

# **Annual Groundwater Monitoring Report**

Appalachian Power Company  
John E. Amos Plant  
Landfill CCR Management Unit  
Winfield, West Virginia

**January 2020**

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## **Table of Contents**

	<b><u>Page</u></b>
I. Overview.....	1
II. Groundwater Monitoring Well Locations and Identification Numbers.....	3
III. Monitoring Wells Installed or Decommissioned.....	5
IV. Groundwater Quality Data and Static Water Elevation Data, With Flow Rate and Direction Calculations and Discussion.....	5
V. Groundwater Quality Data Statistical Analysis.....	5
VI. Alternative Source Demonstration.....	6
VII. Discussion About Transition Between Monitoring Requirements or Alternate Monitoring Frequency.....	6
VIII. Other Information Required.....	6
IX. Description of Any Problems Encountered in 2019 and Actions Taken.....	6
X. A Projection of Key Activities for the Upcoming Year.....	6

**Appendix 1** – GW Quality Data, GW Flow Directions, GW Flow Rates

**Appendix 2** – GW Quality Data Statistical Analysis

**Appendix 3** – Alternative Source Demonstrations

**Appendix 4** – Notices of Monitoring Program Transitions

**Appendix 5** – Well Installation/Decommissioning Logs

## I. Overview

This *Annual Groundwater Monitoring* (Report) has been prepared to report the status of activities for the preceding year for an existing Landfill CCR unit at Appalachian Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), John E. Amos Power Plant. The USEPA's CCR rules require that the Annual Groundwater Monitoring Report be posted to the operating record for the preceding year no later than January 31.

In general, the following activities were completed:

- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units.
- Statistical analyses of the November 2018 and June 2019 detection monitoring samples were completed in 2019. The statistical analysis determined that Appendix III SSIs were observed.
- As required by the CCR detection monitoring rules, semi-annual groundwater sampling events to include the Appendix III parameters were performed in June and November 2019 in accordance with 40 CFR §§257.94. Based on the results, verification sampling events were completed for respective potential SSIs. The verification sampling, analytical analysis, and statistical analysis for the November 2018 event was completed in 2019. This resulted in confirmed SSIs and an ASD was successfully completed. SSIs were confirmed for the June 2019 sampling event. Laboratory analytical is on-going for the November 2019 event. An alternative source demonstration was undertaken and completed related to the SSI confirmed for the June 2019 detection monitoring event in accordance with 40 CFR §257.94(e)(2). The demonstrations to date have been successful and are discussed below. If potential SSIs are observed from the November 2019 detection sampling, verification samples will be obtained and statistical analysis completed. If an SSI is confirmed, an ASD will be attempted and completed to determine if the SSI is valid.
- Two additional downgradient groundwater monitoring wells were installed at the CCR Unit in 2018 and were discussed in last year's annual report. These monitoring wells are discussed below. The boring logs and well construction forms are included in this report.

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

- A map/aerial photograph showing the Amos Landfill CCR management unit, all groundwater monitoring wells, and monitoring well identification numbers.
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened (**Appendix 5**).

- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (**Appendix 1**).
- Results of the required statistical analysis of groundwater monitoring results (**Appendix 2**).
- Discussion of the successful alternative source demonstrations (**Appendix 3**).
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations, if applicable (**Appendix 4**).
- Other information required to be included in the annual report such as assessment of corrective measures, if applicable.


In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.

## **II. Groundwater Monitoring Well Locations and Identification Numbers**

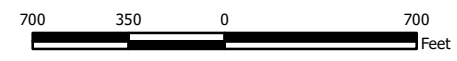
Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification numbers. The monitoring well distribution adequately covers downgradient and upgradient areas as detailed in the *Groundwater Monitoring Network Evaluation Report* that was placed in the American Electric Power CCR public internet site on March 9, 2017. The groundwater quality monitoring network includes the following:

- Five upgradient wells: MW-6, MW-7R, MW-8, MW-9, and MW-10; and
- Four downgradient wells: MW-1, MW-2, MW-4, and MW-5.



- Legend**
-  Upgradient Sampling Location
  -  Downgradient Sampling Location
  -  FGD Landfill

**Notes**  
 - Monitoring well coordinates provided by AEP.



**Site Layout  
 FGD Landfill**

AEP Amos Generating Plant  
 Winfield, West Virginia



Columbus, Ohio

2018/01/26

Figure

**1**

### **III. Monitoring Wells Installed or Decommissioned**

There were two monitoring wells installed in 2018 at the Amos Plant Landfill. MW-1801 was installed downgradient of the south valley portion of the landfill. MW-1802 was installed downgradient of the north valley portion of the landfill. These wells were installed in late 2018 and are currently being evaluated for use in the CCR groundwater monitoring network as downgradient groundwater sampling and/or static water level gauging locations. Boring logs and monitoring well construction forms are included in **Appendix 5**.

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

**Appendix 1** contains tables showing the groundwater quality data collected since initiating CCR background sampling through results received in 2019 as part of the detection monitoring program. Static water elevation data from each monitoring event in 2019 are also shown in **Appendix 1**, along with the groundwater velocity calculations, groundwater flow direction, and potentiometric maps developed after each sampling event.

### **V. Groundwater Quality Data Statistical Analysis**

Statistical analysis of the November 2018 detection monitoring samples was completed in March 2019. Statistically significant increases (SSIs) in the Appendix III parameters of boron and chloride were documented in the March 6, 2019 *Evaluation of Detection Monitoring Data at Amos Plant's Landfill* memorandum (**Appendix 2**). An alternative source demonstration was undertaken for these parameters and was successful. That demonstration is discussed in the next section of this report.

Statistical analysis of the detection monitoring samples taken in June 2019 was completed in August 2019. Statistically significant increase (SSI) in the Appendix III parameter of chloride was documented in the statistical analysis memo included in **Appendix 2**. An alternative source demonstration was undertaken for this parameter and was successful. That demonstration is discussed in the next section of this report.

Statistical analysis of the detection monitoring samples taken in November 2019 will be completed in 2020. If SSIs are confirmed, an alternative source demonstration will be performed in accordance with 40 CFR §257.94(e)(2).

## **VI. Alternative Source Demonstration**

An alternative source demonstration (ASD) relative to the Appendix III SSIs resulting from the November 2018 detection monitoring event of the federal CCR Rule was performed and completed in March 2019. The demonstration concluded that the groundwater quality and Appendix III indicator parameter SSIs identified in the statistical evaluation are attributable to an alternative source. The successful ASD for Appendix III parameters is attached in **Appendix 3**.

An alternative source demonstration (ASD) relative to the Appendix III SSI resulting from the June 2019 detection monitoring event of the federal CCR Rule was performed and completed in October 2019. The demonstration concluded that the groundwater quality and Appendix III indicator parameter SSI identified in the statistical evaluation is attributable to an alternative source. The successful ASD for the Appendix III parameter is attached in **Appendix 3**.

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

As of this annual report date there has been no transition between detection monitoring and assessment monitoring. Detection monitoring will continue in 2020 pending the results of the aforementioned statistical analysis regarding the November 2019 groundwater sampling event. If the statistical analysis confirms any SSIs, an ASD will be performed if applicable. The sampling frequency of twice per year will be maintained for the Appendix III parameters upon a successful alternative source demonstration. If necessary, a transition to the assessment monitoring program will occur.

Regarding defining an alternate monitoring frequency, the groundwater velocity and monitoring well production are high enough at this facility that no modification to the semiannual assessment monitoring frequency is needed.

## **VIII. Other Information Required**

All required information has been included in this annual groundwater monitoring report.

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

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support the 2019 annual groundwater report preparation covering the year 2019 groundwater monitoring activities.

## **X. A Projection of Key Activities for the Upcoming Year**

Key activities for 2020 include:



- Complete the statistical evaluation of the November 2019 detection monitoring results and subsequent verification sampling, looking for any statistically significant increases, or decreases when pH is considered.
- Continue detection monitoring on a semi-annual basis.
- Continue evaluation of the new groundwater monitoring wells installed downgradient of the CCR unit for inclusion in the CCR groundwater monitoring network.
- Respond to any new data received in light of what the CCR rule requires.
- Preparation of the 2020 annual groundwater report.

## **APPENDIX 1**

Tables follow, showing the groundwater monitoring data collected and received in 2019 or prior, the rate and direction of groundwater flow, and a summary showing the number of samples collected per monitoring well. The dates that the samples were collected also is shown.

**Table 1 - Groundwater Data Summary: MW-1  
Amos - LF  
Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.044	31.1	3.45	0.09 J	6.2	182	30.6
10/18/2016	Background	0.060	29.0	3.31	0.09	6.5	232	30.8
11/9/2016	Background	0.076	29.9	3.42	0.10	6.5	194	31.3
12/13/2016	Background	0.065	29.3	3.08	0.07 J	6.1	250	27.7
2/9/2017	Background	0.050	26.8	3.16	0.09	6.3	234	27.9
3/16/2017	Background	0.046	28.4	3.32	0.09	7.5	216	29.4
5/23/2017	Background	0.123	30.2	3.19	0.09	6.6	215	28.5
6/21/2017	Background	0.037	28.1	4.94	0.08	6.4	204	31.9
11/1/2017	Detection	0.047	28.7	3.08	0.10	6.4	224	30.2
5/2/2018	Detection	0.134	27.2	3.22	0.10	6.5	194	29.9
11/29/2018	Detection	0.143	26.4	3.07	0.11	6.7	191	27.8
12/18/2018	Detection	0.07 J	--	--	--	6.5	--	--
6/11/2019	Detection	0.04 J	28.1	2.86	0.11	7.0	184	29.9

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-1**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.04 J	0.27	207	0.024	0.02 J	0.3	0.097	0.0848	0.09 J	0.186	0.017	<0.002 U	0.04 J	0.9	0.01 J
10/18/2016	Background	0.04 J	0.62	206	0.050	0.03	0.627	0.306	1.24	0.09	0.567	0.017	0.002 J	0.08 J	1.4	0.05 J
11/9/2016	Background	0.04 J	0.44	210	0.036	0.03	0.564	0.200	1.001	0.100	0.450	0.020	<0.002 U	0.14	1.3	0.088
12/13/2016	Background	0.05 J	1.09	232	0.100	0.01 J	2.16	0.613	0.6701	0.07 J	1.45	0.027	<0.002 U	0.11	1.7	0.02 J
2/9/2017	Background	0.03 J	0.37	184	0.026	0.02 J	0.401	0.174	0.836	0.09	0.340	0.015	<0.002 U	0.21	1.6	0.02 J
3/16/2017	Background	0.06	0.67	200	0.057	0.06	0.993	0.393	0.730	0.09	1.03	0.012	0.003 J	0.10	1.1	0.02 J
5/23/2017	Background	0.08	0.40	211	0.032	0.05	0.555	0.292	3.243	0.09	0.697	0.026	<0.002 U	0.11	1.1	0.01 J
6/21/2017	Background	0.07	0.43	200	0.031	0.06	0.547	0.289	1.379	0.08	0.753	0.013	<0.002 U	0.10	1.2	0.02 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

**Table 1 - Groundwater Data Summary: MW-2  
Amos - LF  
Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.201	1.99	4.00	1.34	8.7	362	12.0
10/17/2016	Background	0.198	1.53	4.21	1.26	9.1	354	11.8
11/8/2016	Background	0.216	1.46	4.13	1.3	8.2	378	11.3
12/13/2016	Background	0.217	1.65	2.99	1.19	8.5	350	7.6
2/8/2017	Background	0.190	1.56	2.66	1.33	8.7	374	7.4
3/14/2017	Background	0.184	1.81	3.91	1.20	8.4	354	7.7
5/23/2017	Background	0.187	1.42	4.23	1.17	8.7	354	8.1
6/21/2017	Background	0.189	1.56	3.47	1.19	8.5	356	7.4
11/1/2017	Detection	0.202	1.88	2.34	1.46	8.8	394	8.6
1/8/2018	Detection	0.251	--	--	1.07	8.4	353	--
5/1/2018	Detection	0.241	3.50	3.90	1.45	8.5	344	9.4
6/19/2018	Detection	0.338	1.79	--	1.28	8.5	--	--
9/24/2018	Detection	0.215	--	--	--	--	--	--
11/28/2018	Detection	0.235	1.84	5.09	1.15	8.5	355	8.5
12/17/2018	Detection	0.285	--	--	--	8.6	--	--
1/24/2019	Detection	0.218	--	--	--	--	--	--
6/11/2019	Detection	0.215	1.80	3.26	1.63	8.7	379	9.4
7/22/2019	Detection	--	--	--	1.41	8.7	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-2**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.03 J	6.57	51.8	0.129	0.14	1.3	1.02	0.904	1.34	1.24	0.009	<0.002 U	6.04	0.2 J	0.03 J
10/17/2016	Background	0.01 J	3.94	25.7	0.040	0.005 J	0.592	0.290	0.208	1.26	0.258	0.010	<0.002 U	3.70	0.09 J	0.067
11/8/2016	Background	0.01 J	3.54	23.7	0.02 J	<0.004 U	0.295	0.107	0.8825	1.3	0.077	0.008	<0.002 U	3.84	0.05 J	<0.01 U
12/13/2016	Background	0.01 J	4.36	27.1	0.009 J	<0.004 U	0.952	0.075	0.288	1.19	0.068	0.011	<0.002 U	6.11	0.05 J	<0.01 U
2/8/2017	Background	<0.01 U	4.09	25.5	0.032	0.005 J	0.571	0.287	1.109	1.33	0.279	0.009	<0.002 U	5.55	0.1	0.02 J
3/14/2017	Background	0.02 J	3.72	31.9	0.071	0.02	1.01	0.573	2.863	1.20	0.651	0.010	0.002 J	3.46	0.2	0.02 J
5/23/2017	Background	0.03 J	3.59	27.2	0.043	0.009 J	0.605	0.341	0.796	1.17	0.333	0.010	<0.002 U	3.70	0.1	<0.01 U
6/21/2017	Background	0.03 J	3.80	27.7	0.028	0.01 J	0.490	0.234	1.1188	1.19	0.229	0.004	0.003 J	4.57	0.08 J	0.03 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

