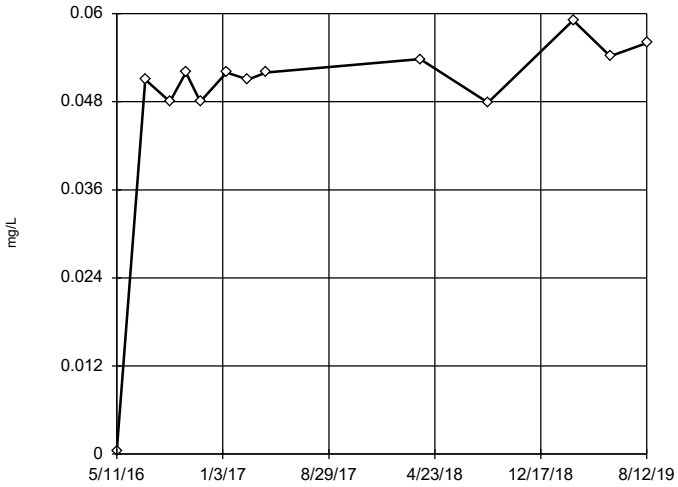
High cutoff = 0.2223, low cutoff = 0.00003174, based on IQR multiplier of 3.

Constituent: Lead, total Analysis Run 11/25/2019 10:13 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



n = 13

No outliers found. Tukey's method selected by user.

Data were x^6 transformed to achieve best W statistic (graph shown in original units).

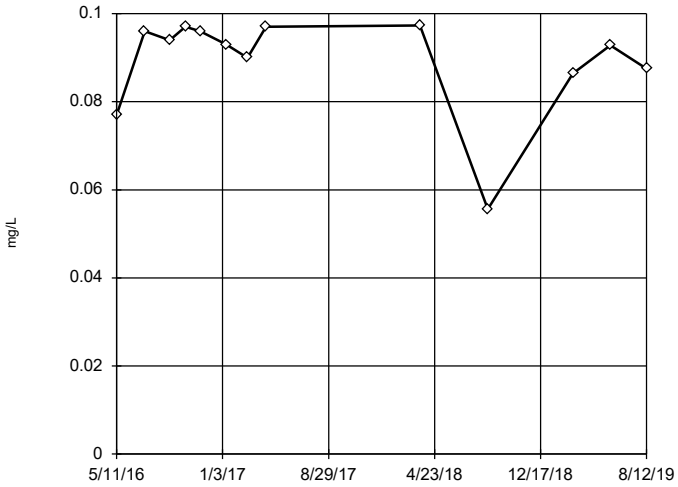
High cutoff = 0.063, low cutoff = -0.05425, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



n = 13

No outliers found. Tukey's method selected by user.

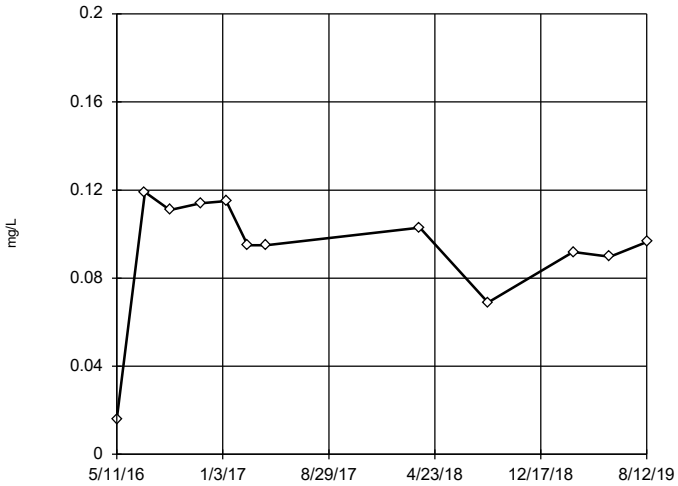
Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1116, low cutoff = -0.09409, based on IQR multiplier of 3.

Constituent: Lithium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-32



n = 12

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 = 0.1446, low cutoff = -0.1202, based on IQR multiplier of 3.

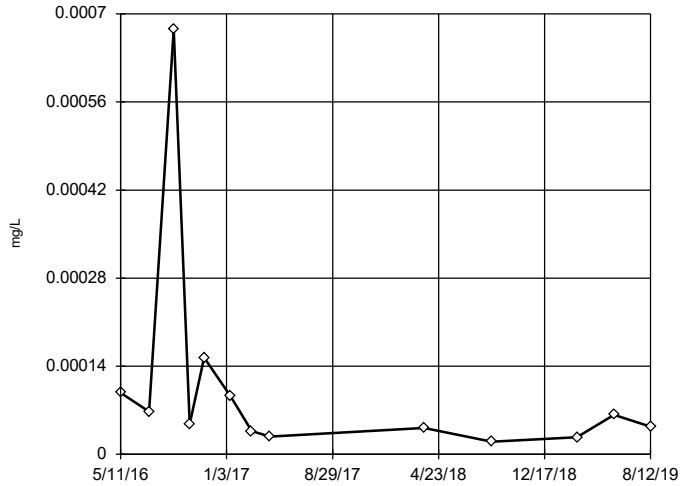
Constituent: Lithium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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 = 0.002491, low cutoff = 0.000001234, based on IQR multiplier of 3.

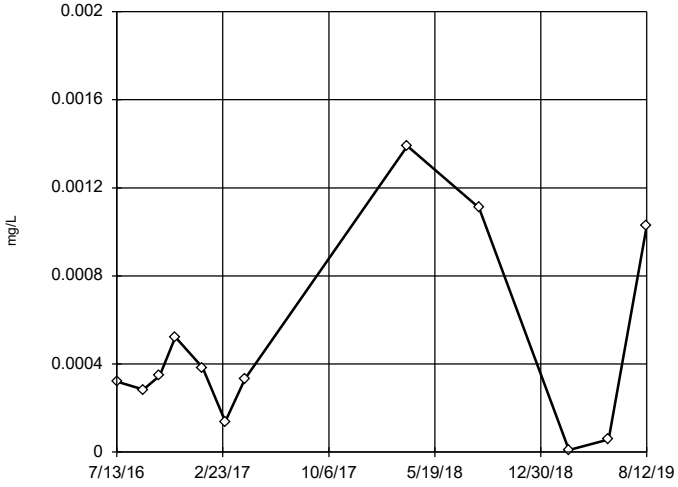
Constituent: Mercury, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



n = 12

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 = 0.006519, low cutoff = -0.00005221, based on IQR multiplier of 3.

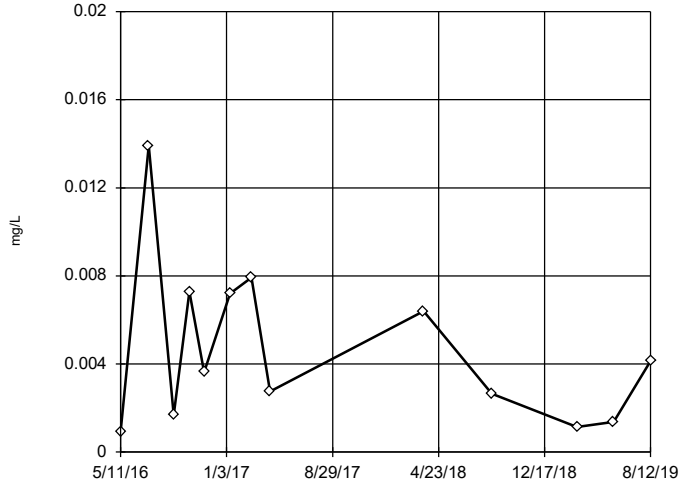
Constituent: Mercury, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



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).

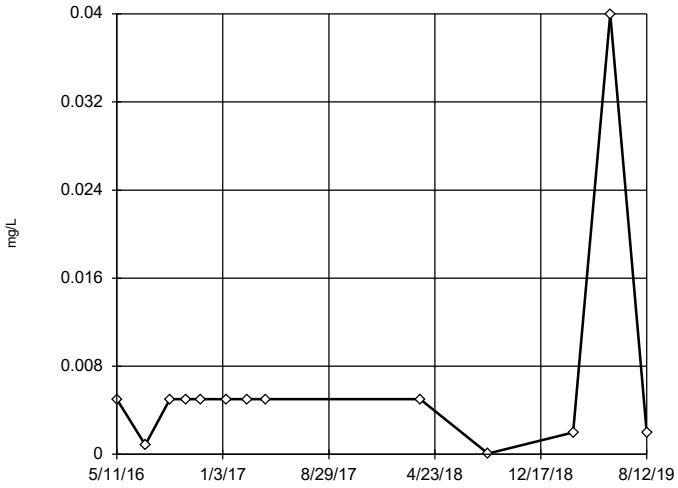
High cutoff = 0.7875, low cutoff = 0.00001396, based on IQR multiplier of 3.

Constituent: Mercury, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-2



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).

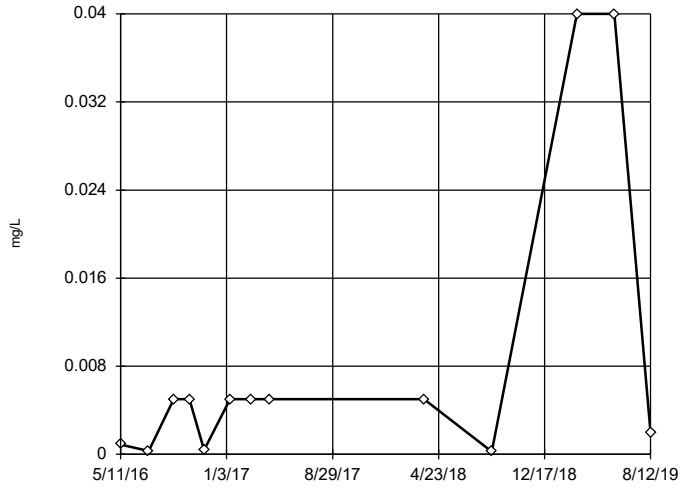
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Molybdenum, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



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).

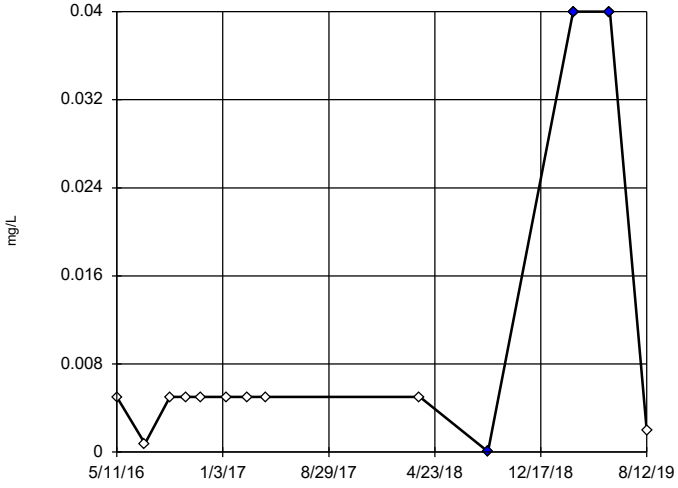
High cutoff = 2.906, low cutoff = 0.000001031, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



n = 13

Outliers are drawn as solid.
Tukey's method selected by user.

Data were cube root transformed to achieve best W statistic (graph shown in original units).

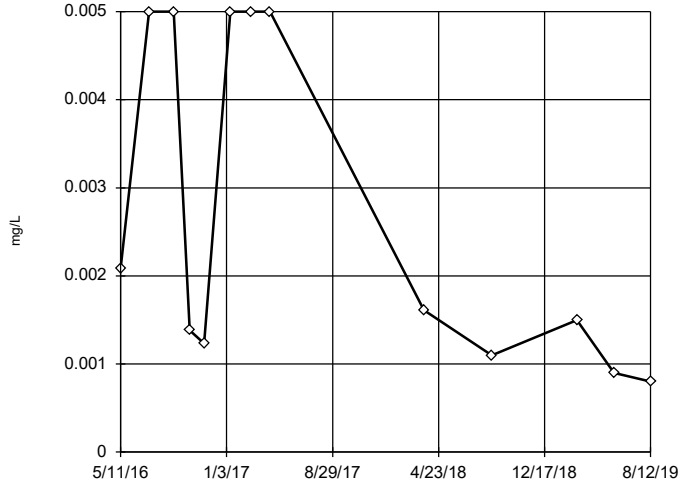
High cutoff = 0.01357, low cutoff = 0.0005312, based on IQR multiplier of 3.

Constituent: Molybdenum, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



n = 13

No outliers found.
Tukey's method selected by user.

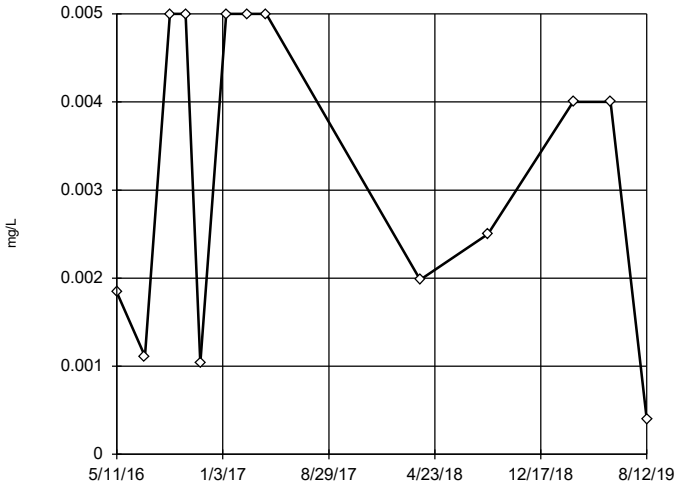
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.3964, low cutoff = 0.00001468, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-31



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).

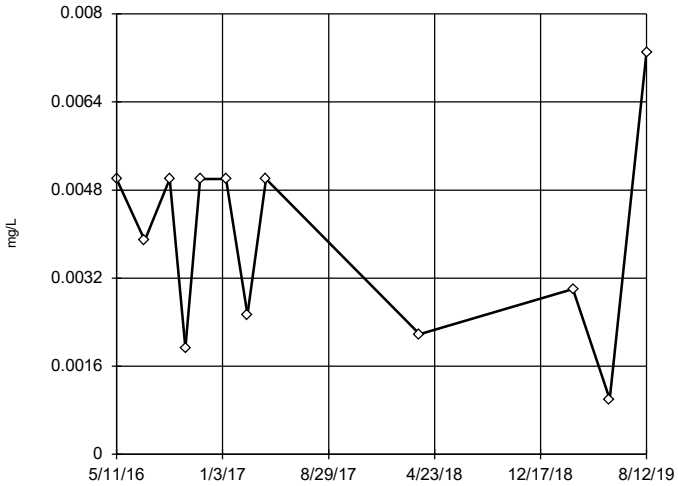
High cutoff = 0.02838, low cutoff = -0.003553, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-32



n = 12

No outliers found. Tukey's method selected by user.

Data were square root transformed to achieve best W statistic (graph shown in original units).

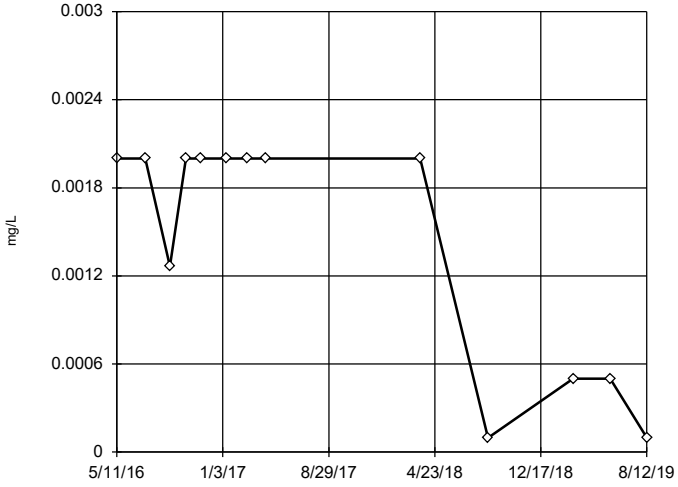
High cutoff = 0.01883, low cutoff = -0.0003234, based on IQR multiplier of 3.

Constituent: Selenium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-2



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).

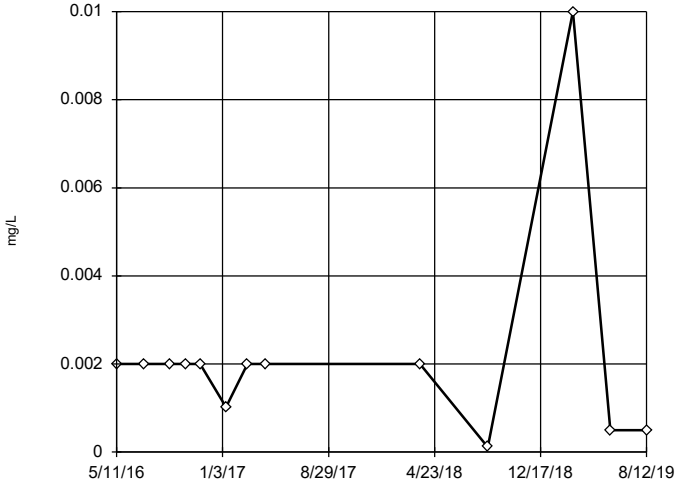
The results were invalidated, because both the lower and upper quartiles represent reporting limits.

Constituent: Thallium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Tukey's Outlier Screening

AD-31



n = 13

No outliers found. Tukey's method selected by user.

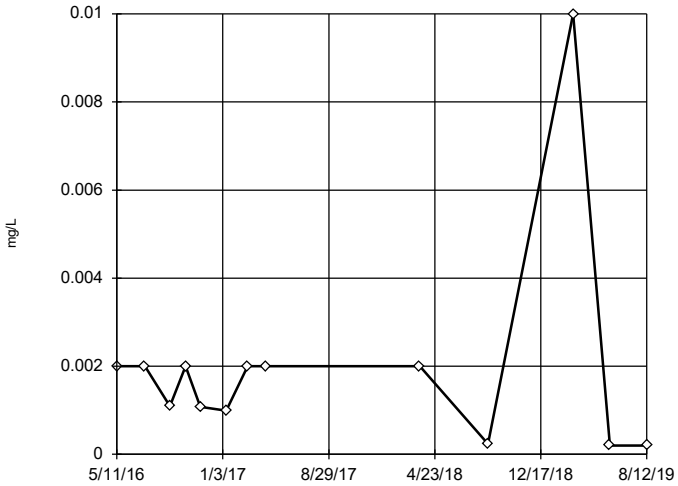
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.04398, low cutoff = 0.00003246, based on IQR multiplier of 3.

Constituent: Thallium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Tukey's Outlier Screening

AD-32



n = 13

No outliers found. Tukey's method select-ed by user.

Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 0.1397, low cutoff = 0.000006954, based on IQR multiplier of 3.

Constituent: Thallium, total Analysis Run 11/25/2019 10:14 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

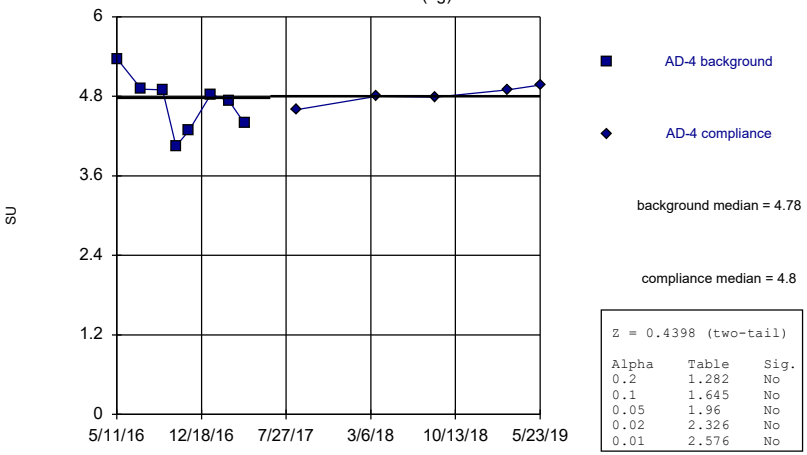
Mann-Whitney - All Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 12/7/2019, 1:55 PM

Constituent	Well	Calc.	0.01	Sig.	Method
pH, field (SU)	AD-4 (bg)	0.4398	No	No	Mann-W
pH, field (SU)	AD-2	0.8051	No	No	Mann-W
pH, field (SU)	AD-31	2.562	No	No	Mann-W
pH, field (SU)	AD-32	0.8807	No	No	Mann-W
pH, field (SU)	**AD-18 (bg)**	**2.858**	**Yes**	**Yes**	**Mann-W**
pH, field (SU)	AD-12 (bg)	1.537	No	No	Mann-W

Mann-Whitney (Wilcoxon Rank Sum)

AD-4 (bg)



background median = 4.78

compliance median = 4.8

Z = 0.4398 (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

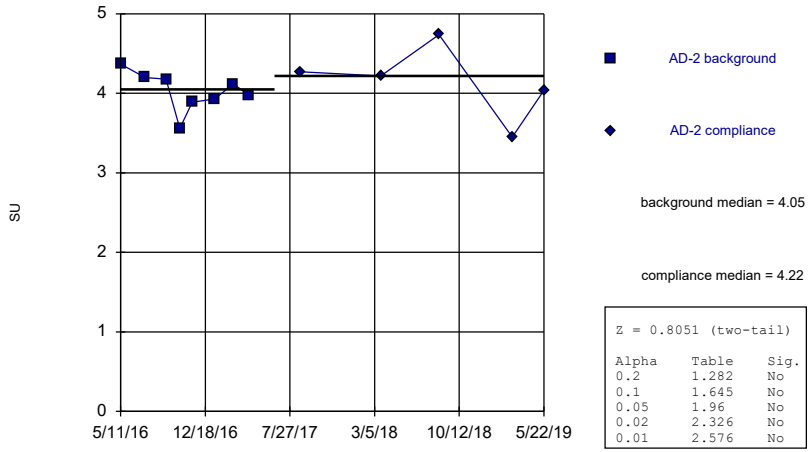
Constituent: pH, field Analysis Run 12/7/2019 1:53 PM View: PL's Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-2



background median = 4.05

compliance median = 4.22

Z = 0.8051 (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

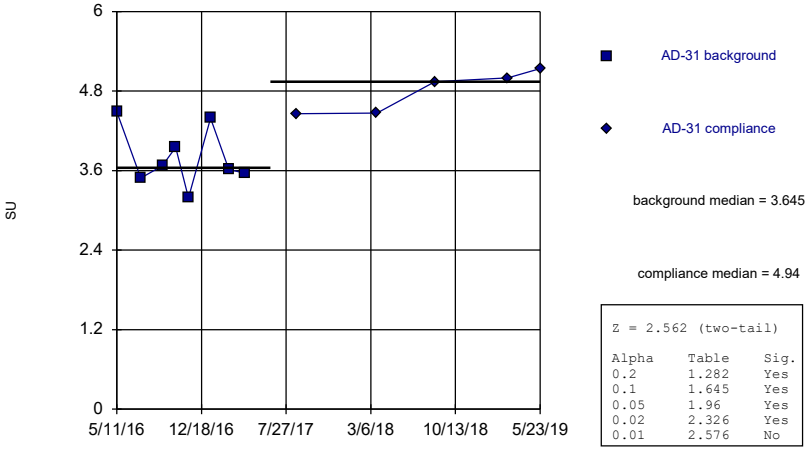
Constituent: pH, field Analysis Run 12/7/2019 1:53 PM View: PL's Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-31



background median = 3.645

compliance median = 4.94

Z = 2.562 (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

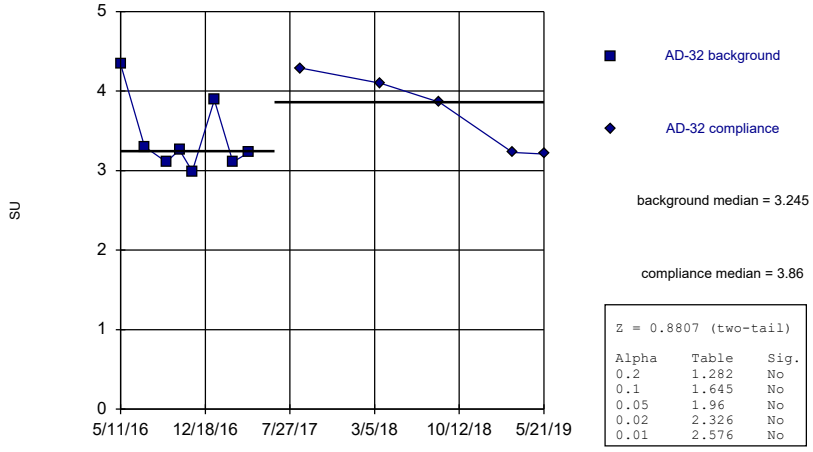
Constituent: pH, field Analysis Run 12/7/2019 1:53 PM View: PL's Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-32



background median = 3.245

compliance median = 3.86

Z = 0.8807 (two-tail)

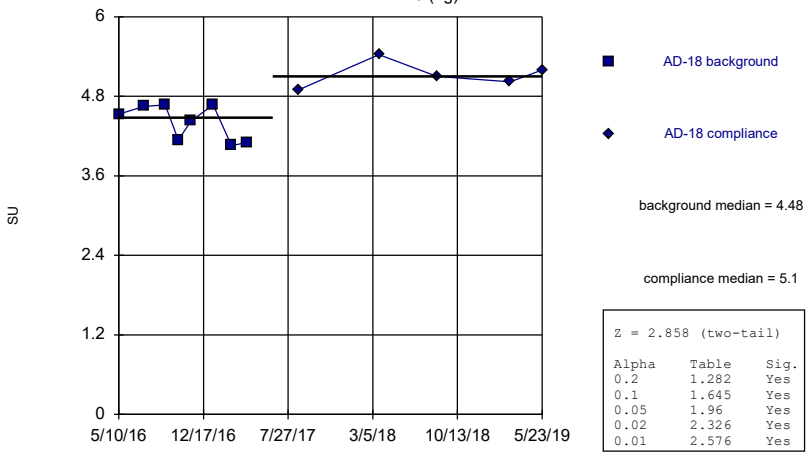
Alpha	Table	Sig.
0.2	1.282	No
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH, field Analysis Run 12/7/2019 1:53 PM View: PL's Intrawell

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Mann-Whitney (Wilcoxon Rank Sum)

AD-18 (bg)



Z = 2.858 (two-tail)

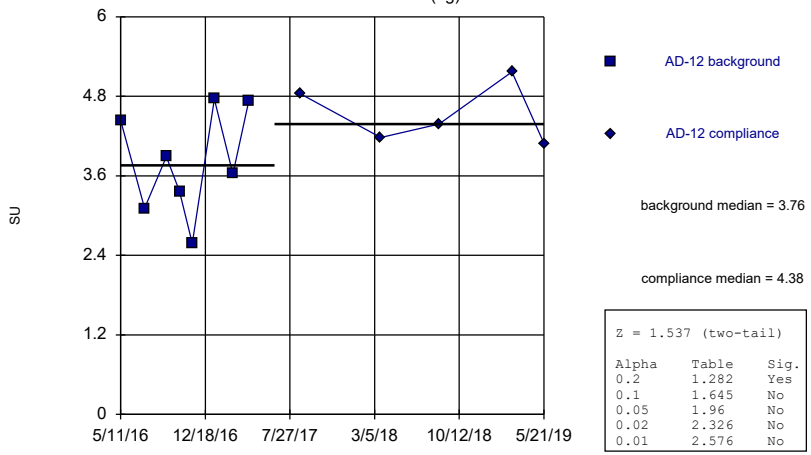
Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	Yes
0.05	1.96	Yes
0.02	2.326	Yes
0.01	2.576	Yes

Constituent: pH, field Analysis Run 12/7/2019 1:53 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

AD-12 (bg)



Z = 1.537 (two-tail)

Alpha	Table	Sig.
0.2	1.282	Yes
0.1	1.645	No
0.05	1.96	No
0.02	2.326	No
0.01	2.576	No

Constituent: pH, field Analysis Run 12/7/2019 1:53 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

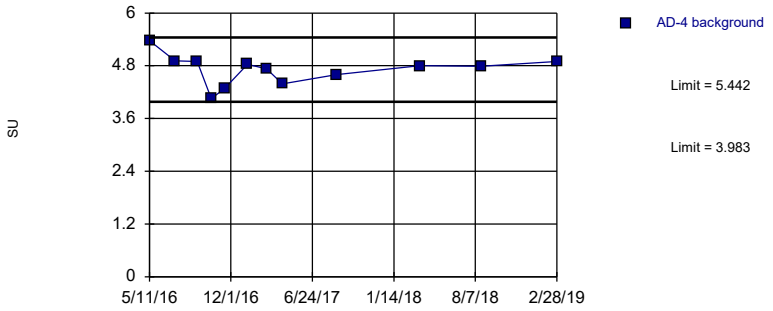
Intrawell Prediction Limit Summary

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 12/7/2019, 2:15 PM

Constituent	Well	Upper Lim.	Lower Lim.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
pH, field (SU)	AD-4	5.442	3.983	n/a	12	4.713	0.3454	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-2	4.812	3.339	n/a	12	4.076	0.3486	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-31	5.368	2.837	n/a	12	4.103	0.5991	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-32	4.613	2.506	n/a	12	3.559	0.4988	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-18	5.539	3.745	n/a	12	4.642	0.4247	0	None	No	0.001253	Param Intra 1 of 2
pH, field (SU)	AD-12	5.754	2.427	n/a	12	4.091	0.7877	0	None	No	0.001253	Param Intra 1 of 2

Prediction Limit

Intrawell Parametric, AD-4 (bg)



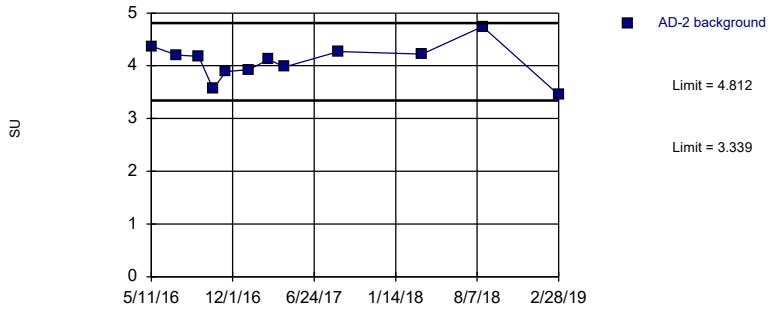
Background Data Summary: Mean=4.713, Std. Dev.=0.3454, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9373, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/7/2019 2:13 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-2



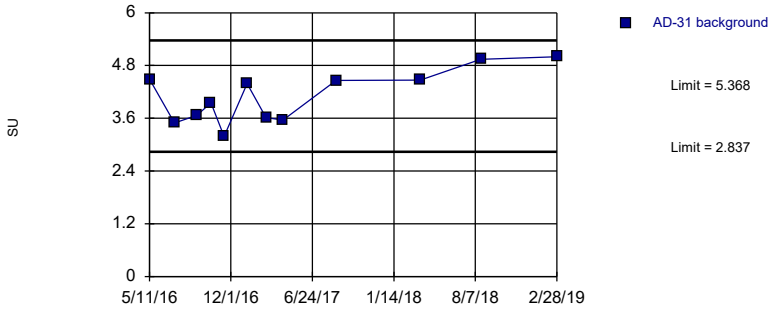
Background Data Summary: Mean=4.076, Std. Dev.=0.3486, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9599, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/7/2019 2:13 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-31



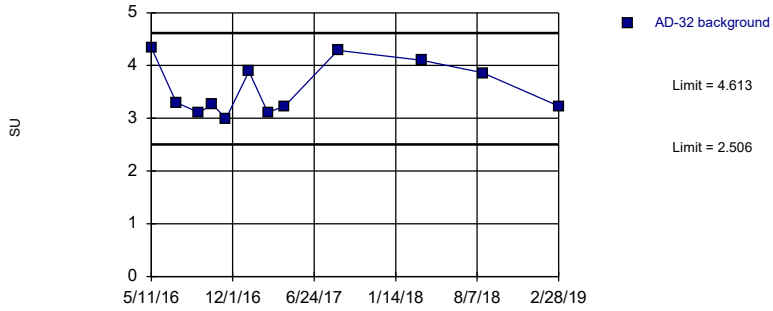
Background Data Summary: Mean=4.103, Std. Dev.=0.5991, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9264, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/7/2019 2:13 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-32

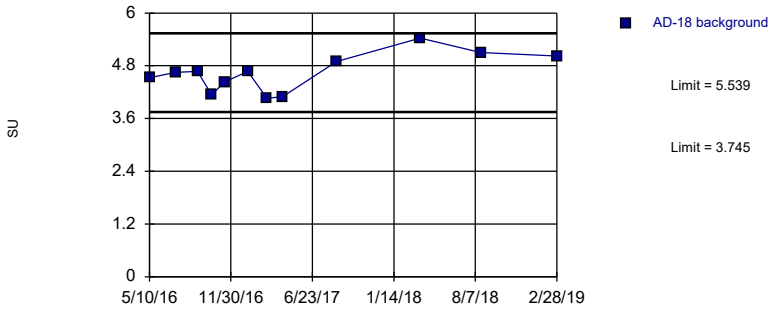


Background Data Summary: Mean=3.559, Std. Dev.=0.4988, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8528, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/7/2019 2:14 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Prediction Limit

Intrawell Parametric, AD-18 (bg)



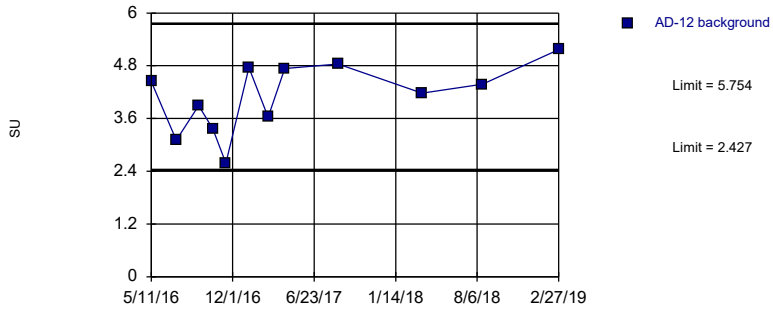
Background Data Summary: Mean=4.642, Std. Dev.=0.4247, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9561, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/7/2019 2:14 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23e Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, AD-12 (bg)



Background Data Summary: Mean=4.091, Std. Dev.=0.7877, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9544, critical = 0.805. Kappa = 2.112 (c=7, w=3, 1 of 2, event alpha = 0.05132). Report alpha = 0.002505. Assumes 1 future value.

Constituent: pH, field Analysis Run 12/7/2019 2:14 PM View: PL's Intrawell
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Trend Test - All Results (No Significant)

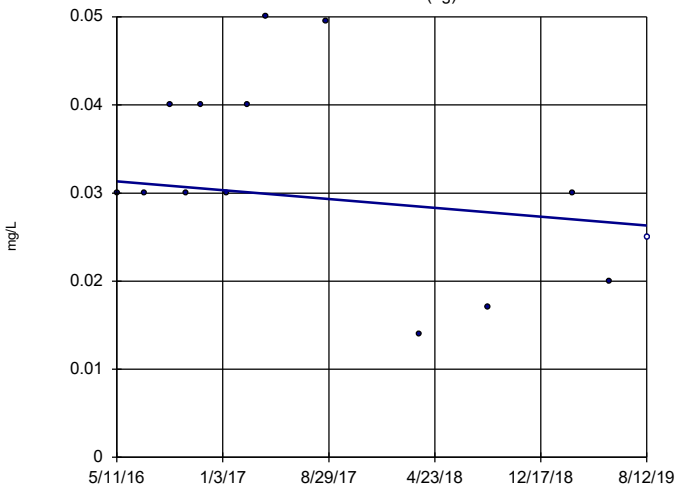
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 10:48 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron, total (mg/L)	AD-12 (bg)	-0.001536	-16	-48	No	14	7.143	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-18 (bg)	0.001347	35	48	No	14	14.29	n/a	n/a	0.01	NP
Boron, total (mg/L)	AD-4 (bg)	0.00035	11	48	No	14	7.143	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-12 (bg)	-0.008986	-7	-48	No	14	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-18 (bg)	0.03037	11	48	No	14	0	n/a	n/a	0.01	NP
Calcium, total (mg/L)	AD-4 (bg)	-0.1891	-19	-48	No	14	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-12 (bg)	0.1051	23	48	No	14	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-18 (bg)	0.0768	18	48	No	14	0	n/a	n/a	0.01	NP
Chloride, total (mg/L)	AD-4 (bg)	0	0	48	No	14	0	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-12 (bg)	-0.08118	-46	-48	No	14	64.29	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-18 (bg)	0	-35	-48	No	14	78.57	n/a	n/a	0.01	NP
Fluoride, total (mg/L)	AD-4 (bg)	0	-32	-48	No	14	78.57	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-12 (bg)	-0.7952	-35	-48	No	14	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-18 (bg)	0	-4	-48	No	14	0	n/a	n/a	0.01	NP
Sulfate, total (mg/L)	AD-4 (bg)	0.9835	26	48	No	14	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	AD-12 (bg)	-4.348	-10	-43	No	13	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	AD-18 (bg)	-7.565	-34	-48	No	14	0	n/a	n/a	0.01	NP
Total Dissolved Solids [TDS] (m...	AD-4 (bg)	-0.7733	-6	-48	No	14	0	n/a	n/a	0.01	NP

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-12 (bg)



n = 14

Slope = -0.001536 units per year.

