American Electric Power
1 Riverside Plaza
Columbus, OH 43215
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March 18, 2021

Submitted Electronically via Email

Ms. Kirsten Hillyer, Environmental Engineer
U.S. Environmental Protection Agency
Office of Resource Conservation & Recovery (ORCR)
Materials Recovery & Waste Management Division (MRWMD)
Cube: S-6834
Washington, DC 20460

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

Dear Ms. Hillyer,

Appalachian Power Company (APCO) John E. Amos Power Plant (Amos Plant) hereby submits the attached information to the U.S. Environmental Protection Agency (EPA) in response to your email to me dated Friday, March 12, 2021, requesting additional information for Amos Plant's Site Specific Alternative Deadline to Initiate Closure under 40 CFR 257.103(f)(1) for the Bottom Ash Pond (BAP) at the Amos Plant near Winfield, West Virginia. Your email requested groundwater monitoring data collected for the reporting year 2020.

The 2020 annual groundwater monitoring reports, which include historical data tables, including groundwater data collected in 2020, for Amos Plant's BAP, Fly Ash Pond, and Landfill are included in attachments A, B, and C respectively. Note that in attachment C Amos Landfill 2020 annual report, MW-1 and MW-5 were removed from the monitoring well network at the beginning of 2020 and were replaced with MW-1801 and MW-1802.

In lieu of hard copies of these documents, electronic files are being submitted to you and Richard Huggins via email. If you have any questions regarding this submittal, please contact me at 614-716-2281 or damiller@aep.com.

Sincerely,

David A. Miller

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

Attachments

cc: Richard Huggins – USEPA

EPA ADDITIONAL INFORMATION REQUEST

ATTACHMENT A

AMOS PLANT BOTTOM ASH POND

2020 ANNUAL GROUNDWATER MONITORING REPORT

Annual Groundwater Monitoring Report

Appalachian Power Company

John E. Amos Plant

Bottom Ash Pond CCR Management Unit

Winfield, West Virginia

January 2021

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

APPALACHIAN POWER
An AEP Company
BOUNDLESS ENERGY™

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I. **Overview**

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

In general, the following activities were completed:

- An assessment monitoring program was established for the AMBAP on April 13, 2018. The CCR unit began 2020 in assessment monitoring and remained in assessment monitoring throughout all of 2020.
- Groundwater samples were collected and analyzed for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.95 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)* in February, May, and October 2020;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Analytical results of the February, May, and October rounds of sampling are listed in the tables in **Appendix 1**. Also shown are the groundwater flow rates and flow directions;
- Statistical analysis of the May 2020 sampling event revealed were no exceedances over established groundwater protection standards, so the unit remains in assessment monitoring. However, the following statistically significant increases occurred for Appendix III indicator parameters:
    - Calcium at MW-1, MW-1604, MW-1605, and MW-1606
    - Chloride at MW-1, MW-1605, and MW-1606
    - Sulfate at MW-1, MW-1605, and MW-1606
    - Total dissolved solids (TDS) at MW-1, MW-1605, and MW-1606
- The statistical analysis report for May 2020 assessment monitoring event was completed in September 2020 and is included in **Appendix 2**.
- October 2020 sampling event data has been received, however, statistical analysis is not yet completed. The statistical analysis will be completed in early 2021. If no SSL's are identified, the unit will remain in assessment monitoring. If SSL's are identified, the unit will either:
    - Attempt an alternative source demonstration, or

  - Transition to the Assessment of Corrective Measures program and make the appropriate transition notifications.
- The AMBAP CCR Unit remains in the Assessment Monitoring Program per the federal CCR Rule at this time.

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

- A map/aerial photograph showing the BAP Complex CCR management unit, all groundwater monitoring wells, and monitoring well identification numbers.
- 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**).
- Statistical analysis reports completed in 2020 for the May 2020 groundwater monitoring event (**Appendix 2**).
- Discussion of any alternative source demonstrations completed (Appendix 3). This is not applicable.
- The notification of the establishment of an assessment monitoring program (**Appendix 4**).
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened, if applicable (Appendix 5). This is not applicable.
- Other information required to be included in the annual report such as assessment of corrective measures, if applicable.

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

II. <u>Groundwater Monitoring Well Locations and Identification Numbers</u>

Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations, and their corresponding identification numbers. The monitoring well distribution adequately covers downgradient and upgradient areas as detailed in the *Groundwater Monitoring Network Evaluation Report* that was placed in the American Electric Power CCR public internet site on March 9, 2017. The *Groundwater Monitoring Network Evaluation Report* was updated in October 2020 to display the AMBAP CCR unit boundary appropriately. The revised report did not change the groundwater monitoring network or any aspect of the groundwater monitoring program. The CCR unit boundary was simply displayed incorrectly and was corrected in this revision. The CCR groundwater quality monitoring network includes the following:

- Four upgradient wells MW-6, MW-1601, MW-1602A, and MW-1603A; and
- Six downgradient wells MW-1, MW-4, MW-5, MW-1604, MW-1605, and MW-1606.

Legend

Monitoring Well Network

- Upgradient Sampling Location
- Downgradient Sampling Location
- Ash Pond System

Notes

- Monitoring well coordinates provided by AEP.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.
- Rev. 1: Updated CCR Unit boundary. September 13, 2018

Site Layout
Ash Pond System

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2018/12/24

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2018\AEP-Amos_BAP_Site_Layout.mxd. ARevezzo. 12/24/2018. CHA8423.

III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned in 2019 at the Amos Plant Bottom Ash Pond Complex. The network design, as summarized in the *Groundwater Monitoring Network Evaluation Report* (*October 2020*) and as posted at the CCR web site for John E. Amos Plant, did not change. That evaluation report, viewable on the AEP CCR web site, discusses the facility location, the hydrogeological setting, the hydrostratigraphic units, the uppermost aquifer, and the design of the groundwater monitoring well network including downgradient and upgradient monitoring well locations.

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

Appendix 1 contains tables showing the groundwater quality data collected and received during the establishment of background quality and the groundwater monitoring samples collected and received through 2020. Static water elevation data from each monitoring event in 2020 are also shown in **Appendix 1**, along with the groundwater velocity calculations, groundwater flow direction and potentiometric maps developed after each sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the assessment monitoring samples taken in May 2020 was completed in September 2020. No SSLs above a GWPS were identified.

However, the following statistically significant increases occurred for Appendix III indicator parameters:

- Calcium at MW-1, MW-1604, MW-1605, and MW-1606
- Chloride at MW-1, MW-1605, and MW-1606
- Sulfate at MW-1, MW-1605, and MW-1606
- Total dissolved solids (TDS) at MW-1, MW-1605, and MW-1606

The full report is included in **Appendix 2**. Statistical analysis of the groundwater monitoring samples from the October 2020 assessment monitoring event is ongoing and will be completed in early 2021, within 90 days of completing sampling and analysis.

VI. Alternative Source Demonstration

No alternative source demonstrations were performed in 2020.

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

The Amos BAP transitioned from detection monitoring to assessment monitoring on April 13, 2018. The notification per 40 CFR 257.94(e)(3) is included in **Appendix 4**.

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

VIII. Other Information Required

The BAP has progressed from detection monitoring to its current status in assessment monitoring since April 2018. All required information has been included in this annual groundwater monitoring report.

IX. Description of Any Problems Encountered in 2020 and Actions Taken

The May 2020 assessment monitoring event encountered a shipping issue. The MW-5 sample along with a duplicate sample and an equipment blank were in a cooler that was rerouted by the shipping company. The samples were not available to the laboratory in time, so resample was necessary. The resample occurred in July 2020. The July 2020 sample data is included in the compliance sampling monitoring data set.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2021 include:

- Complete statistical analysis on the sampling results from the October 2020 assessment monitoring event
- Respond to any new data received in light of what the CCR rule requires.
- Preparation of the 2021 annual groundwater report.

APPENDIX 1 - GW Quality Data, GW Flow Directions, GW Flow Rates

Figures and Tables follow showing data collected and the rate and direction of groundwater flow. The dates that the samples were collected is shown, as well as, whether the data were collected under background, detection, or assessment monitoring.

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.042	41.6	61.6	< 0.05 U	5.0	146	320
8/22/2016	Background	0.051	41.6	60.3	< 0.05 U	4.9	148	320
10/19/2016	Background	0.031	43.7	64.9	< 0.05 U	5.1	150	348
11/7/2016	Background	--	--	--	--	5.1	--	--
12/13/2016	Background	0.053	42.9	69.0	< 0.05 U	5.0	153	318
2/7/2017	Background	0.056	40.4	62.9	0.03 J	5.5	139	314
3/13/2017	Background	0.108	38.1	64.2	0.02 J	5.2	140	330
5/22/2017	Background	0.082	35.7	62.6	0.03 J	6.1	138	316
6/20/2017	Background	0.092	38.2	65.1	< 0.02 U	5.2	147	348
11/1/2017	Detection	0.039	43.7	75.8	0.03 J	5.0	156	358
1/9/2018	Detection	--	43.2	83.2	--	4.9	164	362
5/3/2018	Assessment	0.095	39.9	71.8	0.02 J	7.3	154	328
9/4/2018	Assessment	0.094	38.3	67.9	0.03 J	5.1	145	338
3/14/2019	Assessment	0.2 J	38.4	55.2	0.03 J	5.2	138	321
6/10/2019	Assessment	0.08 J	35.9	64.4	0.03 J	10.2	141	330
7/22/2019	Assessment	0.05 J	36.8	57.4	0.02 J	4.9	143	362
2/12/2020	Assessment	--	--	--	0.03 J	5.3	--	--
5/7/2020	Assessment	0.126	32.9	53.4	0.02 J	5.0	137	336
10/27/2020	Assessment	0.04 J	39.9	64.0	0.03 J	4.8	161	374

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

Table 1 - Groundwater Data Summary: MW-1
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.02 J	0.13	30.2	0.107	2.09	0.1	10.7	0.528	< 0.05 U	0.134	0.004	< 0.002 U	1.67	0.09 J	0.04 J
8/22/2016	Background	0.01 J	0.12	28.5	0.105	2.02	0.1	12.3	0.725	< 0.05 U	0.081	0.003	< 0.002 U	1.48	0.1	0.04 J
10/19/2016	Background	0.02 J	0.15	31.1	0.119	2.33	0.510	13.9	1.86	< 0.05 U	0.133	0.0008 J	< 0.002 U	2.33	0.1	0.066
11/7/2016	Background	--	--	--	--	--	--	--	0.615	--	--	--	--	--	--	--
12/13/2016	Background	0.01 J	0.16	28.9	0.115	2.55	1.24	14.6	0.136	< 0.05 U	0.102	0.014	< 0.002 U	1.38	0.2	0.04 J
2/7/2017	Background	0.01 J	0.20	25.4	0.115	2.43	0.141	14.9	0.609	0.03 J	0.093	0.004	< 0.002 U	0.79	0.1	0.056
3/13/2017	Background	0.02 J	0.14	26.3	0.112	2.36	0.566	12.5	0.675	0.02 J	0.129	0.002	< 0.002 U	1.15	0.1	0.03 J
5/22/2017	Background	0.03 J	0.09	25.8	0.114	2.54	0.113	9.69	0.707	0.03 J	0.066	0.006	0.002 J	0.31	0.1 J	0.04 J
6/20/2017	Background	0.02 J	0.10	27.7	0.123	2.65	0.173	9.38	0.587	< 0.02 U	0.062	0.005	< 0.002 U	0.34	0.09 J	0.04 J
5/3/2018	Assessment	0.01 J	0.13	27.8	0.143	3.12	0.093	15.1	1.74	0.02 J	0.068	0.004	< 0.002 U	0.62	0.2	0.04 J
9/4/2018	Assessment	0.22	0.18	29.4	0.130	2.97	0.548	17.7	0.575	0.03 J	1.16	0.003	--	0.34	0.2	0.05 J
3/14/2019	Assessment	0.05 J	0.12	26.9	0.131	3.48	0.255	10.3	0.887	0.03 J	0.252	< 0.09 U	--	0.5 J	0.09 J	< 0.1 U
6/10/2019	Assessment	0.02 J	0.11	27.5	0.125	2.14	0.2 J	12.8	0.998	0.03 J	0.08 J	< 0.009 U	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U
7/22/2019	Assessment	< 0.02 U	0.09 J	26.4	0.136	2.47	0.06 J	13.5	0.825	0.02 J	0.08 J	0.00257	--	< 0.4 U	0.2 J	< 0.1 U
2/12/2020	Assessment	< 0.02 U	0.09 J	25.7	0.139	2.22	0.2 J	18.6	1.1	0.03 J	0.07 J	0.00259	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U
5/7/2020	Assessment	< 0.02 U	0.06 J	25.7	0.126	2.43	0.1 J	13.9	0.499	0.02 J	< 0.05 U	0.00239	--	< 0.4 U	0.08 J	< 0.1 U
10/27/2020	Assessment	< 0.02 U	0.09 J	25.4	0.130	2.42	0.1 J	20.5	1.722	0.03 J	< 0.05 U	0.00270	--	< 0.4 U	0.1 J	< 0.1 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2016	Background	0.074	16.2	11.7	0.07 J	5.9	44.8	190
8/23/2016	Background	0.054	17.9	10.9	0.04 J	5.5	39.2	184
10/18/2016	Background	0.070	15.2	12.2	< 0.05 U	5.7	44.5	206
11/8/2016	Background	--	--	12.8	0.03 J	5.7	47.3	170
12/12/2016	Background	0.079	16.3	14.0	0.04 J	5.5	48.0	348
2/8/2017	Background	0.087	15.3	13.4	0.06 J	5.6	46.1	176
3/14/2017	Background	0.093	15.8	12.9	0.05 J	5.8	43.5	185
5/22/2017	Background	0.099	15.3	13.2	0.04 J	6.3	43.9	192
6/19/2017	Background	0.097	15.0	13.3	0.03 J	5.5	50.9	196
11/1/2017	Detection	0.073	14.2	12.3	0.06	5.5	43.0	210
5/3/2018	Assessment	0.100	15.9	14.4	0.06 J	5.9	49.2	178
9/5/2018	Assessment	0.067	13.3	13.4	0.06	7.0	42.4	179
3/15/2019	Assessment	< 0.2 U	14.5	13.3	0.06 J	5.5	42.8	184
6/10/2019	Assessment	0.06 J	14.4	13.0	0.06	6.8	43.3	172
7/23/2019	Assessment	0.06 J	14.8	13.4	0.04 J	5.4	44.5	186
2/11/2020	Assessment	--	--	--	0.04 J	5.9	--	--
5/6/2020	Assessment	0.135	17.6	16.9	0.04 J	5.5	54.6	213
10/30/2020	Assessment	0.085	16.0	12.9	0.05 J	5.4	39.0	187