**Table 1 - Groundwater Data Summary: MW-4  
Amos - LF  
Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.173	0.914	14.1	1.49	9.9	368	10.7
10/18/2016	Background	0.165	0.807	13.9	1.33	9.8	386	11.7
11/7/2016	Background	0.203	0.842	14.6	1.44	9.5	376	11.1
12/13/2016	Background	0.180	0.836	15.7	1.34	9.0	372	8.0
2/8/2017	Background	0.17	0.807	14.9	1.4	9.3	412	8.0
3/14/2017	Background	0.173	0.855	14.5	1.46	8.8	381	7.4
5/23/2017	Background	0.190	0.750	15.3	1.38	9.2	390	7.9
6/20/2017	Background	0.161	0.814	15.1	1.36	9.1	392	7.6
11/1/2017	Detection	0.194	0.766	14.2	1.36	9.4	404	9.3
1/8/2018	Detection	0.145	--	--	1.37	3.3	--	--
5/1/2018	Detection	0.199	0.783	14.9	1.47	9.2	380	9.0
11/28/2018	Detection	0.188	0.807	14.1	1.42	8.8	383	8.8
6/12/2019	Detection	0.167	0.788	14.4	1.46	8.6	415	9.0

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-4**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.01 J	9.61	24.1	0.020	0.11	0.9	0.158	0.444	1.49	0.371	0.008	<0.002 U	8.82	0.09 J	<0.01 U
10/18/2016	Background	<0.01 U	8.81	20.2	<0.005 U	0.006 J	0.064	0.014	0.152	1.33	0.021	0.002	<0.002 U	8.01	<0.03 U	0.03 J
11/7/2016	Background	<0.01 U	9.07	21.5	<0.005 U	<0.004 U	1.68	0.029	1.56	1.44	0.007 J	0.003	<0.002 U	8.14	<0.03 U	<0.01 U
12/13/2016	Background	<0.01 U	9.44	22.4	<0.005 U	<0.004 U	0.169	0.011	0.16	1.34	0.009 J	0.007	<0.002 U	8.94	<0.03 U	0.02 J
2/8/2017	Background	<0.01 U	8.78	19.2	0.006 J	<0.004 U	0.122	0.043	0.567	1.4	0.064	0.006	<0.002 U	8.15	<0.03 U	0.03 J
3/14/2017	Background	<0.01 U	10.1	20.4	0.005 J	0.005 J	0.523	0.041	1.456	1.46	0.114	0.006	<0.002 U	9.7	<0.03 U	<0.01 U
5/23/2017	Background	0.02 J	8.96	21.1	<0.004 U	<0.005 U	0.104	0.008 J	0.872	1.38	0.01 J	0.012	<0.002 U	8.21	<0.03 U	<0.01 U
6/20/2017	Background	0.02 J	9.15	21.8	0.004 J	0.005 J	0.157	0.037	0.905	1.36	0.039	0.005	<0.002 U	7.86	0.05 J	<0.01 U

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter



**Table 1 - Groundwater Data Summary: MW-5**  
**Amos - LF**  
**Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/23/2016	Background	0.032	18.4	3.59	0.14	9.9	124	29.3
10/18/2016	Background	0.034	15.6	3.61	0.12	6.4	148	29.3
11/8/2016	Background	0.034	14.3	3.52	0.11	6.3	92	25.5
12/13/2016	Background	0.015	14.6	3.61	0.07	8.2	100	24.3
2/8/2017	Background	0.030	14.1	3.54	0.09	6.4	126	24.0
3/16/2017	Background	0.026	15.9	3.72	0.09	7.0	158	24.9
5/23/2017	Background	0.032	13.7	3.7	0.09	6.3	108	24.2
6/20/2017	Background	0.017	14.5	3.66	0.08	6.0	102	27.8
11/1/2017	Detection	0.046	15.6	4.09	0.09	6.1	136	28.4
1/8/2018	Detection	--	--	4.22	--	6.7	--	--
5/2/2018	Detection	0.123	14.3	4.39	0.09	6.2	122	26.3
6/20/2018	Detection	0.126	--	4.61	--	6.1	--	--
11/28/2018	Detection	--	--	--	--	7.4	--	--
11/29/2018	Detection	<0.02 U	14.1	4.86	0.13	--	113	24.5
12/17/2018	Detection	--	--	4.77	--	6.2	--	--
6/12/2019	Detection	0.02 J	16.2	4.60	0.11	6.1	132	26.4
7/22/2019	Detection	--	--	4.61	--	6.0	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-5**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/23/2016	Background	0.04 J	0.47	93.3	0.02 J	0.07	0.3	0.188	1.025	0.14	0.263	0.006	<0.002 U	0.17	0.1	0.01 J
10/18/2016	Background	0.04 J	0.34	82.5	0.02 J	0.02	0.546	0.198	0.353	0.12	0.250	0.005	<0.002 U	0.16	0.2	0.03 J
11/8/2016	Background	0.04 J	0.49	80.1	0.050	0.05	0.945	0.446	1.847	0.11	0.698	<0.0002 U	<0.002 U	0.14	0.1	0.01 J
12/13/2016	Background	0.04 J	0.51	80.9	0.033	0.03	0.622	0.339	1.18	0.07	0.442	0.010	<0.002 U	0.18	0.2	0.07
2/8/2017	Background	0.02 J	0.30	70.2	0.022	0.02 J	0.465	0.217	0.5868	0.09	0.257	0.005	<0.002 U	0.14	0.1	0.02 J
3/16/2017	Background	0.09	2.32	121	0.183	0.21	4.43	2.92	1.096	0.09	3.77	0.002	0.008	0.40	0.9	0.04 J
5/23/2017	Background	0.06	0.21	77.7	0.01 J	0.02	0.248	0.072	1.312	0.09	0.093	0.011	<0.002 U	0.14	0.09 J	<0.01 U
6/20/2017	Background	0.02 J	0.25	80.6	0.01 J	0.03	0.291	0.092	1.141	0.08	0.097	<0.0002 U	<0.002 U	0.09 J	0.09 J	<0.01 U

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

**Table 1 - Groundwater Data Summary: MW-6  
Amos - LF  
Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.095	40.7	7.78	0.26	7.6	408	41.3
10/19/2016	Background	0.093	39.8	7.67	0.23	7.9	438	51.1
11/7/2016	Background	0.147	42.7	7.76	0.25	7.7	426	51.6
12/12/2016	Background	0.109	44.4	8.17	0.20	7.5	414	54.0
2/7/2017	Background	0.122	36.7	7.2	0.23	7.5	380	31.1
3/16/2017	Background	0.098	37.1	7.09	0.24	7.9	388	29.1
5/22/2017	Background	0.171	33.7	6.89	0.23	7.7	359	24.7
6/19/2017	Background	0.154	37.2	7.01	0.21	7.4	386	33.1
11/2/2017	Detection	0.159	41.3	7.77	0.22	7.5	440	51.8
5/1/2018	Detection	0.163	33.4	6.94	0.26	7.4	358	24.7
11/28/2018	Detection	0.156	35.8	6.85	0.24	7.6	333	22.9
6/12/2019	Detection	0.08 J	32.8	6.85	0.28	7.7	363	21.9

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-6**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.04 J	6.03	245	0.036	0.03	0.5	0.183	2.318	0.26	0.461	0.015	<0.002 U	0.77	0.09 J	0.138
10/19/2016	Background	0.02 J	6.42	235	0.033	0.005 J	0.413	0.148	0.697	0.23	0.381	0.015	<0.002 U	0.36	0.09 J	0.02 J
11/7/2016	Background	0.01 J	6.64	250	0.009 J	<0.004 U	0.160	0.023	2.70	0.25	0.053	0.011	<0.002 U	0.36	<0.03 U	<0.01 U
12/12/2016	Background	0.01 J	7.36	246	0.006 J	0.01 J	0.104	0.020	1.878	0.20	0.039	0.023	<0.002 U	0.39	0.04 J	0.03 J
2/7/2017	Background	<0.01 U	5.47	199	0.02 J	<0.004 U	0.207	0.073	1.151	0.23	0.160	0.013	<0.002 U	0.44	0.05 J	0.01 J
3/16/2017	Background	0.03 J	4.44	224	<0.005 U	0.005 J	0.498	0.028	1.844	0.24	0.048	0.009	0.003 J	0.53	0.03 J	<0.01 U
5/22/2017	Background	0.04 J	4.58	218	0.02 J	0.009 J	0.175	0.063	2.40	0.23	0.117	0.019	<0.002 U	0.50	0.04 J	0.01 J
6/19/2017	Background	0.03 J	4.86	233	0.01 J	<0.005 U	0.274	0.051	1.617	0.21	0.136	0.011	<0.002 U	0.44	0.04 J	<0.01 U

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

**Table 1 - Groundwater Data Summary: MW-7R**  
**Amos - LF**  
**Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.106	31.0	4.13	0.36	7.7	678	228
10/18/2016	Background	0.083	30.9	3.86	0.32	8.0	706	229
11/8/2016	Background	0.102	33.5	3.78	0.31	7.0	618	209
12/14/2016	Background	0.084	32.2	3.94	0.26	7.6	606	217
2/9/2017	Background	0.071	37.7	3.45	0.22	7.6	542	186
3/14/2017	Background	0.078	33.6	3.79	0.30	7.7	640	215
5/24/2017	Background	0.072	30.4	3.80	0.29	7.6	663	226
6/21/2017	Background	0.092	32.5	3.60	0.26	7.6	680	246
11/2/2017	Detection	0.109	31.7	3.59	0.28	7.6	636	211
5/1/2018	Detection	0.145	30.3	4.09	0.36	7.7	688	239
11/28/2018	Detection	0.118	44.4	3.65	0.26	7.4	627	201
6/12/2019	Detection	0.1 J	36.8	3.75	0.35	7.4	700	226

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-7R**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.11	8.37	60.8	0.155	0.04	1.0	0.368	1.043	0.36	1.52	0.016	0.004 J	25.7	0.4	0.061
10/18/2016	Background	0.07	7.13	51.4	0.111	0.01 J	0.760	0.279	0.959	0.32	0.961	0.012	0.002 J	23.2	0.3	0.03 J
11/8/2016	Background	0.08	5.81	42.2	0.026	0.02	2.82	0.084	1.895	0.31	0.261	0.013	<0.002 U	17.5	0.2	0.01 J
12/14/2016	Background	0.09	7.33	44.3	0.028	0.01 J	1.73	0.103	0.962	0.26	0.249	0.014	<0.002 U	24.6	0.2	0.02 J
2/9/2017	Background	0.05	4.21	41.7	0.01 J	0.01 J	0.217	0.065	0.0996	0.22	0.156	0.012	<0.002 U	11.7	0.08 J	0.02 J
3/14/2017	Background	0.08	7.02	40.2	0.01 J	0.01 J	0.234	0.064	2.735	0.30	0.154	0.010	<0.002 U	24.6	0.1	0.02 J
5/24/2017	Background	0.10	7.48	42.0	0.01 J	0.01 J	0.242	0.080	0.3888	0.29	0.171	0.016	<0.002 U	25.7	0.2	0.01 J
6/21/2017	Background	0.08	6.69	39.1	0.006 J	0.006 J	0.154	0.043	1.497	0.26	0.064	0.010	<0.002 U	22.9	0.1	0.01 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