Mann-Kendall statistic = -16
critical = -48

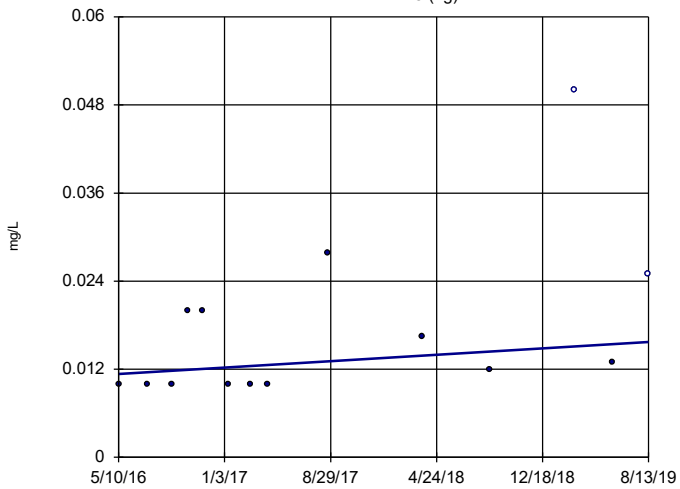
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-18 (bg)



n = 14

Slope = 0.001347 units per year.

Mann-Kendall statistic = 35
critical = 48

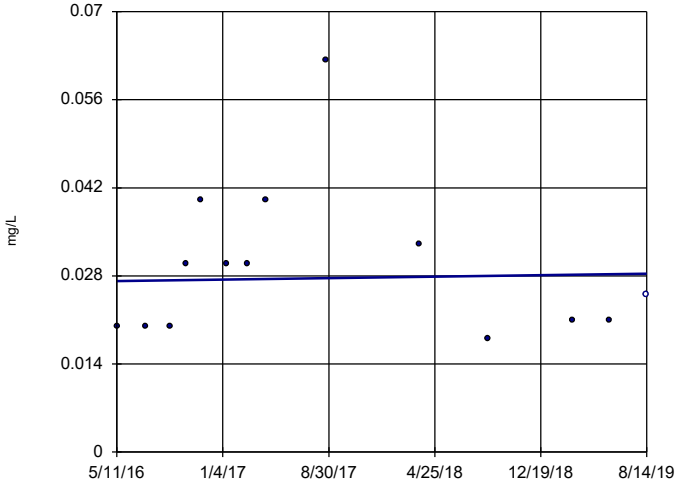
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG
Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-4 (bg)



n = 14

Slope = 0.00035 units per year.

Mann-Kendall statistic = 11
critical = 48

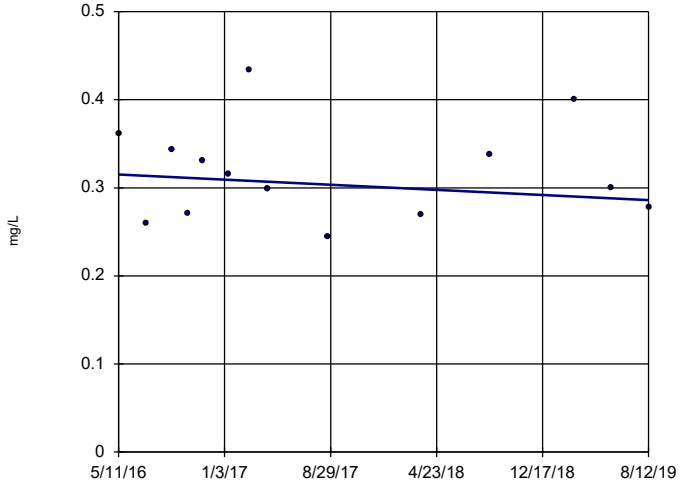
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Boron, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-12 (bg)



n = 14

Slope = -0.008986 units per year.

Mann-Kendall statistic = -7
critical = -48

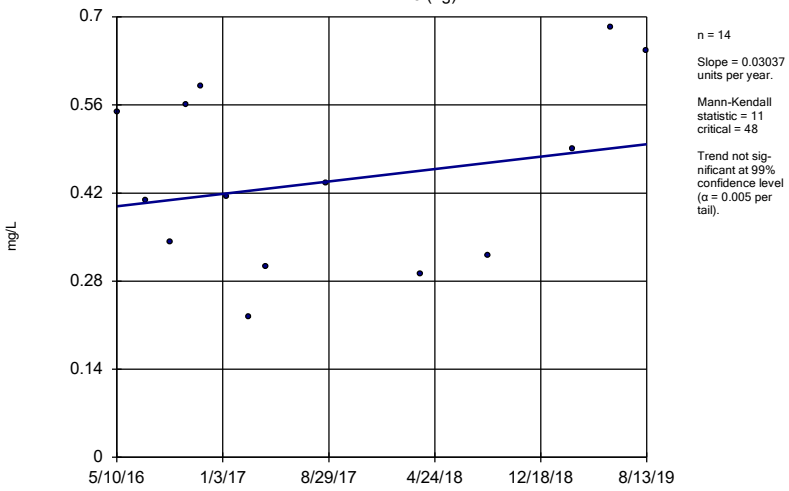
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Calcium, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-18 (bg)



n = 14

Slope = 0.03037 units per year.

Mann-Kendall statistic = 11 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

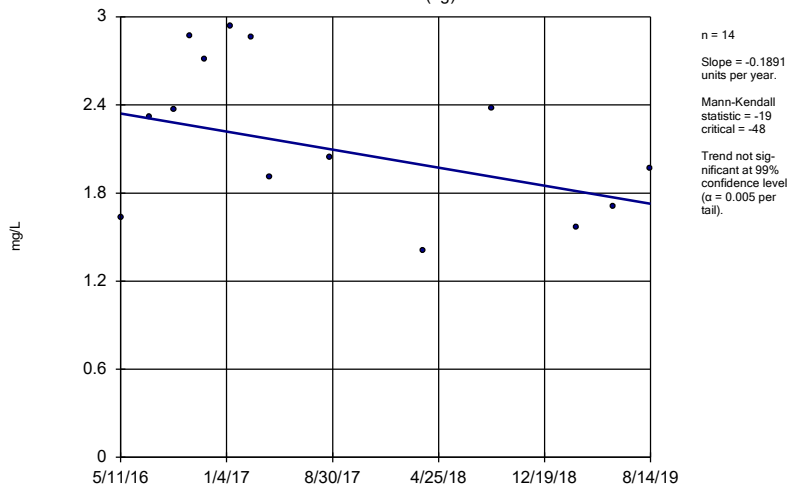
Constituent: Calcium, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-4 (bg)



n = 14

Slope = -0.1891 units per year.

Mann-Kendall statistic = -19 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

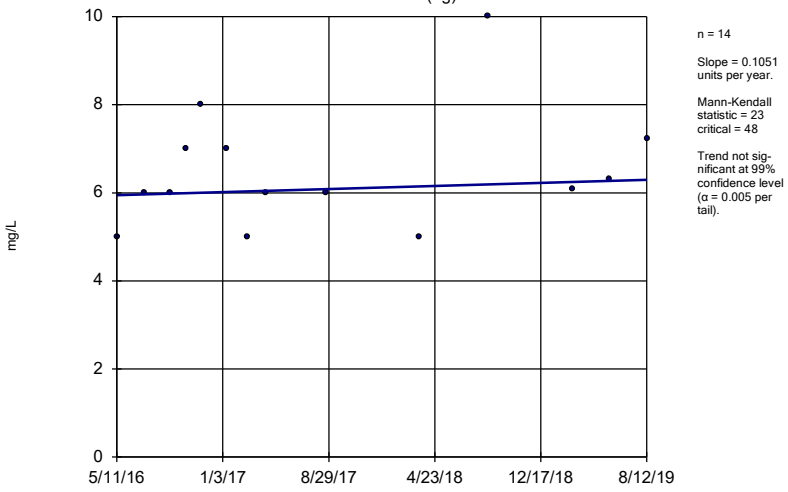
Constituent: Calcium, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-12 (bg)



n = 14

Slope = 0.1051 units per year.

Mann-Kendall statistic = 23 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

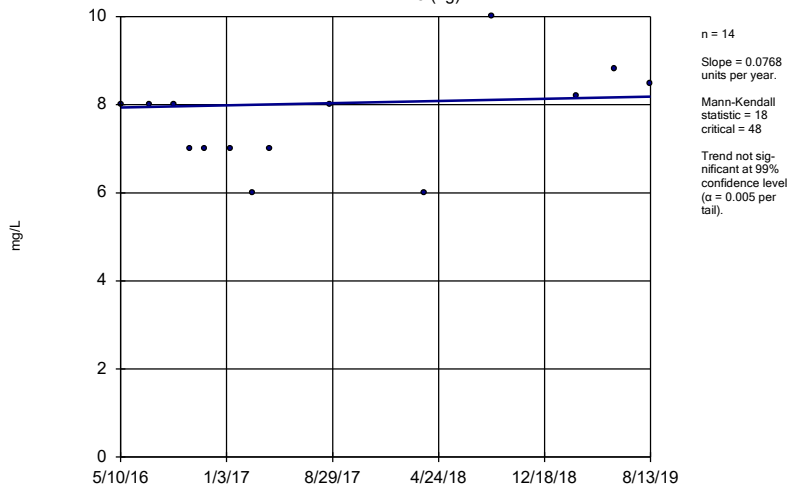
Constituent: Chloride, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-18 (bg)



n = 14

Slope = 0.0768 units per year.

Mann-Kendall statistic = 18 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

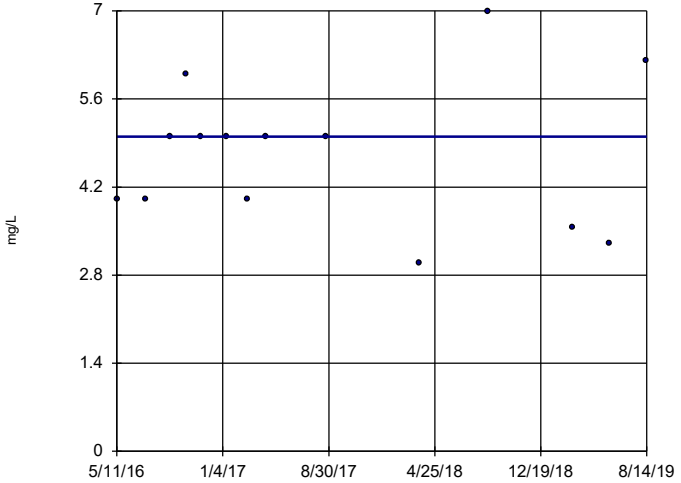
Constituent: Chloride, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-4 (bg)



n = 14

Slope = 0 units per year.

Mann-Kendall statistic = 0 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Chloride, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

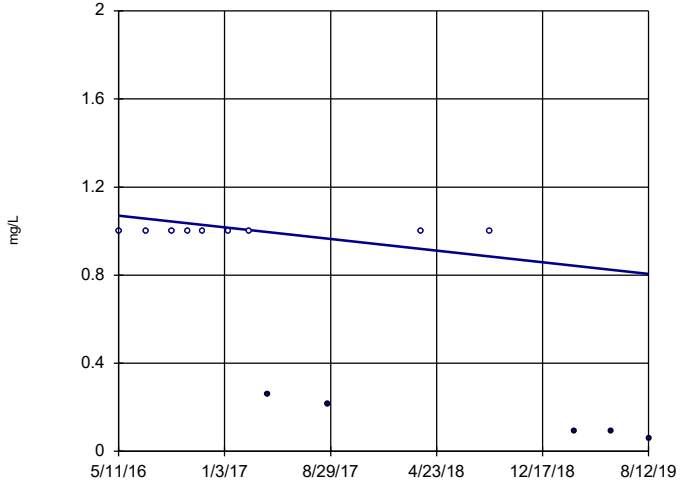
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-12 (bg)



n = 14

Slope = -0.08118 units per year.

Mann-Kendall statistic = -46 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

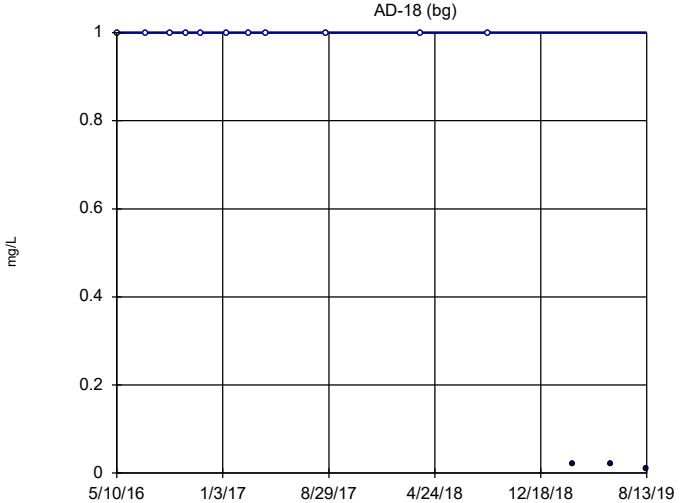
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-18 (bg)



n = 14

Slope = 0 units per year.

Mann-Kendall statistic = -35 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Fluoride, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

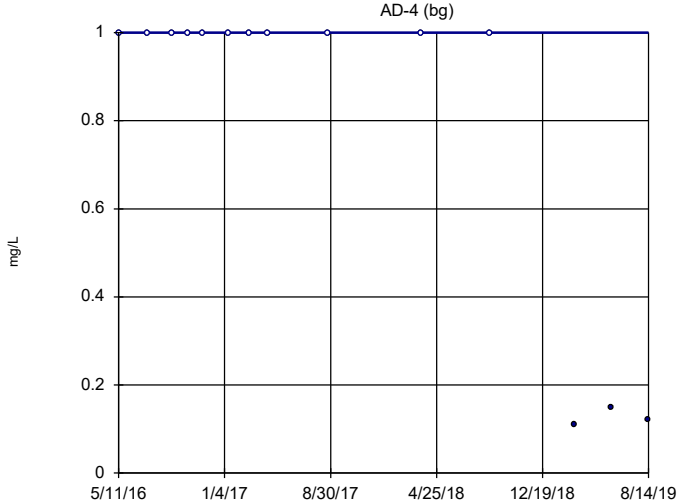
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Hollow symbols indicate censored values.

Sen's Slope Estimator

AD-4 (bg)



n = 14

Slope = 0 units per year.

Mann-Kendall statistic = -32 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

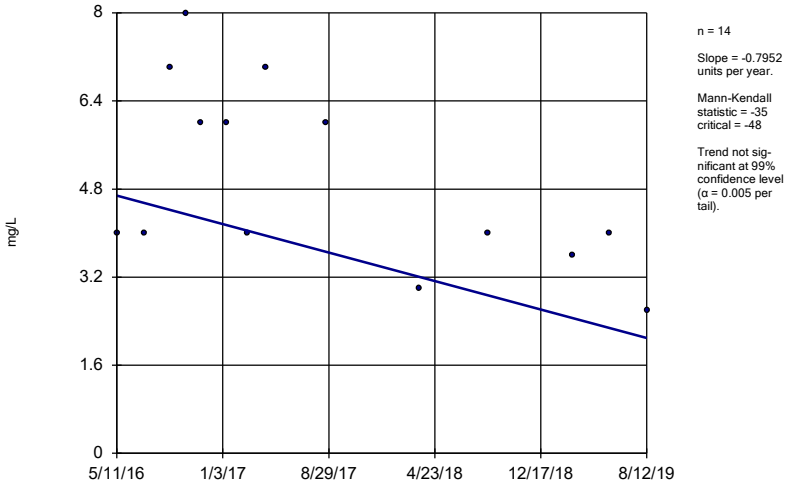
Constituent: Fluoride, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-12 (bg)



n = 14

Slope = -0.7952 units per year.

Mann-Kendall statistic = -35 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

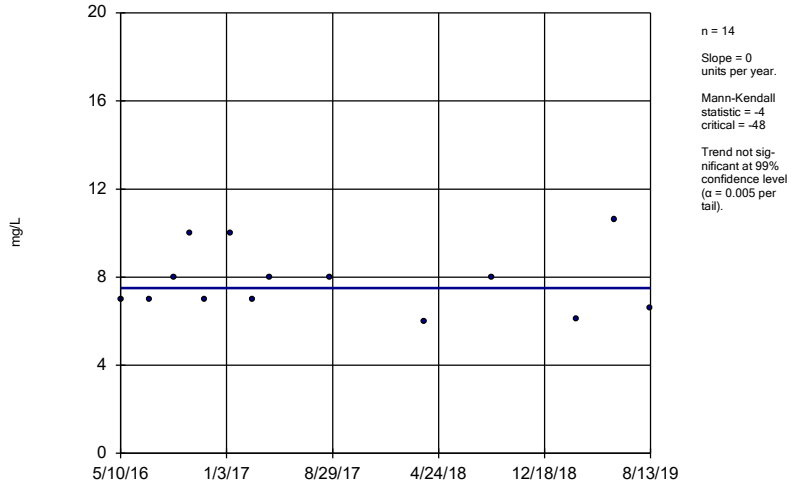
Constituent: Sulfate, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-18 (bg)



n = 14

Slope = 0 units per year.

Mann-Kendall statistic = -4 critical = -48

Trend not significant at 99% confidence level (α = 0.005 per tail).

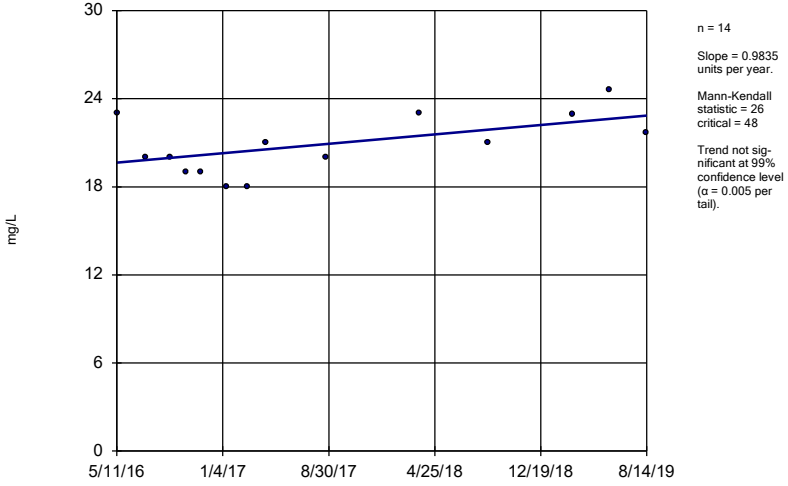
Constituent: Sulfate, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-4 (bg)



n = 14

Slope = 0.9835 units per year.

Mann-Kendall statistic = 26 critical = 48

Trend not significant at 99% confidence level (α = 0.005 per tail).

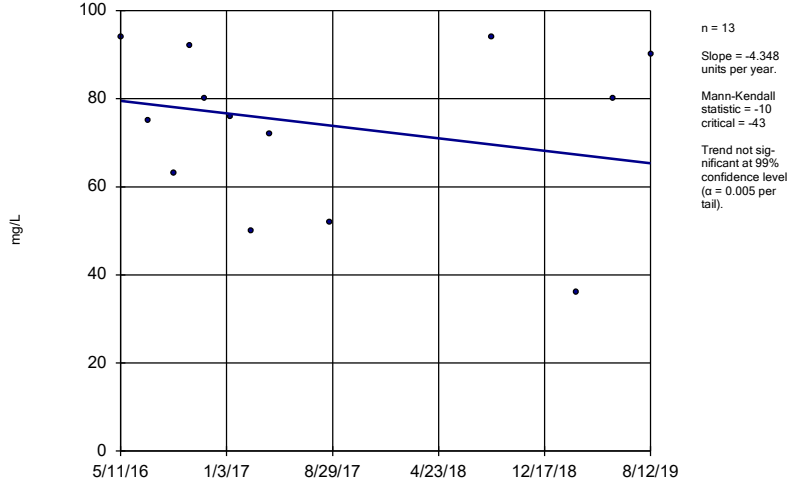
Constituent: Sulfate, total Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-12 (bg)



n = 13

Slope = -4.348 units per year.

Mann-Kendall statistic = -10 critical = -43

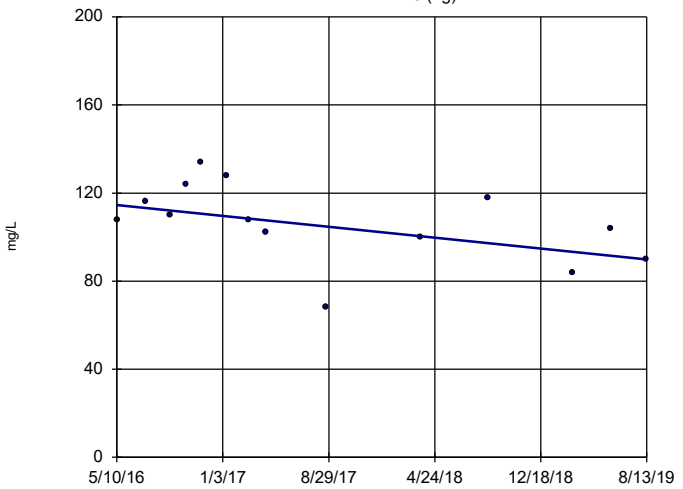
Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/25/2019 10:48 AM View: Interwell AIII

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sen's Slope Estimator

AD-18 (bg)



n = 14

Slope = -7.565 units per year.

Mann-Kendall statistic = -34
critical = -48

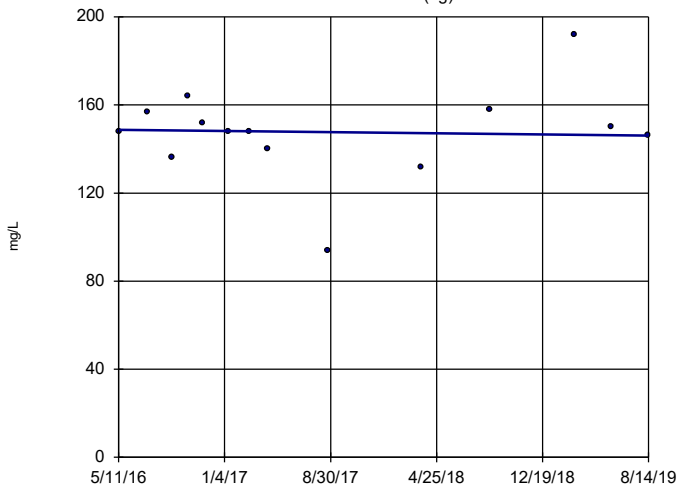
Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/25/2019 10:48 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . UG

Sen's Slope Estimator

AD-4 (bg)



n = 14

Slope = -0.7733 units per year.

Mann-Kendall statistic = -6
critical = -48

Trend not sig-nificant at 99% confidence level (α = 0.005 per tail).

Constituent: Total Dissolved Solids [TDS] Analysis Run 11/25/2019 10:48 AM View: Interwell AIII
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Interwell Prediction Limit Summary

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 12/7/2019, 2:23 PM

Constituent	Well	Upper Lim.	Lower Lim.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	n/a	0.05098	n/a	n/a	36	0.02697	0.01359	2.778	None	No	0.002505	Param 1 of 2
Calcium, total (mg/L)	n/a	2.94	n/a	n/a	36	n/a	n/a	0	n/a	n/a	0.001409	NP (normality) 1 of 2
Chloride, total (mg/L)	n/a	9.158	n/a	n/a	36	6.218	1.665	0	None	No	0.002505	Param 1 of 2
Fluoride, total (mg/L)	n/a	1	n/a	n/a	36	n/a	n/a	86.11	n/a	n/a	0.001409	NP (NDs) 1 of 2
Sulfate, total (mg/L)	n/a	23	n/a	n/a	36	n/a	n/a	0	n/a	n/a	0.001409	NP (normality) 1 of 2
Total Dissolved Solids [TDS] (mg/L)	n/a	175.6	n/a	n/a	35	110.1	37.01	0	None	No	0.002505	Param 1 of 2

Upper Tolerance Limits

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 11:27 AM

Constituent	Well	Upper Lim.	Date	Observ.	Sig.	Bg N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.0025	n/a	n/a	n/a	39	97.44	n/a	0.1353	NP Inter(NDs)
Arsenic, total (mg/L)	n/a	0.011	n/a	n/a	n/a	39	69.23	n/a	0.1353	NP Inter(NDs)
Barium, total (mg/L)	n/a	0.183	n/a	n/a	n/a	39	0	n/a	0.1353	NP Inter(normal...
Beryllium, total (mg/L)	n/a	0.00115	n/a	n/a	n/a	39	10.26	n/a	0.1353	NP Inter(normal...
Cadmium, total (mg/L)	n/a	0.0005	n/a	n/a	n/a	39	74.36	n/a	0.1353	NP Inter(NDs)
Chromium, total (mg/L)	n/a	0.007	n/a	n/a	n/a	39	17.95	n/a	0.1353	NP Inter(Cohens...
Cobalt, total (mg/L)	n/a	0.00939	n/a	n/a	n/a	39	0	n/a	0.1353	NP Inter(normal...
Combined Radium 226 + 228 (pCi/L)	n/a	3.325	n/a	n/a	n/a	39	0	x^(1/3)	0.05	Inter
Fluoride, total (mg/L)	n/a	0.5	n/a	n/a	n/a	42	73.81	n/a	0.116	NP Inter(NDs)
Lead, total (mg/L)	n/a	0.0025	n/a	n/a	n/a	39	79.49	n/a	0.1353	NP Inter(NDs)
Lithium, total (mg/L)	n/a	0.0616	n/a	n/a	n/a	39	2.564	sqrt(x)	0.05	Inter
Mercury, total (mg/L)	n/a	0.000064	n/a	n/a	n/a	39	41.03	n/a	0.1353	NP Inter(normal...
Molybdenum, total (mg/L)	n/a	0.02	n/a	n/a	n/a	39	92.31	n/a	0.1353	NP Inter(NDs)
Selenium, total (mg/L)	n/a	0.0025	n/a	n/a	n/a	39	61.54	n/a	0.1353	NP Inter(NDs)
Thallium, total (mg/L)	n/a	0.001874	n/a	n/a	n/a	37	83.78	n/a	0.1499	NP Inter(NDs)

Confidence Interval Summary Table - Significant Results

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 11:31 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Cobalt, total (mg/L)	**AD-2**	**0.0139**	**0.01**	**0.0094**	**Yes**	**13**	**0**	**No**	**0.01**	**NP (normality)**
Cobalt, total (mg/L)	**AD-32**	**0.06086**	**0.03096**	**0.0094**	**Yes**	**13**	**0**	**x^(1/3)**	**0.01**	**Param.**
Lithium, total (mg/L)	**AD-31**	**0.09599**	**0.08587**	**0.0616**	**Yes**	**13**	**0**	**x^6**	**0.01**	**Param.**
Lithium, total (mg/L)	**AD-32**	**0.112**	**0.08778**	**0.0616**	**Yes**	**11**	**0**	**No**	**0.01**	**Param.**

Confidence Interval Summary Table - All Results

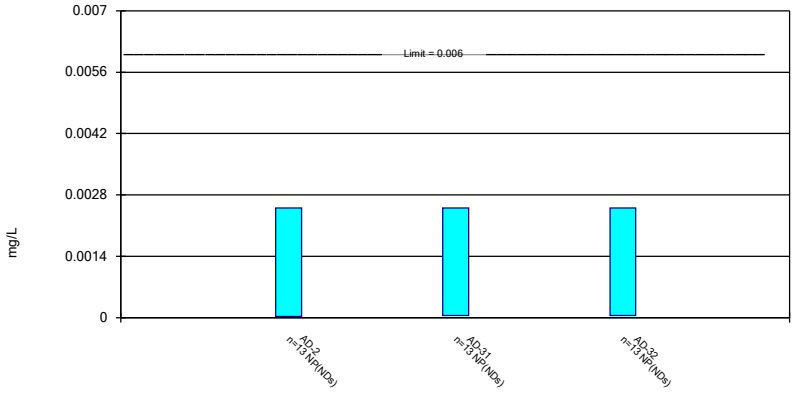
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP Printed 11/25/2019, 11:31 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	%NDs	Transform	Alpha	Method
Antimony, total (mg/L)	AD-2	0.0025	0.000025	0.006	No	13	92.31	No	0.01	NP (NDs)
Antimony, total (mg/L)	AD-31	0.0025	0.00005	0.006	No	13	92.31	No	0.01	NP (NDs)
Antimony, total (mg/L)	AD-32	0.0025	0.00005	0.006	No	13	92.31	No	0.01	NP (NDs)
Arsenic, total (mg/L)	AD-2	0.0025	0.00052	0.011	No	13	76.92	No	0.01	NP (NDs)
Arsenic, total (mg/L)	AD-31	0.006	0.001	0.011	No	12	25	No	0.01	NP (Cohens/xfrm)
Arsenic, total (mg/L)	AD-32	0.006899	0.002442	0.011	No	13	7.692	sqrt(x)	0.01	Param.
Barium, total (mg/L)	AD-2	0.03766	0.0307	2	No	13	0	x^4	0.01	Param.
Barium, total (mg/L)	AD-31	0.08623	0.04485	2	No	12	0	No	0.01	Param.
Barium, total (mg/L)	AD-32	0.04373	0.0285	2	No	13	0	No	0.01	Param.
Beryllium, total (mg/L)	AD-2	0.0005146	0.0003761	0.004	No	13	7.692	No	0.01	NP (normality)
Beryllium, total (mg/L)	AD-31	0.002	0.00085	0.004	No	12	0	No	0.01	NP (normality)
Beryllium, total (mg/L)	AD-32	0.006729	0.003501	0.004	No	13	0	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	AD-2	0.0005	0.00006	0.005	No	13	76.92	No	0.01	NP (NDs)
Cadmium, total (mg/L)	AD-31	0.0008589	0.0000944	0.005	No	13	53.85	No	0.01	NP (NDs)
Cadmium, total (mg/L)	AD-32	0.0006183	0.0003591	0.005	No	13	0	No	0.01	Param.
Chromium, total (mg/L)	AD-2	0.0008854	0.0002438	0.1	No	13	46.15	No	0.01	NP (Cohens/xfrm)
Chromium, total (mg/L)	AD-31	0.01219	0.002111	0.1	No	11	18.18	No	0.01	Param.
Chromium, total (mg/L)	AD-32	0.009243	0.002217	0.1	No	13	0	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	**AD-2**	**0.0139**	**0.01**	**0.0094**	**Yes**	**13**	**0**	**No**	**0.01**	**NP (normality)**
Cobalt, total (mg/L)	AD-31	0.01159	0.009367	0.0094	No	12	0	No	0.01	Param.
Cobalt, total (mg/L)	**AD-32**	**0.06086**	**0.03096**	**0.0094**	**Yes**	**13**	**0**	**x^(1/3)**	**0.01**	**Param.**
Combined Radium 226 + 228 (pCi/L)	AD-2	1.813	0.983	5	No	13	0	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-31	4.122	2.631	5	No	13	0	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	AD-32	5.578	3.893	5	No	12	0	No	0.01	Param.
Fluoride, total (mg/L)	AD-2	0.5	0.1	4	No	15	80	No	0.01	NP (NDs)
Fluoride, total (mg/L)	AD-31	0.5	0.16	4	No	15	80	No	0.01	NP (NDs)
Fluoride, total (mg/L)	AD-32	0.7468	0.4468	4	No	14	35.71	No	0.01	NP (normality)
Lead, total (mg/L)	AD-2	0.0025	0.000338	0.015	No	13	76.92	No	0.01	NP (NDs)
Lead, total (mg/L)	AD-31	0.003933	0.001	0.015	No	12	66.67	No	0.01	NP (NDs)
Lead, total (mg/L)	AD-32	0.0025	0.000714	0.015	No	13	76.92	No	0.01	NP (NDs)
Lithium, total (mg/L)	AD-2	0.05473	0.04944	0.0616	No	12	0	No	0.01	Param.
Lithium, total (mg/L)	**AD-31**	**0.09599**	**0.08587**	**0.0616**	**Yes**	**13**	**0**	**x^6**	**0.01**	**Param.**
Lithium, total (mg/L)	**AD-32**	**0.112**	**0.08778**	**0.0616**	**Yes**	**11**	**0**	**No**	**0.01**	**Param.**
Mercury, total (mg/L)	AD-2	0.00009047	0.00002986	0.002	No	12	0	No	0.01	Param.
Mercury, total (mg/L)	AD-31	0.0007825	0.0001414	0.002	No	12	0	sqrt(x)	0.01	Param.
Mercury, total (mg/L)	AD-32	0.007473	0.001912	0.002	No	13	0	No	0.01	Param.
Molybdenum, total (mg/L)	AD-2	0.02	0.0008627	0.1	No	13	84.62	No	0.01	NP (NDs)
Molybdenum, total (mg/L)	AD-31	0.02	0.0003161	0.1	No	13	69.23	No	0.01	NP (NDs)
Molybdenum, total (mg/L)	AD-32	0.02	0.0007621	0.1	No	13	84.62	No	0.01	NP (NDs)
Selenium, total (mg/L)	AD-2	0.0025	0.0009	0.05	No	13	38.46	No	0.01	NP (Cohens/xfrm)
Selenium, total (mg/L)	AD-31	0.0025	0.001034	0.05	No	13	53.85	No	0.01	NP (NDs)
Selenium, total (mg/L)	AD-32	0.003888	0.001935	0.05	No	12	41.67	No	0.01	NP (normality)
Thallium, total (mg/L)	AD-2	0.001264	0.0001	0.002	No	13	76.92	No	0.01	NP (NDs)
Thallium, total (mg/L)	AD-31	0.001019	0.00025	0.002	No	12	83.33	No	0.01	NP (NDs)
Thallium, total (mg/L)	AD-32	0.001078	0.0002	0.002	No	12	50	No	0.01	NP (normality)

Sanitas™ v.9.6.23 . EPA

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

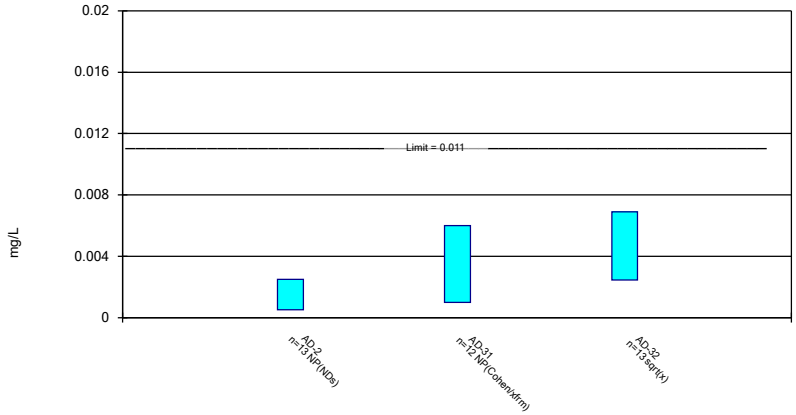


Constituent: Antimony, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

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.

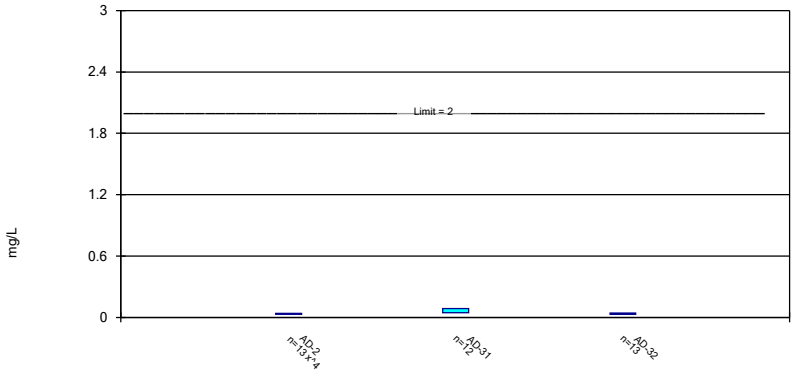


Constituent: Arsenic, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.