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

Table 1 - Groundwater Data Summary: MW-4
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/25/2016	Background	0.05 J	13.6	101	0.068	0.18	0.5	26.6	0.539	0.07 J	0.502	0.007	< 0.002 U	11.1	0.07 J	0.055
8/23/2016	Background	0.02 J	4.34	90.8	0.051	0.03	0.3	5.55	0.405	0.04 J	0.275	0.002	< 0.002 U	19.2	0.08 J	0.01 J
10/18/2016	Background	0.11	15.8	84.1	0.055	0.53	0.600	85.9	1.884	< 0.05 U	0.395	0.002	< 0.002 U	2.44	0.1	0.156
11/8/2016	Background	--	--	--	--	--	--	--	0.457	0.03 J	--	--	--	--	--	--
12/12/2016	Background	0.03 J	3.35	96.0	0.049	0.09	1.18	10.9	2.116	0.04 J	0.255	0.012	< 0.002 U	0.75	0.1 J	0.090
2/8/2017	Background	0.02 J	8.17	82.5	0.045	0.12	0.290	18.9	0.46	0.06 J	0.306	0.001	< 0.002 U	0.93	0.07 J	0.099
3/14/2017	Background	0.03 J	5.36	91.0	0.043	0.16	0.327	23.3	1.339	0.05 J	0.192	0.0005 J	< 0.002 U	0.51	0.07 J	0.072
5/22/2017	Background	0.04 J	6.38	96.2	0.053	0.09	0.226	20.8	0.55	0.04 J	0.188	0.008	< 0.002 U	0.49	0.08 J	0.068
6/19/2017	Background	0.02 J	5.65	88.5	0.049	0.08	0.216	22.1	0.929	0.03 J	0.247	0.002	< 0.002 U	0.31	0.1	0.069
5/3/2018	Assessment	< 0.01 U	1.15	93.1	0.046	0.04	0.175	7.93	1.569	0.06 J	0.153	0.0008 J	< 0.002 U	0.31	0.06 J	0.01 J
9/5/2018	Assessment	0.05 J	11.0	89.1	0.037	0.21	0.200	25.8	0.623	0.06	0.083	0.003	--	0.28	0.06 J	0.109
3/15/2019	Assessment	< 0.02 U	1.63	80.4	0.05 J	0.05	0.2 J	9.81	0.501	0.06 J	0.219	< 0.09 U	--	< 0.4 U	0.06 J	< 0.1 U
6/10/2019	Assessment	< 0.02 U	2.50	90.5	0.06 J	0.07	0.274	10.5	0.787	0.06	0.406	< 0.009 U	< 0.002 U	< 0.4 U	0.08 J	< 0.1 U
7/23/2019	Assessment	0.03 J	2.48	84.6	0.07 J	0.05	0.236	7.24	0.486	0.04 J	0.430	0.00162	--	< 0.4 U	0.1 J	< 0.1 U
2/11/2020	Assessment	< 0.02 U	0.92	96.9	0.04 J	0.05 J	0.2 J	8.30	1.883	0.04 J	0.2 J	0.00151	< 0.002 U	0.9 J	0.06 J	< 0.1 U
5/6/2020	Assessment	< 0.02 U	5.20	110	0.09 J	0.05	0.367	8.17	2.176	0.04 J	0.545	0.00139	--	1 J	0.2 J	< 0.1 U
10/30/2020	Assessment	0.08 J	21.7	83.5	0.07 J	0.61	0.308	42.4	0.2618	0.05 J	0.416	0.00166	--	< 0.4 U	0.09 J	0.2 J

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.051	19.7	21.4	0.04 J	5.8	57.7	156
8/23/2016	Background	0.014	18.4	21.3	0.04 J	5.4	57.5	136
10/18/2016	Background	0.018	18.6	20.0	< 0.05 U	5.9	56.0	188
11/8/2016	Background	--	--	20.1	0.05 J	5.8	56.5	176
12/12/2016	Background	0.002 J	18.1	20.4	0.03 J	5.7	54.1	154
2/8/2017	Background	0.032	16.3	19.6	0.05 J	5.8	51.1	158
3/14/2017	Background	0.028	16.5	19.5	0.03 J	5.9	51.5	172
5/22/2017	Background	0.046	16.8	18.9	0.04 J	6.6	51.1	180
6/19/2017	Background	0.060	11.4	19.1	0.03 J	5.6	57.3	170
11/1/2017	Detection	0.033	15.7	17.5	0.05 J	5.7	53.9	190
5/3/2018	Assessment	0.156	16.6	17.8	0.04 J	6.3	51.9	166
9/4/2018	Assessment	0.028	15.2	17.8	0.05 J	5.8	45.4	151
3/15/2019	Assessment	< 0.2 U	16.2	18.5	0.05 J	5.7	51.3	180
6/10/2019	Assessment	0.04 J	15.7	16.9	0.05 J	5.9	48.4	178
7/23/2019	Assessment	< 0.04 U	14.9	15.3	0.04 J	5.6	45.2	162
2/11/2020	Assessment	--	--	--	0.04 J	6.0	--	--
5/6/2020	Assessment	--	--	--	--	5.5	--	--
7/7/2020	Assessment	0.055	14.7	14.6	0.03 J	6.1	45.7	156
10/27/2020	Assessment	0.04 J	14.3	14.3	0.04 J	5.5	43.5	177

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

Table 1 - Groundwater Data Summary: MW-5
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/26/2016	Background	0.03 J	2.71	170	0.039	0.01 J	0.2	0.966	1.264	0.04 J	0.123	0.0005 J	< 0.002 U	2.15	< 0.03 U	0.04 J
8/23/2016	Background	0.01 J	2.42	157	0.029	0.007 J	0.2	1.01	0.406	0.04 J	0.056	0.004	< 0.002 U	2.57	< 0.03 U	0.01 J
10/18/2016	Background	0.05	4.00	166	0.079	0.007 J	0.841	1.45	1.123	< 0.05 U	0.667	0.004	< 0.002 U	2.20	0.09 J	0.01 J
11/8/2016	Background	--	--	--	--	--	--	--	1.099	0.05 J	--	--	--	--	--	--
12/12/2016	Background	0.08	3.41	166	0.053	0.006 J	0.892	1.14	1.46	0.03 J	0.264	0.006	< 0.002 U	1.01	0.04 J	0.02 J
2/8/2017	Background	0.04 J	3.26	141	0.051	0.006 J	0.237	0.981	3.676	0.05 J	0.216	0.003	< 0.002 U	0.99	< 0.03 U	0.01 J
3/14/2017	Background	0.03 J	2.79	152	0.033	0.007 J	0.170	0.949	1.055	0.03 J	0.022	0.002	< 0.002 U	0.49	< 0.03 U	0.01 J
5/22/2017	Background	0.04 J	2.74	151	0.052	0.007 J	0.195	1.11	1.062	0.04 J	0.236	0.013	< 0.002 U	0.31	0.03 J	< 0.01 U
6/19/2017	Background	0.02 J	3.25	155	0.053	0.006 J	0.237	0.997	1.099	0.03 J	0.207	0.002	< 0.002 U	0.22	0.05 J	< 0.01 U
5/3/2018	Assessment	0.02 J	3.18	149	0.049	0.006 J	0.237	1.03	1.631	0.04 J	0.147	0.0004 J	< 0.002 U	0.31	0.05 J	< 0.01 U
9/4/2018	Assessment	0.02 J	2.34	157	0.034	0.01 J	0.122	1.03	0.3383	0.05 J	0.038	0.002	--	0.15	< 0.03 U	0.03 J
3/15/2019	Assessment	0.02 J	3.63	162	0.06 J	< 0.01 U	0.344	1.21	0.853	0.05 J	0.124	< 0.09 U	--	< 0.4 U	< 0.03 U	< 0.1 U
6/10/2019	Assessment	< 0.02 U	2.85	155	0.04 J	< 0.01 U	0.1 J	1.13	0.89	0.05 J	0.04 J	< 0.009 U	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U
7/23/2019	Assessment	0.10	6.74	158	0.121	< 0.01 U	0.291	1.12	0.811	0.04 J	0.762	0.00153	--	< 0.4 U	0.08 J	< 0.1 U
2/11/2020	Assessment	0.03 J	4.35	130	0.06 J	< 0.01 U	0.273	1.21	1.855	0.04 J	0.201	0.00147	< 0.002 U	< 0.4 U	< 0.03 U	< 0.1 U
7/7/2020	Assessment	< 0.02 U	2.77	140	0.04 J	< 0.01 U	0.1 J	1.39	1.12	0.03 J	0.08 J	0.00157	--	0.5 J	0.06 J	< 0.1 U
10/27/2020	Assessment	< 0.02 U	3.18	134	0.04 J	< 0.01 U	0.214	1.42	2.254	0.04 J	< 0.05 U	0.00138	--	< 0.4 U	< 0.03 U	< 0.1 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.117	12.2	8.88	0.08 J	6.2	2.8	204
8/24/2016	Background	0.023	12.2	10.7	0.03 J	5.5	6.1	244
10/19/2016	Background	0.006	11.3	8.67	0.04 J	6.1	3.7	196
11/8/2016	Background	--	--	--	--	6.0	--	--
12/13/2016	Background	< 0.002 U	12.4	9.79	0.04 J	5.9	2.1	190
2/8/2017	Background	0.051	11.6	10.3	0.06 J	6.0	2.8	170
3/14/2017	Background	0.048	11.5	9.90	0.05 J	6.1	2.1	203
5/23/2017	Background	0.037	11.9	11.5	0.04 J	6.2	4.4	238
6/20/2017	Background	0.183	11.6	9.61	0.07	6.0	2.5	222
11/1/2017	Detection	0.017	12.2	11.6	0.07	5.9	5.5	258
5/3/2018	Assessment	0.056	12.0	10.1	0.07	6.3	2.9	188
9/4/2018	Assessment	< 0.002 U	11.3	8.97	0.09	6.0	1.3	176
3/15/2019	Assessment	< 0.2 U	12.4	10.4	0.05 J	5.9	1.6	226
6/10/2019	Assessment	< 0.02 U	11.8	9.68	0.08	9.3	2.2	205
7/24/2019	Assessment	0.04 J	12.1	9.71	0.05 J	5.9	2.2	199
2/12/2020	Assessment	--	--	--	0.06	6.2	--	--
5/5/2020	Assessment	0.04 J	11.7	8.55	0.09	5.5	1.3	202
10/28/2020	Assessment	< 0.02 U	12.8	10.8	0.06 J	5.8	2.6	244