**Table 1 - Groundwater Data Summary: MW-8  
Amos - LF  
Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.021	141	13.3	0.16	7.0	578	73.6
10/19/2016	Background	0.037	135	12.6	0.15	7.2	538	66.5
11/9/2016	Background	0.029	137	5.12	0.07	6.9	532	26.1
12/14/2016	Background	0.017	136	14.2	0.13	6.8	504	59.7
2/8/2017	Background	0.092	132	12.9	0.15	6.9	540	67.5
3/15/2017	Background	0.074	151	13.5	0.16	7.2	623	74.5
5/24/2017	Background	0.031	137	13.9	0.14	6.8	596	73.2
6/20/2017	Background	0.034	139	12.6	0.13	6.9	574	77.2
11/2/2017	Detection	0.031	125	12.1	0.15	6.8	526	63.1
5/1/2018	Detection	0.065	136	13.1	0.17	6.9	592	78.8
11/29/2018	Detection	0.05 J	126	13.2	0.17	6.8	558	58.8
6/12/2019	Detection	0.03 J	125	8.58	0.20	7.6	540	54.5

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-8**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.04 J	0.41	221	0.021	0.04	0.4	0.27	0.776	0.16	0.393	0.013	<0.002 U	0.4	0.2	0.03 J
10/19/2016	Background	0.03 J	0.35	195	0.01 J	0.04	0.158	0.14	0.746	0.15	0.279	0.006	<0.002 U	0.07 J	0.2	0.02 J
11/9/2016	Background	0.02 J	0.25	209	0.008 J	<0.004 U	0.164	0.082	1.113	0.07	0.028	0.004	<0.002 U	0.08 J	0.2	0.02 J
12/14/2016	Background	0.03 J	0.32	212	0.008 J	0.008 J	0.097	0.083	1.582	0.13	0.062	0.013	<0.002 U	0.10	0.2	0.02 J
2/8/2017	Background	0.03 J	0.37	192	0.01 J	0.007 J	0.131	0.059	1.223	0.15	0.109	0.007	<0.002 U	0.47	0.1	0.136
3/15/2017	Background	0.05 J	1.44	270	0.069	0.02 J	2.39	1.02	3.405	0.16	1.43	0.011	0.003 J	0.28	0.4	0.02 J
5/24/2017	Background	0.07	0.47	201	0.02 J	0.009 J	0.354	0.201	1.257	0.14	0.260	0.016	<0.002 U	0.11	0.2	0.01 J
6/20/2017	Background	0.03 J	0.35	182	0.02 J	0.007 J	0.192	0.077	1.065	0.13	0.142	0.005	<0.002 U	0.07 J	0.3	0.02 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter



**Table 1 - Groundwater Data Summary: MW-9  
Amos - LF  
Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.064	80.1	6.3	0.24	7.3	414	37.3
10/19/2016	Background	0.042	103	6.09	0.18	7.5	444	36.4
11/9/2016	Background	0.076	90.6	6.11	0.22	7.2	420	34.5
12/13/2016	Background	0.057	94.4	6.59	0.18	7.1	390	35.1
2/8/2017	Background	0.052	99.0	6.22	0.16	7.1	382	34.9
3/15/2017	Background	0.093	99.1	6.26	0.22	7.4	402	35.8
5/23/2017	Background	0.084	86.4	6.21	0.18	7.1	438	34.8
6/20/2017	Background	0.079	93.8	6.17	0.15	7.0	424	38.4
11/2/2017	Detection	0.075	79.1	5.97	0.20	7.1	404	33.1
5/1/2018	Detection	0.200	73.1	6.14	0.26	7.2	402	30.9
11/29/2018	Detection	0.09 J	78.8	6.08	0.21	7.1	412	31.6
6/11/2019	Detection	0.04 J	97.6	6.03	0.20	7.3	436	37.9

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

Table 1 - Groundwater Data Summary: MW-9

Amos - LF

Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.07	1.45	443	0.025	0.03	0.8	0.464	1.831	0.24	0.565	0.017	<0.002 U	0.48	0.2	0.03 J
10/19/2016	Background	0.04 J	3.75	441	0.025	0.01 J	0.625	0.372	3.035	0.18	0.478	0.010	<0.002 U	0.27	0.1	0.03 J
11/9/2016	Background	0.05 J	1.12	491	<0.005 U	0.02 J	0.207	0.020	1.735	0.22	0.046	0.008	<0.002 U	0.41	0.1	0.03 J
12/13/2016	Background	0.04 J	1.23	497	<0.005 U	0.04	0.540	0.032	0.39	0.18	0.084	0.019	<0.002 U	0.56	0.2	<0.01 U
2/8/2017	Background	0.02 J	1.78	388	<0.005 U	0.03	0.078	0.033	1.448	0.16	0.058	0.012	<0.002 U	0.27	0.1	0.02 J
3/15/2017	Background	0.04 J	4.40	603	0.074	0.04	1.43	1.51	2.365	0.22	1.81	0.009	0.002 J	0.37	0.5	0.04 J
5/23/2017	Background	0.07	0.96	425	<0.004 U	0.02 J	0.117	0.021	2.173	0.18	0.063	0.021	<0.002 U	0.37	0.2	0.02 J
6/20/2017	Background	0.05 J	1.35	441	<0.004 U	0.03	0.094	0.066	1.992	0.15	0.038	0.014	<0.002 U	0.33	0.07 J	0.02 J

Notes:

µg/L: micrograms per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

- -: Not analyzed

pCi/L: picocuries per liter

**Table 1 - Groundwater Data Summary: MW-10**

**Amos - LF**

**Appendix III Constituents**

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Total Dissolved Solids	Sulfate
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.087	1.68	5.54	0.89	9.0	512	19.1
10/19/2016	Background	0.081	1.09	4.49	0.72	9.6	504	18.0
11/9/2016	Background	0.118	2.31	5.46	0.92	8.9	546	16.9
12/13/2016	Background	0.076	1.24	4.15	0.38	8.7	482	14.1
2/8/2017	Background	0.113	1.37	4.24	0.57	9.1	504	14.4
3/14/2017	Background	0.125	1.18	4.6	0.50	8.7	499	13.3
5/24/2017	Background	0.081	1.16	4.19	0.43	8.9	467	14.3
6/20/2017	Background	0.078	1.04	4.11	0.44	8.6	492	14.9
11/2/2017	Detection	0.095	1.12	5.08	0.55	9.2	508	17.0
5/2/2018	Detection	0.157	1.74	5.67	0.69	9.2	522	16.7
11/29/2018	Detection	0.174	1.03	5.27	0.59	8.7	506	15.3
6/11/2019	Detection	0.08 J	1.03	5.12	0.72	9.0	524	16.0

Notes:

mg/L: milligrams per liter

SU: standard unit

<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.

J: Estimated value. Parameter was detected at concentration below the reporting limit

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-10**

**Amos - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.36	24.5	105	0.058	0.26	0.5	0.367	0.769	0.89	1.11	0.010	0.003 J	3.08	0.5	0.01 J
10/19/2016	Background	0.26	19.4	62.4	0.02 J	0.01 J	0.373	0.102	0.0283	0.72	0.357	0.008	<0.002 U	2.58	0.4	0.082
11/9/2016	Background	0.38	21.5	144	0.264	0.05	3.96	1.66	0.168	0.92	3.41	0.007	0.004 J	2.53	1.1	0.057
12/13/2016	Background	0.63	17.1	69.8	0.029	0.20	1.63	0.212	0.0992	0.38	0.895	0.019	<0.002 U	2.79	0.7	<0.01 U
2/8/2017	Background	0.38	22.8	92.9	0.124	0.04	2.28	0.850	0.14643	0.57	1.89	0.008	0.003 J	2.76	1.9	0.071
3/14/2017	Background	0.32	21.2	69.0	0.039	0.01 J	0.965	0.28	2.089	0.50	0.635	0.01	0.003 J	3.38	2.3	0.02 J
5/24/2017	Background	0.23	9.07	55.6	0.022	0.02 J	0.500	0.151	1.06	0.43	0.469	0.011	<0.002 U	3.52	0.5	0.01 J
6/20/2017	Background	0.30	17.7	61.7	0.025	0.01 J	0.577	0.170	0.1376	0.44	0.448	0.004	<0.002 U	2.40	1.0	0.01 J

Notes:  
 µg/L: micrograms per liter  
 SU: standard unit  
 <: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.  
 J: Estimated value. Parameter was detected at concentration below the reporting limit  
 - -: Not analyzed  
 pCi/L: picocuries per liter

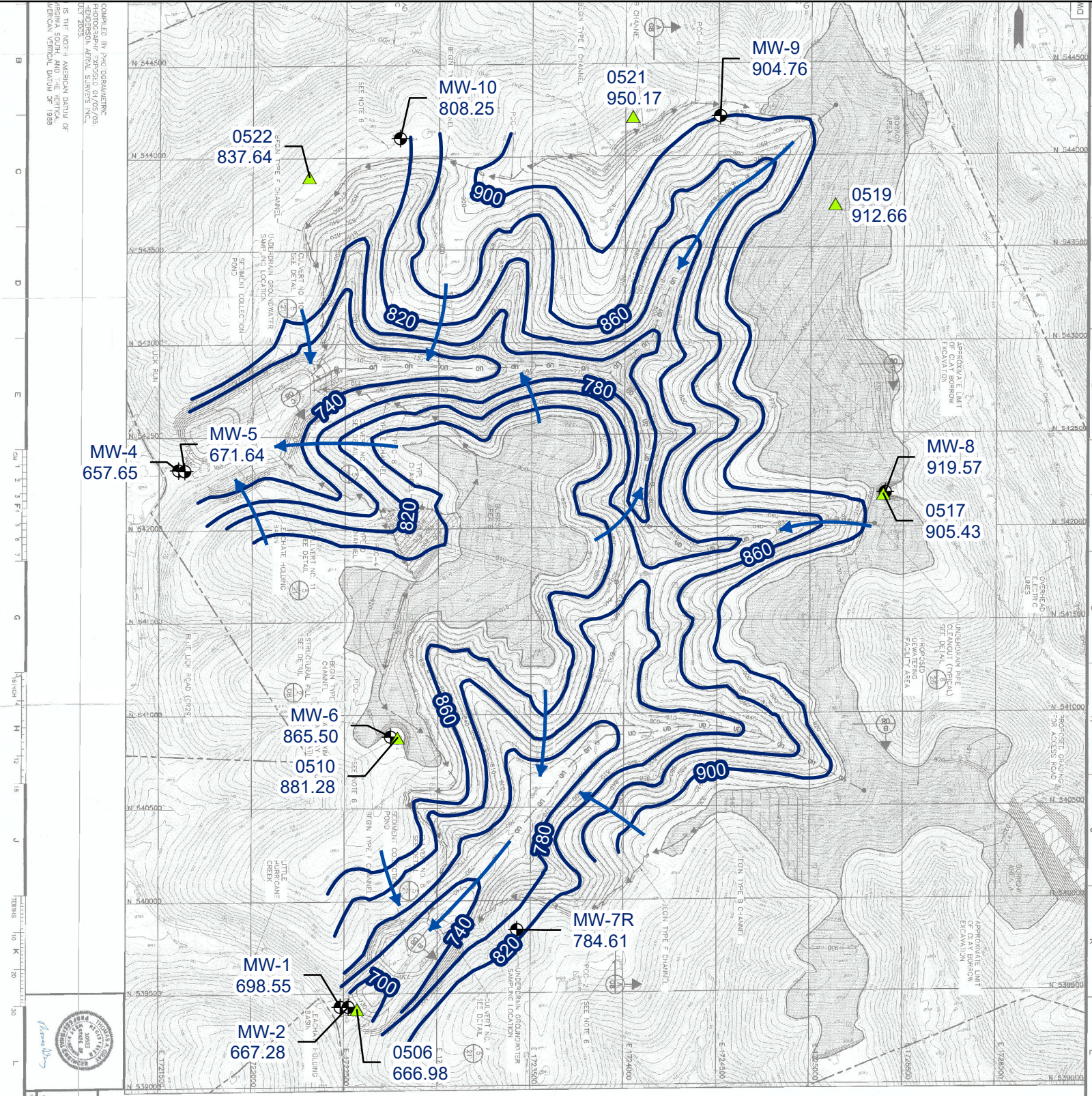
**Table 2: Residence Time Calculation Summary  
Amos Landfill**

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2019-06	
			Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW-1 <sup>[2]</sup>	2.0	3.1	19.3
	MW-2 <sup>[2]</sup>	2.0	0.6	94.3
	MW-4 <sup>[2]</sup>	2.0	1.8	33.5
	MW-5 <sup>[2]</sup>	2.0	1.8	33.5
	MW-6 <sup>[1]</sup>	2.0	1.9	31.3
	MW-7R <sup>[1]</sup>	2.0	0.8	72.3
	MW-8 <sup>[1]</sup>	2.0	2.3	26.2
	MW-9 <sup>[1]</sup>	2.0	3.4	18.2
	MW-10 <sup>[1]</sup>	2.0	1.1	56.7

Notes:

[1] - Background Well

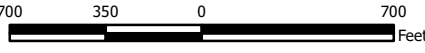
[2] - Downgradient Well



COMPILED BY PAUL DORRBAUMER, P.E.  
 GEOSYNTEC CONSULTANTS  
 10000 W. STATE ST., SUITE 200  
 COLUMBUS, OHIO 43240  
 IS THE NORTH AMERICAN DATUM OF 1983  
 UNLESS OTHERWISE NOTED.