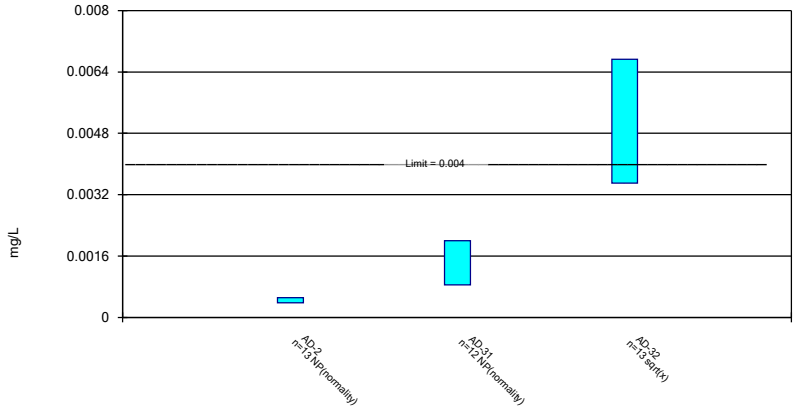


Constituent: Barium, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

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.

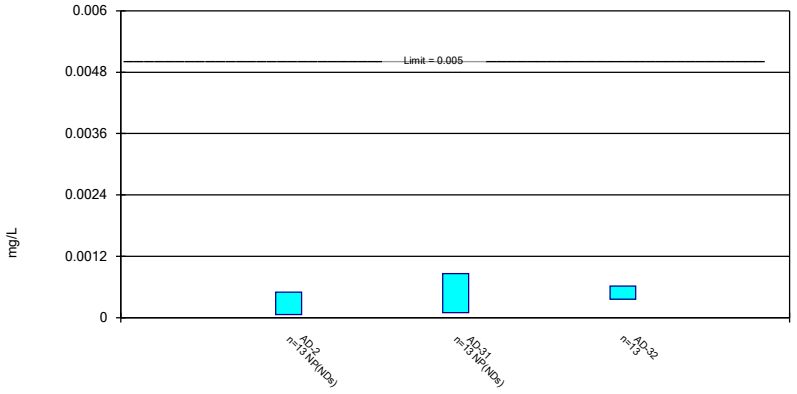


Constituent: Beryllium, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

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.

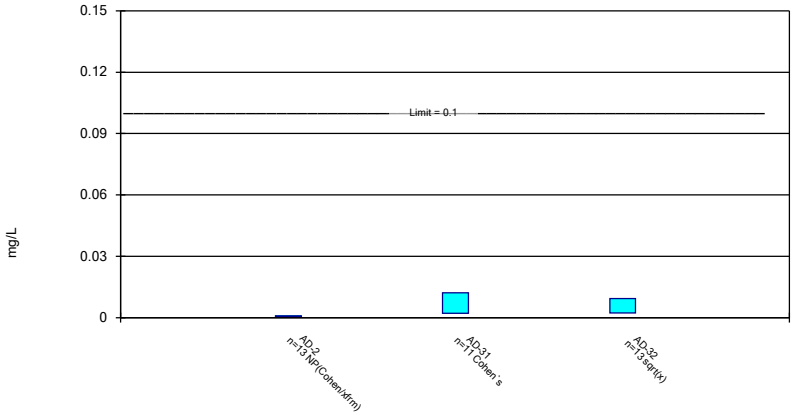


Constituent: Cadmium, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

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.

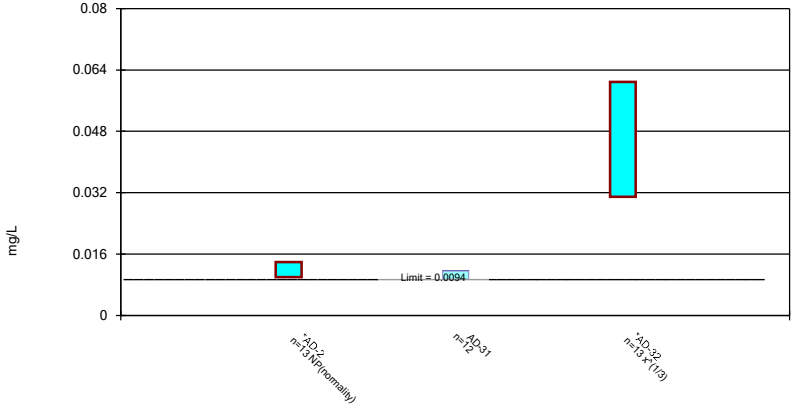


Constituent: Chromium, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Parametric and Non-Parametric (NP) Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



Constituent: Cobalt, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Parametric Confidence Interval

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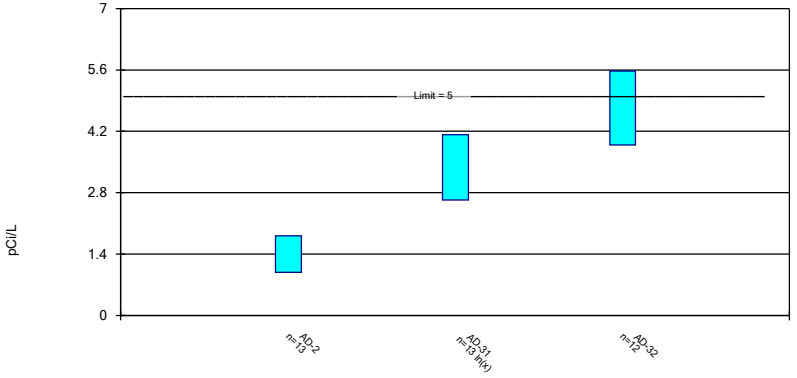
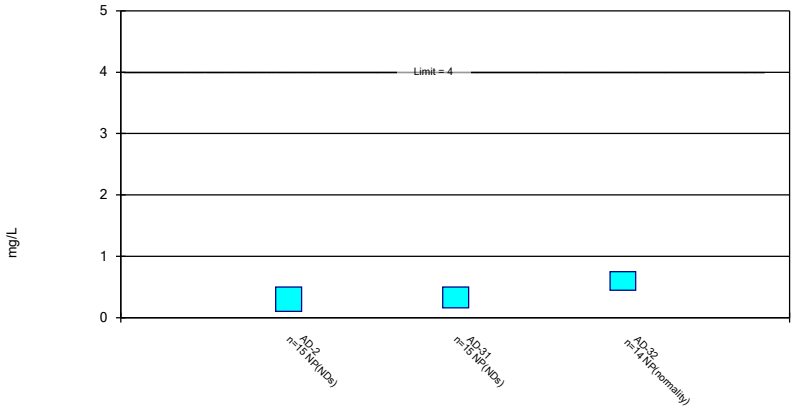


Constituent: Combined Radium 226 + 228 Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



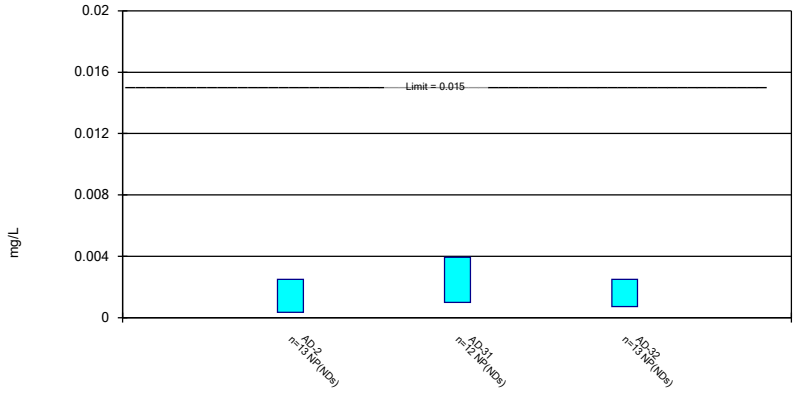
Constituent: Fluoride, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



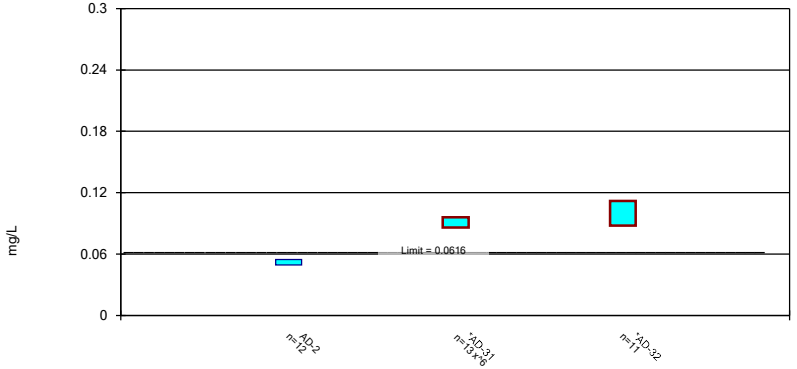
Constituent: Lead, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Parametric Confidence Interval

Compliance limit is exceeded.* Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



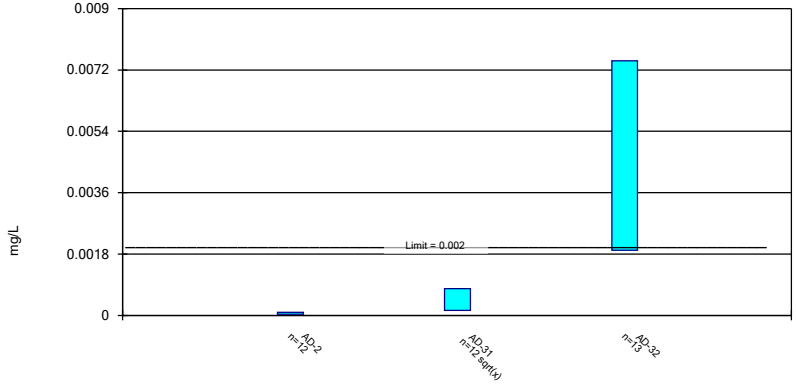
Constituent: Lithium, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01. Normality Test: Shapiro Wilk, alpha based on n.



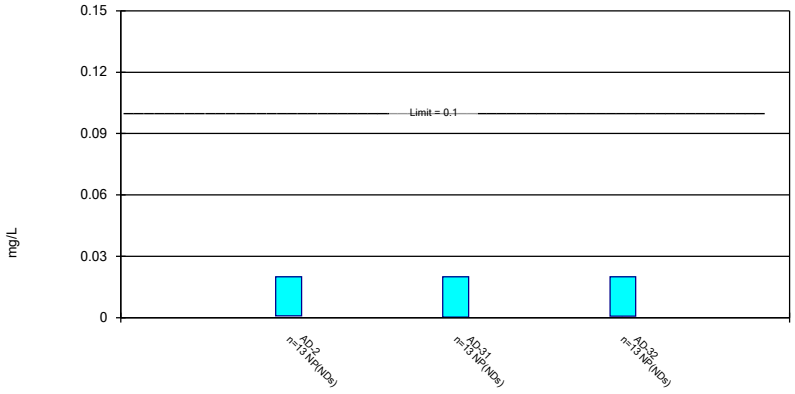
Constituent: Mercury, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV

Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

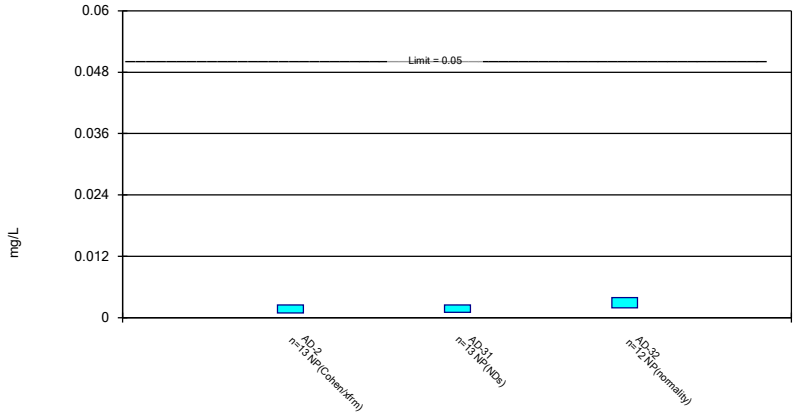


Constituent: Molybdenum, total Analysis Run 11/25/2019 11:29 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.

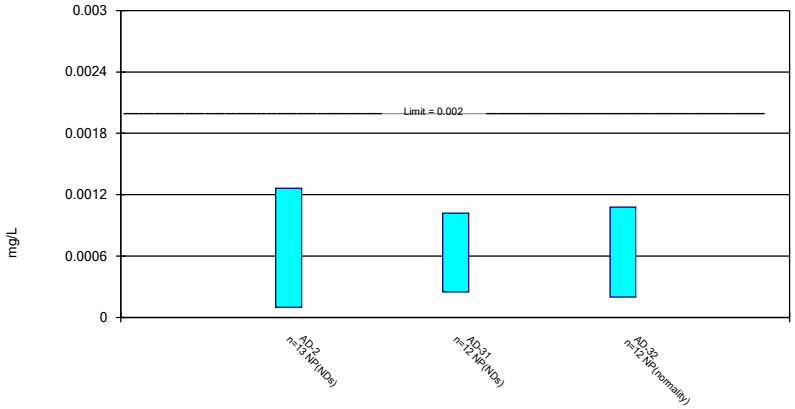


Constituent: Selenium, total Analysis Run 11/25/2019 11:30 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

Sanitas™ v.9.6.23 . EPA

Non-Parametric Confidence Interval

Compliance Limit is not exceeded. Per-well alpha = 0.01.



Constituent: Thallium, total Analysis Run 11/25/2019 11:30 AM View: Interwell AIV
Pirkey EBAP Client: Geosyntec Data: Pirkey EBAP

APPENDIX III

Alternate source demonstrations are included in this appendix. Alternate sources are sources or reasons that explain that statistically significant increases over background or statistically significant levels above the groundwater protection standard are not attributable to the CCR unit.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

H.W. Pirkey Power Plant
East Bottom Ash Pond
Hallsville, Texas

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, OH 43221

April 24, 2019

CHA8462

TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASL	Alternate Screening Level
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EBAP	East Bottom Ash Pond
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
MCL	Maximum Contaminant Level
QA	Quality Assurance
QC	Quality Control
SPLP	Synthetic Precipitation Leaching Procedure
SSL	Statistically Significant Level
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the East Bottom Ash Pond (EBAP, Figure 1). In 2018, two assessment monitoring events were conducted at the EBAP in accordance with 40 CFR 257.95. The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were established for each Appendix IV parameter in accordance with the statistical analysis plan developed for the facility (AEP, 2017) and United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The GWPS for each parameter was established as the greater of the background concentration and the maximum contaminant level (MCL) or alternate screening level (ASL) provided in 40 CFR 257.95(h)(2). 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.

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 GWPSs. An SSL was concluded if the lower confidence limit (LCL) of a parameter exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). The following SSLs were identified at the Pirkey EBAP:

- LCLs for cobalt exceeded the GWPS of 0.0094 mg/L at AD-2 (0.010 mg/L), AD-31 (0.00949 mg/L), and AD-32 (0.0353 mg/L).
- LCLs for lithium exceeded the GWPS of 0.051 mg/L at AD-31 (0.0556 mg/L) and AD-32 (0.0722 mg/L).

No other SSLs were identified (Geosyntec, 2018).

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations regarding assessment monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (40 CFR 257.95(g)(3)(ii)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a*

> *qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section….*

Pursuant to 40 CFR 257.95(g)(3)(ii), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSLs identified for cobalt should not be attributed to the EBAP. The SSLs identified for lithium will be addressed in a separate submittal.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSL 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 SSLs identified for cobalt were based on a Type IV cause and not by a release from the Pirkey EBAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal CCR Rule allows the owner or operator 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. The methodology used to evaluate the SSLs identified for cobalt and the proposed alternative source are described below.

2.1 Alternative Source for Cobalt

Initial review of site geochemistry, site historical data, and laboratory QA/QC data did not identify alternative sources due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSLs for cobalt have been attributed to natural variation associated with the underlying geology, which is a Type IV issue.

The onsite hydrostratigraphic unit for the EBAP was identified as the clayey and silty sand stratum located between an elevation of approximately 325 and 340 feet above mean sea level (Arcadis, 2016). This unit is within the Reklaw Formation, which consists predominantly of clay and fine-grained sand and is underlain by the Eocene-age Carrizo Sand. The presence of lignite in the area is well-documented (Broom and Myers, 1966; ETTL, 2010).

Soil samples collected across the site identified cobalt in the aquifer material at varying concentrations, including locations near the EBAP (Table 1). While data are not available for AD-2, the highest reported cobalt concentration of 15 milligrams per kilogram (mg/kg) was collected at AD-30, which is located approximately 650 feet to the northwest of AD-2 (Figure 2). In addition, up to 1.9 mg/kg and 9.1 mg/kg of cobalt were detected in the samples at EBAP downgradient wells AD-31 and AD-32, respectively. Up to 3.6 mg/kg of cobalt was detected in the samples at upgradient well AD-18.

Mineralogic samples collected from across the site identified pyrite (cubic FeS_2) and marcasite (orthorhombic FeS_2) at concentrations up to 3% by dry weight (Table 1). Pyrite and marcasite were detected in the shallow (12 feet below ground surface [ft bgs]) sample collected at AD-31 at a combined concentration of 2%. Cobalt is known to substitute for iron in crystalline iron minerals such as pyrite and marcasite due to their similar ionic radii (Krupka and Serne, 2002; Hitzman et al., 2019).

While cobalt was detected in the samples collected at AD-32, pyrite and marcasite were not detected. However, the boring log for AD-32 noted that iron ore was present at 16 ft bgs, which is within the screened interval of the well (Attachment A). The presence of limonite (FeO(OH)) in the Reklaw formation has been noted (Brooms and Myers, 1966), which is a likely weathering product of the iron ore identified in the boring log. In addition to iron sulfides, cobalt can also substitute in or adsorb onto iron oxides such as limonite (Hitzman et al., 2019; Appelo and Postman, 2005). While soil analytical and mineralogical data are not available for AD-2, the wide

distribution of cobalt and iron-containing minerals across the site suggests that naturally occurring cobalt may be present in the aquifer media near AD-2.

Naturally occurring cobalt in the aquifer media is presented as the alternative source for cobalt concentrations in the groundwater which exceed the GWPS at the EBAP. Evidence from the EBAP itself shows that a release from the pond is not a probable source for cobalt in groundwater. An analysis of a sample of the bottom ash sluiced to the EBAP gave a reported cobalt concentration of 6.1 mg/kg (Attachment B). When Synthetic Precipitation Leaching Procedure (SPLP) analysis (SW-864 Test Method 1312, [USEPA, 1994]) was conducted on the ash sample to evaluate cobalt mobility under simulated landfill conditions, cobalt was not detected above the reporting limit of 0.010 milligrams per liter (mg/L) in the leachate sample (Attachment B). Cobalt was detected with an estimated concentration of 0.0024 mg/L in a grab sample of the pond water (Attachment C). However, the reported concentration of cobalt in the pond water sample is more than an order of magnitude lower than the average concentration of cobalt observed at all three wells where SSLs were identified. Results of the pond sample analyses are summarized in Table 2.

Because cobalt mobility is affected by pH, the SPLP test results are likely even more conservative than actual pond conditions, as SPLP is run at a pH of 5 SU, whereas the operational pH of the pond varies between approximately 5.8 and 7.0 SU. According to a recent study, cobalt mobility increases under more acidic conditions, although even at a pH of approximately 5 SU, only 2% of cobalt in fly ash is mobile (Izquierdo and Querol, 2012).

The EBAP was not identified as the source of cobalt at AD-2, AD-31, or AD-32 based on the documented low mobility of cobalt under the pond conditions. This is further supported by the lack of detected cobalt in the SPLP analysis and the low observed cobalt concentration in the pond water itself. Instead, the widespread distribution of cobalt within the aquifer material is presented as the alternate source. This cobalt could be present as substitutions within iron-containing minerals such as pyrite, marcasite, or limonite, all of which are observed across the site.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.95(g)(3)(ii) and supports the position that the SSLs for cobalt at AD-2, AD-31, and AD-32 identified during assessment monitoring in 2018 was not due to a release from the EBAP. The identified SSLs were, instead, attributed to natural variation in the underlying geology. Therefore, no further action for cobalt is warranted, and the EBAP will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment D.

SECTION 4

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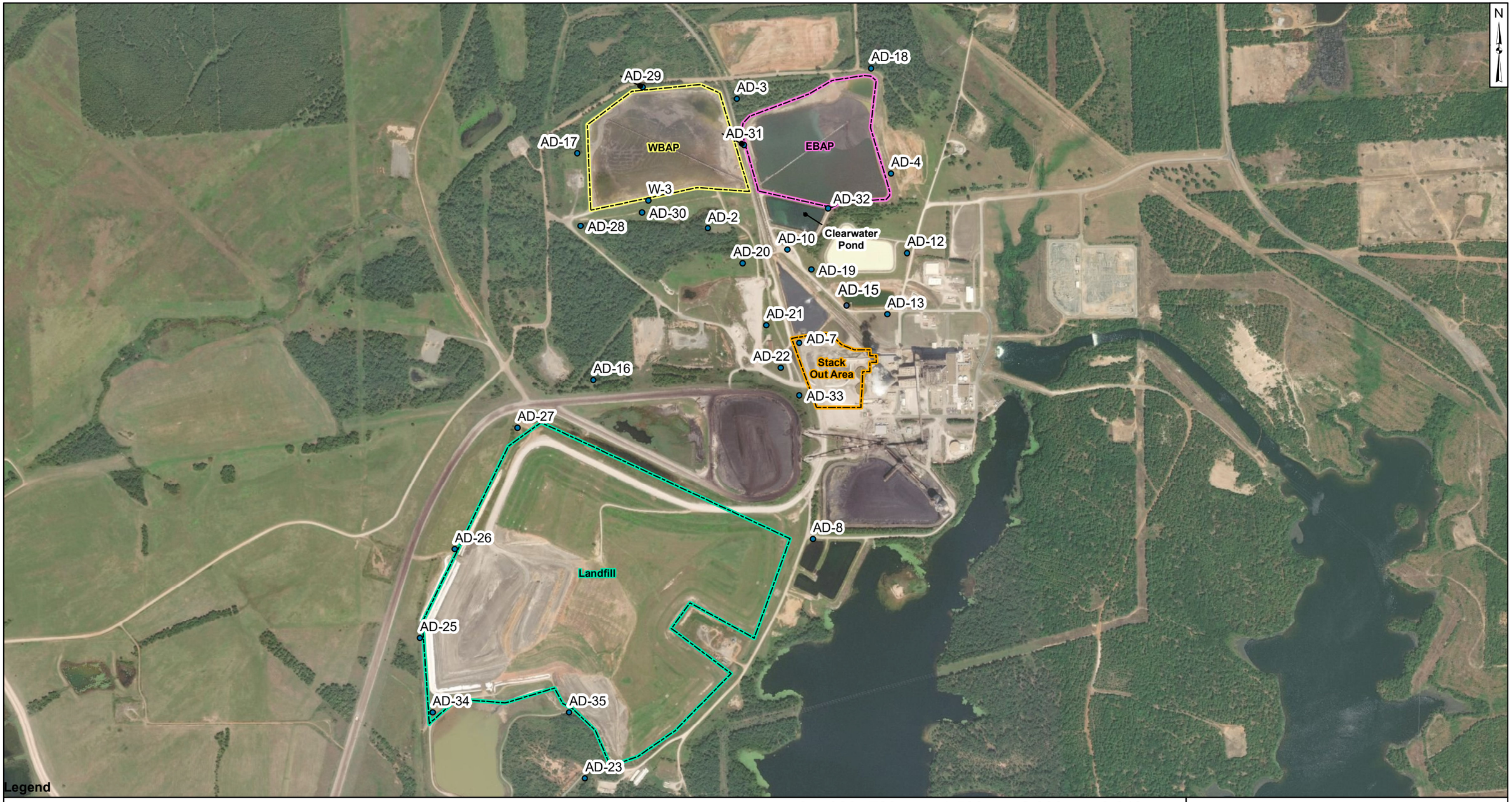
FIGURES



Legend

- AD-15
- Monitoring Wells

Location Boundaries

CCR Units

- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019
- AD-15 location is approximate.

0 380 760 1,520 2,280 3,040 Feet

Site Layout

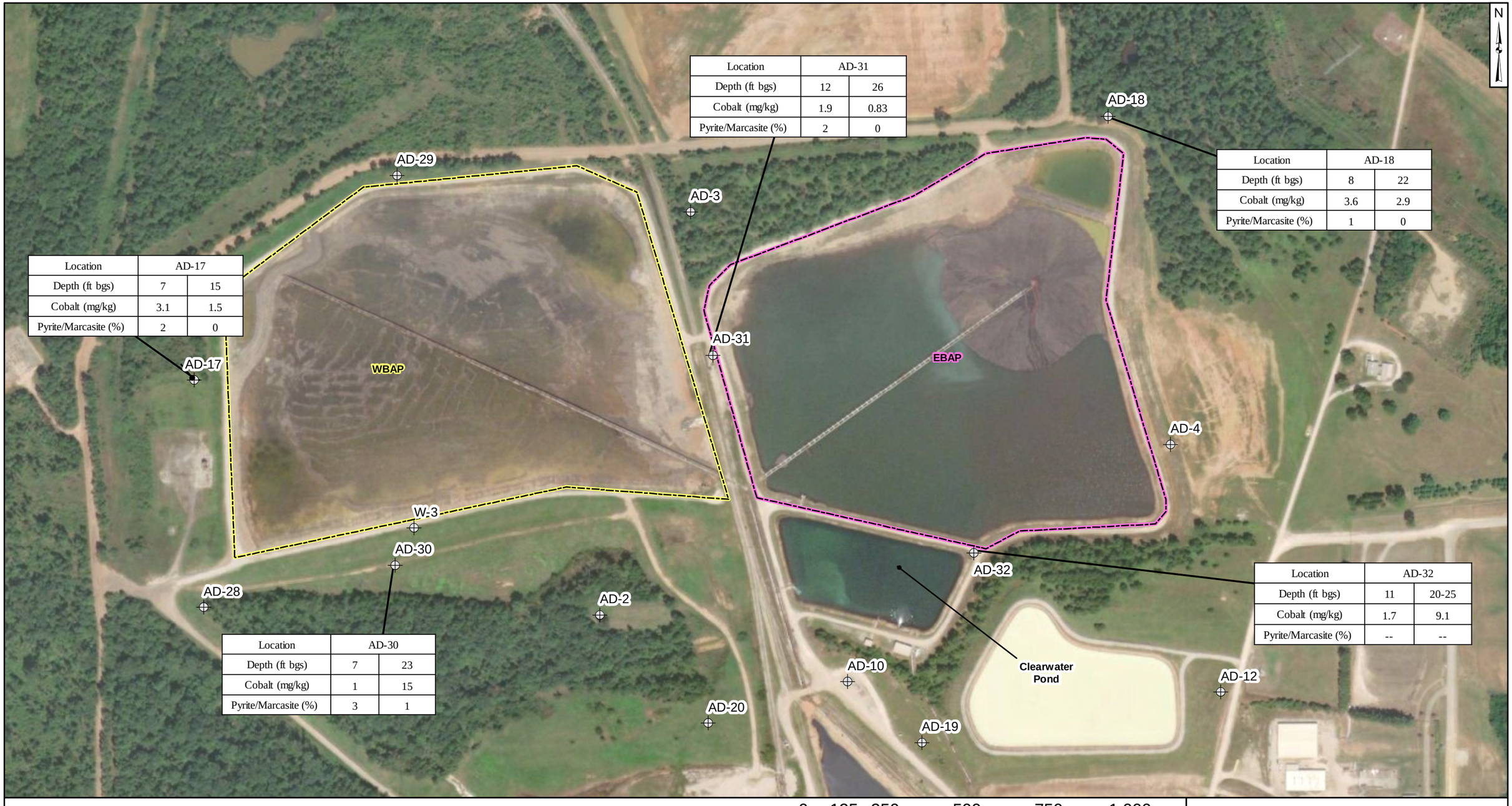
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/03/25

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\Site_Layout_20190322.mxd. HDuff. 3/25/2019. Project/Phase/Task.



Location	AD-31	
Depth (ft bgs)	12	26
Cobalt (mg/kg)	1.9	0.83
Pyrite/Marcasite (%)	2	0

Location	AD-18	
Depth (ft bgs)	8	22
Cobalt (mg/kg)	3.6	2.9
Pyrite/Marcasite (%)	1	0

Location	AD-17	
Depth (ft bgs)	7	15
Cobalt (mg/kg)	3.1	1.5
Pyrite/Marcasite (%)	2	0

Location	AD-32	
Depth (ft bgs)	11	20-25
Cobalt (mg/kg)	1.7	9.1
Pyrite/Marcasite (%)	--	--

Location	AD-30	
Depth (ft bgs)	7	23
Cobalt (mg/kg)	1	15
Pyrite/Marcasite (%)	3	1

Legend

Monitoring Wells

Notes
- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019
- ft bgs: feet below ground surface
- mg/kg: milligrams per kilogram

0 125 250 500 750 1,000 Feet

Soil Chemical and Mineralogical Analysis Results

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/03/25

Figure 2

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\Pirkey_SoilChem_minerals_March2019.mxd. SKaroly. 3/25/2019. Project/Phase/Task.

TABLES

Table 1: Soil Cobalt and Mineralogy Data
East Bottom Ash Pond - H.W. Pirkey Plant

Location ID	Sample Depth (ft bgs)	Cobalt (mg/kg)	Pyrite/Marcasite (%)
AD-15	13	0.85	--
	40-43	0.79	--
AD-16	10	0.17	0
	19	0.44	1
AD-17	7	3.10	2
	15	1.50	0
AD-18	8	3.60	1
	22	2.90	0
AD-30	7	1.00	3
	23	15.0	1
AD-31	12	1.90	2
	26	0.83	0
AD-32	11	1.70	--
	20-25	9.10	--
AD-33	11	0.61	1
	21	0.64	--
AD-34	6	1.10	1
	24	6.50	2
AD-35	2	2.10	2
	17	0.18	0

Notes:
'--' - analysis not completed
mg/kg- milligram per kilogram
ft bgs - feet below ground surface

Samples were collected from additional boreholes advanced in the immediate area of the location identified by the well ID. Samples were not collected from the cuttings of the borings advanced for well installation.

Table 2: Summary of Key Analytical Data
East Bottom Ash Pond - H.W. Pirkey Plant

Sample	Unit	Cobalt Concentration
Bottom Ash (Solid Material)	mg/kg	6.1
SPLP Leachate of Bottom Ash	mg/L	<0.01
EBAP Pond Water	mg/L	0.0024 J
AD-2 - Average	mg/L	0.0109
AD-31 - Average	mg/L	0.0107
AD-32 - Average	mg/L	0.0529

Notes:
mg/kg - milligram per kilogram
mg/L - milligram per liter
J - Estimated value. Result is less than the reporting limit but greater than or equal to the method detection limit.
Average values were calculated using all cobalt data collected under 40 CFR 257 Subpart D.

ATTACHMENT A
AD-32 Boring Log

Hydrex ENVIRONMENTAL, INC.

Monitor Well

Monitor Well No.: **AD-32**

PROJECT INFORMATION

PROJECT:	Pirkey Power Plant
PROJECT NO.:	I-04-1021
LOGGED BY:	Jeffrey D. Sammons, P.G.
SUPERVISING PG:	Jeffrey D. Sammons, P.G.
COMPLETION:	12/11/2015
DEVELOPMENT:	12/16/2015
SITE LOCATION:	2400 FM 3251, Hallsville, Texas
WELL OWNER:	AEP

DRILLING INFORMATION

DRILLER:	Buford Collier
DRILLER'S LICENSE NO.:	60089
RIG TYPE:	Geoprobe 3230DT
METHOD OF DRILLING:	Hollow Stem Auger
SAMPLING METHODS:	Split Core
SURFACE ELEVATION:	359.18 (Top of Casing)
HOLE DIAMETER:	8.25"
LATITUDE	32 27' 66.20" LONGITUDE 94 29' 11.86"

STATE OF TEXAS — JEFFREY D. SAMMONS — GEOLOGY #10070 — LICENSED PROFESSIONAL GEOSCIENTIST — JDS 1-21-16

Water Level Upon Installation ▽ Water Level at Time of Drilling ■ Geotechnical Lab Sample

TBPG No. 50027

DESCRIPTION	USCS	SOIL SYMBOLS	DEPTH	WATER LEVEL	SAMPLE	% MOISTURE	% FINES	LL	PL	PI	WELL CONSTRUCTION
			-4 to 33								Locking Well Casing Cover; Locking Well Cap; Protective Well Casing; Concrete Pad; Ground Surface; Cement; Bentonite; 2" Sch. 40 PVC Riser; 20/40 Silica Sand; 0.010" Slotted Sch. 40 PVC Well Screen; PVC Bottom Cap
CLAYEY SAND: very fine to fine sand, dark reddish brown, moist - interbeds of sand and clay, yellowish brown and light gray at 1' - reddish brown and light gray at 2' - light gray and yellowish brown at 4', - grayish brown and light gray at 6' - grayish brown, light gray, and reddish brown at 7'	SC		0 to 12	▽	25	46	35	22	13		
					26	44	37	20	17		
SANDY LEAN CLAY: some gravel seams and thin interbeds of cemented sand, light yellowish brown and light gray, moist to saturated within gravel seams - some iron ore gravel at 16', very moist to saturated	CL		12 to 18		28	54	37	22	15		
SILTY SAND: very fine to fine sand, trace clay, brownish gray and dark brownish gray, saturated - reddish brown and brown at 20'	SM		18 to 20								
SANDY LEAN CLAY: gray and dark gray, very moist	CL		20 to 25		26	51	37	24	13		
CLAYEY SAND: fine to very fine sand, gray and dark gray, very moist to saturated	SC		25 to 30		26	47	41	22	19		
SANDY LEAN CLAY: gray and dark gray, very moist	CL		30 to 33		26	59	35	21	14		

NOTES: This log should not be used separately from the original report. Not all USCS descriptors were laboratory verified.