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

Table 1 - Groundwater Data Summary: MW-6
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.03 J	33.6	191	0.065	0.01 J	1.5	13.6	1.3779	0.08 J	1.25	0.002	< 0.002 U	1.77	0.2	0.075
8/24/2016	Background	0.01 J	33.4	185	0.037	0.01 J	1.0	12.4	0.961	0.03 J	0.581	0.003	< 0.002 U	0.97	0.2	0.070
10/19/2016	Background	0.01 J	34.4	171	0.026	0.006 J	0.647	11.0	1.941	0.04 J	0.281	0.0005 J	< 0.002 U	0.78	0.2	0.185
11/8/2016	Background	--	--	--	--	--	--	--	1.026	--	--	--	--	--	--	--
12/13/2016	Background	0.02 J	33.9	169	0.038	0.007 J	1.88	10.6	1.635	0.04 J	0.515	0.006	< 0.002 U	0.53	0.2	0.060
2/8/2017	Background	0.02 J	32.8	157	0.038	0.007 J	0.817	12.3	20.83	0.06 J	0.574	0.004	< 0.002 U	0.60	0.2	0.055
3/14/2017	Background	0.02 J	36.3	168	0.037	0.006 J	1.54	12.0	1.178	0.05 J	0.416	< 0.0002 U	< 0.002 U	0.62	0.2	0.054
5/23/2017	Background	0.04 J	33.6	183	0.032	0.006 J	0.748	13.1	1.013	0.04 J	0.305	0.006	< 0.002 U	0.41	0.2	0.053
6/20/2017	Background	0.02 J	32.4	169	0.022	< 0.005 U	0.496	10.7	1.345	0.07	0.157	0.0003 J	< 0.002 U	0.44	0.1	0.055
5/3/2018	Assessment	0.01 J	34.1	163	0.028	< 0.005 U	0.455	11.9	2.0087	0.07	0.216	< 0.0002 U	< 0.002 U	0.50	0.2	0.092
9/4/2018	Assessment	0.16	29.8	147	0.01 J	0.03	0.380	9.16	0.769	0.09	0.214	< 0.0002 U	--	0.46	0.1	0.084
3/15/2019	Assessment	0.06 J	32.0	184	0.106	0.02 J	1.82	14.0	0.865	0.05 J	1.72	< 0.09 U	--	0.5 J	0.4	0.1 J
6/10/2019	Assessment	0.03 J	34.3	161	< 0.02 U	< 0.01 U	0.309	9.72	0.688	0.08	0.104	< 0.009 U	< 0.002 U	0.5 J	0.1 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	34.2	164	0.03 J	< 0.01 U	0.418	8.97	0.657	0.05 J	0.2 J	0.00114	--	0.4 J	0.1 J	< 0.1 U
2/11/2020	Assessment	< 0.02 U	38.5	165	< 0.02 U	< 0.01 U	0.433	9.52	1.539	0.06	0.07 J	0.00118	< 0.002 U	0.5 J	0.09 J	< 0.1 U
5/5/2020	Assessment	0.17	37.2	149	< 0.02 U	< 0.01 U	0.429	8.80	2.62	0.09	0.390	0.00102	--	1 J	0.09 J	< 0.1 U
10/28/2020	Assessment	< 0.02 U	33.5	152	< 0.02 U	< 0.01 U	0.406	8.57	0.573	0.06 J	< 0.05 U	0.00113	--	0.4 J	0.05 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1601
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.070	11.8	7.17	0.06 J	5.8	54.5	120
8/24/2016	Background	0.035	10.9	6.54	0.05 J	5.6	49.1	142
10/18/2016	Background	< 0.002 U	10.1	6.56	0.05 J	6.0	39.6	136
11/7/2016	Background	--	--	6.79	0.05 J	5.9	39.7	122
12/13/2016	Background	< 0.002 U	10.4	7.79	0.04 J	5.8	43.6	140
2/7/2017	Background	0.109	11.6	9.09	0.05 J	6.0	55.6	168
3/13/2017	Background	0.107	11.2	9.89	0.04 J	6.0	57.4	169
5/23/2017	Background	0.170	11.2	9.75	0.04 J	5.9	52.8	182
6/20/2017	Background	0.107	10.4	8.59	0.04 J	5.9	51.3	184
11/2/2017	Detection	0.087	8.91	9.91	0.05 J	5.8	39.1	164
5/4/2018	Assessment	0.070	11.0	10.3	0.05 J	6.1	53.0	159
9/5/2018	Assessment	< 0.002 U	11.6	10.4	0.04 J	7.8	52.2	157
3/19/2019	Assessment	0.05 J	11.9	8.80	< 0.01 U	5.8	52.7	176
6/12/2019	Assessment	< 0.02 U	11.0	10.0	0.05 J	6.7	48.8	185
7/24/2019	Assessment	< 0.04 U	10.3	10.3	0.05 J	5.9	44.6	154
2/12/2020	Assessment	--	--	--	0.05 J	5.9	--	--
5/6/2020	Assessment	0.03 J	9.42	19.0	0.04 J	5.6	25.9	143
10/28/2020	Assessment	< 0.02 U	10.8	28.3	0.05 J	5.6	24.1	156

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

Table 1 - Groundwater Data Summary: MW-1601
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.01 J	4.57	128	0.030	0.02	0.4	7.24	0.106	0.06 J	0.366	0.003	< 0.002 U	0.32	0.07 J	0.01 J
8/24/2016	Background	< 0.01 U	5.14	120	0.02 J	0.02 J	0.3	6.19	0.975	0.05 J	0.109	0.007	< 0.002 U	0.62	0.09 J	0.02 J
10/18/2016	Background	0.01 J	5.64	118	0.027	0.02 J	0.688	4.04	2.413	0.05 J	0.265	0.003	< 0.002 U	0.26	0.1 J	0.065
11/7/2016	Background	--	--	--	--	--	--	--	0.842	0.05 J	--	--	--	--	--	--
12/13/2016	Background	0.02 J	5.38	113	0.027	0.02 J	1.35	4.67	1.101	0.04 J	0.272	0.009	< 0.002 U	0.16	0.1	0.02 J
2/7/2017	Background	< 0.01 U	5.09	107	0.025	0.02 J	0.224	6.20	35.021	0.05 J	0.227	0.004	< 0.002 U	0.21	0.1	0.01 J
3/13/2017	Background	< 0.01 U	5.54	117	0.023	0.02 J	0.588	6.47	0.7405	0.04 J	0.161	0.004	< 0.002 U	0.16	0.05 J	0.01 J
5/23/2017	Background	0.02 J	7.08	122	0.051	0.02	0.740	5.48	0.573	0.04 J	0.687	0.007	< 0.002 U	0.21	0.2	0.02 J
6/20/2017	Background	0.02 J	5.57	113	0.02 J	0.02 J	0.215	4.72	1.037	0.04 J	0.142	0.003	< 0.002 U	0.17	0.06 J	0.02 J
5/4/2018	Assessment	0.01 J	6.44	112	0.038	0.02	0.353	4.43	1.723	0.05 J	0.397	0.010	< 0.002 U	0.20	0.1	0.02 J
9/5/2018	Assessment	0.02 J	5.39	90.4	0.01 J	0.02	0.270	6.73	0.252	0.04 J	0.045	0.002	--	0.08 J	< 0.03 U	0.02 J
3/19/2019	Assessment	< 0.02 U	6.55	122	0.02 J	0.01 J	0.1 J	3.41	0.666	< 0.01 U	0.105	0.02 J	--	< 0.4 U	0.04 J	< 0.1 U
6/12/2019	Assessment	< 0.02 U	6.02	118	0.04 J	0.02 J	0.2 J	2.75	0.533	0.05 J	0.154	< 0.009 U	< 0.002 U	< 0.4 U	0.08 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	6.63	130	0.02 J	0.01 J	0.2 J	3.01	1.005	0.05 J	0.2 J	0.00141	--	< 0.4 U	0.06 J	< 0.1 U
2/12/2020	Assessment	0.03 J	8.26	122	0.05 J	0.02 J	0.938	3.19	0.398	0.05 J	0.602	0.00159	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U
5/6/2020	Assessment	< 0.02 U	7.83	115	< 0.02 U	0.01 J	0.272	2.78	2.682	0.04 J	0.2 J	0.00121	--	0.5 J	0.04 J	< 0.1 U
10/28/2020	Assessment	< 0.02 U	8.68	127	0.03 J	0.01 J	0.369	3.04	0.447	0.05 J	0.227	0.00138	--	< 0.4 U	0.07 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1602A
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.063	18.2	38.4	0.18	7.0	18.7	172
8/24/2016	Background	0.015	18.2	37.9	0.17	6.1	17.7	200
10/19/2016	Background	0.003 J	17.3	37.2	0.1 J	6.7	15.0	242
11/9/2016	Background	--	--	--	--	6.3	--	--
12/13/2016	Background	< 0.002 U	18.8	39.1	0.1 J	6.5	10.7	170
2/8/2017	Background	0.051	17.7	37.3	0.1 J	6.7	9.8	144
3/15/2017	Background	0.039	16.1	38.1	0.1 J	6.8	11.4	209
5/23/2017	Background	0.081	18.5	38.8	0.1 J	6.7	11.4	224
6/20/2017	Background	0.090	18.5	38.3	0.1 J	6.5	13.5	178
11/2/2017	Detection	0.050	18.6	38.0	0.1 J	6.5	12.8	254
5/10/2018	Assessment	0.127	19.5	39.1	0.16	7.2	13.2	184
9/5/2018	Assessment	< 0.002 U	18.1	40.0	0.14	6.4	12.7	176
3/19/2019	Assessment	0.03 J	19.6	41.0	0.14	6.6	13.2	232
6/11/2019	Assessment	< 0.02 U	18.8	41.9	0.16	9.5	13.8	217
7/23/2019	Assessment	< 0.04 U	16.7	39.4	0.13	6.3	10.3	201
2/12/2020	Assessment	--	--	--	0.14	6.7	--	--
5/6/2020	Assessment	0.03 J	19.3	43.2	0.11	6.3	12.7	209
10/30/2020	Assessment	< 0.02 U	20.5	42.8	0.13	6.4	12.3	220