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

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



**Potentiometric Surface Map - Uppermost Aquifer  
 June 2019**

AEP Amos Generating Plant  
 Winfield, West Virginia



Figure  
**1**

Columbus, Ohio      2020/01/29

## APPENDIX 2

The statistical analysis reports follow.

## Memorandum

Date: March 6, 2019

To: David Miller (AEP)

Copies to: Benjamin Kepchar (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at  
Amos Plant's Landfill

---

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Part D, "CCR rule"), detection monitoring events were completed on November 28-29, 2018 and December 17-18, 2018 at the Landfill (LF), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values based on the eight background monitoring events conducted prior to October 17, 2017. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 13, 2018 which resulted in a revision to the calculated prediction limits for boron and fluoride.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1 and noted exceedances are described in the list below.



Evaluation of Detection Monitoring Data – Amos LF

March 6, 2019

Page 2

- Boron concentrations exceeded the intrawell UPL of 0.231 mg/L in both the initial (0.235 mg/L) and second (0.285 mg/L) samples collected at MW-2. Therefore, an SSI over background is concluded for boron at MW-2.
- Chloride concentrations exceeded the intrawell UPL of 3.81 mg/L in both the initial (4.86 mg/L) and second (4.77 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for chloride at MW-5.

In response to the exceedances noted above the Amos LF CCR unit will either transition to assessment monitoring or an alternate source demonstration for boron and chloride will be conducted.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 259.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

**Table 1: Detection Monitoring Data Evaluation  
Amos Plant - Landfill**

*Geosyntec Consultants, Inc.*

Parameter	Units	Description	MW-1		MW-2		MW-4	MW-5	
			11/29/2018	12/18/2018	11/28/2018	12/17/2018	11/28/2018	11/29/2018	12/17/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.134		0.231		0.213	0.047	
		Detection Monitoring Result	<b>0.143</b>	0.070	<b>0.235</b>	<b>0.285</b>	0.188	0.02	-
Calcium	mg/L	Intrawell Background Value (UPL)	32.6		2.12		0.951	19.1	
		Detection Monitoring Result	26.4	-	1.84	-	0.807	14.1	-
Chloride	mg/L	Intrawell Background Value (UPL)	4.94		5.26		16.4	3.81	
		Detection Monitoring Result	3.07	-	5.09	-	14.1	<b>4.86</b>	<b>4.77</b>
Fluoride	mg/L	Intrawell Background Value (UPL)	0.11		1.43		1.55	0.16	
		Detection Monitoring Result	0.11	-	1.15	-	1.42	0.13	-
pH	SU	Intrawell Background Value (UPL)	7.66		9.29		10.33	10.57	
		Intrawell Background Value (LPL)	5.36		7.91		8.29	3.55	
		Detection Monitoring Result	6.21	6.52	8.49	8.61	8.84	7.39	6.16
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0		15.5		13.7	32.1	
		Detection Monitoring Result	27.8	-	8.5	-	8.8	24.5	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275		387		421	182	
		Detection Monitoring Result	191	-	355	-	383	113	-

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

-: Not Sampled

**Bold values exceed the background value.**

Background values are shaded gray.

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated

**CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER**

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

22663

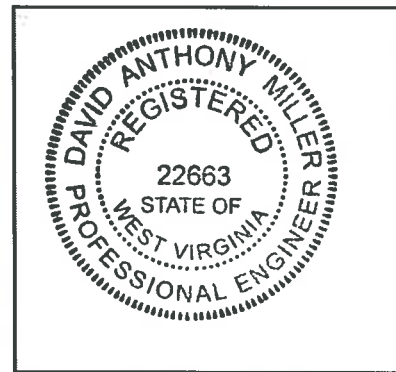
License Number

WEST VIRGINIA

Licensing State

03.19.19

Date



## Memorandum

Date: August 27, 2019

To: David Miller (AEP)

Copies to: Benjamin Kepchar (AEP)

From: Allison Kreinberg and Bruce Sass, Ph.D. (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at  
Amos Plant's Landfill

---

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Part D, "CCR rule"), detection monitoring sampling events were completed on June 11-12, 2019 and July 22, 2019 at the Landfill (LF), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values based on the eight background monitoring events conducted prior to October 17, 2017. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated January 15, 2018. An alternative source demonstration (ASD) was certified on April 13, 2018 which resulted in a revision to the calculated prediction limits for boron and fluoride.

To achieve an acceptably high statistical power while maintaining a site-wide false-positive rate (SWFPR) of 10% per year or less, prediction limits were calculated based on a one-of-two retesting procedure. With this procedure, a statistically significant increase (SSI) is only concluded if both samples in a series of two exceeds the UPL. In practice, if the initial result did not exceed the UPL, a second sample was not collected or analyzed.

Detection monitoring results and the relevant background values are compared in Table 1. Chloride concentrations exceeded the intrawell UPL of 3.81 mg/L in both the initial (4.60 mg/L) and second (4.61 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for chloride at MW-5.

Evaluation of Detection Monitoring Data – Amos LF  
August 27, 2019  
Page 2

In response to the exceedances noted above the Amos LF CCR unit will either transition to assessment monitoring or an alternate source demonstration for chloride will be conducted.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 259.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

**Table 1: Detection Monitoring Data Evaluation**  
**Amos Plant - Landfill**

Parameter	Units	Description	LF-MW-1	LF-MW-2		LF-MW-4	LF-MW-5	
			6/11/2019	6/11/2019	7/22/2019	6/12/2019	6/12/2019	7/22/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.134	0.231		0.213	0.0473	
		Detection Monitoring Result	0.0400	0.215	--	0.167	0.0200	--
Calcium	mg/L	Intrawell Background Value (UPL)	32.6	2.12		0.951	19.1	
		Detection Monitoring Result	28.1	1.80	--	0.788	16.2	--
Chloride	mg/L	Intrawell Background Value (UPL)	4.94	5.26		16.4	3.81	
		Detection Monitoring Result	2.86	3.26	--	14.4	<b>4.60</b>	<b>4.61</b>
Fluoride	mg/L	Intrawell Background Value (UPL)	0.111	1.43		1.55	0.159	
		Detection Monitoring Result	0.110	<b>1.63</b>	1.41	1.46	0.110	--
pH	SU	Intrawell Background Value (UPL)	7.7	9.3		10.3	10.6	
		Intrawell Background Value (LPL)	5.4	7.9		8.3	3.6	
		Detection Monitoring Result	7.0	8.7	--	8.6	6.1	--
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0	15.5		13.7	32.1	
		Detection Monitoring Result	29.9	9.40	--	9.00	26.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275	387		421	182	
		Detection Monitoring Result	184	379	--	415	132	--

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

**Bold values exceed the background value.**

Background values are shaded gray.

--: Not Sampled

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the UPL.

**ATTACHMENT A**  
**Certification by Qualified Professional Engineer**

**CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER**

I certify that the selected statistical method, described above and in the January 15, 2018 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

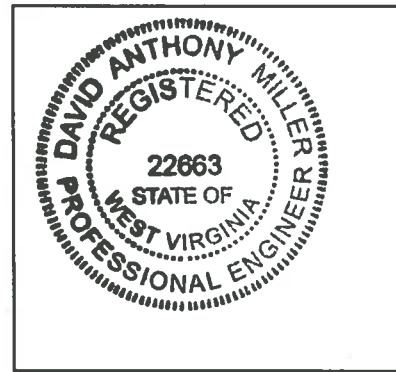
David Anthony Miller

Signature

22663  
License Number

WEST VIRGINIA  
Licensing State

08.29.19  
Date





## APPENDIX 3

The alternative source demonstrations follow.

# ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

## Amos Plant Landfill Winfield, West Virginia

*Submitted to*



1 Riverside Plaza  
Columbus, Ohio 43215-2372

*Submitted by*

**Geosyntec**   
consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103  
Columbus, Ohio 43221

March 15, 2019

CHA8462

**TABLE OF CONTENTS**

SECTION 1 Introduction and Summary..... 1-1  
    1.1 CCR Rule Requirements..... 1-1  
    1.2 Demonstration of Alternative Sources..... 1-2  
SECTION 2 Alternative Source Demonstration..... 2-1  
    2.1 Proposed Alternative Source ..... 2-1  
        2.1.1 MW-2..... 2-1  
        2.1.2 MW-5..... 2-2  
    2.2 Sampling Requirements ..... 2-2  
SECTION 3 Conclusions and Recommendations ..... 3-1  
SECTION 4 References ..... 4-1

**LIST OF TABLES**

Table 1      Detection Monitoring Data Evaluation

**LIST OF FIGURES**

Figure 1     Site Layout

**LIST OF ATTACHMENTS**

- Attachment A Analytical Laboratory Data – November 2018 Quality Control Samples
- Attachment B Analytical Laboratory Data – December 2018 Quality Control Samples
- Attachment C Analytical Laboratory Data – January 2019 MW-2 Sampling
- Attachment D Certification by a Qualified Professional Engineer

## **LIST OF ACRONYMS AND ABBREVIATIONS**

AEP	American Electric Power
ASD	Alternative Source Demonstration
bgs	Below ground surface
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LPL	Lower Prediction Limit
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

## SECTION 1

### INTRODUCTION AND SUMMARY

Eight background monitoring events were previously conducted at the Amos Plant Landfill according to the Coal Combustion Residuals (CCR) Rule [40 CFR 257.90 *et seq.*]. Upper prediction limits (UPLs) were calculated for each Appendix III parameter and lower prediction limits (LPLs) were also calculated for pH, to represent background values. A one-of-two retesting procedure was employed for all groundwater samples collected in the monitoring well network. On this basis a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL or lie below the LPL in the case of pH. Generally, if the initial result did not exceed a prediction limit, a second sample was not collected. These prediction limits were recalculated to reflect natural variability, as described in the Alternate Source Demonstration (ASD) report prepared on April 13, 2018 (Geosyntec, 2018).

The second semi-annual detection monitoring event of 2018 was completed in November and December 2018, and the results were compared to the calculated prediction limits. SSIs were identified for the following constituents listed in 40 CFR Part 257 Appendix III:

- Boron at MW-2; and
- Chloride at MW-5.

The two SSIs above were based on intrawell comparisons, following the procedure indicated in the April 2018 ASD report. A summary of the detection monitoring analytical results and the calculated prediction limits to which they were compared are listed in Table 1.

#### 1.1 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of CCR in landfills and surface impoundments, Rule 40 CFR 257.94(e)(2) states the following:

*The owner or operator may demonstrate that a source other than the CCR unit caused the statistically significant increase over background levels for a constituent or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The owner or operator must complete the written demonstration within 90 days of detecting a statistically significant increase over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report.*

The second semi-annual detection monitoring event for 2018 was completed in November and December 2018 at the Amos Plant Landfill to identify SSIs over background limits. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report, which documents that the SSIs cited above should not be attributed to the Amos Plant Landfill.

## **1.2 Demonstration of Alternative Sources**

An evaluation was completed to assess possible alternative sources to which identified SSIs could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and
- ASD Type V: Alternative Sources.

A demonstration was conducted to show that the increases in constituent concentrations were based on a Type I cause at MW-2 and a Type V cause at MW-5 and not by a release from the Amos Plant Landfill.

## SECTION 2

### ALTERNATIVE SOURCE DEMONSTRATION

The CCR Rule allows the owner or operator 90 days from the determination of an SSI to demonstrate that a source other than the CCR unit caused the SSI. Identified SSIs, evaluation methodology, and the proposed alternative source are described below.

#### **2.1 Proposed Alternative Source**

A review of the sampling methods used identified a Type I issue for the boron SSI at MW-2. A review of the laboratory and statistical methods used did not identify any Type II or Type III issues. A review of site geochemistry revealed anthropogenic impacts as a source of the chloride SSI at MW-5, which is a Type V ASD.

##### **2.1.1 MW-2**

A review of the field quality control (QC) sample results for the November 2018 sampling event identified boron contamination in the equipment blanks and field blanks, which likely impacted the associated sample result as a high bias for boron. An equipment blank and field blank were routinely collected during each sampling event to evaluate the equipment decontamination procedure and ambient environmental conditions where sample collection took place.

The boron concentration at MW-2 was 0.235 milligrams per liter (mg/L). However, boron was detected in the equipment blank and field blank at 0.04 and 0.05 mg/L, respectively. Because the blank concentrations are greater than 10% of the sample concentration, the sample result is considered suspect. The QC procedure indicates that the sample result should be considered estimated with a high bias. The November 2018 analytical report may be found in Attachment A.