ATTACHMENT B
Bottom Ash and Bottom Ash SPLP
Laboratory Analytical Data

Client Sample ID: CCR SAMPLE-EBAP-1

Date Collected: 02/11/19 17:00
Date Received: 02/13/19 09:40

Lab Sample ID: 490-168389-2

Matrix: Solid
Percent Solids: 75.6

Method: 9056 - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	1.3	U	1.3	1.1	mg/Kg	☼		02/14/19 01:19	1

Method: 6010C - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	13	U	13	1.3	mg/Kg	☼	02/13/19 16:11	02/19/19 19:24	1
Arsenic	**3.1**		2.6	1.6	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Barium	**330**		2.6	1.3	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Beryllium	**0.64**	**J**	1.3	0.26	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Boron	**110**		13	5.7	mg/Kg	☼	02/13/19 16:11	02/18/19 22:55	1
Cadmium	1.3	U	1.3	0.13	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Chromium	**13**		1.3	1.2	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Cobalt	**6.1**		2.6	1.3	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Lead	**0.82**	**J**	1.3	0.66	mg/Kg	☼	02/13/19 16:11	02/19/19 19:24	1
Lithium	**3.7**	**J**	13	1.3	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Molybdenum	13	U	13	6.6	mg/Kg	☼	02/13/19 16:11	02/16/19 23:21	1
Selenium	2.6	U	2.6	1.5	mg/Kg	☼	02/13/19 16:11	02/19/19 19:24	1
Thallium	2.6	U	2.6	0.79	mg/Kg	☼	02/13/19 16:11	02/19/19 19:24	1

Method: 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.13	U	0.13	0.039	mg/Kg	☼	02/14/19 10:07	02/14/19 13:20	1

Client Sample ID: CCR SAMPLE-EBAP-1

Date Collected: 02/11/19 17:00
Date Received: 02/13/19 09:40

Lab Sample ID: 490-168389-2

Matrix: Solid

Method: 9056 - Anions, Ion Chromatography - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	**0.023**	**J B**	0.10	0.010	mg/L			02/19/19 23:58	1

Method: 6010C - Metals (ICP) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:58	1
Arsenic	0.010	U	0.010	0.0086	mg/L		02/19/19 16:41	02/20/19 13:58	1
Barium	**0.23**		0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:58	1
Beryllium	0.0040	U	0.0040	0.0020	mg/L		02/19/19 16:41	02/20/19 13:58	1
Boron	**0.032**	**J**	0.050	0.020	mg/L		02/19/19 16:41	02/20/19 13:58	1
Cadmium	0.0010	U	0.0010	0.00050	mg/L		02/19/19 16:41	02/20/19 13:58	1
Chromium	0.0050	U	0.0050	0.0030	mg/L		02/19/19 16:41	02/20/19 13:58	1
Cobalt	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:58	1
Lead	0.0050	U	0.0050	0.0020	mg/L		02/19/19 16:41	02/20/19 13:58	1
Lithium	**0.011**	**J B ***	0.050	0.010	mg/L		02/19/19 16:41	02/20/19 13:58	1
Molybdenum	0.050	U	0.050	0.030	mg/L		02/19/19 16:41	02/20/19 13:58	1
Selenium	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:58	1
Thallium	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:58	1

Method: 7470A - Mercury (CVAA) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.00020	U	0.00020	0.00010	mg/L		02/19/19 16:03	02/21/19 15:47	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	**75.6**		0.1	0.1	%			02/17/19 12:25	1

ATTACHMENT C

Bottom Ash Pond Water Laboratory Analytical Data

Client Sample ID: SW-EGAP-1

Date Collected: 12/15/18 14:50
Date Received: 12/18/18 10:30

Lab Sample ID: 490-165222-6

Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	**0.30**	**J**	1.0	0.010	mg/L			12/20/18 19:46	1
Sulfate	**750**		500	3.0	mg/L			12/30/18 09:58	100
Chloride	**22**	**B**	6.0	0.40	mg/L			12/30/18 09:41	2

Method: 6020A - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.0030	U	0.0030	0.00080	mg/L		12/19/18 14:26	12/27/18 15:18	1
Arsenic	**0.00055**	**J**	0.0050	0.00040	mg/L		12/28/18 12:47	01/03/19 11:14	1
Barium	**0.050**	**J B**	0.20	0.00010	mg/L		12/19/18 14:26	12/27/18 15:18	1
Beryllium	0.0040	U	0.0040	0.00010	mg/L		12/19/18 14:26	12/26/18 22:18	1
Boron	**4.5**	**J**	5.0	0.18	mg/L		12/28/18 12:47	12/30/18 12:35	5
Cadmium	0.0050	U	0.0050	0.00010	mg/L		12/19/18 14:26	12/27/18 15:18	1
Calcium	**140**		1.0	0.053	mg/L		12/19/18 14:26	12/26/18 22:18	1
Chromium	0.0050	U	0.0050	0.00050	mg/L		12/19/18 14:26	12/27/18 15:18	1
Cobalt	**0.0024**	**J**	0.0050	0.00010	mg/L		12/19/18 14:26	12/27/18 15:18	1
Lead	0.0050	U	0.0050	0.00010	mg/L		12/19/18 14:26	12/21/18 21:34	1
Lithium	**0.023**	**J**	0.040	0.0030	mg/L		12/19/18 14:26	12/21/18 21:34	1
Molybdenum	**0.0075**	**J**	0.010	0.0010	mg/L		12/19/18 14:26	12/26/18 22:18	1
Selenium	**0.0059**	**J**	0.010	0.00030	mg/L		12/19/18 14:26	12/26/18 22:18	1
Thallium	0.0020	U	0.0020	0.00080	mg/L		12/19/18 14:26	12/21/18 21:34	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.00020	U	0.00020	0.00010	mg/L		12/20/18 12:26	12/21/18 12:23	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**1100**		25	7.0	mg/L			12/19/18 23:00	1

ATTACHMENT D
Certification by 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 Pirkey East Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.95(g)(3)(ii) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864	Texas	4/25/2019
License Number	Licensing State	Date

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

H.W. Pirkey Power Plant
East Bottom Ash Pond
Hallsville, Texas

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

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engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, OH 43221

July 22, 2019

CHA8462

TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASL	Alternate Screening Level
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
DPT	Direct Push Technology
EBAP	East Bottom Ash Pond
EDS	Energy Dispersive Spectroscopic Analyzer
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
HSA	Hollow Stem Auger
LCL	Lower Confidence Limit
LOI	Loss on Ignition
MCL	Maximum Contaminant Level
NTU	Nephelometric Turbidity Unit
PVC	Polyvinyl Chloride
QA	Quality Assurance
QC	Quality Control
SEM	Scanning Electron Microscope
SSL	Statistically Significant Level
TSS	Total Suspended Solids
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
USCS	Unified Soil Classification System
VAP	Vertical Aquifer Profiling
WBAP	West Bottom Ash Pond
XRD	X-Ray Diffraction

SECTION 1

INTRODUCTION AND SUMMARY

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the East Bottom Ash Pond (EBAP, **Figure 1**). In 2018, two assessment monitoring events were conducted at the EBAP in accordance with 40 CFR 257.95. The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were established for each Appendix IV parameter in accordance with the statistical analysis plan developed for the facility (AEP, 2017) and United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The GWPS for each parameter was established as the greater of the background concentration and the maximum contaminant level (MCL) or alternate screening level (ASL) provided in 40 CFR 257.95(h)(2). 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.

Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV parameters were present at statistically significant levels (SSLs) above the GWPSs. An SSL was concluded if the lower confidence limit (LCL) of a parameter exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). The following SSLs were identified at the Pirkey EBAP:

- LCLs for lithium exceeded the GWPS of 0.051 mg/L at AD-31 (0.0556 mg/L) and AD-32 (0.0722 mg/L); and

- LCLs for cobalt exceeded the GWPS of 0.0094 mg/L at AD-2 (0.010 mg/L), AD-31 (0.00949 mg/L), and AD-32 (0.0353 mg/L).

No other SSLs were identified (Geosyntec, 2018).

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations regarding assessment monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (40 CFR 257.95(g)(3)(ii)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a*

> *qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section….*

Pursuant to 40 CFR 257.95(g)(3)(ii), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSLs identified for lithium should not be attributed to the EBAP. An alternative source for cobalt at wells AD-2, AD-31, and AD-32 was previously identified and documented in an ASD (Geosyntec, 2019).

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSL 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 SSLs identified for lithium were based on a Type IV cause and not by a release from the Pirkey EBAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal CCR Rule allows the owner or operator 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. The methodology used to evaluate the SSLs identified for lithium and the proposed alternative source are described below.

2.1 Alternative Source for Lithium

Initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify alternative sources due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSLs for lithium have been attributed to natural variation associated with the underlying geology, which is a Type IV issue.

Lithium concentrations vary spatially across the Site and do not necessarily appear correlated with the locations of CCR units or other Plant operations in general. While AD-31 and AD-32 have higher lithium concentrations than the upgradient wells in the EBAP network (i.e., AD-4, AD-12, and AD-18), upgradient as well as downgradient wells having similar or higher concentrations of lithium were observed within the networks for other CCR units at the Site (**Table 1**). Additionally, a boring advanced in November 2018 immediately upgradient of the EBAP (SB-01/AD-40) (**Figure 1**) revealed a strong dependence of lithium concentration with elevation, as groundwater collected at shallow intervals had low lithium concentrations e.g., (0.0207 mg/L at 30-40 feet below ground surface [ft bgs]) and groundwater collected at deeper intervals had elevated lithium concentrations (e.g., 0.0844 mg/L at 90-100 ft bgs).

These results suggest that lithium concentrations in groundwater at the site have variability in both their lateral and vertical distribution across the Site. In addition to variable lithium concentrations, it was noted that the recorded turbidity at each groundwater monitoring well is typically above the recommended maximum value of 10 nephelometric turbidity units (NTU) during groundwater sampling (**Table 1**). The recorded turbidity of samples collected during the background monitoring period was occasionally above 400 NTU, and some readings noted that the turbidity saturated the field instrument (~1000 NTU). Based on these observations, additional field work was completed to better understand the spatial distribution of lithium and its relationship to turbidity. The additional field investigation was conducted in May 2019.

2.1.1 May 2019 Field Investigation

Geosyntec advanced three borings upgradient of the EBAP between May 7 and 17, 2019 (**Figure 2**) to collect groundwater chemistry data at locations sufficiently far upgradient to completely avoid all known (present and historical) Plant activities. One shallow boring, B-1, was advanced to 36 ft bgs on a parcel owned by AEP approximately 2,000 feet to the north. Two deep borings, B-2 and B-3, were advanced to refusal at 93 and 97 ft bgs, respectively, in locations closer to the

plant, but upgradient of the EBAP. Permanent wells were installed at locations B-2 and B-3 for ongoing monitoring.

Prior to boring installation, all borings locations were hand-augured to five ft bgs to check for presence of utilities. A Geoprobe® drilling rig with 2" Direct Push Technology (DPT) was used to log and sample the shallow B-1 boring and the shallow intervals of borings B-2 and B-3. Upon refusal with the DPT rig, a truck-mounted 8" hollow stem auger (HSA) drilling rig with a continuous sampler was used to log and sample borings B-2 and B-3 below DPT refusal depth. Soils were logged continuously from the surface using the Unified Soil Classification System (USCS). Boring logs are provided in **Attachment A**. Both soil and groundwater sampling were conducted at each of the three borings. Boring B-1 was not used for a permanent well and was backfilled to the surface with Portland cement and bentonite.

2.1.1.1 Soil Sampling

The onsite hydrostratigraphic unit for the EBAP was identified as the clayey and silty sand stratum located between an elevation of approximately 325 and 340 feet above mean sea level (Arcadis, 2016). This unit is within the Reklaw Formation, which consists predominantly of clay and fine-grained sand and is underlain by the Eocene-age Carrizo Sand. The presence of lignite in the area is well-documented (Broom and Myers, 1966; ETTL, 2010). Geosyntec collected nine additional soil samples to better understand the distribution of lithium in soils in upgradient locations and with depth.

One soil sample at boring B-1, five samples at B-2 (including a sample of coal/lignite material found within the stratigraphic column), and three samples at boring B-3 were collected for total metals analysis via EPA Method 6010. Soil samples were collected just above the groundwater table, at the base of the deep borings, and at intervals of interest. The depths and rationale for each sample collected are summarized in **Table 2**. Except for the coal fragments collected in boring B-2 at 81.5 ft bgs, soil samples represent composite samples of the indicated depth interval.

Lithium concentrations of soil samples collected during the May 2019 field investigation varied from 2.59 mg/kg (B-3, 19.5-20.5 ft bgs) to 13.1 mg/kg (B-2, 87-88 ft bgs), which generally is consistent with soils previously sampled around the site. Results of the coal fragments from 81.5 ft bgs in boring B-2 indicated that the coal contained 4.32 mg/kg lithium. This is comparable to the lithium concentrations of the shallower (< 20 ft bgs) soil samples, which averaged 4.1 mg/kg (n=5), and less than the average concentrations observed in the co-located deeper lithology of 10.54 mg/kg (n=3). Lower lithium in shallower soil intervals could indicate weathering has mobilized lithium from those intervals.

2.1.1.2 Groundwater Sampling

Borings B-2 and B-3 were sampled via vertical aquifer profiling (VAP) techniques, in which multiple temporary well screens were set at the varying depth intervals of interest. Generally, a sample was taken after encountering the water table, followed by subsequent attempts to collect additional samples at ten-foot intervals. Shallow groundwater samples (< 24 ft bgs) were collected

from temporary drop screens installed via DPT in offsets from the originally logged location. Two sampling depths were attempted using DPT in borings B-2 and B-3, one at the water table and one ten feet below the water table. In both borings, only the shallower water-table interval produced enough water to sample due to clayey lithology below the water table. One shallow groundwater grab sample was collected at boring B-1 using DPT and temporary well screen methodology.

Following DPT refusal, VAP samples were collected from the same HSA borehole being logged and soil-sampled at borings B-2 and B-3. After removing the HSA continuous sampler, a four-inch diameter polyvinyl chloride (PVC) casing with a five-foot long well screen were temporarily installed through the HSA tooling, and the augers were retracted to expose the well screen to the formation. Following sampling, the well casing and screen was removed and decontaminated, and drilling resumed for another ten feet. Four samples from boring B-2 and six samples from boring B-3 were collected using the HSA VAP methodology. Five-foot intervals in boring B-2 at 68-73 and 88-93 ft bgs and boring B-3 at 92.5-97.5 bgs did not produce enough water to collect a sample due to clay lithology. **Table 3** summarizes the groundwater samples collected in May 2019.

Groundwater VAP sampling was generally completed using a modified low-flow methodology. When possible, flow rates below 500 ml/min were used during purging, and drawdown was monitored. Geochemical parameters and turbidity were monitored, though stability was not observed during purging the temporary well screens. Wells were purged for a minimum of 20 minutes prior to sampling. However, turbidity remained visibly high at all sampling intervals prior to sample collection.

Groundwater VAP samples were sent to the lab on ice for quick turn-around analysis of total lithium concentrations via EPA Method 6010. Due to the high turbidity in the total lithium samples, extra sample volume was collected in an unpreserved one-liter plastic sample bottle for lab filtration using a 0.45-µm filter and analysis of dissolved lithium. Groundwater samples were also analyzed a full scan of metals, total dissolved solids, major anions, and alkalinity.

Total (unfiltered) lithium concentrations varied from 45 µg/L to 1,140 µg/L (**Table 3**). Lithium concentrations in the lab filtered samples varied from 6 µg/L to 105 µg/L. The lab filtered results were generally lower than the total lithium results, suggesting a correlation between turbidity and lithium concentration. Select total lithium concentrations were higher than previously observed at the Site. This is likely due to the fact that the samples were collected without a developed filter pack and with elevated turbidity. Additional groundwater results are available in **Attachment B**. Total metals data for parameters other than lithium are not available for samples from B-2 as they were analyzed using incorrect laboratory techniques.

2.1.1.3 Permanent Well Sampling

Permanent wells were installed at boring B-2 and B-3, with the screened interval based on VAP sampling results. The HSA drilling rig was used to install a well screen at 38 to 48 ft bgs at boring B-2 and 29 to 34 ft bgs at boring B-3. These elevations are consistent with the screened elevations at AD-31 and AD-32. Well construction diagrams are available in **Attachment C**. Wells were

installed per state regulations and certified by a Texas licensed driller. After an appropriate set-up time for the bentonite seal, the wells were developed with a Proactive Typhoon pump until turbidity and geochemical parameters stabilized (**Attachment D**). Following well development, both new permanent wells were sampled using low-flow methodology (**Attachment E**).

Total lithium concentrations in permanent wells B-2 and B-3 were measured at 0.053 mg/l and 0.061 mg/l, respectively (**Figure 3**). These concentrations are slightly above the GWPS of 0.051 mg/L. Because these wells were installed at upgradient locations unimpacted by Site activities, they suggest that lithium concentrations above the GWPS are located in the vicinity of the EBAP, but not necessarily related to the prevailing groundwater flow direction. Samples were also collected from AD-31 and AD-32 using low-flow methodology, with special effort taken to purge the well until turbidity was below 10 NTU (**Attachment E**). The reported lithium concentrations for these samples were near or below the lowest value observed during monitoring at these locations to date (**Figure 4**). While not a direct correlation, these results suggest that elevated turbidity may be associated with higher lithium concentrations.

2.1.1.4 Investigation of Suspended Solids

It was noted during VAP and permanent well sampling that lithium is biased toward higher concentrations when samples are very turbid. Therefore, an additional investigation was conducted to evaluate the suspended matter and determine whether it could be serving as a background source of lithium. Unpreserved groundwater samples from intervals VAP-B3-(40-45) and VAP-B3-(50-55) were processed to separate the particulate from the groundwater. Aliquots of each sample were centrifuged at approximately 700 Relative Centrifugal Force for five minutes. The supernatant was then decanted, and the solid pellet was transferred to a small glass vial for chemical analysis. The supernatant had a yellowish color, suggesting that especially fine particulate remained in suspension, but accounted for very little mass.

In addition to the centrifuged material from VAP-B3-(40-45), a sample of the bulk soil from interval B2-(19-20) was submitted for analysis by X-ray diffraction (XRD). XRD is commonly used to identify and quantify crystalline solids among an assemblage of solids. Solids that are amorphous (non-crystalline), such as humic substances and other organic matter, cannot be detected with compositional specificity by XRD.

Results of the XRD analysis indicate the presence of common soil minerals (**Table 4**). The bulk soil [B-2-(19-20)] contained a higher fraction of quartz (67%), which is typical of an unconsolidated sandy aquifer. Soil in this depth interval also contained several percent by weight of clay minerals, including kaolinite, chlorite, illite and smectite. Goethite (a mineral composed of iron(III) hydroxide) comprises 2% of the sample and a form of amorphous (non-crystalline) matter makes up approximately 7% of the sample.

The centrifuged sample [VAP-B3-(40-45)] contained less quartz (15%), a higher fraction of clay minerals (42% kaolinite, 4% chlorite, 6% illite and 12% smectite), and 15% (roughly estimated) amorphous matter. According to the XRD results, this soil fraction contains 2% hematite, an iron(III) oxide (Fe_2O_3) and 3% pyrite.

Sulfur and iron were among the elements identified in the VAP-B3-(50-55) centrifuged solid material sample by scanning electron microscopy (SEM) using an energy dispersive spectroscopic analyzer (EDS). Results, reported as weight percent oxides and sulfide in **Table 5**, show 3.4% FeS_2 and 2.8% Fe_2O_3. While these results express chemical composition rather than mineralogy, it is reasonable to infer that FeS_2 represents pyrite and Fe_2O_3 represents hematite (Fe_2O_3) and goethite ($Fe_2O_3 \cdot H_2O$) based on the XRD results. Silica, aluminum and potassium oxides correspond to the quartz and clay minerals identified in **Table 4**.

The abundance of smectite in both XRD samples bears consideration. Smectite is a group name for certain clay minerals with a 2:1 silicate structure which form crystals that are typically sub-micrometer in size. Common types of smectite include montmorillonite and beidellite, but a lithium-bearing form called hectorite is also well known (USGS, 2001). Smectites have among the highest cation-exchange capacities of all clay minerals: their interlayer regions can sorb roughly 100 milli-equivalents of cation charge per 100 grams of clay (100 meq/100 g). Exchangeable metals often include calcium and sodium, but almost all metals with +1 or +2 charge are potential exchange species. The SEM/EDS results also confirm that aluminum and silicon are major constituents, which supports the XRD finding that clays are the predominant mineral in suspension. The presence of potassium also helps confirm the presence of illite (mica), which was identified by XRD.

It is noteworthy that the centrifuged solid material had a higher fraction of amorphous (non-crystalline) material, which could include organic solids. Moreover, this amorphous material may be what contains the abundance of clay minerals. While the XRD results are inconclusive, one possibility is that the amorphous material is lignite and the clays are associated with its mineral fraction.

Because XRD cannot identify if lithium is present within a sample, the centrifuged solid material was submitted for total metals analysis. An additional sample of suspended matter from VAP interval B3-(50-55) was also submitted for metals analysis, as it had the highest total lithium of all the VAP samples that were collected. Lithium was detected in B3-(50-55) and B3-(40-45) (**Table 6**) at concentrations comparable to lithium in the bulk soil (**Table 2**). These results provide evidence that the particulates captured during groundwater sampling contain lithium.

Metals in a lignite sample from the nearby surficial mine were compared to concentrations in the suspended matter (**Figure 5)**. The concentrations of lithium and other constituents are similar, suggesting that some fraction of the suspended solids consists of degraded lignite. Thin seams of lignite were noted in boring logs at the depth most monitoring wells at the Site were installed (**Attachment A**).

Loss on ignition (LOI) testing was completed to quantify mass loss after heating the sample to 550°C in an oxygen-rich environment, which allows for measurement of the combustible carbon and loss of semi-volatile constituents. Centrifuged solid material from both the VAP B3-(40-45) and B3-(50-55) fraction were air-dried in pre-weighed pans to 103˚C to remove excess water from the samples. The samples were weighed again and then heated to 550˚C until the mass of the fraction was steady, signifying complete combustion of the volatile fraction. The B3-(40-45) sample had a volatile fraction of 13.1%, and the B3-(50-55) sample had a volatile fraction of 11.4% of the total mass, respectively. These fractions are believed to represent organic compounds, such as lignite. The volatile fraction in the 40-45 ft sample (13.1%) is in good agreement with the determination of 15% amorphous matter by XRD (**Table 4**). By difference, the solid fractions consist of 87-89% refractory minerals including clays, metal oxides, and pyrite. Because lignite typically contains ~20 % hydrocarbons (plus oxygen and nitrogen), and only 6-19% mineral matter (Ghassemi, 2001), the results of the LOI tests suggest that most of the organic fraction of the lignite has been lost to degradation, primarily leaving the mineral fraction in place of the original lignite deposit.

Based on chemical analysis of the two solid samples, the iron content is 1.1% for B-2 and 2.6% for B-3, which is comparable to the amount of iron in the lignite sample (1.4%) from the Plant (**Table 6**). While some of the iron is associated with the oxidized iron minerals, goethite and hematite, which were detected by XRD (**Table 4**), some iron is likely present in pyrite as well. As noted above, pyrite was detected by XRD in the particulate sample (B-3) and iron and sulfur were both detected in the particulate by SEM/EDS, but the results were not quantified.

Together with the evidence presented for pyrite in the suspended solids and in locally-mined lignite, the solid phase results support the proposed alternative source for lithium, which is naturally suspended matter that likely originates from lignite and is ubiquitous in the shallow aquifer.

The total metal concentrations in the centrifuged solid material samples and the total groundwater concentrations were used to calculated partition coefficients values (K_d) for multiple constituents, including lithium. The calculated K_d values were comparable to literature K_d values reported for organic-rich soil media such as bogs and peats (**Table 7**) (Sheppard et al, 2009; 2011). Additionally, total suspended solids (TSS) concentrations were calculated using the solids and groundwater concentrations and compared to TSS concentration measured using gravimetric techniques (**Table 7**). These values were also comparable, providing further evidence that lithium behavior at the site is similar to its adsorption and mobility at other organic-rich sites described in the literature.

2.1.2 Proposed Mechanism for Lithium Transport in Groundwater

Based on the chemistry results, it is proposed that lithium is associated with clay minerals that make up the mineral fraction of lignite, which is deposited in thin beds at various depths within the aquifer. Clay particles which remain suspended due to their association with the lignite matrix are the vehicle for lithium transport. It appears that these particles remain in suspension during

low-flow groundwater sampling even after very long purge times, as evidenced by the historical high turbidities measured in Site groundwater. During groundwater sampling, an abundance of suspended matter is mobilized with the sample which, after nitric-acid preservation, releases the lithium into solution where it often results in elevated concentrations.

A simple model to illustrate the effect of suspended solids on total (unfiltered) lithium is shown in **Figure 6**. This model used the partition coefficients described in Section 2.1.1 to calculate the dissolved phase concentrations of lithium plus the contribution of lithium to groundwater by the particulate (see **Table 7**). Although results for the two sources are not identical, the figure shows that when the abundance of suspended matter reaches a certain level (approximately 10 g/L or higher) the total lithium (dissolved plus suspended) can greatly exceed that of the dissolved phase alone. According to the model, lithium concentrations are less variable when lower concentrations of suspended solids are present in groundwater. This provides an explanation for why observed lithium concentrations at the Site are not clearly correlated with turbidity. The analytical data, geologic information, and sorption model presented above provide a mechanism for the distribution and transport of naturally occurring lithium in Site groundwater.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.95(g)(3)(ii) and supports the position that the SSLs for lithium at wells AD-31 and AD-32 identified during assessment monitoring in 2018 were not due to a release from the EBAP. The identified SSLs were, instead, attributed to natural variation in the underlying geology. Therefore, no further action for lithium is warranted, and the EBAP will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment F**.

SECTION 4

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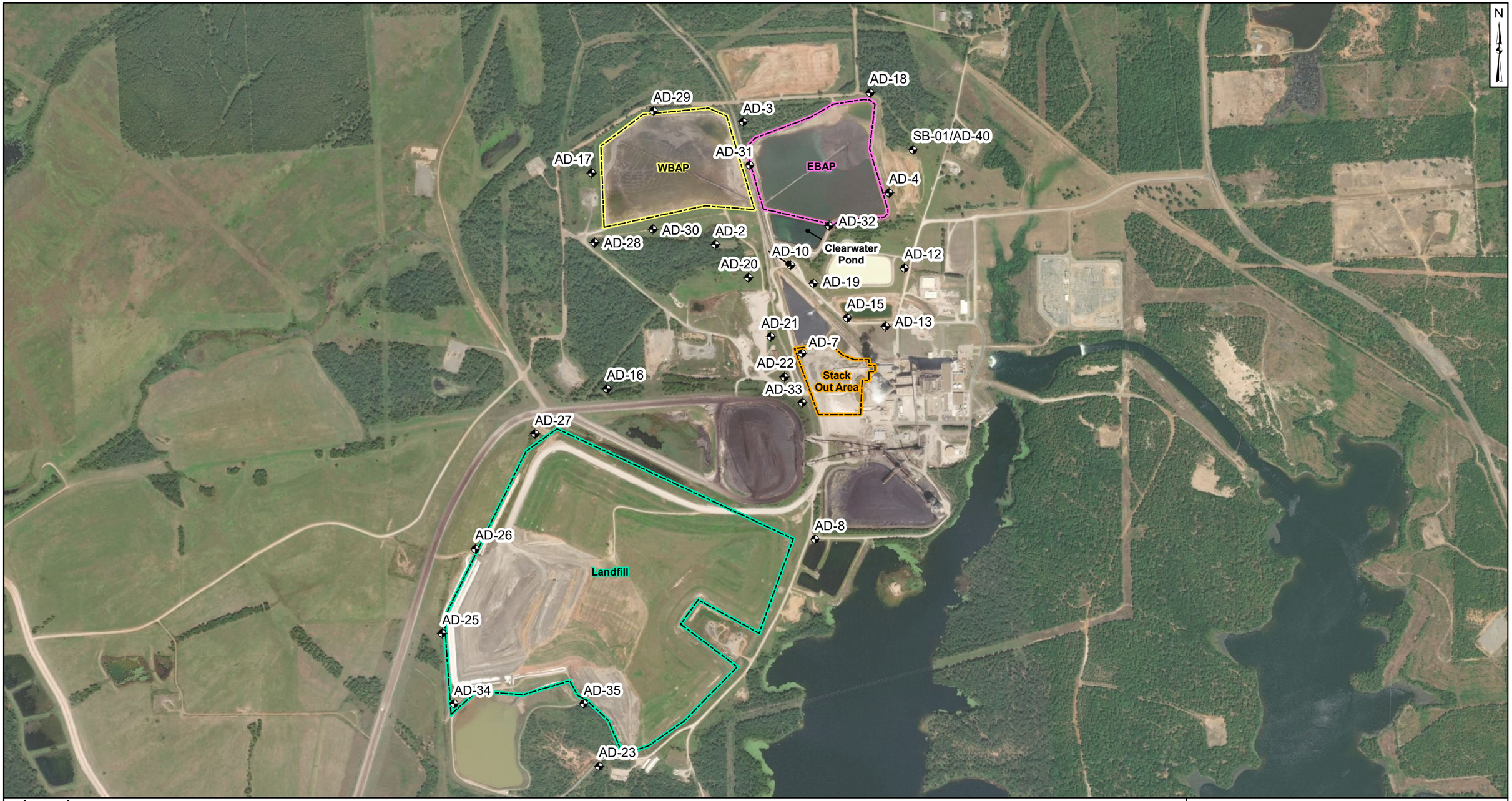
Figures



Legend

- Monitoring Well
- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Monitoring well coordinates provided by AEP.
-AD-15 location is approximated

800 400 0 800 Feet

Site Layout

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/07/10

Figure 1

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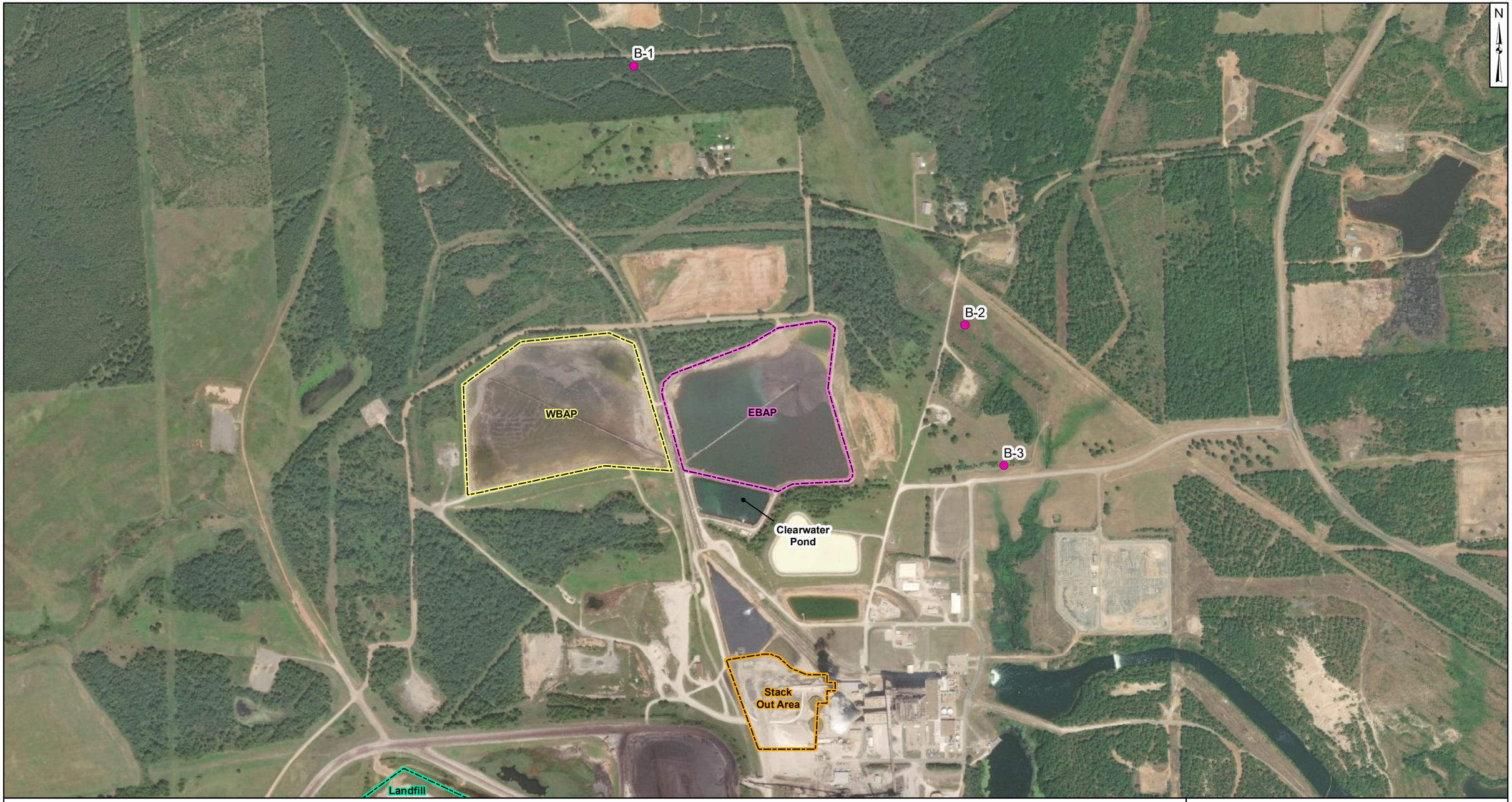

Legend

- Soil Boring Location
- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

-Data provided by AEP, 2019.
-Soil Boring locations are approximate.

0 350 700 1,400 2,100 Feet

Soil Boring Locations

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/07/10

Figure 2

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Legend

- Borehole
- Monitoring Well

Location Boundaries

- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Lithium concentrations in mg/l
- Monitoring well coordinates and water level data (collected on August 20-21, 2018) provided by AEP.
- Data provided by AEP 2019
- AD-15 location is approximated

0 150 300 600 900 1,200 Feet

Lithium Values May 2019

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/07/10

Figure 3

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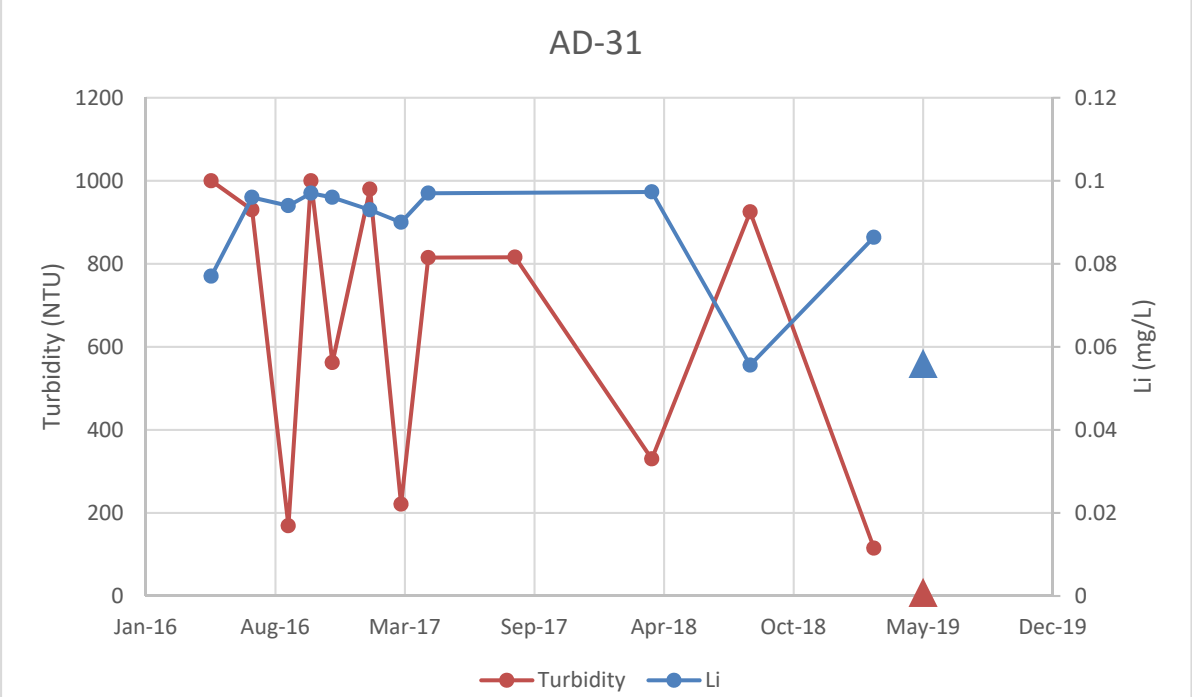
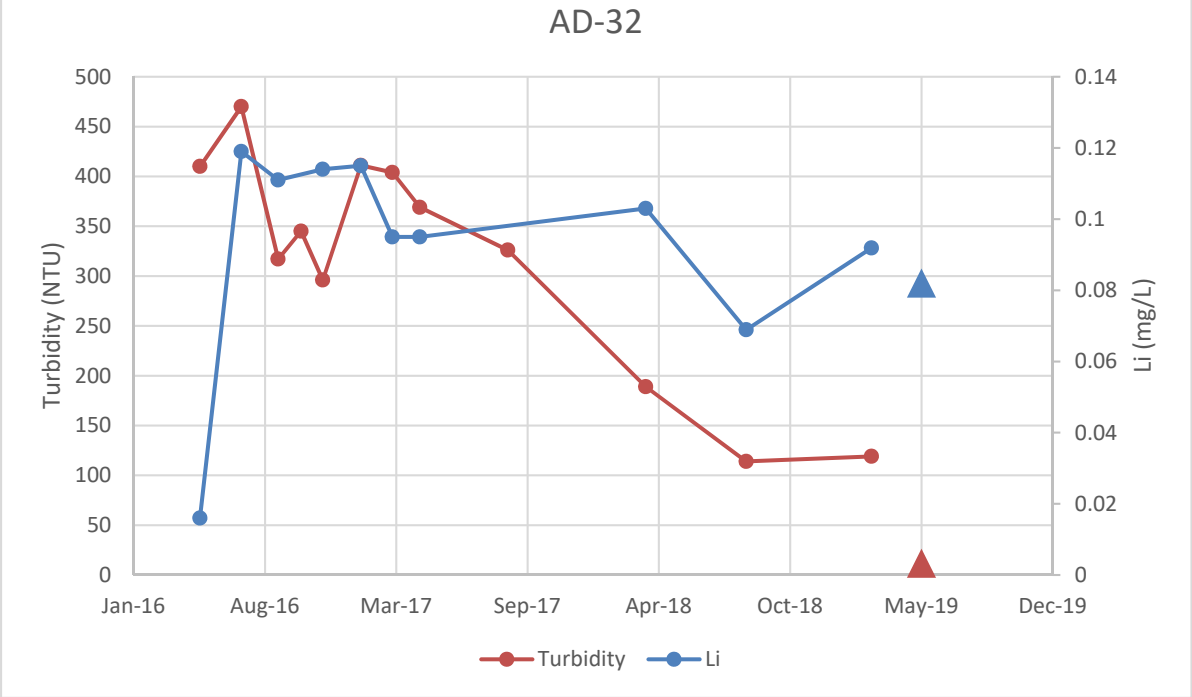




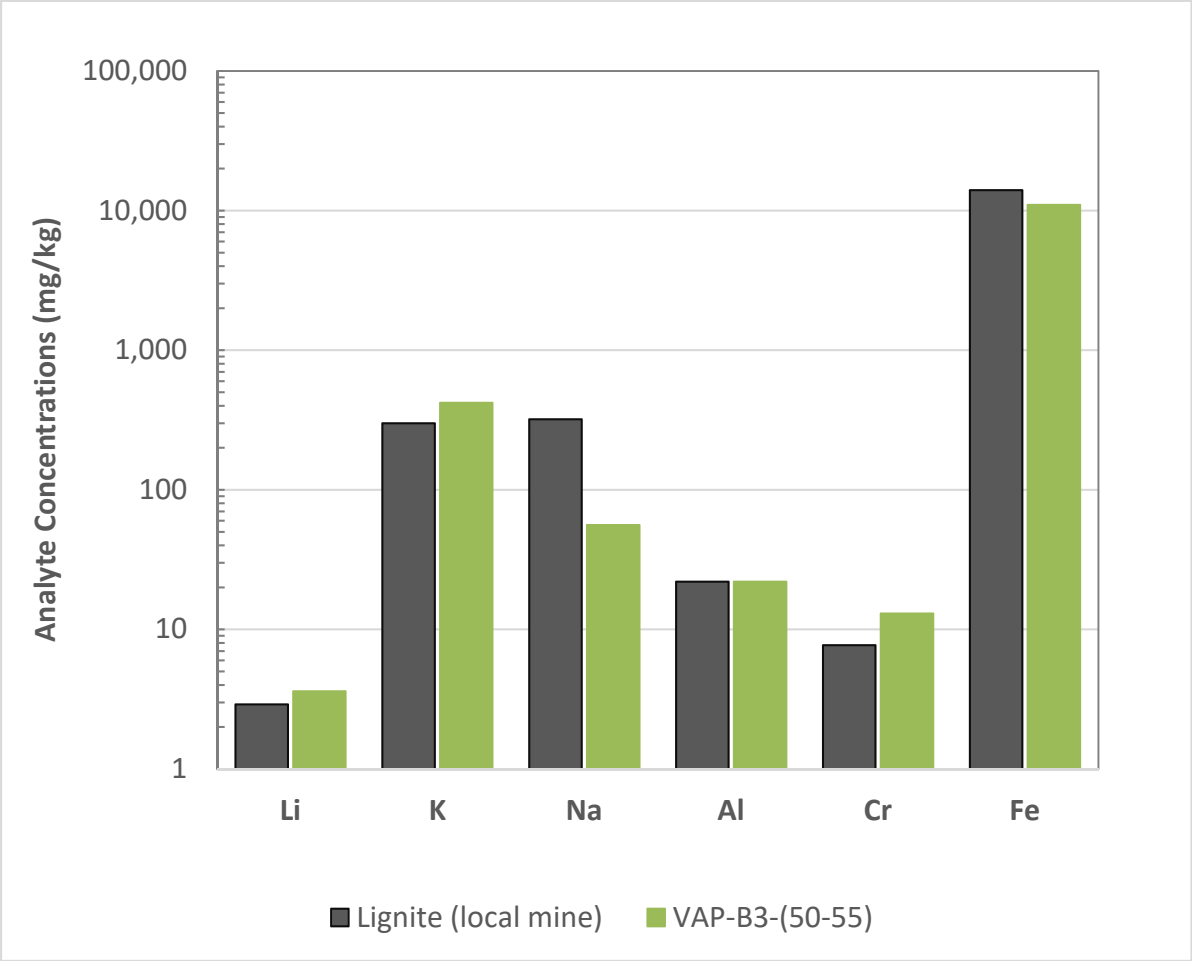
Notes:
NTU: nephelometric turbidity units
mg/L: milligrams per liter

Lithium and Turbidity Time Series Graphs
Pirkey East Bottom Ash Pond

Geosyntec consultants | AMERICAN ELECTRIC POWER | Figure 4

Columbus, Ohio | 7-Jul-2019

internal info: path, date revised, author



Notes: VAP-B3-(50-55) sample was obtained by centrifuging suspended solids in groundwater at the 50-55 ft interval. Locally mined lignite was collected from the coal pile at the Site.