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

Table 1 - Groundwater Data Summary: MW-1602A
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.12	17.6	220	0.085	0.02 J	1.7	4.19	7.914	0.18	7.94	0.004	< 0.002 U	3.62	0.2	0.02 J
8/24/2016	Background	0.04 J	18.1	209	0.036	0.006 J	1.1	3.04	0.569	0.17	2.80	0.003	< 0.002 U	2.80	0.2	0.01 J
10/19/2016	Background	0.10	18.3	213	0.064	0.01 J	1.46	2.38	2.65	0.1 J	6.56	0.003	0.003 J	2.00	0.2	0.063
11/9/2016	Background	--	--	--	--	--	--	--	0.874	--	--	--	--	--	--	--
12/13/2016	Background	0.08	19.3	217	0.048	0.01 J	2.24	2.00	0.989	0.1 J	4.53	0.006	0.002 J	1.90	0.2	0.02 J
2/8/2017	Background	0.05	19.1	194	0.051	0.009 J	0.981	1.87	6.853	0.1 J	4.07	0.005	< 0.002 U	1.68	0.2	0.224
3/15/2017	Background	0.04 J	21.5	198	0.055	0.008 J	0.951	1.47	1.094	0.1 J	2.65	0.0005 J	0.002 J	1.22	0.2	0.01 J
5/23/2017	Background	0.04 J	20.8	221	0.029	0.006 J	0.568	1.23	1.833	0.1 J	2.11	0.005	< 0.002 U	1.22	0.1	< 0.01 U
6/20/2017	Background	0.07	20.3	224	0.043	0.01 J	0.807	1.30	0.901	0.1 J	2.68	< 0.0002 U	< 0.002 U	1.55	0.2	0.01 J
5/10/2018	Assessment	0.03 J	20.4	223	0.022	< 0.005 U	0.437	0.940	0.438	0.16	0.982	0.004	< 0.002 U	0.91	0.1	< 0.01 U
9/5/2018	Assessment	0.08	20.5	223	0.055	0.01 J	0.855	1.05	0.941	0.14	5.99	0.001	--	0.71	0.2	0.03 J
3/19/2019	Assessment	0.04 J	19.7	217	0.04 J	< 0.01 U	0.472	0.691	0.5231	0.14	2.64	< 0.009 U	--	0.7 J	0.09 J	< 0.1 U
6/11/2019	Assessment	< 0.04 U	20.6	229	< 0.04 U	< 0.02 U	0.3 J	0.523	1.144	0.16	0.677	< 0.009 U	< 0.002 U	< 0.8 U	< 0.06 U	< 0.2 U
7/23/2019	Assessment	< 0.02 U	21.7	213	< 0.02 U	< 0.01 U	0.297	0.545	0.888	0.13	1.08	0.000908	--	0.7 J	0.06 J	< 0.1 U
2/12/2020	Assessment	0.03 J	21.9	234	0.03 J	< 0.01 U	0.758	0.632	0.699	0.14	1.23	0.00127	< 0.002 U	0.7 J	0.05 J	< 0.1 U
5/6/2020	Assessment	0.02 J	21.8	238	< 0.02 U	< 0.01 U	0.361	0.468	1.429	0.11	1.22	0.000954	--	0.9 J	0.07 J	< 0.1 U
10/30/2020	Assessment	0.05 J	22.1	229	0.02 J	< 0.01 U	0.749	0.587	1.067	0.13	1.20	0.00117	--	0.8 J	< 0.03 U	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1603A
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.051	17.4	4.76	0.29	7.3	0.9	116
8/24/2016	Background	0.012	16.9	5.62	0.28	6.2	0.1	84
10/19/2016	Background	< 0.002 U	17.2	5.11	0.29	7.0	< 0.04 U	168
11/9/2016	Background	--	--	5.60	0.28	6.5	< 0.04 U	90
12/13/2016	Background	< 0.002 U	16.6	5.41	0.20	6.7	< 0.04 U	93
2/9/2017	Background	0.038	15.5	5.00	0.22	7.0	< 0.04 U	80
3/15/2017	Background	0.025	15.6	5.12	0.24	7.1	< 0.04 U	102
5/24/2017	Background	0.061	15.2	5.35	0.23	6.8	< 0.04 U	108
6/20/2017	Background	0.069	14.6	4.93	0.23	6.7	< 0.04 U	100
11/2/2017	Detection	0.035	15.2	5.61	0.24	6.7	< 0.04 U	150
5/2/2018	Assessment	0.051	17.2	5.18	0.28	6.8	< 0.04 U	100
9/5/2018	Assessment	< 0.002 U	15.8	4.99	0.28	6.7	< 0.04 U	89
3/15/2019	Assessment	< 0.2 U	15.5	5.65	0.27	7.1	< 0.06 U	95
6/11/2019	Assessment	< 0.02 U	15.5	5.70	0.31	8.8	< 0.06 U	95
7/24/2019	Assessment	< 0.04 U	14.4	5.73	0.28	6.8	< 0.06 U	102
2/11/2020	Assessment	--	--	--	0.24	6.9	--	--
5/6/2020	Assessment	0.02 J	15.5	5.87	0.23	6.5	< 0.06 U	121
10/30/2020	Assessment	< 0.02 U	16.3	6.03	0.25	6.9	< 0.06 U	115

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

Table 1 - Groundwater Data Summary: MW-1603A
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/26/2016	Background	0.04 J	78.0	303	0.052	0.01 J	1.2	1.04	1.619	0.29	1.35	0.002	< 0.002 U	2.11	0.09 J	0.01 J
8/24/2016	Background	0.03 J	77.6	264	0.044	0.008 J	1.0	0.725	0.726	0.28	1.07	0.007	< 0.002 U	1.36	0.1 J	< 0.01 U
10/19/2016	Background	0.04 J	73.7	258	0.096	0.01 J	1.94	1.23	2.39	0.29	2.18	< 0.0002 U	< 0.002 U	1.34	0.2	0.02 J
11/9/2016	Background	--	--	--	--	--	--	--	1.039	0.28	--	--	--	--	--	--
12/13/2016	Background	0.05 J	78.3	270	0.102	0.01 J	3.27	1.13	0.524	0.20	1.81	0.009	< 0.002 U	1.22	0.2	0.03 J
2/9/2017	Background	0.01 J	78.3	229	0.055	0.008 J	0.915	0.746	0.693	0.22	1.19	0.0005 J	< 0.002 U	1.15	0.2	0.075
3/15/2017	Background	0.04 J	83.4	245	0.070	0.01 J	1.42	1.02	0.974	0.24	1.25	0.002	0.002 J	1.27	0.1	0.01 J
5/24/2017	Background	0.05	63.3	233	0.033	0.009 J	0.999	0.619	0.72	0.23	0.900	0.011	< 0.002 U	1.56	0.09 J	< 0.01 U
6/20/2017	Background	0.03 J	81.3	257	0.054	0.02	1.12	0.846	0.603	0.23	0.970	0.004	< 0.002 U	1.11	0.1	0.01 J
5/2/2018	Assessment	0.04 J	80.0	251	0.093	0.01 J	1.82	1.52	0.23065	0.28	1.60	0.0008 J	< 0.002 U	1.21	0.3	0.02 J
9/5/2018	Assessment	0.02 J	87.1	242	0.006 J	0.007 J	0.180	0.246	0.577	0.28	0.045	0.002	--	1.07	0.04 J	0.01 J
3/15/2019	Assessment	< 0.02 U	89.9	252	< 0.02 U	< 0.01 U	0.407	0.360	1.261	0.27	0.232	< 0.09 U	--	1 J	0.05 J	< 0.1 U
6/11/2019	Assessment	< 0.02 U	90.3	255	< 0.02 U	< 0.01 U	0.280	0.288	0.3562	0.31	0.163	< 0.009 U	< 0.002 U	1 J	0.04 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	85.8	249	0.04 J	< 0.01 U	0.650	0.517	0.439	0.28	0.580	0.000870	--	1 J	0.07 J	< 0.1 U
2/11/2020	Assessment	< 0.02 U	87.7	241	0.03 J	< 0.01 U	0.663	0.376	0.984	0.24	0.347	0.000630	< 0.002 U	1 J	0.06 J	< 0.1 U
5/6/2020	Assessment	< 0.02 U	90.2	241	< 0.02 U	< 0.01 U	0.362	0.255	2.242	0.23	0.2 J	0.000339	--	1 J	< 0.03 U	< 0.1 U
10/30/2020	Assessment	0.03 J	88.9	239	< 0.02 U	< 0.01 U	0.293	0.209	0.384	0.25	0.1 J	0.000324	--	1 J	< 0.03 U	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1604
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.116	20.5	23.0	0.1 J	6.2	2.2	236
8/22/2016	Background	0.074	18.0	22.9	0.05 J	6.2	0.3	168
10/18/2016	Background	0.059	18.2	22.6	0.05 J	6.3	0.3	196
11/8/2016	Background	--	--	22.5	0.05 J	6.2	0.3	206
12/13/2016	Background	0.042	17.9	24.0	0.05 J	6.1	0.9	182
2/8/2017	Background	0.094	16.6	23.1	0.09	6.2	0.7	172
3/14/2017	Background	0.083	16.1	24.1	0.08	6.4	0.9	204
5/23/2017	Background	0.129	17.4	26.1	0.08	6.1	2.2	222
6/20/2017	Background	0.152	16.2	25.2	0.09	6.2	1.2	224
11/1/2017	Detection	0.153	16.8	23.4	0.10	6.1	0.5	228
5/3/2018	Assessment	0.200	17.8	25.5	0.13	6.4	< 0.04 U	210
9/5/2018	Assessment	0.043	15.1	22.8	0.12	7.2	< 0.04 U	180
3/15/2019	Assessment	< 0.2 U	13.1	16.6	0.09	6.3	< 0.06 U	170
6/10/2019	Assessment	0.09 J	16.5	24.4	0.11	8.7	< 0.06 U	60
7/24/2019	Assessment	0.132	18.7	27.0	0.07	5.9	< 0.06 U	242
2/12/2020	Assessment	--	--	--	0.08	6.3	--	--
5/6/2020	Assessment	0.175	20.8	29.4	0.06 J	6.0	< 0.06 U	241
10/28/2020	Assessment	0.200	19.5	27.7	0.08	6.0	< 0.06 U	266

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

Table 1 - Groundwater Data Summary: MW-1604
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/26/2016	Background	0.05 J	4.43	139	0.087	0.007 J	1.9	2.06	3.5822	0.1 J	1.58	0.002	< 0.002 U	0.74	0.2	0.02 J
8/22/2016	Background	0.04 J	5.15	147	0.063	0.02 J	1.4	1.06	0.695	0.05 J	1.14	0.004	0.002 J	0.64	0.2	0.02 J
10/18/2016	Background	0.03 J	4.60	134	0.048	0.005 J	1.27	0.805	1.387	0.05 J	0.869	< 0.0002 U	< 0.002 U	0.30	0.2	0.01 J
11/8/2016	Background	--	--	--	--	--	--	--	0.512	0.05 J	--	--	--	--	--	--
12/13/2016	Background	0.02 J	4.58	137	0.038	< 0.004 U	1.20	0.632	1.743	0.05 J	0.603	0.004	< 0.002 U	0.25	0.2	0.02 J
2/8/2017	Background	0.02 J	4.52	125	0.039	< 0.004 U	0.814	0.638	1.239	0.09	0.719	0.004	< 0.002 U	0.32	0.2	0.05 J
3/14/2017	Background	0.02 J	4.46	132	0.038	< 0.004 U	0.824	0.570	0.892	0.08	0.482	0.0008 J	< 0.002 U	0.22	0.2	< 0.01 U
5/23/2017	Background	0.04 J	3.90	142	0.042	< 0.005 U	0.836	0.647	0.859	0.08	0.444	0.006	< 0.002 U	0.21	0.2	< 0.01 U
6/20/2017	Background	0.02 J	4.44	146	0.040	< 0.005 U	0.706	0.601	1.459	0.09	0.406	0.003	< 0.002 U	0.20	0.2	< 0.01 U
5/3/2018	Assessment	0.02 J	6.33	146	0.047	< 0.005 U	0.556	0.494	1.334	0.13	0.230	< 0.0002 U	< 0.002 U	0.25	0.2	0.01 J
9/5/2018	Assessment	0.03 J	6.11	135	0.043	< 0.005 U	0.649	0.533	0.248	0.12	0.349	0.0008 J	--	0.22	0.3	0.01 J
3/15/2019	Assessment	0.04 J	6.78	118	0.07 J	< 0.01 U	0.931	0.406	0.596	0.09	1.19	< 0.09 U	--	< 0.4 U	0.2	< 0.1 U
6/10/2019	Assessment	0.05 J	4.88	142	0.142	< 0.01 U	0.360	0.306	0.831	0.11	0.148	< 0.009 U	< 0.002 U	< 0.4 U	0.1 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	4.76	170	0.06 J	< 0.01 U	1.33	0.415	0.943	0.07	0.294	0.000485	--	0.4 J	0.1 J	< 0.1 U
2/12/2020	Assessment	< 0.02 U	3.88	174	0.05 J	< 0.01 U	0.798	0.538	1.375	0.08	0.319	0.000626	< 0.002 U	< 0.4 U	0.2 J	< 0.1 U
5/6/2020	Assessment	< 0.02 U	4.04	175	0.04 J	< 0.01 U	0.484	0.406	1.647	0.06 J	0.1 J	0.000430	--	< 0.4 U	0.2 J	< 0.1 U
10/28/2020	Assessment	< 0.02 U	3.98	156	0.05 J	< 0.01 U	0.595	0.387	0.261	0.08	0.232	0.000515	--	< 0.4 U	0.1 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1605
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2016	Background	0.091	63.6	111	0.09	6.2	170	490
8/22/2016	Background	0.038	50.8	114	0.08	5.9	174	440
10/17/2016	Background	0.025	57.5	108	0.06 J	6.1	161	446
11/8/2016	Background	--	--	116	0.06 J	5.9	162	456
12/12/2016	Background	< 0.002 U	53.9	125	< 0.05 U	5.8	164	920
2/7/2017	Background	0.055	47.6	110	< 0.05 U	5.9	161	472
3/13/2017	Background	0.039	45.7	106	0.03 J	5.8	173	455
5/22/2017	Background	0.071	46.4	109	0.03 J	6.6	171	458
6/19/2017	Background	0.103	48.1	111	< 0.02 U	5.5	193	462
11/1/2017	Detection	0.076	50.0	113	0.03 J	5.6	212	488
1/9/2018	Detection	--	45.9	108	--	5.5	202	462
5/3/2018	Assessment	0.109	47.0	97.7	< 0.02 U	6.1	246	434
9/5/2018	Assessment	< 0.002 U	49.4	97.1	0.03 J	5.6	213	483
3/14/2019	Assessment	< 0.2 U	45.4	92.5	< 0.01 U	5.6	222	507
6/11/2019	Assessment	0.06 J	45.5	91.8	0.02 J	5.7	226	530
7/24/2019	Assessment	0.06 J	46.5	91.6	0.02 J	5.4	226	517
2/11/2020	Assessment	--	--	--	0.02 J	5.7	--	--
5/5/2020	Assessment	0.051	49.6	85.6	0.03 J	5.3	236	526
10/27/2020	Assessment	0.051	49.7	84.2	0.02 J	5.3	234	521