A verification sample was collected at MW-2 in December 2018, with a reported boron concentration of 0.285 mg/L. Again, boron was detected in the equipment blank and field blank (0.03 mg/L and 0.02 mg/L, respectively). The boron detection in the equipment blank is greater than 10% of the sample concentration and, therefore, the sample result is considered suspect. The QC procedure again indicates that the sample result should be considered estimated with a high bias. These results are contained in the December 2018 analytical report (Attachment B).

To verify whether cross contamination resulted in biased sample results, an additional sample and duplicate sample were collected at MW-2 on January 24, 2019. A field blank and equipment blank were also collected during this event. The reported boron concentrations for the primary and duplicate samples at MW-2 were 0.218 and 0.212 mg/L, respectively, which are below the intrawell UPL (0.231 mg/L). Boron was not detected in either the field blank or the equipment blank during this sampling event, suggesting that cross-contamination was not an issue during the January 2019 sampling event. The analytical report for this event may be found in Attachment C.

These observations indicate that a Type I alternative source was responsible for the boron SSI at MW-2. The additional samples collected at MW-2 on January 24, 2019, in which the boron concentration was found to be 0.218 mg/L in the primary sample (and 0.212 mg/L in the duplicate), is considered more representative of the groundwater conditions at MW-2 than both the initial sample collected in November 2018 and the verification sample collected in December 2018 for the reasons described above.

### **2.1.2 MW-5**

The Amos Plant Landfill consists of a northern valley and southern valley which are surrounded by bedrock ridges. A topographic high point separates the two valleys (Arcadis, 2016), as shown in Figure 1. MW-5 is a designated downgradient well in the northern valley, which is hydrologically distinct from the southern valley, due to separation by the topographic high point. Significantly, no CCR waste has yet been placed in the northern valley, although landfill construction has been ongoing since 2013. The absence of CCR waste in the northern valley makes it extremely unlikely that the chloride SSI is attributable to CCRs at MW-5.

In addition, MW-5 is a shallow well which is screened between 5 and 10 feet below ground surface (bgs) and intercepts a perched groundwater zone (referred to in Figure 5B of the Groundwater Monitoring Well Network Evaluation report by Arcadis, 2016). The proximity of the screened interval to the ground surface suggests that MW-5 may be susceptible to impacts from surface activities in the northern valley. For example, construction activities, which include excavation and stockpiling as well as road salting may have released chloride which has affected the perched water table.

In conclusion, because MW-5 was installed in the perched groundwater zone and has a shallow screen depth (5-10 ft bgs), groundwater quality at MW-5 is potentially susceptible to influence from non-CCR sources as described above. Additionally, the absence of waste placement at hydrologically upgradient locations suggest that the SSIs for chloride have not been caused by a release from the storage unit. Thus, the exceedance at MW-5 was attributed to a Type V issue.

## **2.2 Sampling Requirements**

As this ASD supports a position that the identified SSIs are not due to a release from the Amos Plant Landfill, the unit will remain in the detection monitoring program. Groundwater at the unit will continue to be sampled for Appendix III parameters on a semi-annual basis.



### **SECTION 3**

#### **CONCLUSIONS AND RECOMMENDATIONS**

The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and supports the position that the SSIs in Appendix III detection monitoring constituents are not due to a release from the Amos Plant Landfill during the second semi-annual detection monitoring event that was conducted in November and December 2018. A review of sampling results identified sampling errors which likely resulted in the boron SSI at MW-2. The lack of waste placement upgradient of MW-5 provides evidence that the observed chloride concentrations were not caused by a release from the Landfill. Therefore, no further action is warranted, and the Amos Plant Landfill will remain in the detection monitoring program.

## **SECTION 4**

### **REFERENCES**

Arcadis. 2016. FGD Landfill – CCR Groundwater Monitoring Well Network Evaluation. October 2016.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Site. 3002010920. October 2017.

Geosyntec Consultants, 2018. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. April 2018.

U.S. EPA, 2015. Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities (Final Rule). Fed. Reg. 80 FR 21301, pp. 21301-21501, 40 CFR Parts 257 and 261, April.

# **TABLES**

**Table 1: Detection Monitoring Data Evaluation  
Amos Plant - Landfill**

*Geosyntec Consultants, Inc.*

Parameter	Units	Description	MW-1		MW-2		MW-4	MW-5	
			11/29/2018	12/18/2018	11/28/2018	12/17/2018	11/28/2018	11/29/2018	12/17/2018
Boron	mg/L	Intrawell Background Value (UPL)	0.134		0.231		0.213	0.047	
		Detection Monitoring Result	<b>0.143</b>	0.070	<b>0.235</b>	<b>0.285</b>	0.188	0.02	-
Calcium	mg/L	Intrawell Background Value (UPL)	32.6		2.12		0.951	19.1	
		Detection Monitoring Result	26.4	-	1.84	-	0.807	14.1	-
Chloride	mg/L	Intrawell Background Value (UPL)	4.94		5.26		16.4	3.81	
		Detection Monitoring Result	3.07	-	5.09	-	14.1	<b>4.86</b>	<b>4.77</b>
Fluoride	mg/L	Intrawell Background Value (UPL)	0.11		1.43		1.55	0.16	
		Detection Monitoring Result	0.11	-	1.15	-	1.42	0.13	-
pH	SU	Intrawell Background Value (UPL)	7.66		9.29		10.33	10.57	
		Intrawell Background Value (LPL)	5.36		7.91		8.29	3.55	
		Detection Monitoring Result	6.21	6.52	8.49	8.61	8.84	7.39	6.16
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0		15.5		13.7	32.1	
		Detection Monitoring Result	27.8	-	8.5	-	8.8	24.5	-
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275		387		421	182	
		Detection Monitoring Result	191	-	355	-	383	113	-

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

-: Not Sampled

**Bold values exceed the background value.**

Background values are shaded gray.

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the calculated

# FIGURES

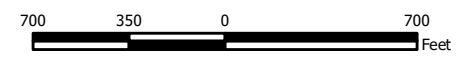


- Legend**
- Upgradient Sampling Location
  - Downgradient Sampling Location

- Name**
- Northern Valley
  - Southern Valley
  - Inferred Groundwater Flow Direction
  - FGD Landfill

**Notes**

- Monitoring well coordinates provided by AEP.
- Aerial imagery provided by DigitalGlobe and dated 8/30/2016.



**Site Layout  
FGD Landfill**

AEP Amos Generating Plant  
Winfield, West Virginia

**Geosyntec**  
consultants

Columbus, Ohio

2018/09/28

Figure

**1**

# **ATTACHMENT A**

## **ANALYTICAL LABORATORY DATA NOVEMBER 2018 QUALITY CONTROL SAMPLES**

## LF-CCR-Dup Dissolved

Sample Number: 184013-010A

Date Collected: 11/28/2018

Date Received: 11/30/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Iron, Fe	0.02	mg/L	J	0.02	0.003	DAM	12/07/2018 08:43	EPA 200.7-1994, Rev. 4.4
Manganese, Mn	0.0478	mg/L		0.001	0.0002	DAM	12/07/2018 08:43	EPA 200.7-1994, Rev. 4.4

## LF-CCR-FB

Sample Number: 184013-011

Date Collected: 11/29/2018 11:10

Date Received: 11/30/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.05	mg/L	J	0.1	0.02	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.1	mg/L	J	0.3	0.04	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	0.02	mg/L	J	0.05	0.01	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	0.5	0.2	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Sodium, Na	0.2	mg/L	J	0.2	0.06	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	0.0008	mg/L	J	0.005	0.0008	DAM	12/06/2018 18:21	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 3	mg/L	U	10	3	MGK	12/03/2018	SM 2320B-2011
Bromide, Br	< 0.04	mg/L	U	0.2	0.04	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.01	mg/L	U	0.04	0.01	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.01	mg/L	U	0.06	0.01	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	< 5	mg/L	U	20	5	KAL	12/04/2018	SM 2540C-2011
Sulfate, SO4	< 0.06	mg/L	U	0.4	0.06	CRJ	12/04/2018 01:35	EPA 300.1-1997, Rev. 1.0

## LF-CCR-EB

Sample Number: 184013-012

Date Collected: 11/29/2018 11:00

Date Received: 11/30/2018

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.04	mg/L	J	0.1	0.02	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Calcium, Ca	0.1	mg/L	J	0.3	0.04	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Magnesium, Mg	< 0.01	mg/L	U	0.05	0.01	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Potassium, K	< 0.2	mg/L	U	0.5	0.2	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Sodium, Na	< 0.06	mg/L	U	0.2	0.06	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Strontium, Sr	< 0.0008	mg/L	U	0.005	0.0008	DAM	12/06/2018 18:24	EPA 200.7-1994, Rev. 4.4
Alkalinity, as CaCO3	< 3	mg/L	U	10	3	MGK	12/03/2018	SM 2320B-2011
Bromide, Br	< 0.04	mg/L	U	0.2	0.04	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0
Chloride, Cl	< 0.01	mg/L	U	0.04	0.01	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0
Fluoride, F	< 0.01	mg/L	U	0.06	0.01	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0
Residue, Filterable, TDS	< 5	mg/L	U	20	5	KAL	12/04/2018	SM 2540C-2011
Sulfate, SO4	< 0.06	mg/L	U	0.4	0.06	CRJ	12/04/2018 01:58	EPA 300.1-1997, Rev. 1.0

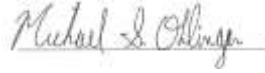


**Location: Amos Plant**

**Report Date: 12/7/2018**

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit

J: Analyte was positively identified, though the quantitation was below Reporting Limit.



**Michael Ohlinger, Chemist**

Email [msohlinger@aep.com](mailto:msohlinger@aep.com)

Tel.

Fax 614-836-4168

Audinet 8-210-

**THIS TEST REPORT RELATES ONLY TO THE ITEMS TESTED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT WRITTEN APPROVAL OF THE LABORATORY. ALL TEST RESULTS MEET ALL OF THE REQUIREMENTS OF THE ACCREDITING AUTHORITY, UNLESS OTHERWISE NOTED.**

# **ATTACHMENT B**

## **ANALYTICAL LABORATORY DATA DECEMBER 2018 QUALITY CONTROL SAMPLES**



Dolan Chemical Laboratory  
4001 Bixby Road  
Groveport, OH 43125  
T: 614-836-4221, Audinet 210-4221  
F: 614-836-4168, Audinet 210-4168  
<http://aepenv/labs>

**Water Analysis**

**Location: Amos Plant**

**Report Date: 12/26/2018**

**LF-CCR-MW-1**

**Sample Number: 184285-001**                      **Date Collected: 12/18/2018 10:10**                      **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.07	mg/L	J	0.1	0.02	DAM	12/21/2018 11:20	EPA 200.7-1994, Rev. 4.4

**LF-CCR-MW-2**

**Sample Number: 184285-002**                      **Date Collected: 12/17/2018 11:25**                      **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.285	mg/L		0.1	0.02	DAM	12/21/2018 11:32	EPA 200.7-1994, Rev. 4.4

**LF-CCR-MW-5**

**Sample Number: 184285-003**                      **Date Collected: 12/17/2018 13:20**                      **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.08	mg/L	J	0.1	0.02	DAM	12/21/2018 11:42	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	4.77	mg/L		0.04	0.01	CRJ	12/20/2018 16:15	EPA 300.1-1997, Rev. 1.0

**LF-Verification-EB-1**

**Sample Number: 184285-004**                      **Date Collected: 12/18/2018 08:50**                      **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.03	mg/L	J	0.1	0.02	DAM	12/21/2018 11:45	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	0.01	mg/L	J	0.04	0.01	CRJ	12/20/2018 15:29	EPA 300.1-1997, Rev. 1.0

**LF-Verification-FB-1**

**Sample Number: 184285-005**                      **Date Collected: 12/18/2018 10:15**                      **Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.02	mg/L	J	0.1	0.02	DAM	12/21/2018 11:48	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	0.03	mg/L	J	0.04	0.01	CRJ	12/20/2018 15:52	EPA 300.1-1997, Rev. 1.0

**LF-Verification-DUP-1**

**Sample Number: 184285-006**

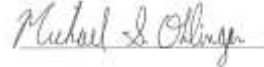
**Date Collected: 12/18/2018**

**Date Received: 12/19/2018**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.04	mg/L	J	0.1	0.02	DAM	12/21/2018 11:51	EPA 200.7-1994, Rev. 4.4
Chloride, Cl	4.77	mg/L		0.04	0.01	CRJ	12/20/2018 16:38	EPA 300.1-1997, Rev. 1.0

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit

J: Analyte was positively identified, though the quantitation was below Reporting Limit.



**Michael Ohlinger, Chemist**

Email [msohlinger@aep.com](mailto:msohlinger@aep.com) Tel.