Total Metals Concentrations
Pirkey East Bottom Ash Pond

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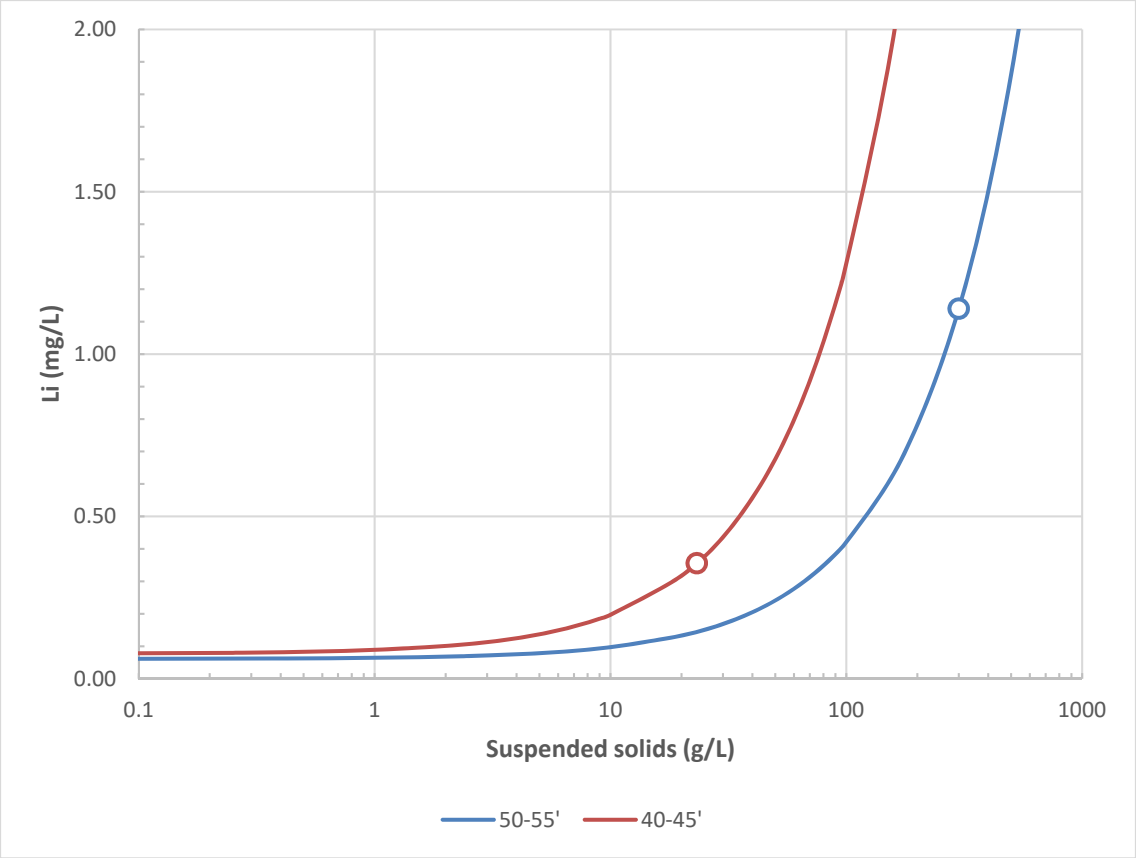
Figure **5**

internal info: path, date revised, author



Notes: Model for lithium concentrations based on sorption on suspended solids. The model was generated using the results from VAP-B3-(50-55) and –(45-55). Symbols represent results of unfiltered samples.

Calculated Lithium Sorption Model
Pirkey East Bottom Ash Pond

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Figure **6**

internal info: path, date revised, author

Tables

Table 1: August 2018 Groundwater Lithium and Turbidity Results
Pirkey Plant - East Bottom Ash Pond

Geosyntec Consultants, Inc.

Well	Lithium (mg/L)	Turbidity (NTU)	CCR Unit Network
AD-2	0.0479	155	EBAP
AD-3	0.0876	190	WBAP
AD-4	0.0294	201	EBAP
AD-7	0.0877	103	Stackout
AD-8	0.0221	103	Landfill
AD-12	0.0143	177	EBAP/WBAP/Landfill/Stackout
AD-13	0.146	181	Stackout
AD-16	0.0347	100	Landfill
AD-17	0.0234	124	WBAP
AD-18	0.0175	278	EBAP/WBAP
AD-22	0.132	235	Stackout
AD-23	0.00634	995	Landfill
AD-27	0.0921	279	Landfill
AD-28	0.0307	216	WBAP
AD-30	0.0118	142	WBAP
AD-31	0.0556	925	EBAP
AD-32	0.0689	114	EBAP
AD-33	0.0178	102	Stackout
AD-34	0.114	131	Landfill
AD-35	0.00876	258	Landfill

Notes:
mg/L: milligrams per liter
NTU: nephelometric turbidity units
EBAP: East Bottom Ash Pond
WBAP: West Bottom Ash Pond
Stackout: Stackout Pad

Table 2: Soil Sampling Results
Pirkey Plant - East Bottom Ash Pond

	Boring	B-1	B-2					B-3		
	Depth (ft bgs)	16-21	9.5-10.5	19-20	71-72	81.5	87-88	9.5-10.5	19.5-20.5	96.5-97
	Sampling Rationale	Soil above groundwater table	Soil 10 ft bgs	Soil above groundwater table	Soil with abundant coal material	Coal Fragments	Soil at auger refusal depth (93 ft bgs)	Soil 10 ft bgs	Soil above groundwater table	Soil at auger refusal depth (97 ft bgs)
	Soil Type	Sandy clay/clay/ clayey sand	Fat clay	Clay, medium plasticity	Coal/sand interbeds with clay	--	Silty clay, low plasticity	Silty clay	Fat clay	Silty clay, low plasticity
Metals Concentrations (mg/kg)	Aluminum	NM	NM	NM	NM	NM	NM	15600	8170	NM
	Antimony	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
	Arsenic	14.3	17.9	12.3	7.94	5.01	1.88	17.4	9.96	0.89
	Barium	51.7	53.8	39.5	39.4	53.7	27.5	47.2	206	35.5
	Beryllium	0.376	0.477	0.385	0.217	1.99	0.233	0.419	0.301	0.273
	Boron	11.9	11	13.1	13.6	48.3	12.1	11.2	5.44	7.8
	Cadmium	0.185	0.116	0.234	0.208	<0.05	<0.05	<0.05	<0.05	0.05
	Calcium	183	117	195	245	1820	479	36	45.4	226
	Chromium	37.6	33.3	26.2	6.93	42.5	16.1	31.2	19.6	13.2
	Cobalt	2.95	2.36	3.62	10.3	7.21	3.11	1.3	0.593	1.11
	Iron	41000	36900	42800	38100	22600	17300	25300	13800	2880
	Lead	12.1	9.31	8.29	6.87	9.5	10.5	8.8	5.21	9.1
	Lithium	5	5.3	3.97	7.42	4.32	13.1	3.64	2.59	11.1
	Magnesium	968	2840	1720	362	716	845	1400	528	365
	Manganese	15.6	10.4	12.7	38.8	48.8	32.1	10.5	6.9	16.1
	Molybdenum	0.828	0.608	0.479	3.38	1.63	0.8	0.692	0.654	0.334
	Nickel	NM	NM	NM	NM	NM	NM	3.05	4.26	NM
	Potassium	1370	2360	1860	456	276	663	2230	1120	437
	Selenium	1.57	1.02	1.13	2.04	2.52	1.84	0.666	0.448	1.39
	Sodium	53.1	139	51.7	57.6	86.3	53.7	47.3	56.3	39.9
	Strontium	62.5	47.9	13.4	6.52	15.5	10.5	12.8	6.51	8.24
	Thallium	<0.25	<0.25	<0.25	0.306	0.799	<0.25	<0.25	<0.25	<0.25
	Dry Weight (%)	74.3	78.5	78.9	84.7	75.3	87.3	80.3	78.5	86.8

Notes:
ft bgs - feet below ground surface
< - Analyte not detected above analytical detection limit
NM - Not measured

Table 3: Groundwater Lithium Sampling Results
Pirkey Plant - East Bottom Ash Pond

Boring	Depth Interval (ft bgs)	Drilling Method	Lithium Concentration (mg/L)	
			Total	Lab Filtered
B-1	16-21	DPT	0.202	0.022
B-2	10-14	DPT	0.045	0.006
	38-43	HSA	0.140 (0.142)	0.056 (<0.05)
	48-53	HSA	0.112	<0.05
	58-63	HSA	0.143	<0.05
	78-83	HSA	0.201	0.097
B-3	20-24	DPT	0.053	0.013
	33-37	HSA	0.152	0.105
	40-45	HSA	0.356	0.077
	50-55	HSA	1.140	0.061
	60-65	HSA	0.098	0.052
	72.5-77.5	HSA	0.812	0.009
	82.5-87.5	HSA	0.102	0.023

Notes:
< - Analyte not detected above analytical detection limit
DPT: Direct push technology
HSA: Hollow stem auger
Results for other groundwater parameters available for B-1 and B-3 in Attachment B.
Total lithium results from unfiltered sample volume collected in HNO3 preserved bottle.
Lab filtered results from laboratory vacuum-filtered sample volume collected in unpreserved bottle.
Duplicate results in parentheses.

Table 4: X-Ray Diffraction Results *Geosyntec Consultants, Inc.*
Pirkey Plant - East Bottom Ash Pond

	B-2(19-20)	VAP-B3-(40-45)
Quartz	67	15
Plagioclase Feldspar	ND	0.5
Orthoclase	<0.5	ND
Calcite	<0.5	ND
Dolomite	1	ND
Siderite	ND	0.5
Goethite	2	ND
Hematite	ND	2
Pyrite	ND	3
Kaolinte	4	42
Chlorite	1	4
Illite/Mica	2	6
Smectite	16	12
Amorphous	7	15

Notes:
ND: Not detected
<0.5 indicates mineral phase is present but below quantification limits.
B-2(19-20) sample represents bulk soil.
VAP-B3-(40-45) is the centrifuged solid material from the groundwater sample collected at that interval.

Table 5: SEM/EDS Microscopy Results
Pirkey Plant - East Bottom Ash Pond

	Centrifuged Material (Weight Percent)
Al_2O_3	31.1%
SiO_2	60.9%
FeS_2	3.4%
K_2O	1.7%
TiO_2	ND
Fe_2O_3	2.8%

Notes:

ND: component not detected
concentration below the analytical detection limit

Centrifuged material was the solid material which separate from the groundwater sample at VAP interval B3-(50-55) after centrifugation.

Oxide calculations are expressed on a dry basis and do not include molecular structural water.

Table 6: Centrifuged Solids Total Metals Results
Pirkey Plant - East Bottom Ash Pond

Depth (ft bgs)		B3-(40-45)	B3-(50-55)	Lignite
Analyte Concentrations (mg/kg)	Aluminum	68 J	22 J	22 J
	Boron	6.4 J	2.3 J	77
	Calcium	1,200	160 J	7,700
	Chromium	37	13	7.7
	Iron	26,000	11,000	14,000
	Lithium	12	3.6 J	2.9 J
	Magnesium	880	260	1,900
	Potassium	960	420 J	300 J
	Sodium	270 J	56 J	320 J
	Mercury	1.1	0.026 J	0.13 J

Notes:
ft bgs - feet below ground surface
< - Analyte not detected above analytical detection limit
mg/kg: milligrams per kilogram
J - Estimated analyte concentration below the reporting limit and above the method detection limit
B-3 samples are centrifuged solid material separated from groundwater samples collected at the designated interval.
Lignite was collected from a local mine.

Table 7: Calculated Site-Specific Partition Coefficients
Pirkey Plant - East Bottom Ash Pond

Source	B-3 40-45 ft bgs						Literature Value
Unit	mg/L	mg/L	mg/L	mg/kg	g/L	L/kg	L/kg
Element	**Aqueous Phase**	**Aqueous + Suspended**	**Suspended**	**Adsorbed**	**Calculated Suspended Solids**	**Kd**	**Kd**
Li	0.0770	0.356	0.279	12	23	156	43-370
K	2.46	19.1	16.6	960	17	390	42-1200
Na	12.6	18.1	5.50	270	20	21	5.2-82
Mg	1.92	12.6	10.7	880	12	458	46-1400
Ca	1.84	7.00	5.16	1200	4	652	24-460
Cr	0.0442	0.253	0.209	37	6	838	140-5,500
B	0.02	0.03	0.01	6.4	2	320	63-170
Fe	2.03	361	359	26000	14	12808	4900-160000
Measured Total Suspended Solids					10		

Source	B-3 50-55 ft bgs						Literature Value
Unit	mg/L	mg/L	mg/L	mg/kg	g/L	L/kg	L/kg
Element	**Aqueous Phase**	**Aqueous + Suspended**	**Suspended**	**Adsorbed**	**Calculated Suspended Solids**	**Kd**	**Kd**
Li	0.061	1.14	1.079	3.6	300	59	43-370
K	2.86	53.3	50.44	420	120	147	42-1200
Na	12.8	17.9	5.1	56	91	4	5.2-82
Mg	0.925	41	40.075	260	154	281	46-1400
Ca	0.749	16.4	15.651	160	98	214	24-460
Cr	0.0213	1.9	1.879	13	145	611	140-5,500
B	0.203	0.675	0.472	2.3	205	11	63-170
Fe	3.88	1440	1436	11000	131	2835	4900-160000
Measured Total Suspended Solids					51		

Notes:
mg/L: milligrams per liter
mg/kg: milligrams per kilogram
g/L: grams per liter
L/kg: liters per kilogram
Kd: partition coefficient
Adsorbed values are total metals concentrations reported by USEPA Method 6010B.
Literature values represent maximum and minimum values for the parameter as reported in Sheppard et al, 2009 (Table 4-1, all sites) and Sheppard et al, 2011 (Table 3-3 cultivated peat and wetland peat only).

Attachment A
Boring Logs

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name: B-1

Project Location: Hallsville, TX

Boring Date: 5/14/2019

Depth Scale Feet	Water Table	Soil Profile Description	PID
0		0.0' - 5.0' were hand augered on a previous date.	
		0.0'-1.0': No Recovery	
		1.0'-4.0': Light gray and dark red clay, medium plasticity, low stiffness; trace silt	
		4.0'-5.1': No Recovery	
5		5.1'-5.5': Light gray and dark red clay, high plasticity, low stiffness	
		5.5'-8.0': Light gray and orange clay, high plasticity, low stiffnedd; trace silt	
		8.0'-8.9': Light gray and dark red clay, high plasticity, low stiffness	
		8.9'-9.6': Light purple and gray clay, high plasticity, low stiffness; trace silt	
		9.6'-10.5': Light gray sandy clay, very fine grained; sand grains are orange	
10		10.5'-10.7': Light gray fine grained sand, very well sorted	
		10.7'-10.9': Moist, Tan and orange fine grained sand, very well sorted	
		10.9'-12.0': Light purple and gray sandy clay	
		12.0'-12.5': No Recovery	
		12.5'-13.0': Moist, Light brown silty clay	
15		13.0'-14.1': Moist, light brown silty sand, fine grained, moderate sorting	
		14.1'-16.0': Light purple and gray clay, medium stiffness, medium plasticity	
		16.0'-17.3': Wet, light brown sandy clay	
		17.3'-20.0': Maroon/Purple clay, high stiffness, medium plasticity	
20		20.0'-20.9': Wet, Light brown clayey sand	
		20.9'-24.0': Maroon/Purple clay, high stiffness, low plasticity; trace brown silt	
		24.0'-24.3': Maroon/Purple clay, high stiffness, low plasticity; trace brown silt	
		24.3'-26.5': Dark purple/black clay, high stiffness, no plasticity	
25		26.5'-28.0': Moist, Dark gray clayey sand, fine grained	
		28.0'-28.7': Wet, Brown and dark gray clayey sand	
		28.7'-29.7': Dark gray fine grained sand, well sorted; trace sand	
		29.7'-30.3': Dark gray clay, medium stiffness, Medium plasticity	
30		30.3'-30.6': Tan silt with gravel	
		30.6'-32.0': Dark gray/black and purple clay, very high stiffness, no plasticity	
		32.0'-33.8': Wet, Brown and dark green silty clay, low plasticity	
		33.8'-35.1': Moist, Dark green fine grained sand, well sorted	
35		35.1'-36.0': Moist, Dark gray fine grained sand, well sorted; trace clay	
		EOB @ 36' BGS	
		Boring backfilled with bentonite	
40			

Drill Rig: Geoprobe 7822 DT

Drilling Contractor: Best Drilling

Driller: Ramon Gutierrez

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-2

Project Location: Hallsville, TX | Boring Date: 5/13/2019 to 5/17/2019

Depth Scale Feet	Water Table	Soil Profile Description	PID
0		0.0' - 5.0' were hand augered on a previous date.	
		0.0'-0.5': Black, soft fine grained silty sand, vegetation	
		0.5-2.0': Red/brown fine grained sand, moderate sorting	
		2.5-5.0': Alternating layers red+brown sandy clay, low plasticity	
5		5.0-5.5': No Recovery	
		5.5-6.7': Gray + brown/red sandy clay, medium plasticity, low stiffness	
		6.7'-8.0': Gray clay, medium plasticity, medium hardness with brown/red sand lenses throughout	
		8.0-11.0': Gray clay with brown striations, high stiffness, high plasticity, tree roots present @ 8.3' bgs	
10		11.0-11.5': Gray clay, medium stiffness, high plasticity, trace gravel @ 11.25'	
		11.5-12.0': (Gray) clayey (red-brown) sand, poorly sorted, soft	
		12.0-14.0': No Recovery	
		14.0-14.75': Reddish brown + gray sandy clay, trace gravel @ 14.5', medium stiffness, medium plasticity	
15		14.75-16.0': Gray + red clay, medium hardness, high plasticity, trace brown fine grained sand	
		16.0-18.5': No Recovery	
	▮	18.5-18.75': Soft, red + gray clay, high plasticity, trace silt	
		18.75-18.95': Tan, sand fine-coarse grained, poorly sorted, small coal fragment	
		18.95-20.0': Red/dark gray clay, high stiffness, medium plasticity	
20		20.0-21.1': No recovery	
		21.1'-21.8': Wet, sandy clay, light brown + red	
		21.8-24.0': Red + dark gray clay, hard stiffness, medium plasticity; 1" gravel lens present @ 22.5'	
		24.0-24.5': Light brown sandy clay, wet, very soft, no plasticity	
25		24.5-24.8': Red-brown sandy clay, wet, medium plasticity	
		24.8-28.0': Purple + gray clay, high stiffness, no plasticity, trace fine grained sand @ 25.0' & 26.7'	
		28.0-29.9': Dark purple clay, high stiffness, no plasticity	
30		29.9-30.7': Black/dark gray clay, high stiffness, no plasticity	
		30.7-32.0': Balck/dark gray silty clay, medium stiffness, medium plasticity	
		32.0-33.5': Dark gray silty clay, soft, high plasticity	
		33.5-36': Black silty clay, high stiffness, no plasticity	
35		36-36.5': No recovery	
		36.5-40': Dark green fine grained sand, well sorted	
40		Geoprobe refusal @ 40' bgs. HSA continued drilling, log continued on next page.	

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-2

Project Location: Hallsville, TX | Boring Date: 5/13/2019 to 5/17/2019

Depth Scale Feet	Water Table	Soil Profile Description	PID
35		0.0' - 40.0' were drilled with DPT, logged on previous page. HSA boring log follows.	
		38.1-38.3': Dark brown silty sand, fine grained, trace clay, loose, wet, well graded	
		38.3-38.4': Very dark brown clayey sand; thin seam of red-brown lean clay @ 38.4', med soft	
		38.4-38.5': Dark green silty sand, fine grained, wet	
		38.5-39.0': Dark brown silty sand, fine grained, trace clay, loose, wet, well graded	
		39.0-39.2': Laminated sandy clay/clayey sands, gray to dark gray, loose/soft, wet	
40		39.2-43.1': No Recovery	
		43.1-44.5': Greenish gray w. graded fine sand w/ trace silt, loose, wet; thin layer of light gray silty sand @ 44.5'	
		44.5-47.0': Dark brown clayey sand/sandy clay, fine sand, w. graded, low plastiicty, dense/stiff, moist	
		47.0-48.1': No Recovery	
45			
		48.1-54.2': Same clayey sand/sandy clay as above; thin bed of gray fine grained sand, trace clay @ 51.6'	
50			
		54.2-55.0': Dark brown hard, sandy clay, low plas	
55		55.0-57.1': Dark brown clayey sand/sandy clay, fine sand, w. graded, low plastiicty, dense/stiff, moist	
		57.1-58.1': Dark brown clayey sand w/ thin intermittent balck hard material layers, possible coal/plant debris	
		58.1-61.9': Dark grayish brown clayey sand, fine grained, w. graded, moise, med-dense to loose	
60		61.9-63.1': Same clayey sand as above with thin bands of mottled dark brown silty clay with gray silty sand	
		63.1-64.6': Gray silty sands mottled 50/50 w/ dark brown sandy clays, trace coal fragments, stiff/dense	
65		64.6-68.1 Grades from above to thinly laminated interbeds of silty/clayey sands and sandy clay. Clays are dark brown, sand is gray. Low plasticity, moist, dense/stiff	
		68.1-70.7': Dark brown sandy clay w/ 1% mottles of gray silty sand, low plasticity, trace moist, silty, stiff	
70		70.7-71.3': Dark brown clayey sand, fine grained, trace coal fragments, moist, dense/med dense	
		71.3-71.5': Interval of coal/sand interbeds w/ clay, friable	
		71.5-73.5': Dark brown sandy clay, low plas, trace moist, stiff to hard	
		73.5-74.5': Sandy clay grading to clayey sand (fine grained, w. graded moist)	
		74.5-75.1': Gray silty sand, fine grained, moist, w. graded, med. Dense	
75			

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name: B-2

Project Location: Hallsville, TX

Boring Date: 5/13/2019 to 5/17/2019

Depth Scale Feet	Water Table	Soil Profile Description		PID
75				
		75.1-75.3':	SAA except trace clay	
		75.3-75.6':	Interval of gray sand interbedded w/ dark brown silty/sandy clay	
		75.6-79.2':	Dark brown clayey sand w/ some 1-2 mm lenses of gray sand mottled throughout, moist, fine grained, dense. Dark brown interbeds of silty clay @ 78.1-79.2'	
		79.2-80.4':	Dark brown sandy clay mottled w/ gray sand, stiff, low plasticity, trace moist, trace coal fragments	
80		80.4-82.1':	Dark grayish brown silty sand w/ trace clay, loose; coal fragment @ 81.6'	
		82.1-83.6':	Dark brown silty clay w/ some sand, low plasticity, hard, trace moist; thin lighter color laminations @ 83.1'	
		83.6-85.5':	Dark grayish brown sandy clay, fine sand, low plasticity, very stiff, trace mottles of sandier material, trace moist	
85		85.5-93.1':	Dark reddish brown silty clay w/ trace fine sand, trace moist, hard, low plasticity, trace mottles of light gray sand, some black mottling. Color fades to dark brown when exposed to air.	
90		90.1'	Thin gray sand seam	
		92.3'	Thin gray sand seam	
			HSA refusal, EOB @ 93.1' bgs	
95			Boring grouted to surface, permanent well installed in offset w/ screen @ 38-48' bgs.	
100				
105				
110				
115				

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey

Boring/Well Name: B-3

Project Location: Hallsville, TX

Boring Date: 5/7/19, 5/13/19

Depth Scale Feet	Water Table	Soil Profile Description	PID
0		0.0' - 5.0' were hand augered	
		0.0-2.0': Clay, medium-red brown, some fine to medium grain material, poorly graded, silty clays, medium plasticity, medium dense, dry, mottled	
		2.0-3.0': Clay, light brown, some fine to medium grain material, poorly graded, silty clays, medium plasticity, medium dense, dry, mottled	
		3.0-4.0': Organic clay, Grey to light brown, soft, medium density, some medium grain sand, moist	
		4.0-4.5': Organic clay, light brown, soft, medium density, moist	
5		4.5-5.0': Organic clay, light brown to reddish brown, soft, medium density, moist	
		5.0-9.5': Organic clay, light brown to reddish brown, soft, medium density, moist	
		9.5-10.5': Silty clay, reddish-orange, poorly graded, medium to low plasticity, wet (perched zone)	
10		10.5-11.0': Poorly-graded gravel, lense of cobbly material, moist	
		11.0-13.0': Clayey sand, mottled clay and sand	
		13.0-13.9': Sandy clay, brown to orange, low plasticity, some cobbles, loose, wet, nonplastic	
		13.9-15.0': Sand, orange, loose, nonplastic, very fine grained, moist	
15		15.0-16.0': Sandy clay, medium plasticity, cohesive, medium stiff, moist	
		16.0-18.0': Sand, orange, gray organic staining, moist	
		18.0-18.5': A lense of fat clay, grayish purple, medium to high plasticity, moist	
		18.5-19.5': Sand, orange to grayish orange, moist	
		19.5-20.0': Fat clay, greyish purple, dense, medium stiff to stiff, medium to high plasticity, moist.	
20		20.0-22.1': Sand, light brown to orange, fine to medium grained, wet	
		22.1-22.3': Lense of fat clay, dark grey to purple, stiff, high plasticity, wet	
		22.3-22.6': Sand, light brown to orange, fine grained, moist	
		22.6-23.0': Gravelly sand, orange to gray mottles, loose, well graded	
		23.0-24.0': Sandy clay, grayish purple and brown mottles, moist	
25		24.0-25.6': Sand, tan to light brown, fine to medium grained, well sorted, moist	
		25.6-26.4': Clay, purple and gray, medium plasticity, trace fine grained sand	
		26.4-26.8': Clayey sand, tan to light brown, fine grained, medium sorted	
		26.8-27.3': Clay, purple, medium stiffness, medium plasticity	
		27.3-28.0': Clay, dark gray, hard, trace silt, high plasticity	
30		28.0-28.6': no recovery	
		28.6-29.2': Sand, light brown, fine grained, moderate sorting, wet, from casing trip	
		29.2-29.5': Silty clay, dark gray, fine grained, low plasticity	
		29.5-32.0': Clay, dark gray to black, hard, low plasticity, trace silt	
		32.0-32.7': Clay, dark gray, medium stiff, medium plasticity, trace silt	
35		32.7-33.1': Clayey silt, dark gray, medium plasticity	
		33.1-36.0': Sand, dark gray, fine grained, well sorted, moist	
		36.0-36.3': no recovery	
		36.3-36.9': Silty sand, dark gray to black, very fine grained, well sorted, moist	
		36.9-37.3': Sand, gray, fine grained, well sorted, moist	
40		37.3-38.4': Silty clay, dark gray, soft, low plasticity, 1" coal seam at 37.8 ft bgs	

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-3

Project Location: Hallsville, TX | Boring Date: 5/7/19, 5/13/19

Depth Scale Feet	Water Table	Soil Profile Description	PID
40		38.4-40.0': Clay, dark gray to black, very stiff, low plasticity (DPT refusal @ 40' bgs, HSA drilling continued below)	
		40.0-42.5': Silty clay with trace sand, dark gray, very stiff to hard, mottled	
		42.5-46.4': Interbedded sandy clays and clayey sands, dark gray to black, moist, very dense, stiff, low plasticity, low cohesivity, coal and plant fragments at 45.1 to 45.25 feet bgs	
45		46.4-47.5': Sandy clay with silt, dark gray to black, hard, low plasticity, moist, fine grained sand	
		47.5-48.7': Sand with trace silt, brown, poorly graded, some brown clay laminations, coal seam from 48.4 to 48.7 feet bgs,	
		48.7-49.6': Sand, gray to brown, well graded, with dark clayey interbeds/laminations, trace silt, loose to medium dense, moist	
		49.6-52.8': Sand, brown to grayish brown, well graded, trace silt, loose to medium dense, moist to wet	
50		52.8-53.6': Interbedded sandy clays and clayey sands, gray to dark gray, moist, dense to very dense	
		53.6-53.7': Silty clay, dark brown, very stiff	
		53.7-55.0': Interbedded sandy clays and clayey sands, gray to dark gray, moist, dense to very dense	
55		55.0-58.8': Interbedded sandy clays and clayey sands, gray to dark gray, moist, dense to very dense	
		58.8-59.0': Sand with some clay and silt, very dark gray, fine grained, massive bedding, moist	
		59.0-60.0': no recovery	
60		60.0-60.7': Sand with some silt and trace clay, very dark gray, fine grained, massive bedding, moist	
		60.7-61.6': Sand with some silt and trace clay, gray, fine grained, massive bedding, moist, laminations of dark gray clayey sand	
		61.6-61.8': Silty clay, dark gray, hard, no plasticity	
		61.8-63.0': Silty clay, dark gray, fine grained, well graded, at 62.8 feet bgs a layer of dark gray silty clay	
		63.0-65.0': no recovery	
65		65.0-67.5': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		67.5-72.5': No recovery, heavy sands. Water introduced to retrieve samples. During flushing, some grayish brown silty sand observed	
70		72.5-73.1': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		73.1-73.6': Sand with trace silt, gray, fine grained, well graded, wet, loose	
		73.6-74.7': Thin layer of dark brown friable material, possibly plant material	
		74.7-74.8': Thin layer of stiff sand and silt, dark brown	
		74.8-76.0': Silty sand, grayish brown, fine grained, well graded, wet, loose	
75		76.0-76.1': Thin layer of clay, dark brown, stiff, trace coal fragments	
		76.1-76.4': Silty sand, grayish brown, fine grained, well graded, wet, loose	
		76.4-76.5': Silty clay, dark brown, stiff	
		76.5-77.5': Silty sand, grayish brown, fine grained, well graded, wet, loose	
80		77.5-82.9': Silty sand, dark gray to brown, fine grained, well graded, medium dense to dense, moist to wet, trace clay	

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Soil Boring Log

Project: AEP Pirkey | Boring/Well Name: B-3

Project Location: Hallsville, TX | Boring Date: 5/7/19, 5/13/19

Depth Scale Feet	Water Table	Soil Profile Description	PID
80			
		82.9-84.3': Silty sand, gray to dark gray, fine grained, well graded, medium dense to dense, moist to wet, trace clay	
		84.3-85.2': Clayey sand, dark grayish brown, fine grained, well graded, moist	
		85.2-85.3': Silty sand, gray	
85			
		85.3-85.5': Silty sand, gray to dark gray, fine grained, well graded, medium dense to dense, moist to wet, trace clay	
		85.5-86.3': Silty clay with sand, dark brown, low plasticity, hard, moist, laminated with gray sand layers ~1-2mm thick	
		86.3-87.5': Clayey sand, dark grayish brown, fine grained, well graded, moist	
		87.5-88.2': Clayey sand, dark grayish brown, fine grained, well graded, moist	
		88.2-89.1': Clayey sand, dark grayish brown, fine grained, well graded, moist. Clay laminations darker than surrounding sand	
90			
		89.1-89.4': Interval of interbedded sandy clays and clayey sands, breaks apart along bedding planes, medium dense, medium stiff	
		89.4-92.5': Silty clay, dark brown to black, hard, trace moisture, low plasticity	
		92.5-97.5': Silty clay, dark brown to black, hard, trace moisture, low plasticity. Thin gray sand layer at 94.7 feet bgs	
95			
		HSA refusal, EOB @ 97.1' bgs	
		Boring grouted to surface.	
		Permanent well installed in offset boring, screen set @ 29-34' bgs.	
100			
105			
110			
115			
120			

Drill Rig: Geoprobe 7822 DT & HSA Rig

Drilling Contractor: Best Drilling & AEP Drillers

Driller: Ramon Gutierrez & Zack Racer

Geosyntec Consultants

Attachment B
Groundwater Analytical Results

Attachment B: Groundwater Analytical Data
Pirkey Plant - East Bottom Ash Pond

Boring	Depth (ft bgs)	Metals (mg/l)															
		Antimony		Arsenic		Barium		Beryllium		Boron		Cadmium		Calcium		Chromium	
		Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered
B-1	16-21	<0.00093	<0.0035805	0.214	0.0041586	3.28	0.0267562	0.01693	<0.000077	0.293	0.038043	0.03747	<0.0002695	41.8	1.34	1.08	<0.0008855
B-3	20-24	<0.00093	<0.0465	0.141	0.0472	0.779	0.132	0.00571	<0.001	0.105	0.308	0.00032	<0.0035	4.19	1.42	0.46	<0.0115
	33-37	0.00113	0.005776	0.02767	<0.113925	0.299	0.114	0.00427	<0.00217	0.104	0.443	<0.00007	<0.007595	15.6	5.95	0.208	<0.024955
	40-45	<0.00093	<0.17856	0.141	0.0851	1.64	0.0314	0.04958	<0.00384	0.292	0.453	0.00266	<0.01344	7	<1.8432	0.253	<0.04416
	50-55	<0.0465	<0.086025	0.662	<0.097125	4.76	0.09501	0.098	<0.00185	0.675	0.203	<0.0035	<0.006475	16.4	0.749	1.9	<0.021275
	60-65	<0.00093	<0.0465	0.05695	0.0472	0.412	0.0849	0.00559	<0.001	0.06661	0.071	0.00265	<0.0035	1.37	<0.48	0.307	<0.0115
	72.5-77.5	<0.00093	0.0022	0.932	0.0116	7.97	0.0123	0.132	<0.0002	1.52	0.375	0.277	<0.0007	36.9	0.209	3.25	0.0005
	82.5-87.5	<0.00093	0.0014372	0.04923	0.0058415	0.583	0.0083163	0.00297	<0.000111	0.214	0.311	0.00368	<0.0003885	1.44	0.21	0.152	<0.0012765

Boring	Depth (ft bgs)	Metals (mg/l)															
		Cobalt		Iron		Lead		Lithium		Magnesium		Manganese		Molybdenum		Potassium	
		Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered
B-1	16-21	0.192	0.001279	988	0.669	0.392	<0.002618	0.202	0.0217358	40	0.59	1.14	0.0206	0.02491	<0.0011165	37.1	1.07
B-3	20-24	0.02653	0.01	430	3.91	0.07225	<0.034	0.05327	0.0127	8	1.15	0.189	<0.05	0.00807	0.0022	15.2	1.26
	33-37	0.02721	0.00368	95.2	<1.085	0.0148	<0.07378	0.152	0.105	5.19	3.12	1.02	0.599	0.07587	0.012642	9.29	5.39
	40-45	0.23	0.00467	361	2.03	0.149	<0.13056	0.356	0.07701	12.6	<1.92	0.819	<0.192	0.01355	<0.05568	19.1	2.46
	50-55	0.786	0.01441	1440	3.88	0.703	<0.0629	1.14	0.060508	41	<0.925	3.46	0.0968	0.106	<0.026825	53.3	2.86
	60-65	0.07494	0.004	122	2.07	0.04529	<0.034	0.09786	0.0518	2.75	0.6	0.29	0.07	0.01507	0.0019	7.59	2.76
	72.5-77.5	1.37	0.0015	3250	0.587	0.636	<0.0068	0.812	0.0089	67.3	0.139	7.78	0.01	0.057	0.0013	57.9	1.26
	82.5-87.5	0.05576	0.000855	281	0.0745	0.05542	<0.003774	0.102	0.0228905	2.75	0.124	0.282	0.00751	0.01954	0.0172347	11.1	1.59

Boring	Depth (ft bgs)	Metals (mg/L)								General Chemistry (mg/L)		Anions (mg/L)			
		Selenium		Sodium		Strontium		Thallium		Total Alkalinity	Total Dissolved Solids	Chloride	Fluoride	Sulfate	Bromide
		Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Lab Filtered	Total	Total	Total	Total	Total	Total
B-1	16-21	0.0124	<0.0038115	10.7	8.31	2.3	0.00834	0.00339	0.002654	5.72	220	4.31	<0.04	13.8	<0.1
B-3	20-24	0.00647	<0.0495	25.6	22.6	0.078	<0.05	0.00309	0.026	0.76	156	33.7	0.04	14.6	0.2
	33-37	0.00142	<0.107415	22	17.1	0.079	<0.1085	0.00151	0.00642	49.54	132	10.9	0.1	19.4	<0.1
	40-45	0.01837	<0.19008	18.1	12.6	0.229	<0.192	0.00229	<0.16512	1.54	1394	8.91	<0.04	21.1	<0.1
	50-55	0.0269	<0.091575	17.9	12.8	0.686	<0.0925	0.067	<0.07955	12.68	734	13.4	<0.04	17.3	<0.1
	60-65	0.00539	<0.0495	8.13	7.64	0.053	<0.05	<0.00086	<0.043	3.14	148	12	<0.04	7.9	<0.1
	72.5-77.5	0.04618	<0.0099	156	65.5	0.575	0	0.00092	<0.0086	140.74	632	44.5	0.04	24.5	<0.1
	82.5-87.5	0.00987	<0.0054945	148	103	0.101	0.00278	0.00224	<0.004773	210.08	1026	35.8	0.35	13	<0.1

Notes:

< - Analyte not detected above analytical detection limit

NM - Not measured

Total lithium results from unfiltered sample volume collected in HNO3 preserved bottle.