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

Table 1 - Groundwater Data Summary: MW-1605
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2016	Background	0.04 J	5.70	83.2	0.035	< 0.004 U	0.4	32.1	1.722	0.09	0.201	0.008	< 0.002 U	0.66	0.05 J	< 0.01 U
8/22/2016	Background	0.03 J	4.96	69.1	0.027	< 0.004 U	0.1	24.5	0.683	0.08	0.062	0.004	< 0.002 U	0.39	0.06 J	< 0.01 U
10/17/2016	Background	0.02 J	4.98	67.3	0.034	< 0.004 U	0.244	15.8	5.063	0.06 J	0.038	0.005	< 0.002 U	0.27	0.06 J	< 0.01 U
11/8/2016	Background	--	--	--	--	--	--	--	1.249	0.06 J	--	--	--	--	--	--
12/12/2016	Background	0.03 J	4.33	73.8	0.060	0.005 J	0.645	11.5	0.853	< 0.05 U	0.159	0.011	< 0.002 U	0.30	0.1	0.062
2/7/2017	Background	0.03 J	4.03	68.8	0.063	< 0.004 U	0.381	10.3	0.586	< 0.05 U	0.298	0.004	< 0.002 U	0.36	0.1	0.04 J
3/13/2017	Background	0.01 J	3.70	75.1	0.056	< 0.004 U	0.456	9.14	1.073	0.03 J	0.059	0.005	< 0.002 U	0.12	0.03 J	< 0.01 U
5/22/2017	Background	0.03 J	3.38	80.5	0.062	< 0.005 U	0.193	8.77	0.852	0.03 J	0.071	0.003	< 0.002 U	0.15	0.04 J	0.02 J
6/19/2017	Background	0.01 J	3.64	82.2	0.061	< 0.005 U	0.250	9.07	0.746	< 0.02 U	0.050	0.004	< 0.002 U	0.12	0.08 J	< 0.01 U
5/3/2018	Assessment	0.01 J	3.34	80.4	0.069	0.009 J	0.176	9.75	1.068	< 0.02 U	0.148	0.006	< 0.002 U	0.10	0.1	0.01 J
9/5/2018	Assessment	0.02 J	3.19	103	0.074	0.02 J	0.260	10.7	0.916	0.03 J	0.080	0.003	--	0.1 J	0.07 J	0.02 J
3/14/2019	Assessment	< 0.02 U	2.95	88.1	0.08 J	< 0.01 U	0.2 J	8.83	0.3036	< 0.01 U	0.161	< 0.09 U	--	< 0.4 U	0.05 J	< 0.1 U
6/11/2019	Assessment	< 0.02 U	3.01	93.2	0.07 J	0.01 J	0.2 J	9.09	1.061	0.02 J	0.06 J	< 0.009 U	< 0.002 U	< 0.4 U	0.06 J	< 0.1 U
7/24/2019	Assessment	< 0.02 U	2.82	108	0.09 J	< 0.01 U	0.306	8.57	0.739	0.02 J	0.2 J	0.00255	--	< 0.4 U	0.08 J	< 0.1 U
2/11/2020	Assessment	< 0.02 U	2.75	89.3	0.08 J	< 0.01 U	0.205	9.47	2.668	0.02 J	0.1 J	0.00259	< 0.002 U	< 0.4 U	0.07 J	< 0.1 U
5/5/2020	Assessment	0.27	2.99	97.8	0.08 J	0.01 J	0.363	9.99	1.427	0.03 J	0.973	0.00232	--	< 0.4 U	0.09 J	< 0.1 U
10/27/2020	Assessment	< 0.02 U	2.69	92.3	0.09 J	< 0.01 U	0.334	9.65	0.81	0.02 J	0.230	0.00234	--	< 0.4 U	0.1 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1606
Amos - BAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2016	Background	0.084	43.4	55.5	0.03 J	5.7	189	410
8/23/2016	Background	0.023	45.6	56.8	< 0.05 U	5.3	186	372
10/17/2016	Background	0.013	47.3	61.5	< 0.05 U	5.6	202	390
11/7/2016	Background	--	--	--	--	5.5	--	--
12/12/2016	Background	< 0.002 U	50.4	27.0	< 0.02 U	5.3	215	418
2/7/2017	Background	0.048	42.2	57.9	< 0.05 U	5.7	179	370
3/14/2017	Background	0.036	42.2	59.5	< 0.05 U	5.6	180	384
5/23/2017	Background	0.061	49.2	75.0	< 0.05 U	5.6	199	442
6/19/2017	Background	0.108	48.3	78.8	< 0.05 U	5.3	219	440
11/1/2017	Detection	0.055	51.6	91.4	< 0.05 U	5.3	227	462
1/8/2018	Detection	--	43.9	88.3	--	8.4	190	400
5/4/2018	Assessment	0.077	53.0	119	0.03 J	7.5	232	478
9/5/2018	Assessment	0.032	51.7	133	< 0.02 U	5.4	202	507
3/15/2019	Assessment	< 0.2 U	59.0	157	< 0.01 U	5.4	232	597
6/11/2019	Assessment	0.04 J	56.6	177	0.02 J	6.7	204	571
7/24/2019	Assessment	0.04 J	52.8	186	0.02 J	5.4	191	597
2/12/2020	Assessment	--	--	--	0.02 J	5.4	--	--
5/6/2020	Assessment	0.03 J	36.7	116	0.02 J	5.2	108	372
10/26/2020	Assessment	0.03 J	32.4	100	0.02 J	5.6	98.5	335

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

Table 1 - Groundwater Data Summary: MW-1606
Amos - BAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/25/2016	Background	0.04 J	2.89	71.8	0.112	0.12	1.3	14.9	0.2045	0.03 J	1.01	0.005	< 0.002 U	0.26	0.09 J	0.03 J
8/23/2016	Background	0.02 J	2.58	67.2	0.087	0.14	0.6	14.5	1.039	< 0.05 U	0.483	0.007	< 0.002 U	0.14	0.1 J	0.01 J
10/17/2016	Background	0.03 J	2.58	69.5	0.131	0.14	1.58	13.1	1.347	< 0.05 U	1.20	0.006	0.002 J	0.15	0.2	0.02 J
11/7/2016	Background	--	--	--	--	--	--	--	1.331	--	--	--	--	--	--	--
12/12/2016	Background	0.03 J	2.55	65.8	0.100	0.17	1.03	13.9	0.651	< 0.02 U	0.588	0.010	< 0.002 U	0.12	0.2	0.04 J
2/7/2017	Background	0.03 J	3.50	57.5	0.134	0.31	1.76	14.2	0.886	< 0.05 U	1.55	0.003	< 0.002 U	0.29	0.3	0.05 J
3/14/2017	Background	0.02 J	3.52	56.3	0.091	0.16	0.920	13.4	2.45	< 0.05 U	0.572	0.003	< 0.002 U	0.14	0.1	0.01 J
5/23/2017	Background	0.02 J	2.83	59.8	0.085	0.12	0.286	14.2	0.236	< 0.05 U	0.448	0.007	< 0.002 U	0.1 J	0.1	0.01 J
6/19/2017	Background	0.03 J	3.42	61.8	0.097	0.13	0.596	13.7	0.769	< 0.05 U	0.666	< 0.0002 U	< 0.002 U	0.13	0.09 J	0.02 J
5/4/2018	Assessment	0.01 J	2.81	58.7	0.088	0.15	0.289	16.9	1.012	0.03 J	0.286	0.003	< 0.002 U	0.07 J	0.1	0.02 J
9/5/2018	Assessment	0.01 J	2.21	61.0	0.073	0.17	0.249	16.4	0.1805	< 0.02 U	0.088	0.003	--	0.04 J	0.06 J	0.01 J
3/15/2019	Assessment	0.03 J	2.94	74.6	0.152	0.19	1.24	18.2	0.295	< 0.01 U	1.06	< 0.09 U	--	< 0.4 U	0.2 J	< 0.1 U
6/11/2019	Assessment	< 0.02 U	2.44	64.1	0.08 J	0.18	0.2 J	16.5	0.4433	0.02 J	0.181	< 0.009 U	< 0.002 U	< 0.4 U	0.06 J	< 0.1 U
7/24/2019	Assessment	0.03 J	3.44	72.9	0.140	0.21	1.14	16.2	0.743	0.02 J	1.11	0.00340	--	< 0.4 U	0.2 J	< 0.1 U
2/12/2020	Assessment	0.04 J	2.82	50.2	0.112	0.19	0.680	10.1	1.515	0.02 J	0.644	0.00256	< 0.002 U	< 0.4 U	0.07 J	< 0.1 U
5/6/2020	Assessment	0.03 J	3.43	51.3	0.08 J	0.18	0.645	11.7	1.529	0.02 J	0.549	0.00239	--	< 0.4 U	0.09 J	< 0.1 U
10/26/2020	Assessment	< 0.02 U	2.26	41.8	0.06 J	0.26	0.286	11.6	0.2071	0.02 J	0.1 J	0.00228	--	< 0.4 U	< 0.03 U	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: 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: Residence Time Calculation Summary
Amos Bottom Ash Pond

			2020-02		2020-05		2020-10	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Bottom Ash Pond	MW-1 [2]	2.0	21.2	2.9	24.7	2.5	21.5	2.8
	MW-4 [2]	2.0	79.1	0.8	59.4	1.0	63.1	1.0
	MW-5 [2]	2.0	41.2	1.5	40.0	1.5	43.9	1.4
	MW-6 [1]	2.0	64.3	0.9	63.3	1.0	48.0	1.3
	MW-1601 [1]	2.0	12.8	4.8	19.7	3.1	15.4	4.0
	MW-1602A [1]	2.0	8.7	7.0	7.5	8.1	11.8	5.1
	MW-1603A [1]	2.0	127.2	0.5	139.4	0.4	345.1	0.2
	MW-1604 [2]	2.0	68.2	0.9	71.1	0.9	50.6	1.2
	MW-1605 [2]	2.0	42.7	1.4	41.1	1.5	23.0	2.6
	MW-1606 [2]	2.0	23.3	2.6	28.0	2.2	32.0	1.9

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

Legend

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

Notes

- Monitoring well coordinates and water level data (collected on February 10, 2020) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