Fax 614-836-4168 Audinet 8-210-

**THIS TEST REPORT RELATES ONLY TO THE ITEMS TESTED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT WRITTEN APPROVAL OF THE LABORATORY. ALL TEST RESULTS MEET ALL OF THE REQUIREMENTS OF THE ACCREDITING AUTHORITY, UNLESS OTHERWISE NOTED.**

# **ATTACHMENT C**

## **ANALYTICAL LABORATORY DATA JANUARY 2019 QUALITY CONTROL SAMPLES**



Dolan Chemical Laboratory  
4001 Bixby Road  
Groveport, OH 43125  
T: 614-836-4221, Audinet 210-4221  
F: 614-836-4168, Audinet 210-4168  
<http://aepenv/labs>

**Water Analysis**

**Location: Amos Plant**

**Report Date: 2/7/2019**

**LF-CCR-MW-2**

**Sample Number: 190294-001**                      **Date Collected: 01/24/2019 13:40**                      **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.218	mg/L		0.1	0.02	DAM	02/07/2019 10:50	EPA 200.7-1994, Rev. 4.4

**LF-CCR-Dup-2**

**Sample Number: 190294-002**                      **Date Collected: 01/24/2019**                      **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	0.212	mg/L		0.1	0.02	DAM	02/07/2019 10:53	EPA 200.7-1994, Rev. 4.4

**LF-CCR-EB-2**

**Sample Number: 190294-003**                      **Date Collected: 01/24/2019 13:40**                      **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.02	mg/L	U	0.1	0.02	DAM	02/07/2019 10:56	EPA 200.7-1994, Rev. 4.4

**LF-CCR-FB-2**

**Sample Number: 190294-004**                      **Date Collected: 01/24/2019 13:40**                      **Date Received: 1/25/2019**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Boron, B	< 0.02	mg/L	U	0.1	0.02	DAM	02/07/2019 10:59	EPA 200.7-1994, Rev. 4.4

U: Analyte was analyzed and not detected at or above adjusted Method Detection Limit  
J: Analyte was positively identified, though the quantitation was below Reporting Limit.

**Michael Ohlinger, Chemist**

Email [msohlinger@aep.com](mailto:msohlinger@aep.com) Tel.

Fax 614-836-4168 Audinet 8-210-

**THIS TEST REPORT RELATES ONLY TO THE ITEMS TESTED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT WRITTEN APPROVAL OF THE LABORATORY. ALL TEST RESULTS MEET ALL OF THE REQUIREMENTS OF THE ACCREDITING AUTHORITY, UNLESS OTHERWISE NOTED.**

# **ATTACHMENT D**

## **CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER**

**CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER**

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Amos Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

John Seymour

Printed Name of Licensed Professional Engineer

John Seymour

Signature

17091

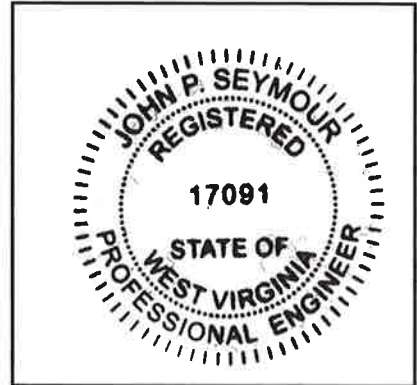
License Number

WV

Licensing State

3/15/2019

Date





## Memorandum

Date: October 3, 2019  
To: Ben Kepchar, American Electric Power (AEP)  
From: John Seymour, P.E., Geosyntec  
Subject: Amos Plant Landfill Alternative Source Demonstration

---

A semi-annual detection monitoring event was recently completed at the Amos Plant Landfill in accordance with the Coal Combustion Residual (CCR) Rule [40CFR257.94]. The results of this event (Table 1) were compared to previously calculated upper prediction limits (UPLs) for each Appendix III parameter. In addition, the reported pH values were also compared to previously calculated lower prediction limits (LPLs). A statistically significant increase (SSI) was noted for chloride at well MW-5 during this detection monitoring event. No other SSIs were observed in the well network during this semi-annual detection monitoring event (Table 1).

### DEMONSTRATION OF AN ALTERNATIVE SOURCE

SSIs for chloride were identified at well MW-5 for three previous detection monitoring events (November 2017, April 2018, and November 2018). In all three instances, alternative source demonstrations (ASD) were prepared (Geosyntec, 2018a; Geosyntec, 2018b; Geosyntec, 2019). For the current semi-annual detection monitoring event, the SSI was concluded after the intrawell background UPL for chloride was exceeded in both the initial and verification sampling events completed on June 12, 2019 and July 22, 2019, respectively. An evaluation was completed to assess possible alternative sources to which the identified SSI could be attributed. Alternative sources were identified amongst five types, based on methodology provided by EPRI (2017):

- ASD Type I: Sampling Causes;
- ASD Type II: Laboratory Causes;
- ASD Type III: Statistical Evaluation Causes;
- ASD Type IV: Natural Variation; and

- ASD Type V: Alternative Sources.

The lack of waste placement hydrologically upgradient of MW-5 provides evidence that the observed chloride concentrations were not caused by a release from the Landfill. Using EPRI (2017) nomenclature, the SSI for chloride at well MW-5 was determined to be a Type IV alternative source.

The Amos Plant Landfill consists of a northern valley and southern valley which are surrounded by bedrock ridges. A topographic high point separates the two valleys (Arcadis, 2016) as shown in Figure 1. MW-5 is a designated downgradient well in the northern valley, which is hydrologically distinct from the southern valley, due to separation by the topographic high point. Significantly, no CCR waste has yet been placed in the northern valley, although landfill construction has been ongoing since 2013. The absence of CCR waste in the northern valley makes it extremely unlikely that the chloride SSI is attributable to CCRs at MW-5.

MW-5 is a shallow well that is screened between 5 and 10 feet below ground surface (bgs) and intercepts a perched groundwater zone (referred to in Figure 5B of the Groundwater Monitoring Well Network Evaluation report by Arcadis, 2016). The proximity of the screened interval to the ground surface suggests that MW-5 may be susceptible to impacts from surface activities in the northern valley. Landfill construction has been ongoing in the northern valley since 2013. Activities completed this year and in the past, such as excavation, stockpiling, road salting, and blasting, may have released chloride that has affected the perched water table.

In conclusion, because MW-5 was installed in the perched groundwater zone and has a shallow screen depth (5-10 ft bgs), groundwater quality at this location is potentially susceptible to influence from non-CCR sources such as construction road salting. Additionally, the absence of waste placement at hydrologically upgradient locations suggest that the SSI for chloride was not caused by a release from the storage unit. Therefore, the exceedance at MW-5 was attributed to a Type IV issue. The preceding information serves as the ASD prepared in accordance with 40 CFR 257.94(e)(2) and in agreement with the previous ASDs prepared for this unit (Geosyntec, 2018a; Geosyntec, 2018b; Geosyntec, 2019). Certification of this ASD by a qualified professional engineer is provided in Attachment A.

\*\*\*\*\*

Arcadis, 2016. FGD Landfill – CCR Groundwater Monitoring Network Evaluation. October.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites. 3002010920. October.

Ben Kepchar  
03 October 2019  
Page 3

Geosyntec, 2018a. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. Winfield, West Virginia. April.

Geosyntec, 2018b. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. Winfield, West Virginia. October.

Geosyntec, 2019. Alternative Source Demonstration Report – Federal CCR Rule. Amos Plant Landfill. Winfield, West Virginia. March

**Table 1: Detection Monitoring Data Evaluation  
Amos Plant - Landfill**

Parameter	Units	Description	LF-MW-1	LF-MW-2		LF-MW-4	LF-MW-5	
			6/11/2019	6/11/2019	7/22/2019	6/12/2019	6/12/2019	7/22/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.134	0.231		0.213	0.0473	
		Detection Monitoring Result	0.0400	0.215	--	0.167	0.0200	--
Calcium	mg/L	Intrawell Background Value (UPL)	32.6	2.12		0.951	19.1	
		Detection Monitoring Result	28.1	1.80	--	0.788	16.2	--
Chloride	mg/L	Intrawell Background Value (UPL)	4.94	5.26		16.4	3.81	
		Detection Monitoring Result	2.86	3.26	--	14.4	<b>4.60</b>	<b>4.61</b>
Fluoride	mg/L	Intrawell Background Value (UPL)	0.111	1.43		1.55	0.159	
		Detection Monitoring Result	0.110	<b>1.63</b>	1.41	1.46	0.110	--
pH	SU	Intrawell Background Value (UPL)	7.7	9.3		10.3	10.6	
		Intrawell Background Value (LPL)	5.4	7.9		8.3	3.6	
		Detection Monitoring Result	7.0	8.7	--	8.6	6.1	--
Sulfate	mg/L	Intrawell Background Value (UPL)	34.0	15.5		13.7	32.1	
		Detection Monitoring Result	29.9	9.40	--	9.00	26.4	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	275	387		421	182	
		Detection Monitoring Result	184	379	--	415	132	--

Notes:

UPL: Upper prediction limit

LPL: Lower prediction limit

**Bold values exceed the background value.**

Background values are shaded gray.

--: Not Sampled

Based on a 1-of-2 resampling, a statistically significant increase (SSI) is only identified when both samples in the detection monitoring period are above the UPL.

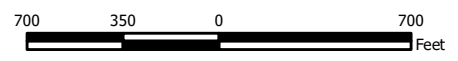


- Legend**
- Upgradient Sampling Location
  - Downgradient Sampling Location

- Name**
- Northern Valley
  - Southern Valley
  - Inferred Groundwater Flow Direction
  - FGD Landfill

**Notes**

- Monitoring well coordinates provided by AEP.
- Aerial imagery provided by DigitalGlobe and dated 8/30/2016.



**Site Layout  
FGD Landfill**

AEP Amos Generating Plant  
Winfield, West Virginia

**Geosyntec**  
consultants

Columbus, Ohio

2018/09/28

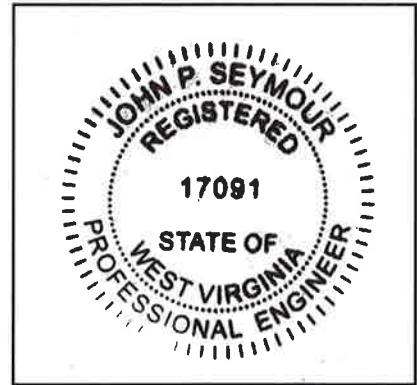
Figure  
**1**

**CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER**

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Amos Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

John Seymour

Printed Name of Licensed Professional Engineer



A handwritten signature in blue ink, appearing to read "John Seymour", written over a horizontal line.

Signature

17091

License Number

West Virginia

Licensing State

10/3/2019

Date

\* \* \* \* \*

**APPENDIX 4**

Not applicable.

## **APPENDIX 5**

Well installation/decommissioning logs follow.



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

JOB NUMBER **WV015976.0005**  
 COMPANY **American Electric Power**  
 PROJECT **Amos - FGD Landfill**  
 COORDINATES **N 38.5 E 81.6**  
 GROUND ELEVATION **735.6** SYSTEM **NAVD88**

BORING NO. **MW-1801** DATE **5/3/19** SHEET **1** OF **5**  
 BORING START **8/7/18** BORING FINISH **8/8/18**  
 PIEZOMETER TYPE **PVC** WELL TYPE **OW**  
 HGT. RISER ABOVE GROUND **2.8** DIA **2"**  
 DEPTH TO TOP OF WELL SCREEN **50.4** BOTTOM **114.4**  
 WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**  
 FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ <b>21.0</b>	▼	▼
TIME			
DATE	<b>8/15/2018</b>		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		5.0	6.5	50/4	3.6		5		CL ML	0-5': SILTY CLAY; 2.5YR 5/6 (red); moist; backfill material.		0-49': Riser
		6.5	8.0	48-23-15	3.6					5-6': SANDSTONE.		
		8.0	9.5	11-3-5	7.2				CL ML	6-6.3': SHALE; GLEY1 5/N (gray); dry; thin bedded; hard.		
		9.5	11.0	4-4-7	10.8		10		ML	6.3-6.5': SILTY CLAY; red; moist; hard		
		11.0	12.5	4-8-50/3	10.8				MH	6.5-8': SILT; 10YR 6/2 (tan); with sandstone and shale fragments; compacted fill material.		
		12.5	14.0	50/3					CL ML	8-9.5': CLAYEY SILT; 5YR 4/2 (brown); firm; moist; fill material.		
		14.0	15.5	50/4					CL ML	9.5-11': SILTY CLAY; 10YR 6/3 (brown) to brown clayey silt; dry; crumbly; fill material.		
		14.9	19.9	51			15		ML	11-12.5': SILTY CLAY; 5YR 4/2 (brown); moist; firm.		
										Note: Sandstone at 12-12.3'. 12.5-14': SILT, compacted; 10YR 7/4 (tan); very hard; dry; fill material.		
										14-14.5': SILTY SHALE material, weathered; mottled tan and dark brown; dry; very hard.		
										14.5-14.9': SANDSTONE; strong field strength; 2.5Y 6/2; fine-grained texture; massive structure; slightly to moderately decomposed; moderately disintegrated with Fe staining; fracture at 14.3-14.5'. 14.9-19.9': SHALE; moderate field strength; GLEY1 5/GY; fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated along bedding planes and fracture; vertical fracture with Fe staining at 15.5-16.5'.		