Lab filtered results from laboratory vaccum-filtered sample volume collected in unpreserved bottle.

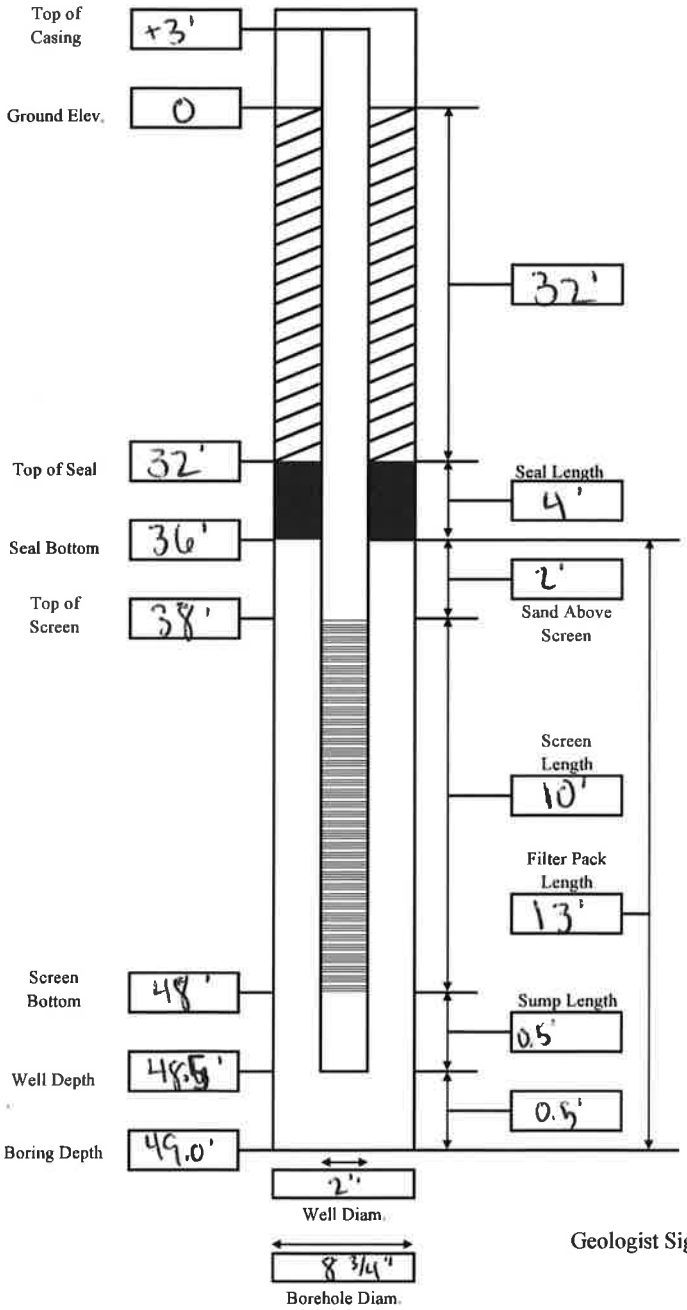
Total metals data are not available for B-2 sample intervals due to incorrect analytical techniques.

Attachment C
Well Construction Diagrams

Geosyntec
consultants
Well Construction Log

Site: AEP Pirney Power Plant
Well ID: B-2
Drilling Company: AEP Service
Drillers: Zach Racer
Geologist: Nathan Quick

Date: 5/20/19
Drilling Method: Hollow Stem Auger
Boring Depth: 49'
Boring Diameter: 8 3/4"
Well Depth: 48.5'
Well Diameter: 2"



Well Construction:
- Material: Sch. 40 PVC
- Inside Diamter: 2"
- Screen Slot Size: 0.01'
- Screen Beg.: 38 End: 48
- Sump (Y) / N
- Type/Lenth: Sch. 40 PVC, 10"

Filter Pack:
- Type/Brand: Pioneer Sands 20/40
- Amount Used: 8.5 bags (50 lbs per bag)
- Placement Method: Surface

Seal:
- Type/Brand: Plug Pel coated bentonite chips
- Amount Used: 100 lbs
- Vol. Fluid Added:
- Set-up Time: 1.5 hours
- Placement Method: surface

Grout:
- Type/Brand:
- Amount Used:
- Vol. Fluid Added:
- Placement Method: tremie

Well Completion:
- (Above Grade) / Below Grade
- Guard Posts? (Y) / N
- Pad Size: 2x2
- Cover Type/Size: Stainless steel

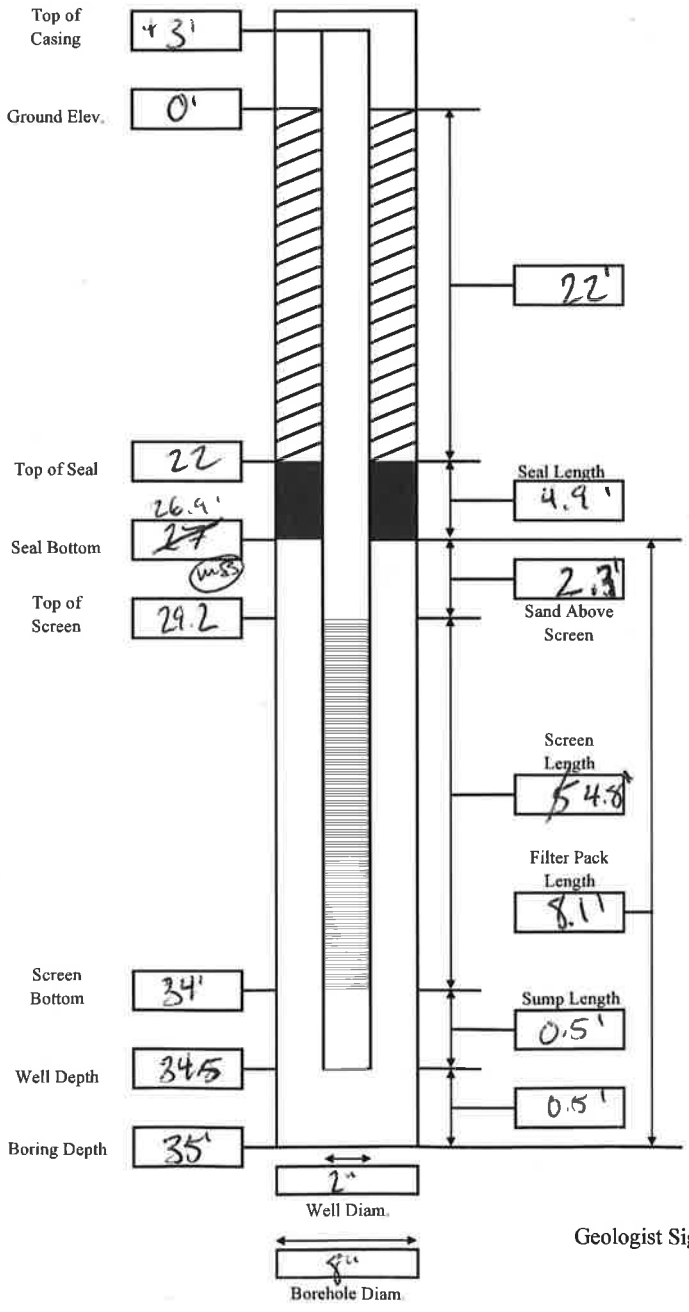
Comments:

Geologist Signature:

Geosyntec consultants
Well Construction Log

Site: AEP Pickaway Power Plant
Well ID: B-3
Drilling Company: AEP / Best Drilling
Drillers: Z. Rowe
Geologist: M. Bizjack

Date: 5/15/19
Drilling Method: HSA
Boring Depth: 35'
Boring Diameter: 8"
Well Depth: 35'
Well Diameter: 2"



Well Construction:
- Material: Sched 40 PVC
- Inside Diamter: Sched 40
- Screen Slot Size: 10 gauge
- Screen Beg.: ~~34~~ 29' End: 34'
- Sump (Y) N
- Type/Lenth: End cap, 0.5'

Filter Pack:
- Type/Brand: Pioneer 20/40 0.45-0.48
- Amount Used: ½ 5.5 bags (275 lbs)
- Placement Method: Manual

Seal:
- Type/Brand: 3/8" Pel-plug coated Bentonite Pellets
- Amount Used: 2 buckets (100 lbs)
- Vol. Fluid Added:
- Set-up Time: >8hr
- Placement Method: Manual

Grout:
- Type/Brand: Halliburton Quick Grout
- Amount Used:
- Vol. Fluid Added:
- Placement Method: Pump

Well Completion:
- (Above Grade) / Below Grade
- Guard Posts? Y / N
- Pad Size: 2x2
- Cover Type/Size:

Comments:

Geologist Signature: Matt Bizjack

Attachment D
Well Development Logs

well development

LOW FLOW GROUNDWATER SAMPLING LOG

Geosyntec consultants

MONITORING WELL ID: B-2
PROJECT: AEP Pirkey
PROJECT NO: CHA8462.12
SITE LOCATION: Hallsville, TX
DATE MONITORED: 5/22/19 **WATER QUALITY METER MAKE/MODEL:** Horiba
DATE PURGED: 5/22/19 **LATEST CALIBRATION DATE/TIME:** 5/22/19
SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:**

MONITORING WELL INFORMATION

Well Diameter:	2	IN.	
Static Depth to Groundwater (DTW):	12.31	FT.	**Coversion Factors:**
Total Depth of Monitoring Well (TD):	51.50	FT. btoc	Well Volume (2-in): Hx0.17 gal/ft
Screen Length (SL) from Boring Logs:	10	FT.	1 L = 0.264 gal
Depth to Top of Well Screen (TD-SL):	NA	FT.	
Height of Water Column in Monitoring Well (H=TD-DTW):		FT.	**Purge Method:**
Pump Depth		FT.	Tornado pump

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	<0.5 L/min	NTU --
1157		5.89	0.219	9.87	24.01	42	21.31	.5	1000+ light brown, silty
1202		5.93	0.241	9.47	22.11	25	22.21	.5	950 light brown
1207		5.94	0.217	9.36	22.09	23	22.31	.5	890 "
1212		5.87	0.214	9.64	21.89	30	22.83	.5	669 "
1217		5.82	0.201	9.50	22.18	42	22.31	.5	390 "
1222		5.82	0.201	9.50	22.25	38	20.58	.5	260 cloudy
1227		5.82	0.198	9.102	22.12	41	19.41	.5	152 cloudy
1232		5.76	0.194	9.44	22.11	40	18.83	.5	84.9
1237		5.76	0.194	8.92	22.08	46	18.15	.5	75.2
1242		5.72	0.194	9.54	22.15	45	17.97	.5	72.4
1247		5.73	0.194	9.34	22.21	42	17.45	.5	66.9
1252		5.75	0.195	9.50	22.34	44	22.15	.5	146 light brown
1302		5.74	0.200	9.76	22.31	49	22.41	.5	352 "
1312		5.75	0.194	9.41	22.30	51	22.71	.5	105 cloudy
1322		5.75	0.189	9.43	22.41	53	23.00	.5	57.4 clear
1332		5.75	0.189	9.53	22.48	56	23.15	.5	50.7 "

Notes: 1) well was surged using pump to make sure all fines were removed — end of development

1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) _____ gal per min _____ liter per min (3.8 x gpm)
TOTAL Volume Purged _____ gallons _____ liters

Date & Time of Sample Collection _____ - **DATE** _____ - **TIME** NA **INITIALS** *revised: Feb. 2007*

Well Development

~~LOW FLOW~~ GROUNDWATER SAMPLING LOG

Geosyntec consultants

MONITORING WELL ID: B-3
PROJECT: AEP Pirkey
PROJECT NO: CHA8462.12
SITE LOCATION: Hallsville, TX
DATE MONITORED: 5/17/16 **WATER QUALITY METER MAKE/MODEL:** Horiba
DATE PURGED: 5/17/16 **LATEST CALIBRATION DATE/TIME:** 5/17/16
SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:** —

MONITORING WELL INFORMATION

Well Diameter:	2 IN.	
Static Depth to Groundwater (DTW):	9.02' FT.	**Coversion Factors:**
Total Depth of Monitoring Well (TD):	36.95 FT.	Well Volume (2-in): Hx0.17 gal/ft
Screen Length (SL) from Boring Logs:	FT.	1 L = 0.264 gal
Depth to Top of Well Screen (TD-SL):	FT.	
Height of Water Column in Monitoring Well (H=TD-DTW):	FT.	**Purge Method:**
Pump Depth	FT.	tornado pump

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	~~<0.5 L/min~~ NTU	--
0944		6.07	.1005	3.30	20.34	89			brown, silty
0947		6.14	0.516	0.51	20.72	28			brown
0951		5.84	.438	3.42	21.37	64			brown
		well is purging to let well recharge & continue to develop		dry, pump is kicking off & on due to low water level;					
1034		6.18	.450	4.01	22.09	88	19.34		
		pump removed to check connections;							
1900		6.17	0.263	3.78	22.15	78	15.25		
					went dry				
1216		5.81	0.282	2.64	22.74	85	15.32		lightbrown
1220		5.64	0.195	2.07	22.04	102			cloudy
1225		5.65	0.194	1.87	22.24	98	23.05	888	cloudy
1235		5.71	0.191	1.59	22.98	85		683	cloudy
1240		5.71	0.190	1.48	23.05	87	25.75	605	cloudy
1250		5.69	0.188	1.43	23.36	83		462	
1257		5.69	0.184	1.19	23.14	81	28.14	370	

Notes:

1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) _____ gal per min _____ liter per min (3.8 x gpm)
TOTAL Volume Purged _____ gallons _____ liters

Date & Time of Sample Collection — **DATE** — **TIME** NQ **INITIALS** *revised: Feb. 2007*

Natoa

Development

~~LOW FLOW~~ GROUNDWATER SAMPLING LOG

Geosyntec consultants

MONITORING WELL ID: B-3
PROJECT: AEP Pirkey
PROJECT NO: CHA8462.12
SITE LOCATION: Hallsville, TX
DATE MONITORED: 5/17/19 **WATER QUALITY METER MAKE/MODEL:** Horiba
DATE PURGED: 5/17/19 **LATEST CALIBRATION DATE/TIME:** 5/17/19
SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:** —

MONITORING WELL INFORMATION

Well Diameter:	2	IN.
Static Depth to Groundwater (DTW):	6.02	FT.
Total Depth of Monitoring Well (TD):	30.65	FT.
Screen Length (SL) from Boring Logs:		FT.
Depth to Top of Well Screen (TD-SL):		FT.
Height of Water Column in Monitoring Well (H=TD-DTW):		FT.
Pump Depth		FT.

Coversion Factors:
Well Volume (2-in): Hx0.17 gal/ft
1 L = 0.264 gal

Purge Method: tornado pump

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	<0.5 L/min	NTU --
1305		5.68	0.182	1.08	23.31	87	28.09		312
1310		5.67	0.181	1.03	23.25	83			275
1315		5.67	0.179	1.01	23.70	81	25.81		238
1325		5.66	0.178	1.00	23.62	82			192
1330		5.65	0.176	0.89	23.80	81	25.34		165 clear/slightly cloudy
			end of development						

Notes:
1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) _____ gal per min _____ liter per min (3.8 x gpm)
TOTAL Volume Purged _____ gallons _____ liters

Date & Time of Sample Collection — **DATE** — **TIME** NQ **INITIALS** *revised: Feb. 2007*

Nat Quick

Attachment E
Low-Flow Groundwater Sampling Logs

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**	SITE LOCATION: **Hallsville, TX**

WELL NO: B-2		SAMPLE ID: B-2-well-20190522-1 + -2		DATE: 5/22/19
WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 38 feet to 48 feet bgs	STATIC DEPTH TO WATER (feet): 12.61	PURGE PUMP TYPE OR BAILER: Hurricane

WELL VOLUME PURGE: (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(51.50 ft − 12.61 ft) X 0.16 gal/ft = 6.22 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (0.0006 gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 45	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 45	PURGING INITIATED AT: 1630	PURGING ENDED AT: 1825	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1637		250	14.24	5.74	22.99	0.195	2.50	1000+	79
1642		250	15.08	5.72	21.89	0.184	3.95	1000+	54
1647		250	16.62	5.71	21.52	0.196	5.47	705	53
1652		250	17.38	5.72	21.29	0.201	9.21	454	56
1657		250	18.24	5.70	21.23	0.197	8.33	271	61
1702		250	18.51	5.68	21.22	0.197	2.25	178	52
1707		250	18.66	5.65	21.12	0.196	2.42	136	68
1712		250	19.21	5.64	20.83	0.195	1.89	92.2	65
1717		250	19.29	5.61	21.16	0.192	1.95	89.2	69
1722		250	19.40	5.60	20.91	0.195	2.42	90.6	65
1727		250	19.55	5.59	20.54	0.193	2.97	102	71
1732		250	19.61	5.58	20.89	0.195	3.09	62.5	74

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Nathan Quick / Geosyntec	SAMPLER(S) SIGNATURES: Nat Qu	SAMPLING INITIATED AT: 1825	SAMPLING ENDED AT:
PUMP OR TUBING DEPTH IN WELL (feet): 45	SAMPLE PUMP FLOW RATE (mL per minute): 250	TUBING MATERIAL CODE:	

FIELD DECON: Y N	FLD-FILTERED: Y (N) FILTER SIZE: 45 µm Filtration Equipment:	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = **± 0.2**	ORP = **± 20 mV**	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Nat Qu

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**	SITE LOCATION: **Hallsville, TX**

WELL NO: B-2		SAMPLE ID: B-2-well-20190522-1/-2		DATE: 5/22/19
WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 38 feet to 48 feet bgs	STATIC DEPTH TO WATER (feet): 12.61	PURGE PUMP TYPE OR BAILER: hurricane

WELL VOLUME PURGE: (TOTAL WELL DEPTH − STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(51.50 ft − 12.61 ft) X 0.16 gal/ft = 6.22 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 45	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 45	PURGING INITIATED AT: 1630	PURGING ENDED AT: 1825	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1737		250	19.64	5.56	20.80	0.197	3.42	61.2	75
1742		250	19.67	5.55	20.85	0.199	1.71	52.9	74
1747		250	19.70	5.53	20.86	0.200	1.87	44.3	72
1752		250	19.68	5.53	20.81	0.200	1.93	42.4	76
1757		250	19.64	5.52	20.75	0.202	2.01	30.7	70
1802		250	19.62	5.50	20.82	0.200	1.97	25.7	73
1807		250	19.62	5.49	20.73	0.198	1.93	25.0	75
1812		250	19.63	5.49	20.75	0.199	1.93	40.2	74
1817		250	19.60	5.48	20.82	0.193	1.67	27.7	80
1822		250	19.61	5.48	20.77	0.192	1.65	19.5	79
		sampled via disconnected tubing ; 2 hour max hold							

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Nathan Quick / Geosyntec	SAMPLER(S) SIGNATURES: Nat Quick	SAMPLING INITIATED AT: 1825	SAMPLING ENDED AT:
PUMP OR TUBING DEPTH IN WELL (feet):	SAMPLE PUMP FLOW RATE (mL per minute): 250	TUBING MATERIAL CODE:	

FIELD DECON: Y N	FLD-FILTERED: (Y) N FILTER SIZE: 45 µm Filtration Equipment:	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = ± 0.2	ORP = ± 20 mV	Specific Conductance = 3 **readings within** ± 3%
Dissolved Oxygen =	A) ≤ **10% saturation** (≤ 1.82 mg/l @ 20 °C , ≤ 1.65 mg/l @ 25 °C , ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within** ± **0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**	SITE LOCATION: **Hallsville, TX**

WELL NO: B-3		SAMPLE ID: B-3-well-20190521		DATE: 5/21/19
WELL DIAMETER (inches): 2"	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL : feet to feet	STATIC DEPTH TO WATER (feet): 10.15	PURGE PUMP TYPE OR BAILER: hurricane

WELL VOLUME PURGE: (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(ft – 10.15 ft) X 0.16 gal/ft = gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + NA 0.0004 gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 38.5	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 38.5	PURGING INITIATED AT: 1106	PURGING ENDED AT: 1245	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1110		200	10.87	6.57	26.79	0.241	9.14	47.7	125
1115		200	11.91	6.16	24.77	0.257	9.78	525	98
1120		200	14.72	6.01	23.45	0.218	3.01	504	105
1125		200	18.01	5.98	22.95	0.207	5.89	550	87
1130		200	22.18	5.82	23.18	0.250	8.87	602	85
1135		200	24.91	5.81	23.29	0.225	8.82	625	88
1145		200	25.52	5.76	23.56	0.217	8.79	572	89
1155		200	26.12	5.78	23.51	0.189	8.90	501	89
1205		200	26.23	5.68	23.39	0.180	4.71	128	88
1210		200	26.31	5.66	23.28	0.181	5.02	58	88
1215		200	26.51	5.65	23.40	0.174	4.64	64	90
1225		200	26.63	5.65	23.53	0.166	4.52	66.2	81

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Nathan Quirk / Geosyntec	SAMPLER(S) SIGNATURES:	SAMPLING INITIATED AT: 1245	SAMPLING ENDED AT: 1305
PUMP OR TUBING DEPTH IN WELL (feet):	SAMPLE PUMP FLOW RATE (mL per minute): 200	TUBING MATERIAL CODE:	

FIELD DECON: Y N	FLD-FILTERED: Y (N) FILTER SIZE: 45 µm Filtration Equipment:	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = ± 0.2	ORP = ± 20 mV	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C , ≤ 1.65 mg/l @ 25 °C , ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Nate Quirk

LOW FLOW GROUNDWATER SAMPLING LOG

Geosyntec consultants

MONITORING WELL ID: B-3
PROJECT: AEP Pirkey
PROJECT NO: CHA8462.12
SITE LOCATION: Hallsville, TX
DATE MONITORED: 5/21/19 **WATER QUALITY METER MAKE/MODEL:** Horiba
DATE PURGED: 5/21/19 **LATEST CALIBRATION DATE/TIME:** 5/21/19
SAMPLING PERSONNEL: N. Quick **DUP OR MS/MSD:** -

MONITORING WELL INFORMATION

Well Diameter:	2	IN.
Static Depth to Groundwater (DTW):	10.15	FT.
Total Depth of Monitoring Well (TD):	39.	FT.
Screen Length (SL) from Boring Logs:	10	FT.
Depth to Top of Well Screen (TD-SL):		FT.
Height of Water Column in Monitoring Well (H=TD-DTW):		FT.
Pump Depth		FT.

Coversion Factors:
Well Volume (2-in): Hx0.17 gal/ft
1 L = 0.264 gal

Purge Method:
N/A low flow

LOW FLOW MONITORING PARAMETERS

Time	Volume Purged	pH	Specific Conductivity	Dissolved Oxygen	Temp.	ORP	Depth to Water	Flow Rate	Turbidity, Odor, Color
Hr : Min	mL	-	mS/cm	mg/L	C	mV	Feet	L/min	--
Targets	--	+/- 0.1	+/- 3%	+/- 10%	+/- 1 C	+/- 10 mV	<0.3 ft. drawdown	<0.5 L/min	nTU --
1230		5.63	0.169	4.01	23.88	103		.20	74.2
	Sampled via dedicated tubing								

Notes:
1. Water quality parameter measurements obtained every 3 to 5 minutes.
2. Well is **STABLE** once 3 consecutive measurements have been obtained for as many as 3 water quality parameters
3. Low flow rate target is 0.1 to 0.5 liters/min (0.026 to 0.132 Gallons per Minute).

Purge Flow Rate (pump purge only) _____ gal per min _____ liter per min (3.8 x gpm)
TOTAL Volume Purged _____ gallons _____ liters

Date & Time of Sample Collection 5/21/19 **DATE** 1245 **TIME** NQ **INITIALS** *revised: Feb. 2007*

Nat Ok

Geosyntec consultants

GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**		SITE LOCATION: **Hallsville, TX**	
WELL NO: AD-31	SAMPLE ID: AD-31-20190515		DATE: 5/15/19
WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 30.5 feet to 40.5 feet	STATIC DEPTH TO WATER (feet): 10.90	PURGE PUMP TYPE OR BAILER: Hurricane SS

WELL VOLUME PURGE: (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(40.5 ft – 10.92 ft) X 0.16 gal/ft = 4.73 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 35.0	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 35.0	PURGING INITIATED AT: 1220	PURGING ENDED AT: 1250	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or mL/min)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1223	NM	400	11.32	3.19	26.94	0.302	3.81	736	435
1229	NM	400	11.43	3.18	25.04	0.311	0.48	610	439
1236	NM	400	12.54	3.11	24.13	0.319	0.38	87.9	450
1243	NM	400	11.49	3.03	23.83	0.317	0.33	13.1	452
1248	NM	350	11.39	3.06	24.34	0.319	0.32	8.38	449

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Olivia Bramlet / Geosyntec	SAMPLER(S) SIGNATURES:	SAMPLING INITIATED AT: 1259	SAMPLING ENDED AT: 1337
PUMP OR TUBING DEPTH IN WELL (feet): 35.0	SAMPLE PUMP FLOW RATE (mL per minute):	TUBING MATERIAL CODE:	

FIELD DECON: Y N	FLD-FILTERED: Y N FILTER SIZE: ____ µm Filtration Equipment: ____	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: Y (N)

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE

REMARKS:

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = **± 0.2**	ORP = **± 20 mV**	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

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GROUNDWATER SAMPLING LOG

SITE NAME: **AEP Pirkey Power Plant**		SITE LOCATION: **Hallsville, TX**	
WELL NO: AD32	SAMPLE ID: AD-32-20190515		DATE: 5/15/2019
WELL DIAMETER (inches): 2	TUBING DIAMETER (inches): 3/8	WELL SCREEN INTERVAL: 13.0 feet to 33.0 feet	STATIC DEPTH TO WATER (feet): 4.61	PURGE PUMP TYPE OR BAILER: Hurricane SS

WELL VOLUME PURGE: (TOTAL WELL DEPTH – STATIC DEPTH TO WATER) X WELL CAPACITY = WELL VOLUME

(33.0 ft – 4.61 ft) X 0.16 gal/ft = 4.54 gallons

EQUIPMENT VOLUME PURGE: PUMP VOL. + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOL = EQUIPMENT VOLUME

Gal + (gal/ft X ft) + gal = gal

INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 23.0	FINAL PUMP OR TUBING DEPTH IN WELL (feet):	PURGING INITIATED AT: ~~1015~~ 1015	PURGING ENDED AT: 1113	TOTAL VOLUME PURGED (gallons):

TIME	CUMUL.VOL. PURGED (gallons)	PURGE RATE (gpm or ~~mL/min~~)	DEPTH TO WATER (feet)	pH (S.U.)	TEMP. (°C)	COND. (mS/cm)	DO (mg/L)	TURBIDITY (NTUs)	ORP (mV)
1021	NM	250	4.89	2.35	24.22	0.339	0.68	827	389
1030	NM	300	4.99	2.23	~~23~~.04	0.226	0.37	92.3	402
1040	NM	400	5.06	2.05	22.85	0.348	0.30	39.7	418
1046	NM	400	5.08	2.00	22.95	0.351	0.28	26.8	~~433~~ 422
1054	NM	450	5.24	1.96	22.76	0.354	0.37	20.1	427
1102	NM	400	5.08	1.89	23.72	0.354	0.29	18.2	428
1110	NM	350	5.05	1.85	23.81	0.354	0.26	11.8	431

WELL CAPACITY (Gallons Per Foot): **0.75"** = 0.02; **1"** = 0.04; **1.25"** = 0.06; **2"** = 0.16; **3"** = 0.37; **4"** = 0.65; **5"** = 1.02; **6"** = 1.47; **12"** = 5.88

TUBING INSIDE DIA. CAPACITY (Gal./Ft.): **1/8"** = 0.0006; **3/16"** = 0.0014; **1/4"** = 0.0026; **5/16"** = 0.004; **3/8"** = 0.006; **1/2"** = 0.010; **5/8"** = 0.016

SAMPLED BY (PRINT) / AFFILIATION: Dilna Bramlet / Geosyntec	SAMPLER(S) SIGNATURES:	SAMPLING INITIATED AT: 1115	SAMPLING ENDED AT: 1128
PUMP OR TUBING DEPTH IN WELL (feet): 23.0	SAMPLE PUMP FLOW RATE (mL per minute): 350	TUBING MATERIAL CODE:	
FIELD DECON: Y N	FLD-FILTERED: Y N FILTER SIZE: ____ µm Filtration Equipment: ____	EQUIPMENT. BLANK: Y (N) Sample ID:	DUPLICATE: (Y) N

SAMPLE ID CODE	# Bottles	MATERIAL CODE	VOLUME	PRESERV. USED	ANALYSIS/ METHOD	SAMPLING EQUIPMENT CODE
AD-32-20190515	4					
AD-32-20190515 DUP	4					

REMARKS: After sampling the Horiba unit, checked w/ cal solution & reading low @ 2.96 pH – pH on form likely low. All WL measurements from top of casing.

MATERIAL CODES: **AG** = Amber Glass; **CG** = Clear Glass; **PE** = Polyethylene; **PP** = Polypropylene; **S** = Silicone; **T** = Teflon; **O** = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: **APP** = After Peristaltic Pump; **B** = Bailer; **BP** = Bladder Pump; **ESP** = Electric Submersible Pump; **PP** = Peristaltic Pump; **RFPP** = Reverse Flow Peristaltic Pump; **SM** = Straw Method (Tubing Gravity Drain); **VT** = Vacuum Trap; **O** = Other (Specify)

STABILIZATION CRITERIA	pH = **± 0.2**	ORP = **± 20 mV**	Specific Conductance = 3 **readings within ± 3%**
Dissolved Oxygen =	A) **≤ 10% saturation** (≤ 1.82 mg/l @ 20 °C, ≤ 1.65 mg/l @ 25 °C, ≤ 1.51 mg/l @ 30 °C)		
	B) **readings within ± 0.2 mg/L (for readings ≤ 2 mg/L), whichever greater**		
Turbidity =	**A)** ≤ 10 NTUs; OR		
	B) 3 readings within ± 10%		

Attachment F

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 Pirkey East Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.95(g)(3)(ii) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864	Texas	July 22, 2019
License Number	Licensing State	Date

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

H.W. Pirkey Power Plant
East Bottom Ash Pond
Hallsville, Texas

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, OH 43221

September 23, 2019

CHA8462

TABLE OF CONTENTS

FIGURES

TABLES

ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EBAP	East Bottom Ash Pond
EDS	Energy Dispersive Spectroscopic Analyzer
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
MCL	Maximum Contaminant Level
QA	Quality Assurance
QC	Quality Control
SEM	Scanning Electron Microscopy
SPLP	Synthetic Precipitation Leaching Procedure
SSL	Statistically Significant Level
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
VAP	Vertical Aquifer Profiling
XRD	X-Ray Diffraction

SECTION 1

INTRODUCTION AND SUMMARY

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the East Bottom Ash Pond (EBAP, Figure 1). In February 2019, a semi-annual assessment monitoring event was conducted at the EBAP in accordance with 40 CFR 257.95(d)(1). The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were established for each Appendix IV parameter in accordance with the statistical analysis plan developed for the facility (AEP, 2017) and United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The GWPS for each parameter was established as the greater of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2). 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.

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 GWPSs. An SSL was concluded if the lower confidence limit (LCL) of a parameter exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). The following SSLs were identified at the Pirkey EBAP:

- LCLs for cobalt exceeded the GWPS of 0.0094 mg/L at AD-2 (0.0100 mg/L), AD-31 (0.00943 mg/L), and AD-32 (0.0333 mg/L).
- LCLs for lithium exceeded the GWPS of 0.052 mg/L at AD-31 (0.077 mg/L) and AD-32 (0.075 mg/L).

No other SSLs were identified (Geosyntec, 2019a).

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations regarding assessment monitoring programs for coal combustion residuals (CCR) landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (40 CFR 257.95(g)(3)(ii)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a*

> *qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section….*

Pursuant to 40 CFR 257.95(g)(3)(ii), Geosyntec Consultants, Inc. (Geosyntec) has prepared this Alternative Source Demonstration (ASD) report to document that the SSLs identified for cobalt and lithium should not be attributed to the EBAP.

1.2 Demonstration of Alternative Sources

An evaluation was completed to assess possible alternative sources to which the identified SSL 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 SSLs identified for cobalt and lithium were based on a Type IV cause and not by a release from the Pirkey EBAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The Federal CCR Rule allows the owner or operator 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. The methodology used to evaluate the SSLs identified for cobalt and lithium and the proposed alternative source are described below.

2.1 Proposed Alternative Sources

Initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify alternative sources due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSLs for cobalt and lithium have been attributed to natural variation associated with the underlying geology, which is a Type IV issue.

2.1.1 Cobalt

In a previous ASD for cobalt at the EBAP, evidence was provided to show that the observed cobalt concentrations were due to natural variation (Geosyntec, 2019b). The previous ASD discussed that the EBAP itself did not appear to be a source for cobalt in downgradient groundwater, based on observed concentrations of cobalt both in the ash material and in leachate from Synthetic Precipitation Leaching Procedure (SPLP) analysis (SW-864 Test Method 1312, [USEPA, 1994]) of the ash material. Cobalt was not detected in the SPLP leachate above the reporting limit of 0.01 mg/L. Because cobalt mobility is affected by pH, the SPLP test results are likely even more conservative than actual pond conditions. SPLP is run at a pH of 5 SU, whereas the operational pH of the pond varies between approximately 5.8 and 7.0 SU. Cobalt mobility increases under more acidic conditions, although even at a pH of approximately 5, only 2% of cobalt in fly ash is mobile (Izquierdo and Querol, 2012).