600 300 0 600 Feet

Potentiometric Surface Map - Uppermost Aquifer February 2020

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

Geosyntec consultants

Figure **2**

Columbus, Ohio | 2020/04/22

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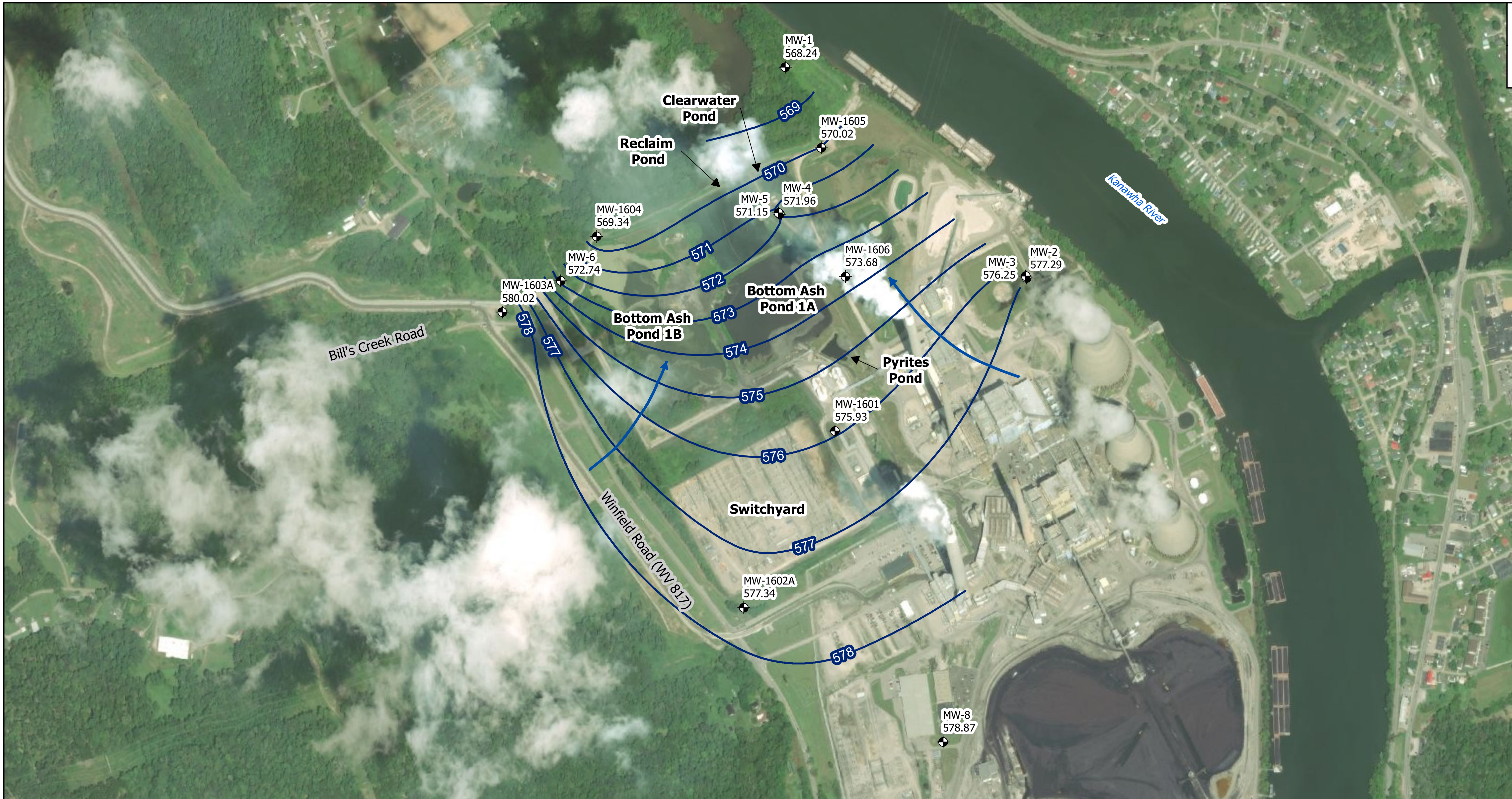

Legend

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

Notes

- Monitoring well coordinates and water level data (collected on May 4, 2020) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

600 300 0 600 Feet

Potentiometric Surface Map - Uppermost Aquifer
May 2020

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

Geosyntec consultants

Figure **3**

Columbus, Ohio | 2020/09/10

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Legend

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

Notes

- Monitoring well coordinates and water level data (collected on October 26, 2020) provided by AEP.
- MW-1603A (Elevation = 548.75 ft amsl) was not used to generate contours due to anomalous or inconsistent reading.
- Groundwater elevation units are feet above mean sea level.
- Site features based on information available in the Ash Pond- CCR Groundwater Monitoring Well Network Evaluation - Amos Plant (Arcadis, 2016) provided by AEP.

600 300 0 600 Feet

Potentiometric Surface Map - Uppermost Aquifer
October 2020

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

Geosyntec consultants

Columbus, Ohio | 2021/01/28

Figure **4**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2020\AEP-Amos_BAP_GW_2020_10October.mxd. ARevezzo. 1/28/2021. CHA8423/04/08.

APPENDIX 2 - Statistical Analysis

Statistical analysis reports completed in 2020 follow.

STATISTICAL ANALYSIS SUMMARY
BOTTOM ASH POND
Amos Plant
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

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September 2, 2020

CHA8473

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LIST OF ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
BAP	Bottom Ash Pond
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Verification
CFR	Code of Federal Regulations
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
MCL	Maximum Contaminant Level
NELAP	National Environmental Laboratory Accreditation Program
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SSL	Statistically Significant Level
SU	Standard Units
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency
UTL	Upper Tolerance Limit

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the Bottom Ash Pond (BAP), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia.

Based on detection monitoring conducted in 2017 and 2018, statistically significant increases (SSIs) over background were concluded for calcium, chloride, total dissolved solids (TDS), and sulfate at the BAP. An alternative source was not identified following the detection monitoring events, so the BAP has been in assessment monitoring since 2018. During the most recent assessment monitoring event, completed in July 2019, no statistically significant levels (SSLs) were identified during this event and the unit remained in assessment monitoring (Geosyntec, 2019). Two assessment monitoring events were conducted at the BAP in February 2020 and May/July 2020, in accordance with 40 CFR 257.95. The statistical summary of the results of these assessment sampling events are documented in this report.

Prior to conducting the statistical analyses, the groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact data usability .

The monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. Groundwater protection standards (GWPSs) were re-established for the Appendix IV parameters. Confidence intervals were calculated for Appendix IV parameters at the compliance wells to assess whether any were present at concentrations above the GWPSs. No statistically significant levels (SSLs) were identified; however, concentrations of Appendix III parameters remained above background. Thus, the unit will remain in assessment monitoring. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

BOTTOM ASH POND EVALUATION

2.1 Data Validation & QA/QC

During the assessment monitoring program, two sets of samples were collected for analysis from each upgradient and downgradient well to meet the requirements of 40 CFR 257.95(b) (February 2020) and 257.95(d)(1) (May 2020). The sample at MW-5 collected in May 2020 was delayed in transit to the lab and was received outside of hold time for a number of parameters. A replacement sample was collected from MW-5 in July 2020 and this sample was used in statistical analysis in lieu of the May data. Samples from the February 2020 event were analyzed for Appendix IV parameters only, whereas samples from the May/July 2020 sample event were analyzed for all Appendix III and detected Appendix IV parameters based on the results of the February event. A summary of data collected during these assessment monitoring events may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.26d statistics software. The export file was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.2 Statistical Analysis

Statistical analyses for the BAP were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. Time series plots and results for all completed statistical tests are provided in Attachment B.

The data obtained in February and May/July 2020 were screened for potential outliers; however, no outliers were identified in either set of data (Attachment B).

2.2.1 Establishment of GWPSs

A GWPS was established for each Appendix IV parameter in accordance with 40 CFR 257.95(h) and the *Statistical Analysis Plan* (AEP, 2017). The established GWPS was determined to be the greater value of the background concentration and the maximum contaminant level (MCL) or risk-based level specified in 40 CFR 257.95(h)(2) for each Appendix IV parameter. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events. Generally, tolerance limits were calculated parametrically with 95% coverage and 95% confidence. Non-parametric tolerance limits were calculated for antimony, arsenic, cadmium, fluoride, selenium, and thallium due to apparent non-normal distributions. Non-parametric tolerance limits were calculated for mercury because greater than 50% of the data was non-detect results. Tolerance limits and the final GWPSs are summarized in Table 2.

2.2.2 Evaluation of Potential Appendix IV SSLs

A confidence interval was constructed for each Appendix IV parameter at each compliance well. Confidence limits were generally calculated parametrically ($\alpha = 0.01$); however, non-parametric confidence limits were calculated in some cases (e.g., when the data did not appear to be normally distributed or when the non-detect frequency was too high). An SSL was concluded if the lower confidence limit (LCL) exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). Calculated confidence limits are shown in Attachment B.

No SSLs were identified at the Amos BAP.

2.2.3 Evaluation of Potential Appendix III SSIs

The Appendix III results were analyzed to assess whether concentrations of Appendix III parameters at the compliance wells exceeded background concentrations. Data collected during the May/July 2020 assessment monitoring events from each compliance well were compared to the prediction limits to assess whether the results are above background values. The results from these events and the prediction limits are summarized in Table 3. The following exceedances of the upper prediction limits (UPLs) were noted:

- Calcium concentrations exceeded the interwell UPL of 19.6 mg/L at MW-1 (32.9 mg/L), MW-1604 (20.8 mg/L), MW-1605 (49.6 mg/L), and MW-1606 (36.7 mg/L).

- Chloride concentrations exceeded the interwell UPL of 41.0 mg/L at MW-1 (53.4 mg/L), MW-1605 (85.6 mg/L), and MW-1606 (116 mg/L).

- Sulfate concentrations exceeded the intrawell UPL of 57.4 mg/L at MW-1 (137 mg/L), MW-1605 (236 mg/L), and at MW-1606 (108 mg/L).

- TDS concentrations exceeded the interwell UPL of 260 mg/L at MW-1 (336 mg/L), MW-1605 (526 mg/L), and MW-1606 (372 mg/L).

While the prediction limits were calculated for a one-of-two retesting procedure, SSIs were conservatively assumed if the May/ July 2020 sample was above the UPL or below the LPL. Based on this evaluation, concentrations of Appendix III constituents appear to be above background concentrations and the unit will remain in assessment monitoring.

2.3 Conclusions

A semi-annual assessment monitoring event was conducted in accordance with the CCR Rule. The laboratory and field data were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. A review of outliers identified no potential outliers in the 2020 data. GWPSs were re-established for the Appendix IV parameters. A confidence interval was constructed at each compliance well for each Appendix IV parameter; SSLs were concluded if the entire confidence interval exceeded the GWPSs. No SSLs were identified.

The Appendix III results were evaluated to assess whether concentrations of Appendix III parameters exceeded background levels. Calcium, chloride, sulfate, and TDS results exceeded background levels at select downgradient wells.

Based on this evaluation, the Amos BAP CCR unit will remain in assessment monitoring.

SECTION 3

REFERENCES

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

Geosyntec Consultants (Geosyntec). 2019. Statistical Analysis Summary – Bottom Ash Pond, Amos Plant, Winfield, West Virginia. December 23, 2019.

TABLES

Table 1 - Groundwater Data Summary
Amos Plant - Bottom Ash Pond

Parameter	Unit	MW-1		MW-4		MW-5		MW-6		MW-1601	
		2/12/2020	5/7/2020	2/11/2020	5/6/2020	2/11/2020	7/7/2020	2/11/2020	5/5/2020	2/12/2020	5/6/2020
Antimony	µg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.03 J	0.1 U	0.1 U	0.17	0.03 J	0.1 U
Arsenic	µg/L	0.09 J	0.06 J	0.92	5.2	4.35	2.77	38.5	37.2	8.26	7.83
Barium	µg/L	25.7	25.7	96.9	110	130	140	165	149	122	115
Beryllium	µg/L	0.139	0.126	0.04 J	0.09 J	0.06 J	0.04 J	0.1 U	0.1 U	0.05 J	0.1 U
Boron	mg/L	-	0.126	-	0.135	-	0.055	-	0.04 J	-	0.03 J
Cadmium	µg/L	2.22	2.43	0.05 J	0.05	0.05 U	0.2 U	0.05 U	0.05 U	0.02 J	0.01 J
Calcium	mg/L	-	32.9	-	17.6	-	14.7	-	11.7	-	9.42
Chloride	mg/L	-	53.4	-	16.9	-	14.6	-	8.55	-	19
Chromium	µg/L	0.2 J	0.1 J	0.2 J	0.367	0.273	0.1 J	0.433	0.429	0.938	0.272
Cobalt	µg/L	18.6	13.9	8.30	8.17	1.21	1.39	9.52	8.8	3.19	2.78
Combined Radium	pCi/L	1.10	0.499	1.88	2.18	1.86	1.12	1.54	2.62	0.398	2.68
Fluoride	mg/L	0.03 J	0.02 J	0.04 J	0.04 J	0.04 J	0.03 J	0.06	0.09	0.05 J	0.04 J
Lead	µg/L	0.07 J	0.2 U	0.2 J	0.545	0.201	0.08 J	0.07 J	0.39	0.602	0.2 J
Lithium	mg/L	0.00259	0.00239	0.00151	0.00139	0.00147	0.00157	0.00118	0.00102	0.00159	0.00121
Mercury	µg/L	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-
Molybdenum	µg/L	2 U	2 U	0.9 J	1 J	2 U	0.5 J	0.5 J	1 J	2 U	0.5 J
Selenium	µg/L	0.1 J	0.08 J	0.06 J	0.2 J	0.2 U	0.06 J	0.09 J	0.09 J	0.1 J	0.04 J
Sulfate	mg/L	-	137	-	54.6	-	45.7	-	1.3	-	25.9
Thallium	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	2 U	0.5 U	0.5 U	0.5 U	0.5 U
Total Dissolved Solids	mg/L	-	336	-	213	-	156	-	202	-	143
pH	SU	5.3	5.0	5.9	5.5	6.0	6.1	6.2	5.5	5.9	5.6