**TYPE OF CASING USED**

<b>X</b>	NQ-2 ROCK CORE
<b>NA</b>	6" x 3.25 HSA
<b>NA</b>	9" x 6.25 HSA
<b>NA</b>	HW CASING ADVANCER 4"
<b>NA</b>	NW CASING 3"
<b>NA</b>	SW CASING 6"
<b>NA</b>	AIR HAMMER 8"

*Continued Next Page*

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

RECORDER **A. Gillespie**

AEP - AEP.GDT - 5/3/19 11:49 - S:\KNOXVILLE-TN\FOR NICOLE AEP LOG EDIT FILES\GINT LOGS OUTPUT\AEP MOUNTAINAEP MOUNTAINEER.GPJ

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1801 DATE 5/3/19 SHEET 2 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/7/18 BORING FINISH 8/8/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		19.9	24.9	8-7-6	55					19.9-24.9': SHALE; moderate field strength; GLEY1 5/GY; fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated; moderately to intensely fractured.  Transition to strong field strength, 2.5YR 4/4; fine-grained texture; massive structure to thinly bedded; slightly decomposed; slightly disintegrated; slightly to moderately fractured.		
		24.9	34.9	4-4-13	72		25			24.9-25.2': SHALE; strong field strength; fine-grained structure; massive structure to thinly bedded; slightly decomposed; slightly disintegrated; slightly to moderately fractured.  25.2-30.7': CLAYSTONE/MUDSTONE, highly weathered; very weak field strength; 10YR 5/3; very fine-grained texture with sandstone fragments; massive structure; highly decomposed; intensely disintegrated; unfractured.		
							30			30.7-32.5': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated; slightly to moderately fractured.		
							35			32.5-34.9': CLAYSTONE/MUDSTONE; moderate field strength; GLEY1 4/104; fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately to intensely fractured.		
		34.9	38.3	4-5-8	36					34.9-38.3': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; moderately to highly decomposed; intensely disintegrated, mottling tan and gray; moderately to intensely fractured.		
		38.3	44.9	5-7-13-9-6-6	70		40			38.3-44.9': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; highly decomposed; intensely disintegrated; intensely fractured.		
		44.9	50.0	4-4-7-8	50		45			44.9-50': CLAYSTONE/MUDSTONE; moderate to weak field strength; 2.5YR 4/4 (red) mottled with		

AEP - AEP.GDT - 5/3/19 11:49 - S:\KNOXVILLE-TN\FOR NICOLE AEP LOG EDIT FILES\GINT LOGS OUTPUT\AEP MOUNTAINEERVAEP MOUNTAINEER.GPJ

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1801 DATE 5/3/19 SHEET 3 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/7/18 BORING FINISH 8/8/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		44.9	50.0	4-4-7-8	50							
		50.0	55.0	4-4-5-4	50		50			tan, black, and gray; fine-grained texture; massive structure; highly decomposed; intensely disintegrated; intensely fractured.		49-52': Bentonite Pellets
		55.0	59.8	5-7-5-36	52		55			50-56.7': CLAYSTONE/MUDSTONE; moderate field strength; 2.5YR 4/4 (red) mottled with tan, black, and gray; fine-grained texture; massive structure; moderately to highly decomposed, becomes less weathered at 50.3'; highly disintegrated, highly mottled; moderately to intensely fractured.		52-53': Secondary Filter Pack 53-75': Primary Filter Pack
		59.8	64.8	8-5-4-4-7-5-5-4	60		60			56.7-58': SANDSTONE, interbedded; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along fracture; moderately fractured at 56.7' and 57.1-57.5'. 58-58.8': SHALE, interbedded; strong field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along fracture.		55-75': Screen
		64.8	74.8	4-5-4-6	76		65			58.8-59.2': SANDSTONE, interbedded; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along fracture. 59.2-59.8': SHALE, interbedded; strong field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated along fracture.		
							70			59.8-60.7': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured. 60.7-63.9': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed along bedding planes; moderately disintegrated with silt filled fractures; moderately fractured. 63.9-64.3': SANDSTONE; strong field strength; GLEY1 6/N (gray-green); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured. 64.3-64.8': SHALE; moderate field strength; 2.5YR 4/4 (red); fine-grained texture; thinly bedded; moderately decomposed; moderately		

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1801 DATE 5/3/19 SHEET 4 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/7/18 BORING FINISH 8/8/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		64.8	74.8	4-5-4-6	76							
		74.8	85.0				75			64.8-74.8': SHALE, highly weathered at base; moderate to weak field strength along some bedding planes; 2.5YR 3/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated, becomes more limestone fragments last 1 ft, 3-5 cm; moderately to intensely fractured. 74.8-85': SHALE, highly weathered; weak field strength; 2.5YR 4/4 (red) with tan and gray mottling; fine-grained texture; massive structure; highly decomposed; highly disintegrated, mottled; intensely fractured.		75-105': Bentonite
		85.0	95.0	5-4-4	120		85			85-92.7': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintegrated, calcite in light colored beds/thin; slightly fractured.		
							90			92.7-94.6': SHALE; moderate field strength; fine-grained texture; massive structure; slightly decomposed; slightly disintegrated, some mottling; moderately fractured.		
		95.0	105.0	7-4-4	120		95			94.6-95': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintegrated, calcite in light colored beds/thin; slightly fractured at 94.6-95'. 95-100.1': SANDSTONE; strong field strength; fine-grained texture; thinly bedded; fresh; slightly disintegrated; slightly fractured at 95-95.2'.		

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1801 DATE 5/3/19 SHEET 5 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/7/18 BORING FINISH 8/8/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		95.0	105.0	7-4-4	120		100			100.1-101.5': SHALE and sandstone interbedded; moderate field strength; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; slightly fractured at 100.2-100.5'. 101.5-105': SHALE; moderate to weak field strength; fine-grained texture; massive structure; highly decomposed; moderately to highly disintegrated mottling with silt filled fractures; highly fractured.		
							105					
							110					
							115					
							120					

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

JOB NUMBER **WV015976.0005**  
 COMPANY **American Electric Power**  
 PROJECT **Amos - FGD Landfill**  
 COORDINATES **N 38.5 E 81.9**  
 GROUND ELEVATION **709.8** SYSTEM **NAVD88**

BORING NO. **MW-1802** DATE **5/3/19** SHEET **1** OF **5**  
 BORING START **8/20/18** BORING FINISH **8/21/18**  
 PIEZOMETER TYPE **NA** WELL TYPE **OW**  
 HGT. RISER ABOVE GROUND **2.91** DIA **2"**  
 DEPTH TO TOP OF WELL SCREEN **50** BOTTOM **114.4**  
 WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**  
 FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ <b>35.0</b>	▼	▼
TIME			
DATE	<b>8/21/2019</b>		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
									GW	0-3.5': GRAVEL backfill; large rip-rap and smaller compacted gravels.		0-41': Bentonite Grout
		4.5	6.0	6-4-5	0		5		CL	3.5-4.5': SILTY CLAY; brown; moist; soft; backfill material.		
										4.5-6': NO RECOVERY, due to gravel blocking cutting shoe.		
		6.0	7.5	4-3-4	3.6				CL	6-17': SILTY CLAY; 7.5YR 4/3 (brown); moist; firm; compacted backfill material; becomes wet at 12.5'.		
		7.5	9.0	3-4-5	7.2							
		9.0	10.5	4-4-6	18		10					
		10.5	12.0	5-4-5	13.2							
		12.0	13.5	3-4-6	15.6							
		13.5	15.0	3-5-8	14.4							
		15.0	16.5	4-7-9	15.6		15					
		16.5	18.0	6-25-8	16.8							
		18.0	19.5	7-23-15	14.4				CL	17-17.5': SANDSTONE, weathered; GLEY1 7/N (gray); dry.		
										17.5-19.5': SILTY CLAY; GLEY1 6/N (gray) mottled with brown, red, tan; moist; soft; crumbles easily.		
		19.5	21.0	20->50/4	10.8				CL			

**TYPE OF CASING USED**

<b>X</b>	NQ-2 ROCK CORE
<b>NA</b>	6" x 3.25 HSA
<b>NA</b>	9" x 6.25 HSA
<b>NA</b>	HW CASING ADVANCER 4"
<b>NA</b>	NW CASING 3"
<b>NA</b>	SW CASING 6"
<b>NA</b>	AIR HAMMER 8"

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

RECORDER **A. Gillespie**

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1802 DATE 5/3/19 SHEET 2 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/20/18 BORING FINISH 8/21/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		19.5	21.0	20->50/4	10.8					19.5-22.5': SILTY CLAY; GLEY1 6/N (gray) mottled with brown, tan; dry; soft; crumbles easily.		
		21.0	22.5	27-50/5	9.6							
		22.5	24.4	4	23					22.5-24': SILTSTONE; moderate to weak field strength; GLEY1 6/N; fine-grained texture; massive structure; highly decomposed; moderately to highly disintegrated with tan/brown mottling; moderately to intensely fractured.		
		24.4	29.4		22		25			24-24.4': SILTSTONE; weak field strength; 10R 4/4 (red) mottled; fine-grained texture; massive structure; highly decomposed; moderately to intensely fractured. 24.4-29.4': SILTSTONE; weak field strength; 10R 4/4 (red) mottled with tan, gray, and black; fine-grained texture; massive structure; highly decomposed; highly disintegrated, highly mottled; moderately fractured.		
		29.4	33.7	5-11-6	40		30			29.4-32.8': SHALE, weathered; moderate field strength; 10YR 4/4 (red) mottled; fine-grained texture; massive structure; moderately decomposed; moderately to intensely disintegrated; moderately fractured.		
		33.7	39.4	5-4-4-7-5	59		35			32.8-33.7': SHALE; moderate field strength; 5YR 5/4 (tan) mottled; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; moderately to intensely fractured. 33.7-39.4': SHALE; moderate field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; intensely fractured.		
		39.4	44.4	4-6-4-4	57		40			39.4-44.4': SHALE; moderate field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated; intensely fractured.		41-44': Bentonite Pellets
		44.4	54.4	7-8-7-5-5-24-5	120		45			44.4-47.8': SHALE, highly weathered; weak field strength; 10YR 4/4 (red) with gray, tan, and black mottling; fine-grained texture; massive structure;		44-45': Secondary Filter Pack 45-71': Primary Filter Pack

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1802 DATE 5/3/19 SHEET 3 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/20/18 BORING FINISH 8/21/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		44.4	54.4	7-8-7-5-5-24-5	120					highly decomposed; intensely disintegrated; intensely fractured.		
							50			47.8-49.9': SHALE, less weathered; moderate field strength; 10R 3/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		
										49.9-50.8': SHALE, interbedded with sandstone; moderate field strength; GLEY1 4/N; fine-grained texture; thinly bedded; moderately decomposed; slightly disintegrated; moderately fractured.		50-70': Screen
										50.8-52.8': SHALE; moderate to strong field strength; 10R 4/3 (red); fine-grained texture; massive structure; slightly decomposed; moderately disintegrated; slightly fractured.		
		54.4	64.4	8-12-5-6-7-4-4-4	114		55			52.8-53.1': SHALE, interbedded with sandstone; strong field strength; GLEY1 4/5GY; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; unfractured.		
										53.1-54.4': SHALE; moderate field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; moderately fractured.		
										54.4-55.4': SANDSTONE, interbedded with shale; moderate field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately decomposed; moderately disintegrated; slightly to moderately fractured.		
							60			55.4-57.1': SHALE, interbedded with sandstone; moderate field strength; GLEY1 4/3, 10R 4/3; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
										57.1-64.4': SHALE, weathered; moderate to weak field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately to highly decomposed; moderately to intensely disintegrated with intense gray mottling; intensely fractured.		
		64.4	74.4	4-6-8-6-4-5-4-4-5	117		65			64.4-70.5': SHALE, highly weathered; moderate to weak field strength; 10R 4/3 (red); fine-grained texture; massive structure; moderately to intensely disintegrated with gray mottling; intensely fractured.		
							70			70.5-74.4': SHALE, interbedded with sandstone; strong field strength; 10R 4/3 (red) interbedded with GLEY1 4/N (gray-green); fine-grained		