Cobalt was detected at an estimated concentration of 0.0024 mg/L in a grab sample of the pond water. However, the reported concentration of cobalt in the pond water sample is significantly lower than the average concentration of cobalt observed at all three wells where SSLs were identified (Table 1). Since the previous ASD was prepared, there have been no notable changes in coal handling or sourcing at the plant that would have affected the composition of the ash or pond water.

Since completion of the prior ASD, four additional permanent wells (B-2, B-3, AD-40, and AD-41) have been installed upgradient of the EBAP. The most recent data available for select wells in the vicinity of the EBAP, including the new upgradient locations, are shown in Figure 2. Groundwater cobalt concentrations at upgradient locations vary from 0.0008 mg/L to 0.0345 mg/L at AD-40 and B-3, respectively. This wide range in cobalt concentrations provides further

evidence for the natural variation of cobalt at the Site, particularly as the concentrations at B-3 exceed both the GWPS for the EBAP and the LCLs calculated for cobalt at the wells of interest.

As noted in the prior ASD, soil samples collected across the site, including from locations near the EBAP, identified cobalt in the aquifer solids at varying concentrations. Since completion of the prior ASD, additional soil samples have been collected from locations upgradient of the EBAP. Select soil sample data from the previous ASD and recently collected data are summarized in Table 2. Cobalt was identified in the aquifer solids at varying concentrations, with the highest value of 23.5 milligrams per kilogram (mg/kg) reported at AD-41, which is upgradient of the EBAP (Figure 3). Other testing included collection of aquifer solids to evaluate for the presence of cobalt-containing minerals. X-ray diffraction evidence identified pyrite and marcasite (both iron sulfides) at select locations at concentrations up to 3% by weight (Table 2). Cobalt is known to substitute for iron in crystalline iron minerals such as pyrite and marcasite due to their similar ionic radii (Krupka and Serne, 2002; Hitzman et al., 2019).

Groundwater samples were collected from upgradient location B-3 via vertical aquifer profiling (VAP), as described in an ASD previously generated for lithium exceedances at the EBAP (Geosyntec, 2019c). The VAP groundwater samples were centrifuged to separate solid and liquid phases, and the solid material was submitted for analysis of total metals and mineralogy by X-ray diffraction (XRD). The samples were also submitted for analysis of chemical composition and mineralogy by scanning electron microscopy (SEM) using an energy dispersive spectroscopic analyzer (EDS). Following installation of permanent monitoring wells at B-2 and B-3, groundwater samples were collected by purging groundwater through the filter pack using a submersible pump. An additional groundwater sample was collected at AD-32. These permanent well groundwater samples were filtered through a 1.5-micron filter and the solid material retained on the filter was submitted for analysis of total metals and by SEM/EDS.

Based on total metals analysis, cobalt was identified both in the centrifuged solid material collected from upgradient location B-3 [VAP-B3-(40-45)] and in the material retained on the filter after processing groundwater from B-2 and B-3 (Table 2). Cobalt was detected in the AD-32 solid material at 5.4 mg/kg, which is comparable to the concentration observed in bulk soil collected at the same location at the screened interval (9.1 mg/kg). These results provide further evidence that cobalt concentrations reported during groundwater sampling are naturally occurring and associated with the solid phase in the aquifer.

According to XRD results of the centrifuged solid sample [VAP-B3-(40-45)], pyrite was present as approximately 3% of the solid phase, with hematite (an iron(III) oxide) present at 2% (Table 3). Logging completed while the VAP boring was advanced identified lignite at several intervals, including 45 and 48 ft bgs (Figure 4). Furthermore, SEM/EDS of both centrifuged solid samples [VAP-B3-(40-45) and VAP-B3-(50-55)] identified pyrite in backscattered electron micrographs by the distinctive framboid pattern (Harris, 1981; Sawlowicz, 2000). Major peaks involving iron and sulfur were identified in the EDS spectrum, which further support the identification of pyrite (Attachment A). While cobalt was not identified in the EDS spectrum, it would likely be present

at concentrations below the detection limit. Pyrite was also identified during SEM/EDS analysis of lignite which is mined immediately adjacent to the site.

The wide distribution of pyrite across the site provides evidence that naturally occurring cobalt, which may substitute for iron in pyrite, may also be present in the aquifer solids near the EBAP. The presence of lignite in the area is well-documented, including at upgradient and downgradient locations relative to the EBAP (Broom and Myers, 1966; ETTL, 2010). Additionally, the pond was not identified as the source of cobalt at wells downgradient of the EBAP in the previous ASD based on the documented low mobility of cobalt under the pond conditions and lack of detectable cobalt in the pond itself.

2.1.2 Lithium

An ASD was previously generated for lithium exceedances at the EBAP which attributed the observed concentrations to natural variation in the aquifer, and more specifically to variations in naturally suspended matter that likely originates from lignite and is ubiquitous in the aquifer (Geosyntec, 2019c). New data gathered since completion of the prior ASD provides additional evidence that the observed lithium concentrations at AD-31 and AD-32 are due to natural variation in the aquifer.

Groundwater samples were collected in August 2019 at B-2, B-3, and AD-32 using low-flow sampling techniques. Total lithium concentrations in permanent upgradient wells B-2 and B-3 were measured at 0.055 mg/l and 0.090 mg/l, respectively, both of which are above the GWPS of 0.052 mg/L (Figure 5). Lithium was detected at AD-32 at 0.103 mg/L, which is comparable to the observed concentration at B-3. Because B-2 and B-3 were installed at upgradient locations Site activities, they suggest that lithium concentrations above the GWPS are naturally present in the vicinity of the EBAP.

The previous ASD generated for lithium at the EBAP developed a proposed mechanism for lithium mobility in groundwater which pointed to desorption from clay minerals associated with naturally occurring lignite material as the source of lithium in both up and downgradient wells at the EBAP (Geosyntec, 2019c).

As described in Section 2.1.1, groundwater samples were collected from B-2, B-3, and AD-32 and filtered to separate captured solid material. Both the solid material and the filtered groundwater were submitted for total metals analysis. Lithium was detected in the solid material at concentrations comparable to bulk soil at all locations, providing evidence that the particulates captured during groundwater sampling contain lithium (Table 4).

The total metal concentrations in the solid materials separated from the groundwater samples during filtration and the filtered groundwater concentrations were used to calculated partition coefficients values (K_d) for lithium, potassium, and sodium. These constituents were selected as they are all monovalent cations, and so have similar geochemical behavior. Partition coefficients are used to express the tendency of a chemical (e.g. lithium) to become adsorbed onto soil (or

sediment). K_d is a ratio of the amount of chemical adsorbed per unit weight of the soil to the concentration of the chemical in solution (i.e., groundwater), as shown in the following equation:

$$K_d = \frac{mg\ adsorbed/kg\ soil}{mg/L\ solution}$$

K_d is characteristic of the soil, so its value varies with soil type. While K_d values were previously calculated using results from the VAP samples, the K_d values presented in this ASD are more likely to represent turbid groundwater which would be captured during regular sampling events, as they were calculated using material collected from permanent wells with conventional filter packs.

K_d values for groundwater and particulate collected from wells B-2, B-3, and AD-32 are comparable to literature K_d values reported for organic-rich media such as bogs and peat beds (Table 5) (Sheppard et al., 2009; 2011). These calculations provide further evidence that lithium mobility in Site groundwater is similar to other sites with organic-rich soils. Additionally, the calculated K_d values for Pirkey soils are consistent with the literature, with potassium being the largest (most sorbable) and sodium the smallest (least sorbable). Furthermore, the values are similar for groundwater from all three wells, suggesting a universal mechanism is controlling the mobilities of lithium, sodium, and potassium in groundwater.

Previously completed XRD analysis of the centrifuged solid material samples [VAP-B3-(40-45) and VAP-B3-50-55] found that clay minerals made up at least 60% of the aquifer solid (Table 3). Clay minerals include kaolinite, smectite, and illite/mica. SEM/EDS analysis identified the presence of silicon, aluminum and oxygen, all of which are indicative of clay minerals (Attachment A). The backscattered electron micrographs of these samples also identified clay particles by morphology. The largest clay particles (> 5 µm) are likely kaolinite, while smectite and illite dominate the smaller size fraction. These results are comparable to preliminary investigation of the VAP material completed by SEM/EDS described in the previous ASD, all of which presented evidence for clay fractions (Geosyntec, 2019c).

These multiple lines of evidence show that elevated lithium concentrations at AD-31 and AD-32 are not due to a release from the EBAP, and instead can be attributed to natural variation. This variation appears related to the distribution of clay fractions associated with lignite materials in the soil aquifer material.

2.2 Sampling Requirements

As the ASD presented above supports the position that the identified SSLs are not due to a release from the Pirkey EBAP, the unit will remain in the assessment monitoring program. Groundwater at the unit will continue to be sampled for Appendix IV parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.95(g)(3)(ii) and provides evidence that the SSLs for cobalt at AD-2, AD-31, and AD-32 and for lithium at AD-31 and AD-32 identified during assessment monitoring in February 2019 were not due to a release from the EBAP. The identified SSLs were, instead, attributed to natural variation in the underlying geology. Therefore, no further action for cobalt or lithium is warranted, and the EBAP will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in Attachment B.

SECTION 4

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Soil, Tills, and Sediments at Forsmark. R-11-24. Swedish Nuclear Fuel and Waste Management Co. R-11-24. November.

Sheppard, S., Long, J., Sanipelli, B., and Sohlenius, G. 2009. Solid/Liquid Partition Coefficients (K_d) for Selected Soil and Sediments at Forsmark and Laxemar-Simpevarp. R-09-27. Swedish Nuclear Fuel and Waste Management Co. March.

United States Environmental Protection Agency (USEPA), 1994. Method 1312 – Synthetic Precipitation Leaching Procedure, Revision 0, September 1994, Final Update to the Third Edition of the Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09/007. March.

TABLES

Table 1: Summary of Key Cobalt Analytical Data
East Bottom Ash Pond - H.W. Pirkey Plant

Sample	Unit	Cobalt Concentration
Bottom Ash (Solid Material)	mg/kg	6.1
SPLP Leachate of Bottom Ash	mg/L	<0.01
EBAP Pond Water	mg/L	0.0024 J
AD-2 - Average	mg/L	0.0111
AD-31 - Average	mg/L	0.0107
AD-32 - Average	mg/L	0.0504

Notes:
mg/kg - milligram per kilogram
mg/L - milligram per liter
J - Estimated value. Result is less than the reporting limit but greater than or equal to the method detection limit.
Average values were calculated using all cobalt data collected under 40 CFR 257 Subpart D, excluding any identified outliers.

Table 2: Soil Cobalt and Mineralogy Data
East Bottom Ash Pond - H.W. Pirkey Plant

Geosyntec Consultants, Inc.

Location ID	Sample Depth (ft bgs)	Cobalt (mg/kg)	Pyrite/Marcasite (%)
Bulk Soil Samples			
AD-17	7	3.10	2
	15	1.50	0
AD-18	8	3.60	1
	22	2.90	0
AD-30	7	1.00	3
	23	15.0	1
AD-31	12	1.90	2
	26	0.83	0
AD-32	11	1.70	--
	20-25	9.10	--
AD-41	15	< 1.0	--
	35	23.5	---
	95	1.90	---
B-2	10	2.36	---
	16	3.62	---
	71	10.30	---
	82	7.21	---
	87	3.11	---
B-3	10	1.30	---
	20	0.59	---
	97	1.11	---
Solid Material Retained After Filtration			
AD-32	13-33	5.4	--
B-2	38-48	4.3	--
B-3	29-34	12.0	--
	VAP 40-45	18.0	3

Notes:

'--' - analysis not completed

mg/kg- milligram per kilogram

ft bgs - feet below ground surface

For AD-XX locations, samples were collected from additional boreholes advanced in the immediate area of the location identified by the well ID. Samples were not collected from the cuttings of the borings advanced for well installation. Samples for B-X locations were collected from cores removed from the borehole during well lithology logging.

Depths for samples collected after filtration represent the screened interval for the permanent well where the sample was collected.

Table 3: X-Ray Diffraction Results
East Bottom Ash Pond - H. W. Pirkey Plant

Constituent	VAP-B3-(40-45)
Quartz	15
Plagioclase Feldspar	0.5
Orthoclase	ND
Calcite	ND
Dolomite	ND
Siderite	0.5
Goethite	ND
Hematite	2
Pyrite	3
Kaolinte	42
Chlorite	4
Illite/Mica	6
Smectite	12
Amorphous	15

Notes:

ND: Not detected

VAP-B3-(40-45) is the centrifuged solid material from the groundwater sample collected at that interval.

Table 4: Soil Lithium Data
East Bottom Ash Pond - H.W. Pirkey Plant

Geosyntec Consultants, Inc.

Location ID	Sample Depth (ft bgs)	Lithium (mg/kg)
Bulk Soil Samples		
AD-32	11	0.53
	20-25	1.60
B-2	10	5.30
	16	3.97
	71	7.42
	87	13.10
B-3	10	3.64
	20	2.59
	97	11.10
Lignite	N/A	2.9 J
Solid Material Retained After Filtration		
AD-32	13-33	9.8 J
B-2	38-48	6.5 J
B-3	29-34	7.8 J
	VAP 40-45	13.0

Notes:
J - estimated value
mg/kg- milligram per kilogram
ft bgs - feet below ground surface
For AD-32, samples were collected from additional boreholes advanced in the immediate area of the location identified by the well ID. Samples were not collected from the cuttings of the borings advanced for well installation. Samples for B-X locations were collected from cores removed from the borehole during well lithology logging.
Depths for samples collected after filtration represent the screened interval for the permanent well where the sample was collected.
VAP - vertical aquifer profiling

Table 5: Calculated Site-Specific Partition Coefficients
East Bottom Ash Pond - H. W. Pirkey Plant

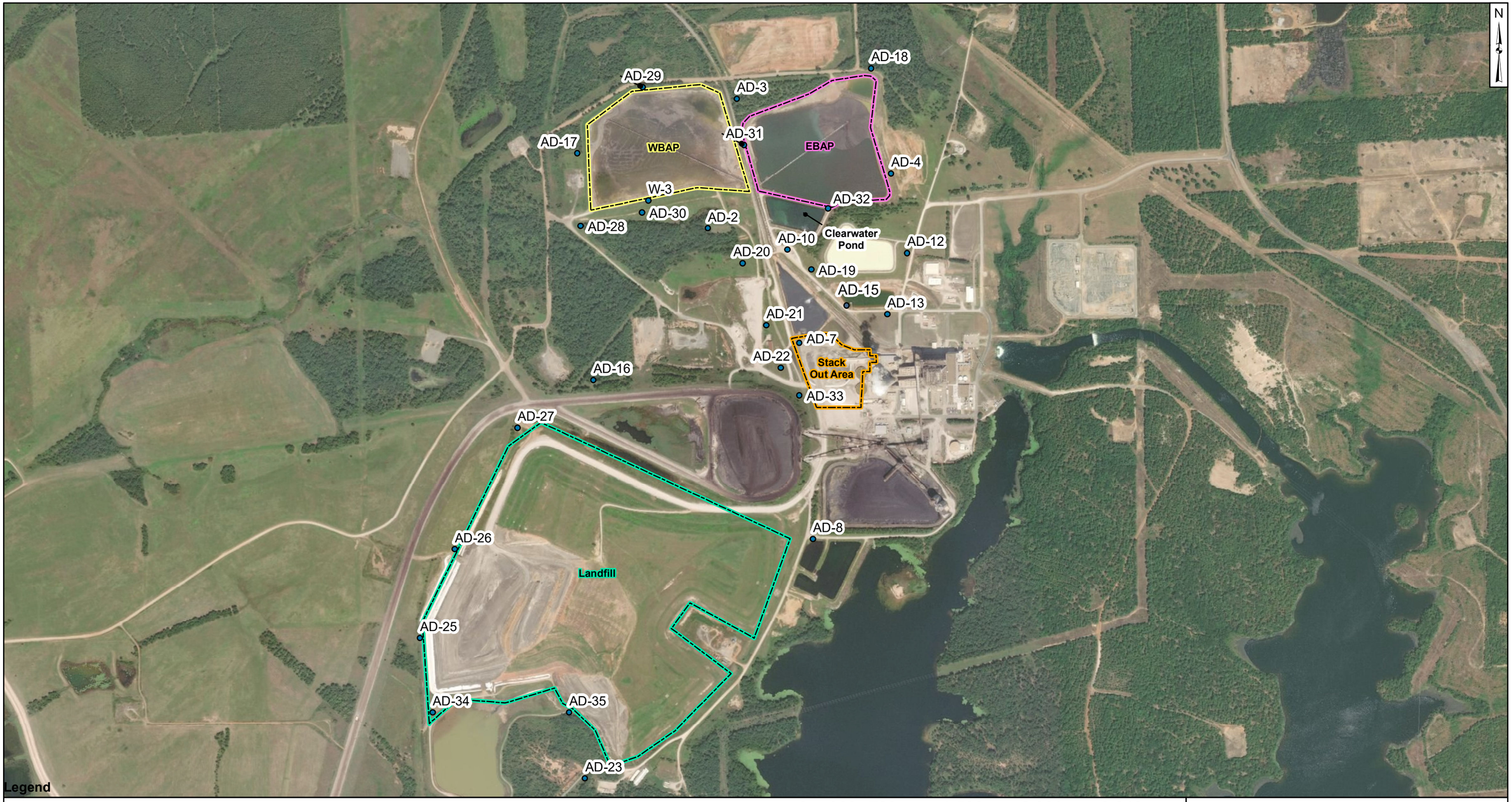
Source	B-2			Literature Value
Unit	mg/L	mg/kg	L/kg	L/kg
Element	**Aqueous Phase**	**Adsorbed**	**Kd**	**Kd**
Li	0.081	6.5	80	43-370
K	2.6	1100	423	42-1200
Na	14	130	9	5.2-82

Source	B-3			Literature Value
Unit	mg/L	mg/kg	L/kg	L/kg
Element	**Aqueous Phase**	**Adsorbed**	**Kd**	**Kd**
Li	0.097	7.8	80	43-370
K	2.9	1100	379	42-1200
Na	32	240	8	5.2-82

Source	AD-32			Literature Value
Unit	mg/L	mg/kg	L/kg	L/kg
Element	**Aqueous Phase**	**Adsorbed**	**Kd**	**Kd**
Li	0.11	9.8	89	43-370
K	3.9	1800	462	42-1200
Na	57	220	4	5.2-82

Notes:
mg/L: milligrams per liter
mg/kg: milligrams per kilogram
L/kg: liters per kilogram
Kd: partition coefficient
Adsorbed values are total metals concentrations reported by USEPA Method 6010B.
Literature values represent maximum and minimum values for the parameter as reported in Sheppard et al, 2009 (Table 4-1, all sites) and Sheppard et al, 2011 (Table 3-3 cultivated peat and wetland peat only).

FIGURES



Legend

- AD-15
- Monitoring Wells

Location Boundaries

CCR Units

- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019
- AD-15 location is approximate.

0 380 760 1,520 2,280 3,040 Feet

Site Layout

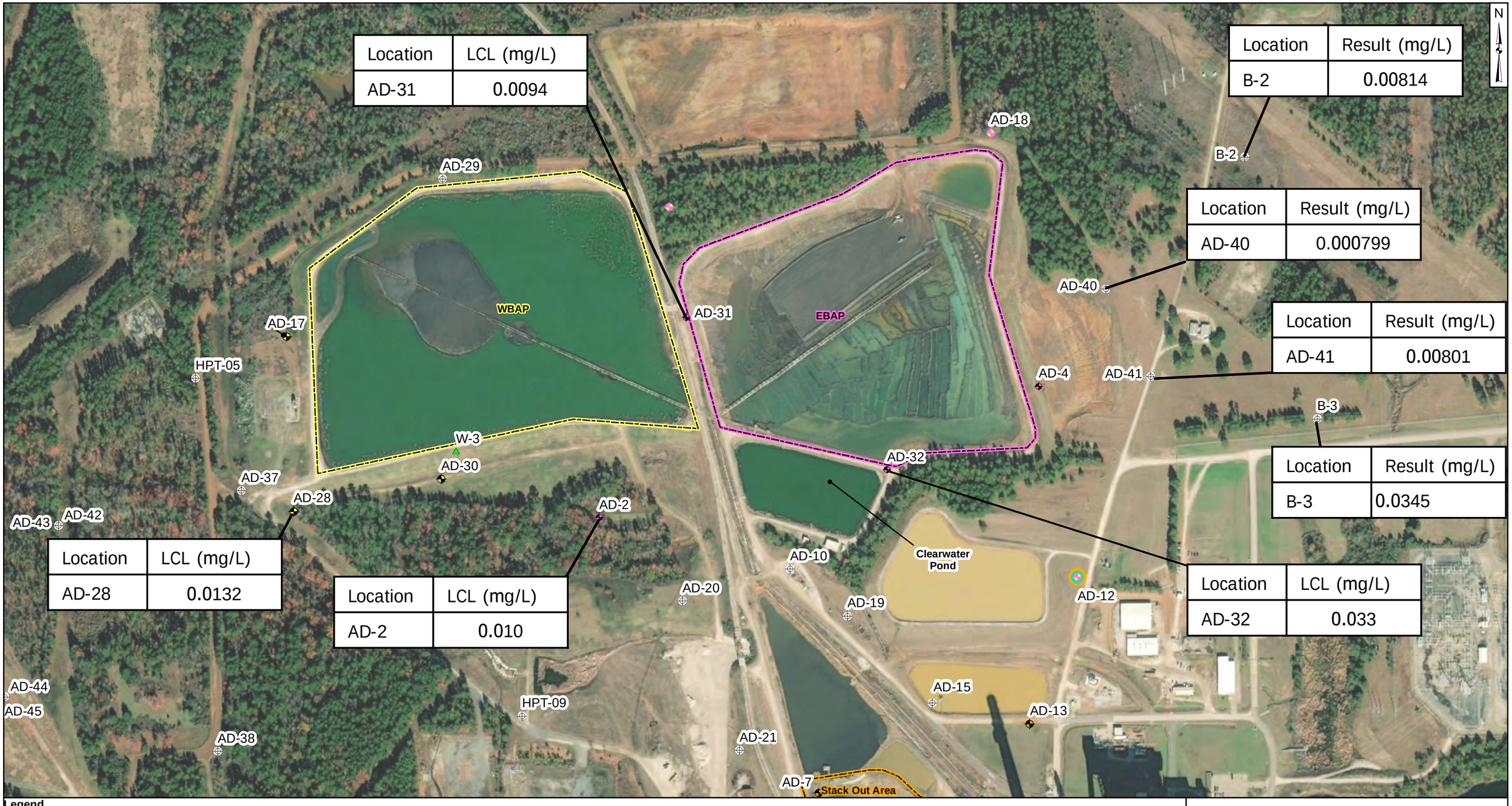
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/03/25

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\Site_Layout_20190322.mxd. HDuff. 3/25/2019. Project/Phase/Task.



Legend

- Out of Network
- EBAP
- WBAP
- Stackout Area
- EBAP and WBAP
- All CCR Unit Networks
- Piezometer
- EBAP
- Stack Out Area
- WBAP

Notes
- Monitoring well coordinates, site features, and data provided by AEP.
- AD-15 location is approximated
- LCL: lower confidence limit
- Cobalt concentrations and LCL values displayed in milligrams per liter (mg/L).

400 200 0 400
Feet

Cobalt Distribution in Groundwater

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/09/17

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2019\AEP_Pirkey_Cobalt_20190912.mxd. ARevezzo. 9/17/2019. Project/Phase/Task.

Location	AD-31	
Depth (ft bgs)	12	26
Cobalt (mg/kg)	1.9	0.83
Pyrite/Marcasite (%)	2	0

Location	AD-18	
Depth (ft bgs)	8	22
Cobalt (mg/kg)	3.6	2.9
Pyrite/Marcasite (%)	1	0

Location	B-2				
Depth (ft bgs)	10	16	71	82	87
Cobalt (mg/kg)	2.36	3.62	10.30	7.21	3.11
Pyrite/Marcasite (%)	-	-	-	-	-

Location	AD-17	
Depth (ft bgs)	7	15
Cobalt (mg/kg)	3.1	1.5
Pyrite/Marcasite (%)	2	0

Location	AD-41		
Depth (ft bgs)	15	35	95
Cobalt (mg/kg)	< 1.0	23.5	1.9
Pyrite/Marcasite (%)	-	-	-

Location	B-3		
Depth (ft bgs)	10	20	97
Cobalt (mg/kg)	1.30	0.59	1.11
Pyrite/Marcasite (%)	-	-	-

Location	AD-30	
Depth (ft bgs)	7	23
Cobalt (mg/kg)	1	15
Pyrite/Marcasite (%)	3	1

Location	AD-32	
Depth (ft bgs)	11	20-25
Cobalt (mg/kg)	1.7	9.1
Pyrite/Marcasite (%)	--	--

AD-29
AD-31
AD-18
B-2
AD-40
AD-17
HPT-05
AD-4
AD-41
WBAP
EBAP
B-3
W-3
AD-30
AD-37
AD-28
AD-2
AD-32
Clearwater Pond
AD-10
AD-12
AD-20
AD-19

N

Legend

- Monitoring Wells
- EBAP
- WBAP

Notes
- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019.
- ft bgs: feet below ground surface.
- mg/kg: milligrams per kilogram.
- -- not analyzed.

300 150 0 300 Feet

Soil Chemical and Mineralogical Analysis Results

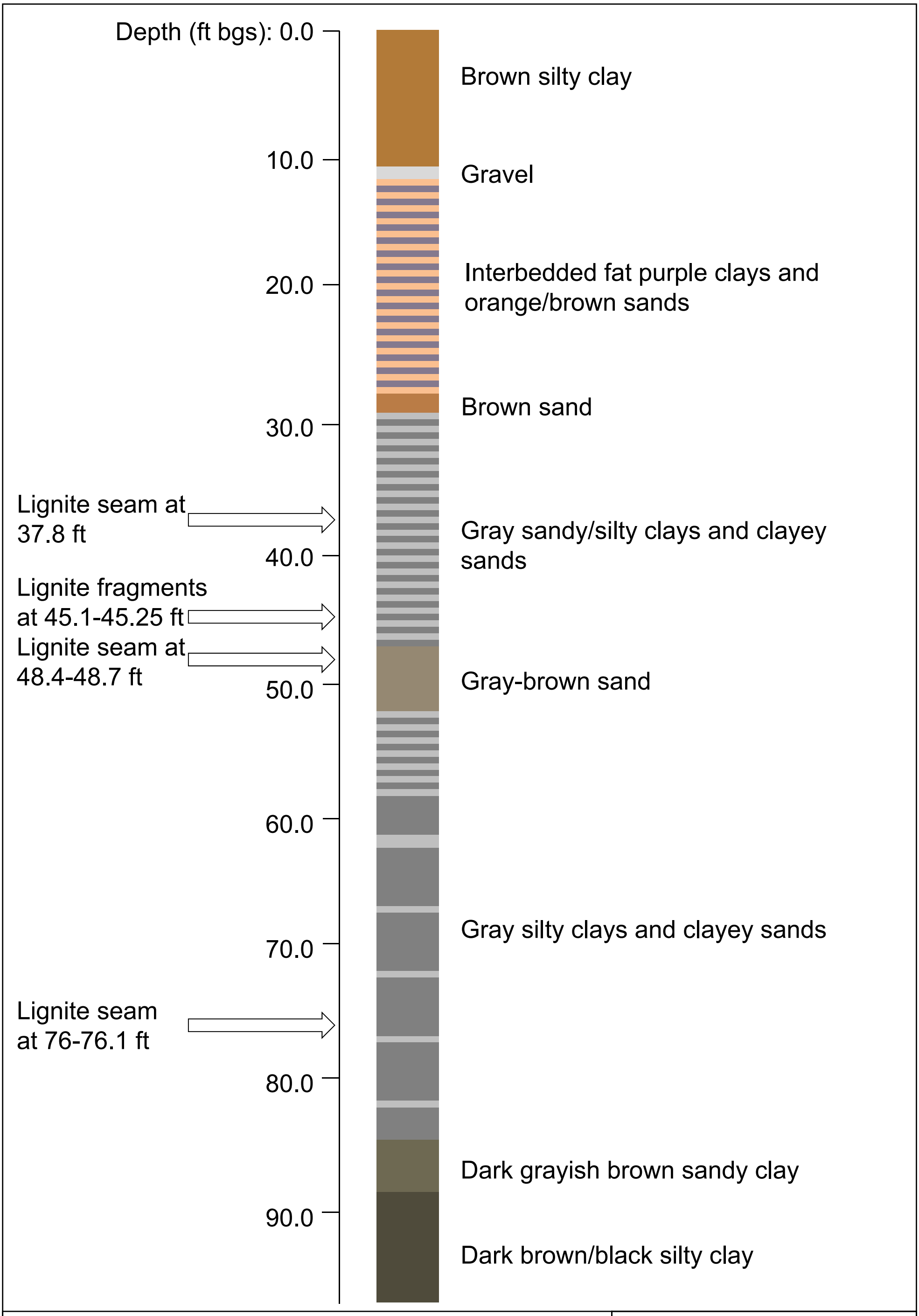
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/09/18

Figure 3

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2019\Pirkey_SoilChem_minerals_March2019.mxd. hduff. 9/18/2019. Project/Phase/Task.



Notes:
- Ft = feet
- Bgs = below ground surface
- Boring completed May 2019
- Total depth of 97.5 ft bgs
- Well installed in offset boring screened at 29-34 ft bgs

Boring B-3 Visual Lithology Log

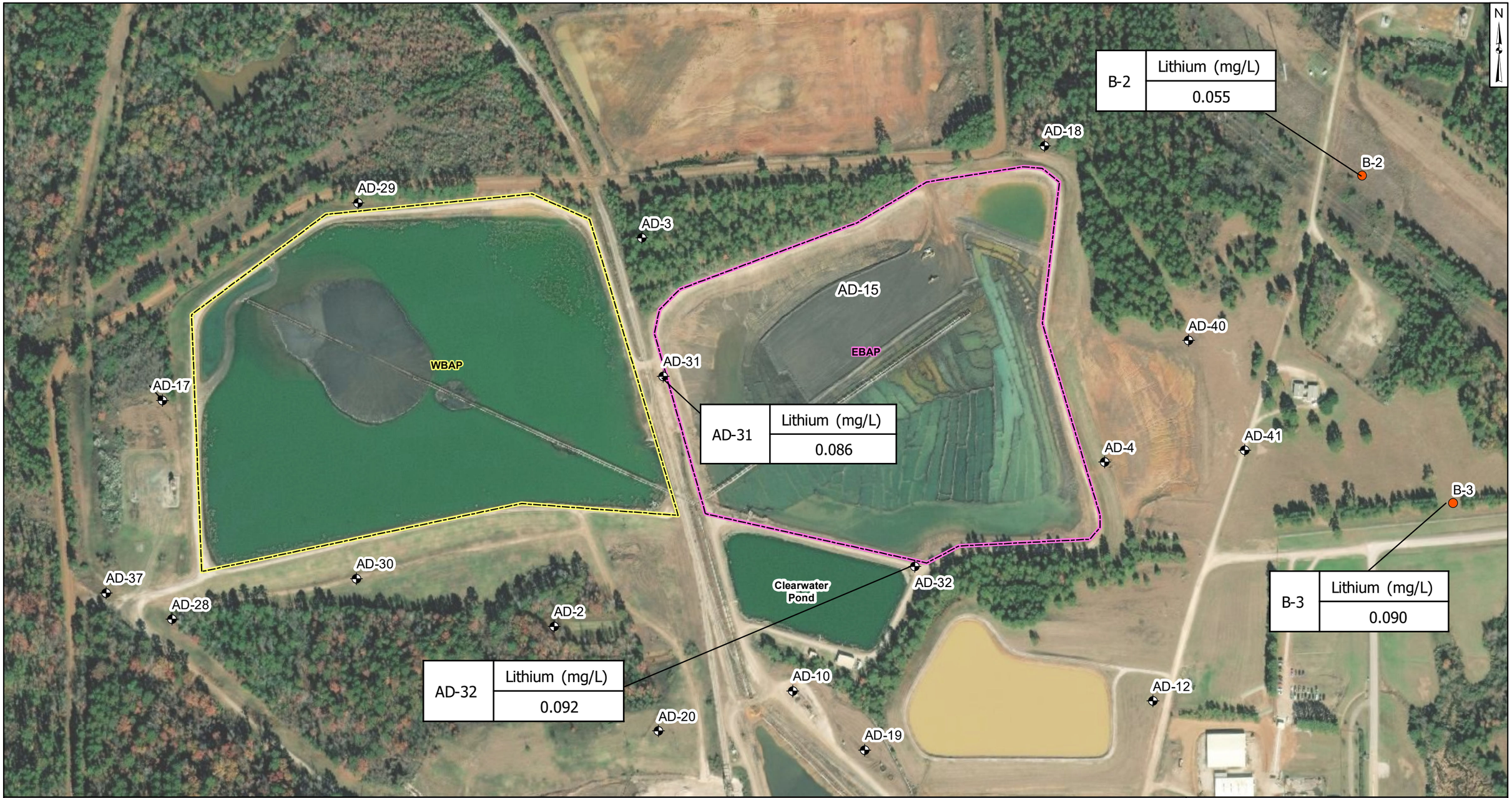
AEP Pirkey Powerplant
Hallsville, TX

Geosyntec consultants

CHA8462 | September 2019

Figure 4

\\annarbor-01\data\Projects\AEP\Legal Department - ASD Review\Pirkey\2019-05 Field Investigation\Field Forms\Compiled Boring Logs\Visual boring logs



Legend

- Borehole
- Monitoring Well

Location Boundaries

- EBAP
- WBAP

Notes

- Lithium concentrations in micrograms per liter ug/L
- Monitoring well coordinates, site features, and data provided by AEP.
- AD-31 and AD-32 collected February 2019. B-2 and B-3 data from August 2019.

300 150 0 300
Feet

Lithium Distribution in Groundwater

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/09/18

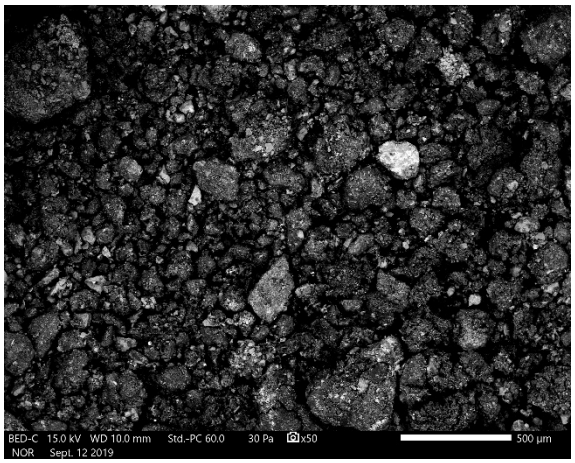
Figure **5**

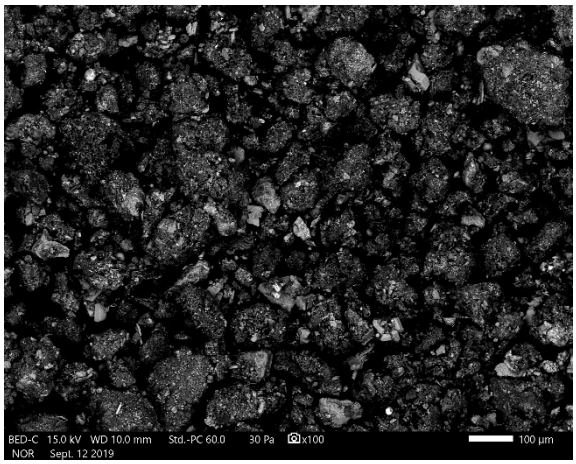
P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2019\AEP-Pirkey_Li_201909.mxd. hduff. 9/18/2019. CHA8462/12/02.