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not analyzed

Table 1 - Groundwater Data Summary
Amos Plant - Bottom Ash Pond

Parameter	Unit	MW-1602A		MW-1603A		MW-1604		MW-1605		MW-1606	
		2/12/2020	5/6/2020	2/11/2020	5/6/2020	2/12/2020	5/6/2020	2/11/2020	5/5/2020	2/12/2020	5/6/2020
Antimony	µg/L	0.03 J	0.02 J	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.27	0.04 J	0.03 J
Arsenic	µg/L	21.9	21.8	87.7	90.2	3.88	4.04	2.75	2.99	2.82	3.43
Barium	µg/L	234	238	241	241	174	175	89.3	97.8	50.2	51.3
Beryllium	µg/L	0.03 J	0.1 U	0.03 J	0.1 U	0.05 J	0.04 J	0.08 J	0.08 J	0.112	0.08 J
Boron	mg/L	-	0.03 J	-	0.02 J	-	0.175	-	0.051	-	0.03 J
Cadmium	µg/L	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.01 J	0.19	0.18
Calcium	mg/L	-	19.3	-	15.5	-	20.8	-	49.6	-	36.7
Chloride	mg/L	-	43.2	-	5.87	-	29.4	-	85.6	-	116
Chromium	µg/L	0.758	0.361	0.663	0.362	0.798	0.484	0.205	0.363	0.680	0.645
Cobalt	µg/L	0.632	0.468	0.376	0.255	0.538	0.406	9.47	9.99	10.1	11.7
Combined Radium	pCi/L	0.699	1.43	0.984	2.24	1.38	1.65	2.67	1.4	1.52	1.5
Fluoride	mg/L	0.14	0.11	0.24	0.23	0.08	0.06 J	0.02 J	0.03 J	0.02 J	0.02 J
Lead	µg/L	1.23	1.22	0.347	0.2 J	0.319	0.1 J	0.1 J	0.973	0.644	0.549
Lithium	mg/L	0.00127	0.000954	0.000630	0.000339	0.000626	0.00043	0.00259	0.00232	0.00256	0.00239
Mercury	µg/L	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-	0.005 U	-
Molybdenum	µg/L	0.7 J	0.9 J	1 J	1 J	2 U	2 U	2 U	2 U	2 U	2 U
Selenium	µg/L	0.05 J	0.07 J	0.06 J	0.2 U	0.2 J	0.2 J	0.07 J	0.09 J	0.07 J	0.09 J
Sulfate	mg/L	-	12.7	-	0.4 U	-	0.4 U	-	236	-	108
Thallium	µg/L	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Total Dissolved Solids	mg/L	-	209	-	121	-	241	-	526	-	372
pH	SU	6.7	6.3	6.9	6.5	6.3	6.0	5.7	5.3	5.4	5.2

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
pCi/L: picocuries per liter
SU: standard unit
U: Non-detect value. For statistical analysis, parameters which were not detected were replaced with the reporting limit.
J: Estimated value. Parameter was detected in concentrations below the reporting limit.
-: Not analyzed

Table 2: Groundwater Protection Standards
Amos Plant - Bottom Ash Pond

Constituent Name	MCL	CCR Rule-Specified	Calculated UTL
Antimony, Total (mg/L)	0.006		0.0002
Arsenic, Total (mg/L)	0.01		0.09
Barium, Total (mg/L)	2		0.3
Beryllium, Total (mg/L)	0.004		0.0001
Cadmium, Total (mg/L)	0.005		0.00005
Chromium, Total (mg/L)	0.1		0.0020
Cobalt, Total (mg/L)	n/a	0.006	0.018
Combined Radium, Total (pCi/L)	5		2.5
Fluoride, Total (mg/L)	4		0.31
Lead, Total (mg/L)	n/a	0.015	0.0072
Lithium, Total (mg/L)	n/a	0.04	0.009
Mercury, Total (mg/L)	0.002		0.000005
Molybdenum, Total (mg/L)	n/a	0.1	0.0024
Selenium, Total (mg/L)	0.05		0.0003
Thallium, Total (mg/L)	0.002		0.0005

Notes:
Grey cell indicates calculated UTL is higher than MCL or CCR Rule-specified value.
MCL = Maximum Contaminant Level
Calculated UTL (Upper Tolerance Limit) represents site-specific background values.
The higher of the calculated UTL or MCL/Rule-Specified Level is used as the GWPS.

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

Analyte	Unit	Description	MW-1	MW-1604	MW-1605	MW-1606	MW-4	MW-5
			5/7/2020	5/6/2020	5/5/2020	5/6/2020	5/6/2020	7/7/2020
Boron	mg/L	Interwell Background Value (UPL)	0.183					
		Analytical Result	0.126	0.175	0.051	0.03	0.135	0.04
Calcium	mg/L	Interwell Background Value (UPL)	19.6					
		Analytical Result	**32.9**	**20.8**	**49.6**	**36.7**	17.6	14.7
Chloride	mg/L	Interwell Background Value (UPL)	41.0					
		Analytical Result	**53.4**	29.4	**85.6**	**116**	16.9	14.5
Fluoride	mg/L	Intrawell Background Value (UPL)	0.03	0.146	0.09	0.03	0.0822	0.05
		Analytical Result	0.02	0.06	0.03	0.02	0.04	0.03
pH	SU	Intrawell Background Value (UPL)	7.3	7.2	6.6	5.9	7.0	6.5
		Intrawell Background Value (UPL)	4.9	6.1	5.2	5.1	5.5	5.2
		Analytical Result	5.0	6.0	5.3	5.2	5.5	6.1
Sulfate	mg/L	Interwell Background Value (UPL)	57.4					
		Analytical Result	**137**	0.06	**236**	**108**	54.6	46
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	260					
		Analytical Result	**336**	241	**526**	**372**	213	182

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

ATTACHMENT A

Certification by Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the Amos Bottom Ash Pond CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663	WEST VIRGINIA	09.04.2020
License Number	Licensing State	Date

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS CONSULTING

August 21, 2020

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

Re: Amos Bottom Ash Pond
Assessment Monitoring Summary – July 2020

Dear Ms. Kreinberg,

Groundwater Stats Consulting (GSC), formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the Assessment Monitoring statistical analysis of groundwater data through July 2020 at American Electric Power Company's Amos Bottom Ash Pond. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the United States Environmental Protection Agency (USEPA) Unified Guidance (2009).

Sampling began at the site for the CCR program in 2016. The monitoring well network, as provided by Geosyntec Consultants, consists of the following:

- **Upgradient wells:** BAP-MW-1601, BAP-MW-1602A, BAP-MW-1603A, and BAP-MW-6
- **Downgradient wells:** BAP-MW-1, BAP-MW-1604, BAP-MW-1605, BAP-MW-1606, BAP-MW-4, and BAP-MW-5

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

The CCR program consists of the following constituents:

- **Appendix IV** (Assessment Monitoring) – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 + 228, fluoride, lead, lithium, mercury, molybdenum, selenium, and thallium

Note that no samples were collected during the May 2020 sampling event for mercury because there were no detections during the February 2020 sampling event. Data in this analysis extend through July 2020 to include the February and May 2020 sampling events as well as the July 2020 resampling event for downgradient well BAP-MW-5.

Time series and box plots for Appendix IV parameters are provided for all wells and constituents; and are used to evaluate concentrations over the entire record (Figures A and B, respectively). Values in background, which have previously been flagged as outliers, may be seen in a lighter font and disconnected symbol on the graphs. Additionally, a summary of flagged values follows this letter.

History of Initial Background Screening Conducted in December 2017

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix IV parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Tukey's outlier test noted a few outliers and a summary of that report was submitted with the screening at that time. Any values flagged as outliers may be seen on the summary following this letter and are plotted in a lighter font on the time series graph. The test identified an outlier for arsenic in well BAP-MW-1604; however, these concentrations were similar to concentrations in neighboring wells and were not flagged as outliers. A substitution of the most recent reporting limit was applied when varying detection limits existed in data.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed a couple statistically significant increasing trends and several statistically significant decreasing trends and a summary of those results were included with the screening. All trends were relatively low in magnitude when compared to average concentrations and data, therefore, no adjustments were required.

Summary of Background Update Conducted in December 2019

Prior to updating Groundwater Water Protection Standards and constructing confidence intervals for the Appendix IV constituents, samples were re-evaluated for all wells using Tukey's outlier test and visual screening through the July 2019 samples. As mentioned above, flagged data may be seen on the summary following this letter and are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. An updated summary of Tukey's test results was included with the screening.

Evaluation of Appendix IV Parameters – July 2020

Prior to constructing background limits, pooled upgradient well data were screened for outliers and extreme trending patterns that would lead to artificially elevated statistical limits. Tukey's outlier test was used to evaluate suspected outliers for combined radium 226 + 228 and identified outliers in upgradient well BAP-MW-1602A which were flagged and deselected. Tukey's test results and an updated summary of all flagged values, which may be seen on the Outlier Summary, follow this letter (Figure C).

Interwell Tolerance limits were used to calculate background limits from all available pooled upgradient well data through July 2020 for Appendix IV parameters to determine the background limit for each constituent (Figure D). Parametric limits use a target of 95% confidence and 95% coverage. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. These limits were compared to the Maximum Contaminant Levels (MCLs) and CCR-Rule specified levels in the Groundwater Protection Standard (GWPS) table following this letter to determine the highest limit for use as the GWPS in the Confidence Interval comparisons (Figure E).

Confidence intervals were then constructed on downgradient wells for each of the Appendix IV parameters using the highest limit of the MCL, CCR-Rule specified levels, or background as discussed above (Figure F). Only when the entire confidence interval is above a GWPS is the well/constituent pair considered to exceed its respective standard. No exceedances were noted for any of the well/constituent pairs. A summary of the confidence interval results follows this letter.

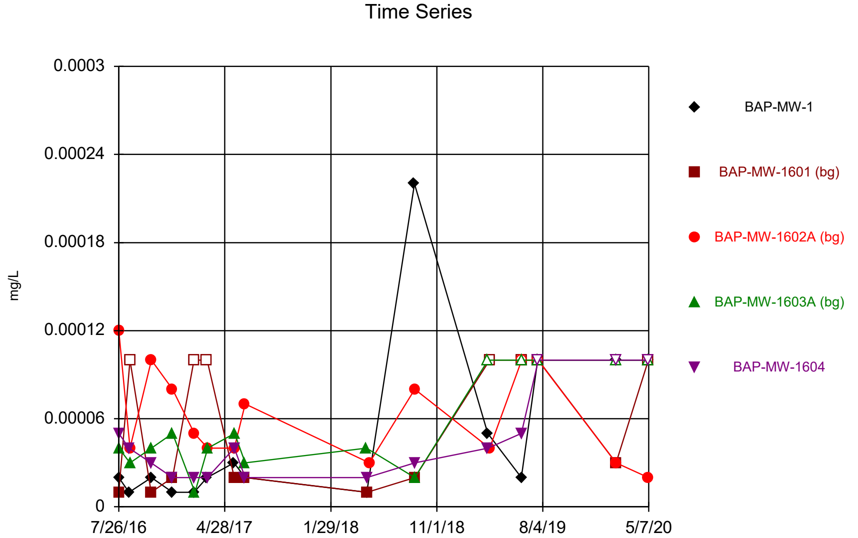
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Amos Bottom Ash Pond. If you have any questions or comments, please feel free to contact us.