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

JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1802 DATE 5/3/19 SHEET 4 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/20/18 BORING FINISH 8/21/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		64.4	74.4	4-6-8-6-4-5-4-4-5	117					texture; thinly bedded; slightly to moderately decomposed along some bedding planes; moderately disintegrated with silt filled fractures; moderately fractured.		
		74.4	84.4	8-7-5-5-14-8-7-22-12	120		75			74.4-77.1': SHALE, with some interbedded sandstone lenses; moderate field strength; 10R 4/3 (red); fine-grained texture; thinly bedded; slightly to moderately decomposed at some bedding planes; slightly disintegrated; moderately fractured.		
							80			77.1-82.7': SANDSTONE, with some red shale lenses; strong field strength; GLEY1 4/N; fine-grained texture; thinly bedded; fresh; moderately disintegrated, calcite reacts to HCl in light colored bands within 0.5' of surrounding contact lines, no HCl/calcite in fractures, no Fe staining; moderately fractured.		
		84.4	94.4	10-11-6-7-7-8-9-8-7-6-6-7-10	120		85			82.7-84.4': SHALE, with some interbedded sandstone lenses; moderate field strength; 10R 4/3 (red); fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured. 84.4-86.7': SHALE, with sandstone lenses; moderate field strength; 10R 4/2 (red) with GLEY1 4/N lenses; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured. 86.7-89.2': SANDSTONE, with shale lenses; moderate field strength; GLEY1 4/N with 10R 4/2 lenses; fine-grained texture; thinly bedded; slightly decomposed; slightly disintegrated; moderately fractured.		
		94.4	104.4	7-4-5-4-9-9-8-5-11-5-6-10-19	120		90			89.2-94.4': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded, micaceous; fresh; slightly disintegrated, some calcite in light bands, no staining, no calcite in fractures; slightly to moderately fractured along bedding planes; fracture at 92.8'.		
							95			94.4-104.4': SANDSTONE; strong field strength; GLEY1 6/N; fine-grained texture; thinly bedded, micaceous, cross-bedding at 94.4-94.8; fresh; slightly disintegrated, calcite in some light bedded planes, no calcite or Fe staining noted in fractures; slightly to moderately fractured along bedding planes.		

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**AEP CIVIL ENGINEERING LABORATORY**  
 LOG OF BORING

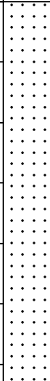
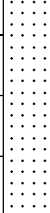

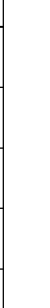
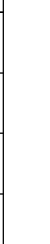
JOB NUMBER WV015976.0005

COMPANY American Electric Power

BORING NO. MW-1802 DATE 5/3/19 SHEET 5 OF 5

PROJECT Amos - FGD Landfill

BORING START 8/20/18 BORING FINISH 8/21/18

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET		STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
		FROM	TO									
		94.4	104.4	7-4-5-4-9-9-8-5-11-5-6-10-19	120		100					
		104.4	114.4	15-6-21-6-4-4-8-8-6-4-13-5-7	120		105			104.4-108': SANDSTONE; strong field strength; GLEY1 6/N; fine to medium-grained texture; thinly bedded, micaceous, shale fragments; fresh; moderately disintegrated, calcite along entire sandstone void and shale fragments at base, calcite in void; slightly fractured.		
							110			108-108.9': SHALE, with interbedded sandstone; moderate field strength; GLEY1 4/N, 10R 4/3 bands; thinly bedded; moderately decomposed between bedding planes; moderately disintegrated along bedding planes; moderately fractured. 108.9-114.4': SHALE; moderate field strength; 10R 4/3 (red) with GLEY1 4/N mottling; fine-grained texture; massive structure; moderately decomposed; moderately to intensely disintegrated, mottling; moderately fractured.		
							115					
							120					

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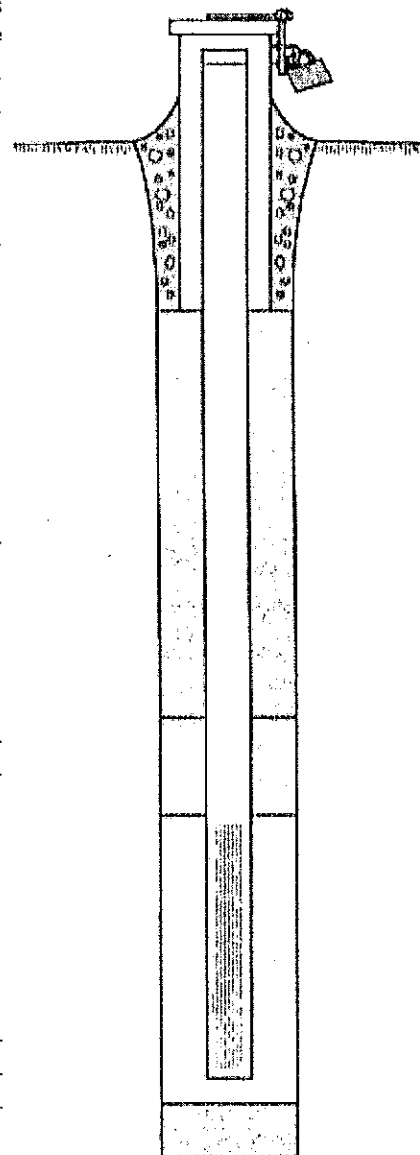
**State of West Virginia  
Department of Environmental Protection**

Monitoring Well Construction  
Well Number: WV00528-0016-18  
Approved

<b>Site Name/Physical Address:</b>		<b>Well Registration No.</b> WV00528-0016-18	<b>Purpose of Monitoring Well:</b>
Site:	John E. Amos Plant	<b>Grid Location:</b>	Assessment
Line 1:	1530 Winfield Rd.	a. Latitude:	38 28 46 .0
Line 2:		b. Longitude:	81 51 28 .0
City:	Winfield	c. Method Used:	GPS
State:	WV		
Zip:	25213-	<b>Company/Project Well No.:</b>	
County:	Putnam	MW-1801	
<b>Well Owner (Name, Firm, Address):</b>		<b>Installed By (Name, Firm, Address):</b>	<b>Date Well Installed:</b>
Owner:	American Electric Power	Installer:	AEP Dolan Lab
Line 1:	1 Riverside Plaza	Line 1:	4001 Bixby Rd.
Line 2:		Line 2:	
City:	Columbus	City:	Groveport
State:	OH	State:	OH
Zip:	43215-	Zip:	43125-
Phone:	614-836-4200	Phone:	614-836-4200
			<b>Driller's WV Cert No.</b> WV00528

**Section B: (all number fields must be in decimal format)**

- 1. Cap and Lock: YES
- 2. Protective Cover: Protective Cover Pipe
- 3. Monitoring Well Reference Point: 0 ft.
- 4. Borehole Diameter: 6 inches.
- 5. Ground Surface Seal:
  - a. Material: bentonite-cement grout
  - b. Installation Procedure: gravity
- 6. Surface Seal Bottom/Annular Space Top: 2 ft.
- 7. Well Riser: a. OD Well Riser: 2 inches. b. ID Well Riser: 1.98 inches.
  - c. Material: PVC
  - d. Installation Procedure: hand set
- 8. Annular Space Seal:
  - a. Material: bentonite pellet -
  - b. Installation Procedure: tremie pipe-gravity
- 9. Well Development Procedure: airlift -
- 10. Drilling Method Used: air rotary -
- 11. Annular Space Seal Bottom/Filter Seal Top: 43.7 ft.
- 12. Drilling Fluid Used: Yes Source: Water
- 13. Filter Pack Seal:
  - a. Material: bentonite pellet
  - b. Installation Procedure: Gravity Fed
  - c. Volume Added: 125 pounds
- 14. Bottom of Bentonite Seal/Filter Pack Top: 53 ft.
- 15. Depth to Top of Screen: 55.4 ft.
- 16. Screen:
  - a. Material: PVC
  - b. Installation Procedure: hand set
  - c. Slot Size: 0.01 inches. d. Screen Length: 19.6 ft.
- 17. Filter Pack:
  - a. Material: fine sand
  - b. Installation Procedure: gravity
- 18. Well Depth: 75 ft.
- 19. Bottom of Filter Pack: 76 ft.
- 20. Bottom of Borehole: 105 ft.
- 21. Backfill Material (below filter pack): N/A
- 22. Decontamination Procedures: Liqui-Nox w/high pressure water pump
- 23. Special Circumstances and Exceptions: No Variance Number:
- 24. WV Contractor License No:



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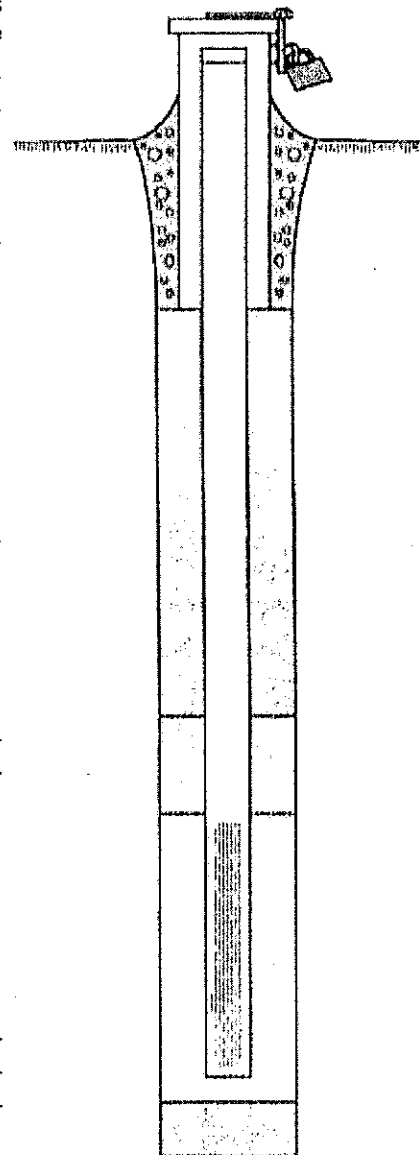
**State of West Virginia  
Department of Environmental Protection**

Monitoring Well Construction  
Well Number: WV00528-0017-18  
Approved

<b>Site Name/Physical Address:</b> Site: John E. Amos Plant Line 1: 1530 Winfield Rd. Line 2: City: Winfield State: WV Zip: 25213- County: Putnam	<b>Well Registration No. WV00528-0017-18</b> <b>Grid Location:</b> a. Latitude: 38 29 15 .0 b. Longitude: 81 51 35 .0 c. Method Used: GPS	<b>Purpose of Monitoring Well:</b> Assessment
<b>Well Owner (Name, Firm, Address):</b> Owner: American Electric Power Line 1: 1 Riverside Plaza Line 2: City: Columbus State: OH Zip: 43215- Phone: 614-836-4200	<b>Company/Project Well No.:</b> MW-1802 <b>Installed By (Name, Firm, Address):</b> Installer: AEP / Dolan Lab Line 1: 4001 Bixby Rd. Line 2: City: Groveport State: OH Zip: 43125- Phone: 614-836-4200	<b>Date Well Installed:</b> 08/22/2018 <b>Driller's WV Cert No.</b> WV00528

**Section B: (all number fields must be in decimal format)**

- 1.Cap and Lock: YES
- 2.Protective Cover: Protective Cover Pipe
- 3.Monitoring Well Reference Point: 0 ft
- 4.Borehole Diameter: 6 inches.
- 5.Ground Surface Seal:  
a.Material: bentonite-cement grout  
b.Installation Procedure: gravity
- 6.Surface Seal Bottom/Annular Space Top: 2 ft
- 7.Well Riser: a.OD Well Riser: 2 inches. b.ID Well Riser: 1.98 inches.  
c.Material: PVC  
d.Installation Procedure: hand set
- 8.Annular Space Seal:  
a.Material: bentonite pellet -  
b.Installation Procedure: tremie pipe-gravity
- 9.Well Development Procedure: airlift -
- 10.Drilling Method Used: air rotary -
- 11.Annular Space Seal Bottom/Filter Seal Top: 30 ft
- 12.Drilling Fluid Used: Yes Source: Water
- 13.Filter Pack Seal:  
a.Material: bentonite pellet  
b.Installation Procedure: Gravity Fed  
c.Volume Added: 650 pounds
- 14.Bottom of Bentonite Seal/Filter Pack Top: 45 ft
- 15.Depth to Top of Screen: 50.4 ft
- 16.Screen:  
a.Material: PVC  
b.Installation Procedure: hand set  
c.Slot Size: 0.01 inches. d.Screen Length: 19.6 ft.
- 17.Filter Pack:  
a.Material: fine sand  
b.Installation Procedure: gravity
- 18.Well Depth: 70 ft
- 19.Bottom of Filter Pack: 71 ft
- 20.Bottom of Borehole: 114.4 ft
- 21.Backfill Material (below filter pack): N/A
- 22.Decontamination Procedures: Liqui-Nox w/high pressure water pump
- 23.Special Circumstances and Exceptions: No Variance Number:
- 24.WV Contractor License No. [REDACTED]



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