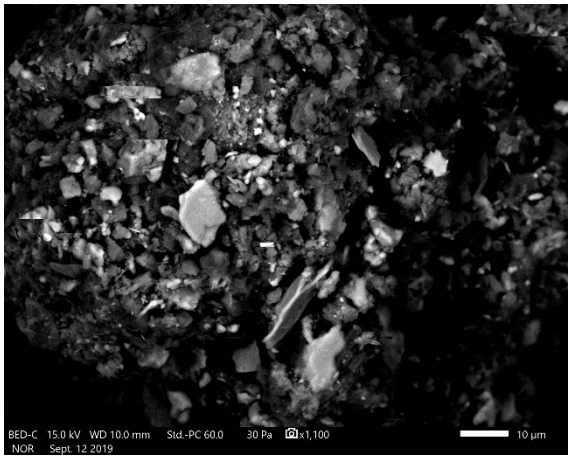
ATTACHMENT A
SEM/EDS Analysis

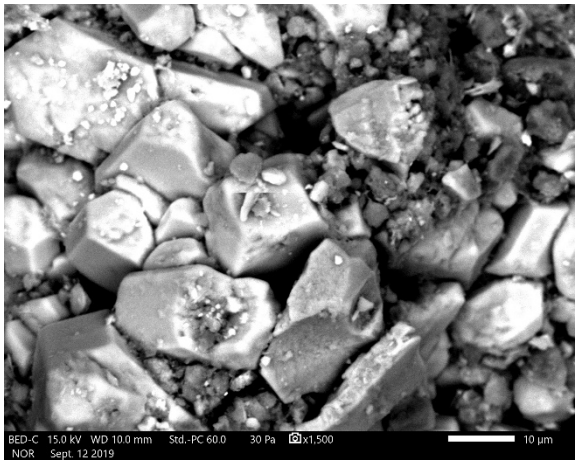
September 16, 2019

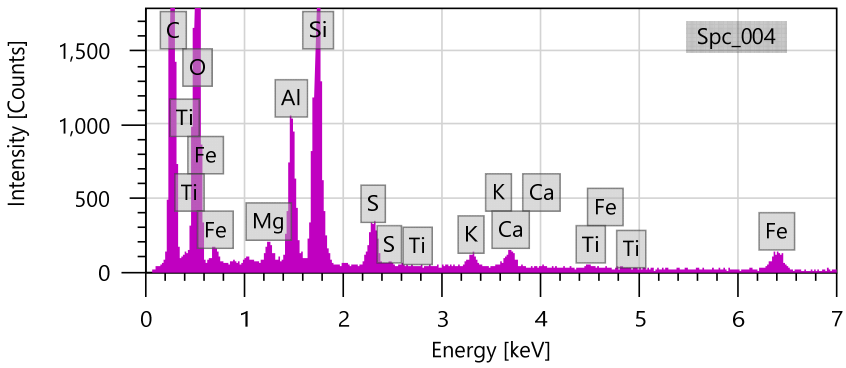
Dr. Bruce Sass
941 Chatham Lane, Suite 103, Columbus, OH 43221
via Email: BSass@geosyntec.com



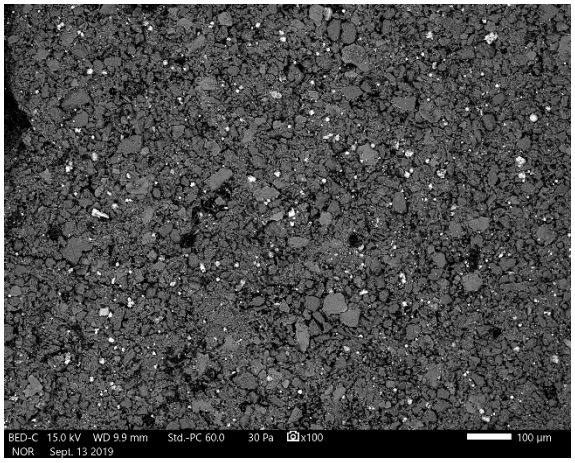


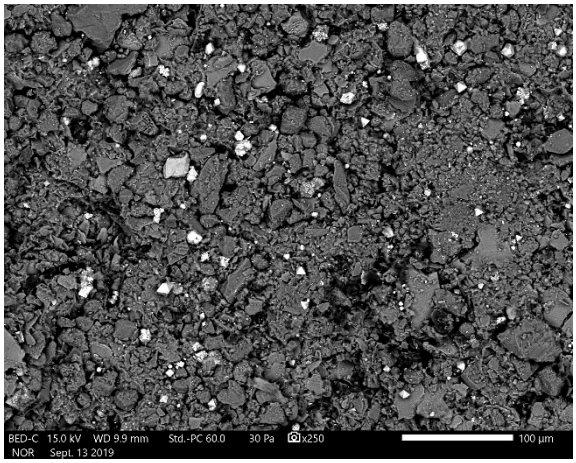


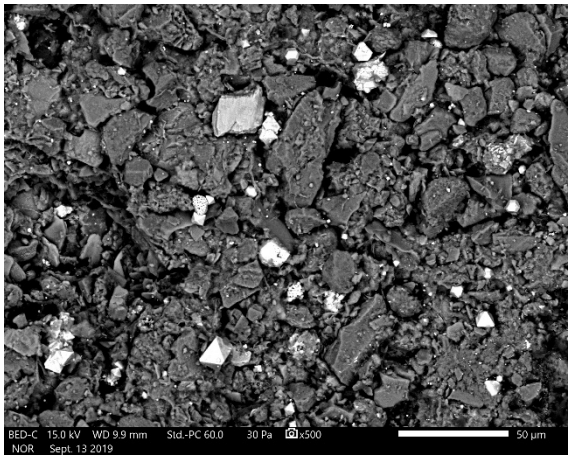


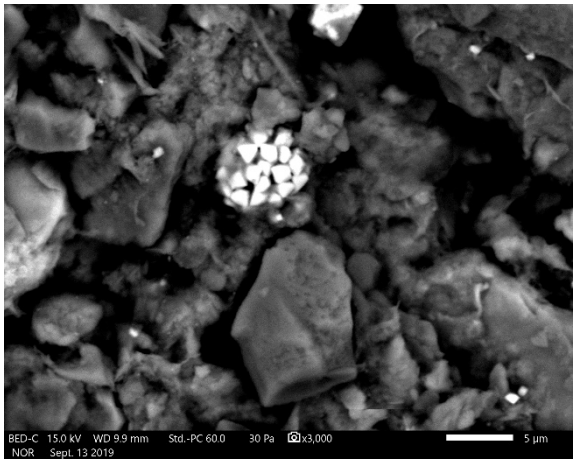


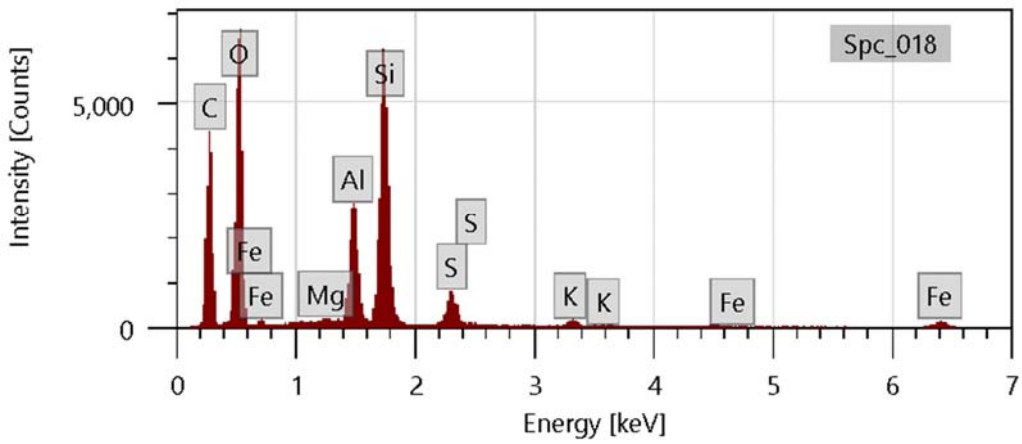
Lignite. Backscattered electron micrographs show the sample at 100X, 1,100X, and 1,500X. EDS spectrum at bottom is an area scan of the region shown in top right micrograph. Bright particles are mostly quartz and feldspar. Major peaks for carbon, oxygen, silicon, and aluminum suggest coal and clay.



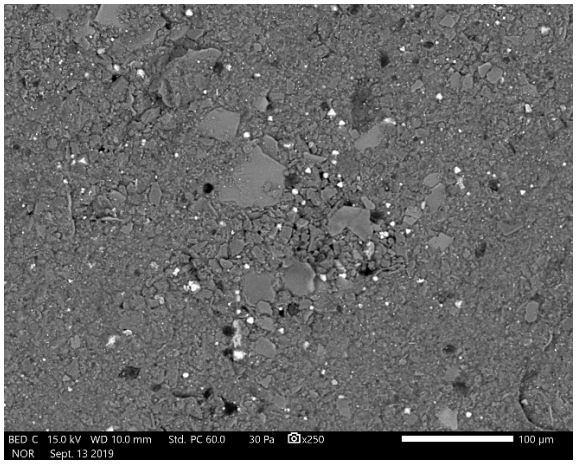


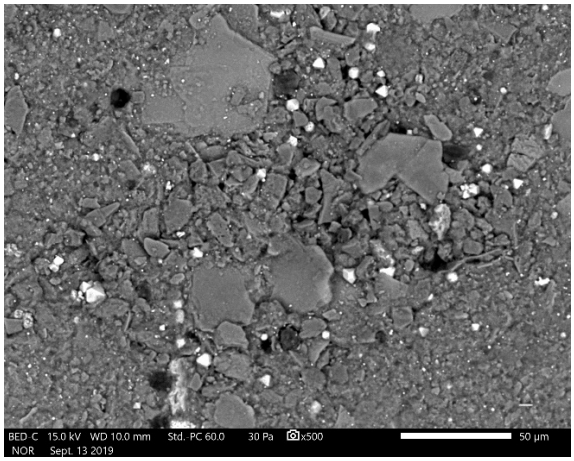


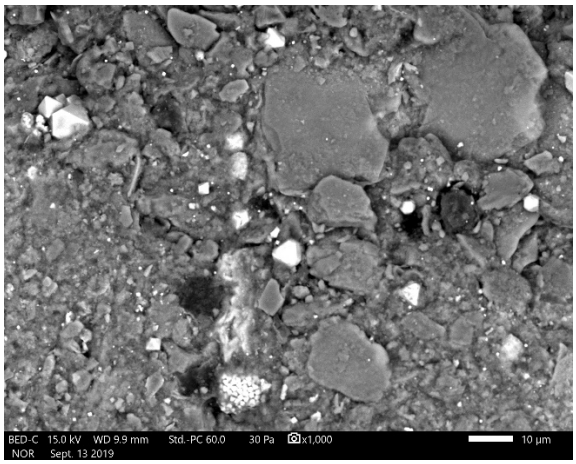


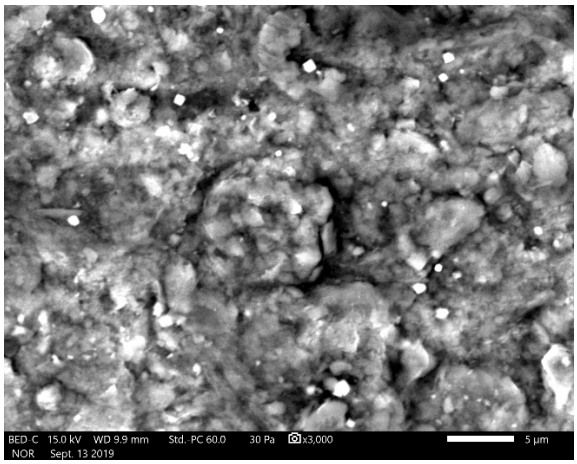


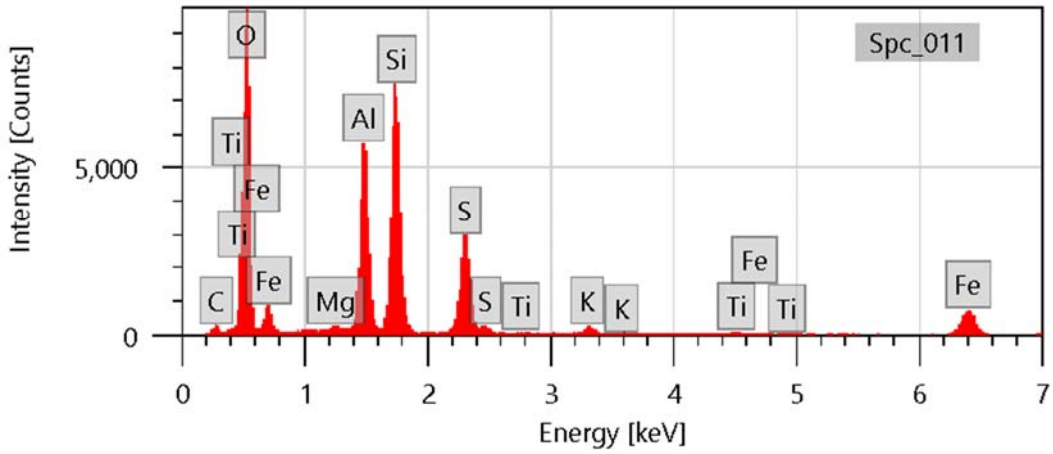
Sample VAP B3 40-45. Backscattered electron micrographs show the sample at 100X, 250X, 500X, and 3000X. EDS spectrum at bottom is an area scan of the region shown at 500X. Bright particles are pyrite (framboid in bottom right micrograph). Major peaks for carbon, oxygen, silicon, and aluminum suggest coal and clay.











Sample VAP B3 50-55. Backscattered electron micrographs show the sample at 250X, 500X, 1000X, and 3000X. EDS spectrum at bottom is an area scan of the region shown at 3000X. Bright particles are mostly pyrite (framboid in bottom left micrograph); occasional particles of Fe-Ti oxide are detected. Major peaks for oxygen, silicon, and aluminum suggest clay. Large blocky particles are mostly quartz, feldspar, and clay.

ATTACHMENT B
Certification by 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 Pirkey East Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.95(g)(3)(ii) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864	Texas	10/3/2019
License Number	Licensing State	Date

APPENDIX IV

Notices of groundwater monitoring program transitions are included in this appendix.

Pirkey Plant

Notice for Initiating an Assessment of Corrective Measures

CCR Unit – East Bottom Ash Pond

As required by 40 CFR 257.95(g)(5), this is a notification that an Assessment of Corrective Measures was initiated on March 26, 2019 for Pirkey Plant's East Bottom Ash Pond due to the statistically significant level detected above the established groundwater protection standard for lithium. This notification is being placed in the plant's operating record, as required by 40 CFR 257.105(h)(9).

APPENDIX V

Reports documenting monitoring well plugging and abandonment or well installation are included in the appendix.

STATE OF TEXAS WELL REPORT for Tracking #506035

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**SB10**
Address:	**2400 FM 3251 HALLSVILLE, TX 75650**	Grid #:	**35-37-4**
Well Location:	**2400 FM 3251 HALLSVILLE, TX 75650**	Latitude:	**32° 26' 52.08" N**
	LOCATED ON OWNERS PROPERTY	Longitude:	**094° 29' 58.82" W**
Well County:	**Harrison**	Elevation:	**No Data**
			****Plugged Within 48 Hours****

****This well has been plugged**** **Plugging Report Tracking #185184**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **2/19/2019** Drilling End Date: **2/20/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**60**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**31**	**38**	**Bentonite 3 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

	Description (number of sacks & material)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Plug Information:	**SAND**	**50**	**60**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**1**	**clay brown**
1	**5**	**silty sand**
5	**9.5**	**clay**
9.5	**11**	**sand**
11	**32**	**clay**
32	**39**	**sand and clay**
39	**55**	**sand**
55	**60**	**fine sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**40**
2	**Screen**	**New Plastic (PVC)**	**40 0.1**	**40**	**50**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

TEX. OCC. CODE Title 12, Chapter 1901.251, authorizes the owner (owner or the person for whom the well was drilled) to keep information in Well Reports confidential. The Department shall hold the contents of the well log confidential and not a matter of public record if it receives, by certified mail, a written request to do so from the owner.

Please include the report's Tracking Number on your written request.

Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS PLUGGING REPORT for Tracking #185184

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**SB10**
Address:	**2400 FM 3251 HALLSVILLE, TX 75650**	Grid #:	**35-37-4**
Well Location:	**2400 FM 3251 HALLSVILLE, TX 75650**	Latitude:	**32° 26' 52.08" N**
		Longitude:	**094° 29' 58.82" W**
	LOCATED ON OWNERS PROPERTY	Elevation:	**No Data**
Well County:	**Harrison**		

Well Type: **Monitor**

Drilling Information

Company: **Plains Environmental Services** Date Drilled: **2/20/2019**

Driller: **Jesse Kalvig** License Number: **5025**

Well Report Tracking #506035

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**60**

Plugging Information

Date Plugged: **2/21/2019** Plugger: **Jesse Kalvig**

Plug Method: **Pour in 3/8 bentonite chips when standing water in well is less than 100 feet depth, cement top 2 feet**

Casing Left in Well:

DIa (in.)	*Top (ft.)*	*Bottom (ft.)*
2	**15**	**50**

Plug(s) Placed in Well:

Top (ft.)	*Bottom (ft.)*	*Description (number of sacks & material)*
1	**40**	**Bentonite 10 Bags/Sacks**

Certification Data: The driller certified that the driller plugged this well (or the well was plugged under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the reports(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

STATE OF TEXAS WELL REPORT for Tracking #506039

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**AD37**
Address:	**2400 FM 3251** **HALLSVILLE, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251** **HALLSVILLE, TX 75650**	Latitude:	**32° 27' 56.32" N**
	LOCATED ON OWNERS PROPERTY	Longitude:	**094° 29' 41.78" W**
Well County:	**Harrison**	Elevation:	**No Data**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **2/22/2019** Drilling End Date: **2/22/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**17**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**1**	**10**	**Bentonite 5 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**8.5**	**CLAYS WITH SOME SAND**
8.5	**10.5**	**SAND**
10.5	**13**	**CLAY SOME SAND**
13	**15**	**SAND WITH SOME CLAYS**
15	**17**	**CLAYS**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**12**
2	**Screen**	**New Plastic (PVC)**	**40 0.1**	**12**	**17**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #506038

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**AD38**
Address:	**2400 FM 3251 HALLSVILLE, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 HALLSVILLE, TX 75650**	Latitude:	**32° 27' 46.12" N**
	LOCATED ON OWNERS PROPERTY	Longitude:	**094° 29' 43.34" W**
Well County:	**Harrison**	Elevation:	**No Data**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **2/21/2019** Drilling End Date: **2/21/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**18**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**1**	**11**	**Bentonite 5 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**5**	**CLAY RED**
5	**7**	**CLAY GRAY/RED**
7	**11.5**	**SAND/CLAY**
11.5	**17.5**	**SAND SOME CLAYS**
17.5	**18**	**CLAY SLITS**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**13**
2	**Screen**	**New Plastic (PVC)**	**40 0.1**	**13**	**18**

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P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #506037

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**AD39**
Address:	**2400 FM 3251 HALLSVILLE, TX 75650**	Grid #:	**35-37-4**
Well Location:	**2400 FM 3251 HALLSVILLE, TX 75650**	Latitude:	**32° 26' 52.05" N**
	LOCATED ON OWNERS PROPERTY	Longitude:	**094° 29' 58.84" W**
Well County:	**Harrison**	Elevation:	**No Data**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **2/20/2019** Drilling End Date: **2/20/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**12**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**1**	**5**	**Bentonite 3 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**1**	**CLAY**
1	**5**	**CLAY/SAND**
5	**9.5**	**CLAY**
9.5	**12**	**SAND/CLAY**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**7**
2	**Screen**	**New Plastic (PVC)**	**40 0.1**	**7**	**12**

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P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508688

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**AD-40 (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 28' 03" N**
		Longitude:	**094° 29' 00.5" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/10/2019** Drilling End Date: **3/10/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**40**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
27	**40**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**13**	**Cement**
13	**27**	**Bentonite 4 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**6**	**tan and brown sandy, silty clay**
6	**15**	**red and tan sand**
15	**28**	**red and grey clay**
28	**40**	**red and grey sand with occasional clay intervals**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**30**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**30**	**40**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508686

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB(MW)-01A**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 28' 03" N**
		Longitude:	**094° 29' 00.5" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/9/2019** Drilling End Date: **3/10/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**100**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
86	**100**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**10**	**Cement**
10	**86**	**Bentonite 17 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**6**	**tan and brown sandy, silty clay**
6	**15**	**red and tan sand**
15	**28**	**red and grey clay**
28	**85**	**red and grey sand with occasional clay intervals**
85	**88**	**grey clay**
88	**100**	**grey sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**90**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**90**	**100**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508703

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-4 shallow (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 55" N**
		Longitude:	**094° 29' 50" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/22/2019** Drilling End Date: **2/22/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**22**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
8	**22**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**3**	**Cement**
3	**8**	**Bentonite 1 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**7**	**tan and brown sandy, silty clay**
7	**22**	**red and grey sand w/occ. lignite layers**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**12**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**12**	**22**

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(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508695

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-4 deep (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 55" N**
		Longitude:	**094° 29' 50" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/20/2019** Drilling End Date: **2/22/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**80**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
56	**80**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**8**	**Cement**
8	**56**	**Bentonite 9 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**7**	**tan and brown sandy, silty clay**
7	**36**	**red and grey sand w/occ. lignite layers**
36	**41**	**red and tan clay**
41	**69**	**red and grey sand with occasional clay iand lignite layers**
69	**80**	**grey sandy clay with lignite layers**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**59**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**59**	**69**

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P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508712

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-5 shallow (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 48" N**
		Longitude:	**094° 29' 53" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/24/2019** Drilling End Date: **2/24/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**25**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
12	**25**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**8**	**Cement**
8	**12**	**Bentonite 1 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**5**	**tan and brown sandy, silty clay**
5	**18**	**red and grey sand w/occ. clay layers**
18	**20**	**gray clay**
20	**25**	**brown sand**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**15**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**15**	**25**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508708

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-5 deep (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 48" N**
		Longitude:	**094° 29' 53" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/23/2019** Drilling End Date: **2/23/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**70**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
45	**70**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**10**	**Cement**
10	**45**	**Bentonite 9 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**5**	**tan and brown sandy, silty clay**
5	**18**	**red and grey sand w/occ. clay layers**
18	**20**	**gray clay**
20	**28**	**brown sand**
28	**41**	**brown and grey silty clay**
41	**70**	**grey sand with occasional lignite layers**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**50**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**50**	**60**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #506040

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**SB6S**
Address:	**2400 FM 3251 HALLSVILLE, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 HALLSVILLE, TX 75650**	Latitude:	**32° 27' 30.34" N**
		Longitude:	**094° 29' 27.76" W**
	LOCAATED ON OWNERS PROPERTY	Elevation:	**No Data**
Well County:	**Harrison**		

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **2/23/2019** Drilling End Date: **2/23/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**18**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**1**	**11**	**Bentonite 5 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**10**	**CLAYS**
10	**18**	**SANDS AND CLAYS**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**13**
2	**Screen**	**New Plastic (PVC)**	**40 0.1**	**13**	**18**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #506041

Owner:	**H W PIRKEY POWER PLANT**	Owner Well #:	**SB6D**
Address:	**2400 FM 3251 HALLSVILLE, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 HALLSVILLE, TX 75650**	Latitude:	**32° 27' 30.28" N**
	LOCATED ON OWNERS PROPERTY	Longitude:	**094° 29' 27.75" W**
Well County:	**Harrison**	Elevation:	**No Data**

Type of Work: **New Well** Proposed Use: **Monitor**

Drilling Start Date: **2/22/2019** Drilling End Date: **2/23/2019**

	Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
Borehole:	**8.25**	**0**	**65**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Screened**

	Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
Annular Seal Data:	**1**	**53**	**Bentonite 19 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **No Data** **Surface Completion NOT by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Plains Environmental Services**

1900 Tonys Rd
salina, KS 67401

Driller Name: **Jesse Kalvig** License Number: **5025**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**10**	**CLAYS**
10	**24**	**SANDS AND CLAYS**
24	**29**	**CLAYS**
29	**42.5**	**SANDS AND CLAYS**
42.5	**48.5**	**SANDS WITH SOME CLAY**
48.5	**56**	**CLAYS WITH SOME SAND**
56	**65**	**SILY SANDS**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**55**
2	**Screen**	**New Plastic (PVC)**	**40 0.1**	**55**	**65**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508722

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-7 shallow (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 27" N**
		Longitude:	**094° 30' 08" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/3/2019** Drilling End Date: **3/3/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**45**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
32	**45**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**32**	**Bentonite 6 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**45**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**35**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**35**	**45**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508720

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-7 deep (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 27" N**
		Longitude:	**094° 30' 08" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/28/2019** Drilling End Date: **2/28/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**70**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
57	**70**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**57**	**Bentonite 10 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**70**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**60**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**60**	**70**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508724

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-8 shallow (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 10" N**
		Longitude:	**094° 30' 12" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/27/2019** Drilling End Date: **2/27/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**35**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
23	**35**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**23**	**Bentonite 4 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**35**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**25**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**25**	**35**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508729

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-8 medium (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 10" N**
		Longitude:	**094° 30' 12" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/27/2019** Drilling End Date: **2/27/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**65**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
52	**65**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**53**	**Bentonite 4 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**65**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**55**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**55**	**65**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508777

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-8 deep (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 10" N**
		Longitude:	**094° 30' 12" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **2/24/2019** Drilling End Date: **2/26/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**93**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
77	**93**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**77**	**Bentonite 15 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**90**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**
90	**93**	**gray clay (old pit base?)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**80**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**80**	**90**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508781

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-9 shallow (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 01" N**
		Longitude:	**094° 30' 11" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/5/2019** Drilling End Date: **3/5/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**30**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
17	**30**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**17**	**Bentonite 1 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**30**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**20**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**20**	**30**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508779

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-9 deep (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 01" N**
		Longitude:	**094° 30' 11" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/4/2019** Drilling End Date: **3/4/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**60**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
48	**60**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**12**	**Cement**
12	**48**	**Bentonite 10 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**60**	**tan and brown sandy, silty clay and occasional lignite inclusions (reclaim)**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**50**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**50**	**60**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508718

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-11 shallow (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 26' 41" N**
		Longitude:	**094° 30' 11" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/8/2019** Drilling End Date: **3/8/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**15**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
3	**15**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**1**	**Cement**
1	**3**	**Bentonite 5 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**18**	**tan and brown sandy, silty clay and occasional gravel**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**5**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**5**	**15**

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #508717

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**SB-11 deep (MW)**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-36-6**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 26' 41" N**
		Longitude:	**094° 30' 11" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **3/7/2019** Drilling End Date: **3/8/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
6.75	**0**	**43**

Drilling Method: **Mud (Hydraulic) Rotary**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
30	**43**	**Sand**	**16/30**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**10**	**Cement**
10	**30**	**Bentonite 5 Bags/Sacks**

Seal Method: **Gravity**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Sleeve Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **Yes**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **Mhc x-ploration corp**

P.O. Box 7405
Tyler, TX 75711

Driller Name: **James K. Collum** License Number: **3184**

Apprentice Name: **Jason Smith** Apprentice Number: **60448**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**18**	**tan and brown sandy, silty clay and occasional gravel**
18	**43**	**red and grey sand w/occ. clay layers**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**33**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**33**	**43**

IMPORTANT NOTICE FOR PERSONS HAVING WELLS DRILLED CONCERNING CONFIDENTIALITY

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #525309

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**B-2**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 54.7" N**
		Longitude:	**094° 28' 25.01" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **5/13/2019** Drilling End Date: **5/17/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8.25	**0**	**49**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
36	**49**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**32**	**Concrete 1 Bags/Sacks**
32	**36**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **Ali Firouzbakht** License Number: **4997**

Apprentice Name: **Ramon Gutierrez** Apprentice Number: **56591**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**0.5**	**SILTY SAND, black**
0.5	**2**	**SAND, red/brown**
2	**5**	**SANDY CLAY, alternating layers red + brown**
5	**5.5**	**NO RECOVERY**
5.5	**6.7**	**SANDY CLAY, gray + brown/red**
6.7	**8**	**CLAY, gray**
8	**11**	**CLAY, gray with brown striations**
11	**11.5**	**CLAY, gray**
11.5	**12**	**CLAYEY, gray SAND, red-brown**
12	**14**	**NO RECOVERY**
14	**14.75**	**SANDY CLAY, reddish brown + gray**
14.75	**16**	**CLAY, gray + red & trace brown fine grained SAND**
16	**18.5**	**NO RECOVERY**
18.5	**18.75**	**CLAY, red & gray, trace SILT**
18.75	**18.95**	**SAND, tan**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**38**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**38**	**48**
2	**SUMP**	**New Plastic (PVC)**	**40**	**48**	**48.5**

18.95	20	CLAY, red/drk. gray
20	21.1	NO RECOVERY
21.1	21.8	SANDY CLAY, lt. brown + red
21.8	24	CLAY, red + drk. gray
24	24.5	SANDY CLAY, lt. brown
24.5	24.8	SANDY CLAY, red-brown
24.8	28	CLAY, purple + gray
28	29.9	CLAY, drk. purple
29.9	30.7	CLAY, black/drk. gray
30.7	32	SILTY CLAY, black/drk. gray
32	33.5	SILTY CLAY, drk. gray
33.5	36	SILTY CLAY, black
36	36.5	NO RECOVERY
36.5	38.1	SAND, drk. green
38.1	38.3	SILTY SAND, drk. brown
38.3	38.4	CLAYEY SAND, very drk. brown
38.4	38.5	SILTY SAND, drk. green
38.5	39	SILTY SAND, drk. brown
39	39.2	Laminated SANDY CLAY/CLAYEY SANDS, gray to drk. gray
39.2	43.1	NO RECOVERY
43.1	44.5	Fine graded SAND w/trace SILT, greenish gray
44.5	47	CLAYEY SAND/SANDY CLAY, drk. brown
47	48.1	NO RECOVERY
48.1	49	CLAYEY SAND/SANDY CLAY, drk. brown

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #525308

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**B-3**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 54.7" N**
		Longitude:	**094° 28' 25.01" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **5/15/2019** Drilling End Date: **5/15/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
8	**0**	**35**

Drilling Method: **Hollow Stem Auger**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
26.9	**35**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**22**	**Concrete 1 Bags/Sacks**
22	**26.9**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **Ali Firouzbakht** License Number: **4997**

Apprentice Name: **Ramon Gutierrez** Apprentice Number: **56591**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**2**	**CLAY, medium red-brown**
2	**3**	**CLAY, lt. brown**
3	**4**	**Organic CLAY, gray to lt. brown**
4	**4.5**	**Organic CLAY, lt. brown**
4.5	**5**	**Organic CLAY, lt. brown to reddish brown**
5	**9.5**	**Organic CLAY, lt. brown to reddish brown**
9.5	**10.5**	**SILTY CLAY, reddish-orange**
10.5	**11**	**Poorly graded gravel**
11	**13**	**CLAYEY SAND,**
13	**13.9**	**SANDY CLAY, brown to orange**
13.9	**15**	**SAND, orange**
15	**16**	**SANDY CLAY**
16	**18**	**SAND, orange**
18	**18.5**	**Fat CLAY, grayish purple**
18.5	**19.5**	**SAND, orange to grayish orange**

Casing:
BLANK PIPE & WELL SCREEN DATA

Dia (in.)	Type	Material	Sch./Gage	Top (ft.)	Bottom (ft.)
2	**Riser**	**New Plastic (PVC)**	**40**	**0**	**29.2**
2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**29.2**	**34**
2	**SUMP**	**New Plastic (PVC)**	**40 0.010**	**34**	**34.5**

19.5	20	Fat CLAY, grayish purple
20	22.1	SAND, lt. brown to orange
22.1	22.3	Lenes of fat CLAY, drk. gray to purple
22.3	22.6	SAND, lt. brown to orange
22.6	23	Gravelly SAND
23	24	SANDY CLAY, grayish purple
24	25.6	SAND, tan to lt. brown
25.6	26.4	CLAY, purple and gray
26.4	26.8	CLAYEY SAND, tan to lt. brown
26.8	27.3	CLAY, purple
27.3	28	CLAY, drk. gray
28	28.6	NO RECOVERY
28.6	29.2	SAND, lt. brown
29.2	29.5	SILTY CLAY, drk. gray
29.5	32	CLAY, drk. gray to black
32	32.7	CLAY, drk. gray
32.7	33.1	CLAYEY SILT, drk. gray
33.1	35	SAND, drk. gray

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Texas Department of Licensing and Regulation
P.O. Box 12157
Austin, TX 78711
(512) 334-5540

STATE OF TEXAS WELL REPORT for Tracking #525304

Owner:	**AEP Pirkey Power Plant**	Owner Well #:	**B-6**
Address:	**2400 FM 3251 Hallsville, TX 75650**	Grid #:	**35-37-1**
Well Location:	**2400 FM 3251 Hallsville, TX 75650**	Latitude:	**32° 27' 54.7" N**
		Longitude:	**094° 28' 25.01" W**
Well County:	**Harrison**	Elevation:	**No Data**
Type of Work:	**New Well**	Proposed Use:	**Monitor**

Drilling Start Date: **5/20/2019** Drilling End Date: **5/20/2019**

Borehole:

Diameter (in.)	*Top Depth (ft.)*	*Bottom Depth (ft.)*
4	**0**	**40**

Drilling Method: **Direct Push**

Borehole Completion: **Filter Packed**

Filter Pack Intervals:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Filter Material*	*Size*
27	**40**	**Sand**	**20/40**

Annular Seal Data:

Top Depth (ft.)	*Bottom Depth (ft.)*	*Description (number of sacks & material)*
0	**25**	**Concrete 1 Bags/Sacks**
25	**27**	**Bentonite 1 Bags/Sacks**

Seal Method: **Tremie**

Sealed By: **Driller**

Distance to Property Line (ft.): **No Data**

Distance to Septic Field or other concentrated contamination (ft.): **No Data**

Distance to Septic Tank (ft.): **No Data**

Method of Verification: **No Data**

Surface Completion: **Surface Slab Installed** **Surface Completion by Driller**

Water Level: **No Data**

Packers: **No Data**

Type of Pump: **No Data**

Well Tests: **No Test Data Specified**

Water Quality:

Strata Depth (ft.)	Water Type
No Data	**No Data**

Chemical Analysis Made: **No**

Did the driller knowingly penetrate any strata which contained injurious constituents?: **No**

Certification Data: The driller certified that the driller drilled this well (or the well was drilled under the driller's direct supervision) and that each and all of the statements herein are true and correct. The driller understood that failure to complete the required items will result in the report(s) being returned for completion and resubmittal.

Company Information: **BEST DRILLING SERVICES, INC.**

P.O. BOX 845
FRIENDSWOOD, TX 77549

Driller Name: **Ali Firouzbakht** License Number: **4997**

Apprentice Name: **Ramon Gutierrez** Apprentice Number: **56591**

Comments: **No Data**

Lithology:
DESCRIPTION & COLOR OF FORMATION MATERIAL

Top (ft.)	Bottom (ft.)	Description
0	**0.4**	**Topsoil with vegetation, black SILT**
0.4	**1.8**	**SILT, brown**
1.8	**7**	**SILTY CLAY, red & lt. gray**
2.3	**23.5**	**SILT, drk. red**
7	**7.2**	**SILT, brown**
7.2	**7.6**	**SILTY CLAY, red & lt. gray**
7.6	**8**	**CLAY, lt. gray**
8	**9**	**CLAY, lt. gray & lt. red**
9	**9.3**	**SILTY CLAY, lt. gray & brown**
9.3	**9.8**	**CLAY, lt. gray**
9.8	**12**	**CLAY, reddish-brown**
12	**12.8**	**SILTY CLAY, red & brown**
12.8	**16**	**SILTY CLAY, drk. brown**
16	**18.1**	**CLAY, red & brown**
18.1	**18.8**	**SILTY CLAY, brown**
18.8	**18.9**	**CLAY, brown**
18.9	**19.1**	**SILT, lt. gray & brown**

Casing:
BLANK PIPE & WELL SCREEN DATA

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2	**Screen**	**New Plastic (PVC)**	**40 0.010**	**29**	**39**
2	**SUMP**	**New Plastic (PVC)**	**40**	**39**	**39.5**

19.1	19.4	SILTY CLAY, brown
19.4	20	CLAYEY SILT, lt. gray & brown
20	20.9	CLAY, red/brown
20.9	22.1	CLAYEY SILT, lt. brown
22.1	23.2	SILTY CLAY, lt. brown & gray
23.5	24	SILTY CLAY, lt. brown & gray
24	25.9	NO RECOVERY
25.9	26.1	CLAYEY SILT, lt. brown
26.1	26.3	SILTY CLAY, brown
26.3	28	SILTY CLAY, black & drk. green
28	28.7	Trace CLAY, brown SILT
28.7	29.6	SILTY CLAY, drk. brown & green
29.6	29.9	CLAY, drk. brown
29.9	30.3	CLAYEY SAND, drk. green & drk. brown
30.3	32	Fine grained SAND, drk. green
32	34.4	Fine grained SAND, gray & brown
34.4	34.5	SILT w/gravel, tan/brown
34.5	34.7	CLAY, drk. brown
34.7	35.1	Fine grained SAND, drk. green
35.1	36	Fine grained SANDY SILT, drk. green & black
36	37.4	Fine grained SAND, drk. brown
37.4	38.5	Fine grained SILTY SAND, drk. gray & drk. green
38.5	40	SANDY SILT, drk. green & black

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