For Groundwater Stats Consulting,

Andrew T. Collins
Project Manager

Kristina L. Rayner
Groundwater Statistician

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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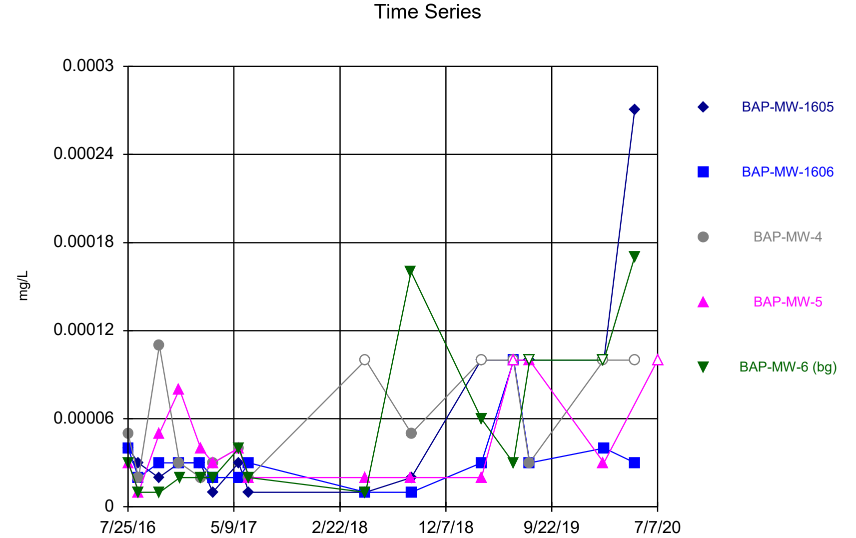
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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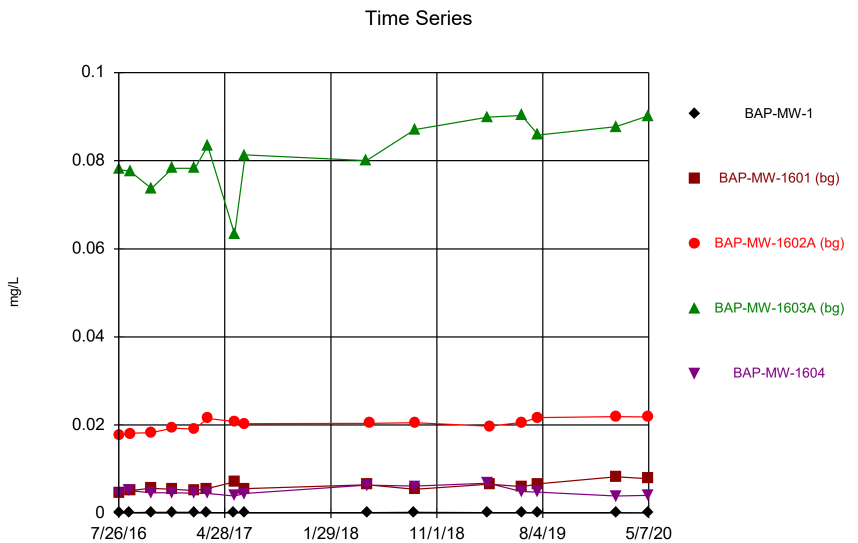

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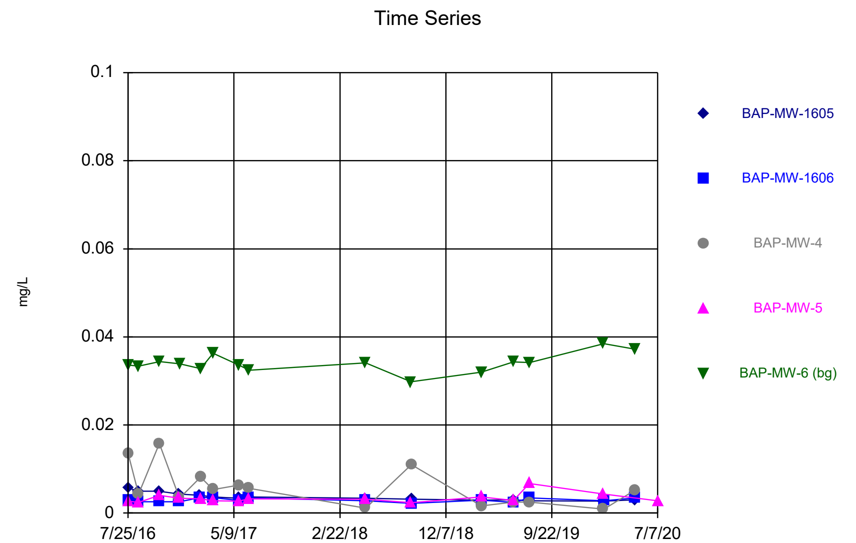

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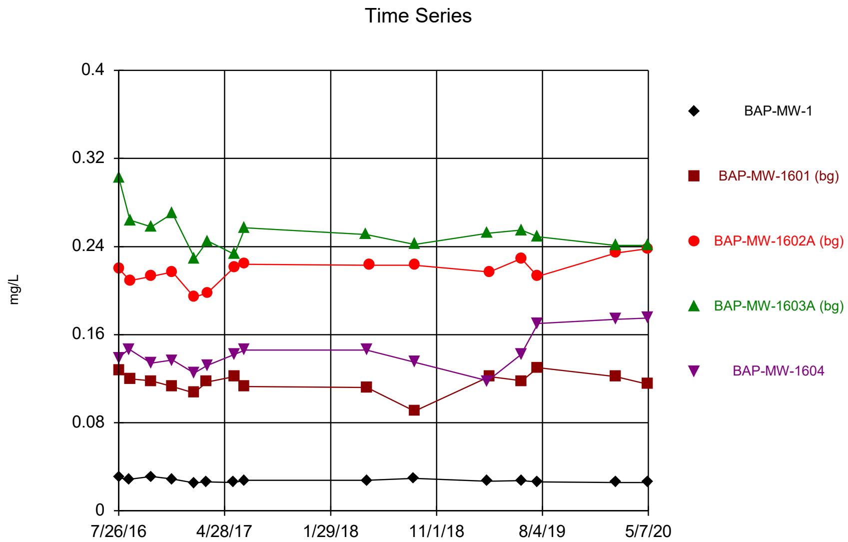

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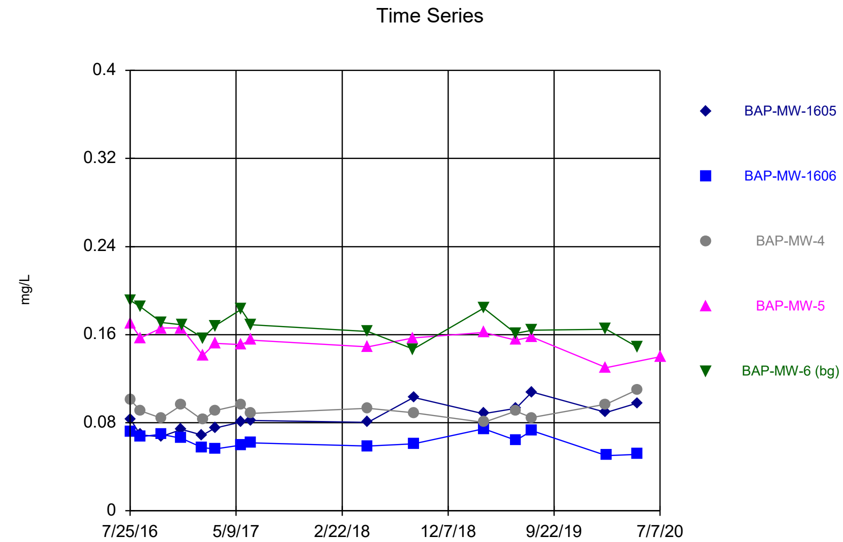

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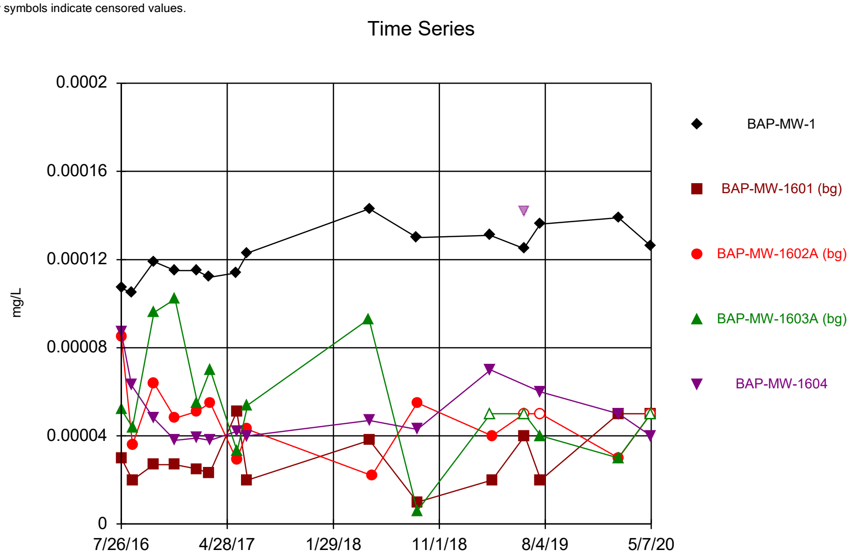

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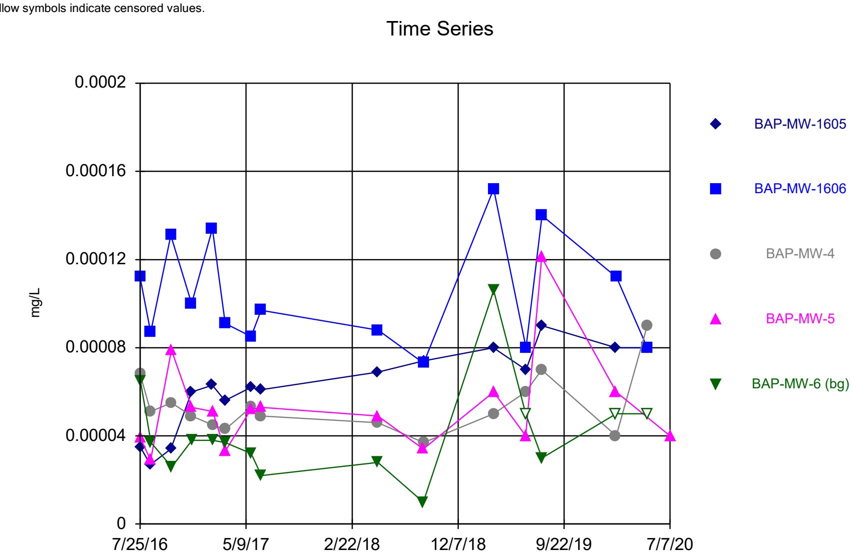
Hollow symbols indicate censored values.



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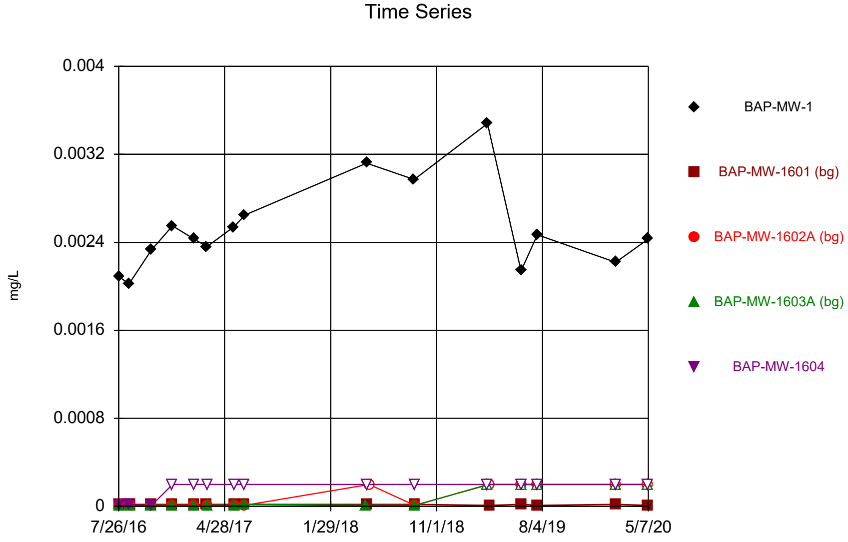

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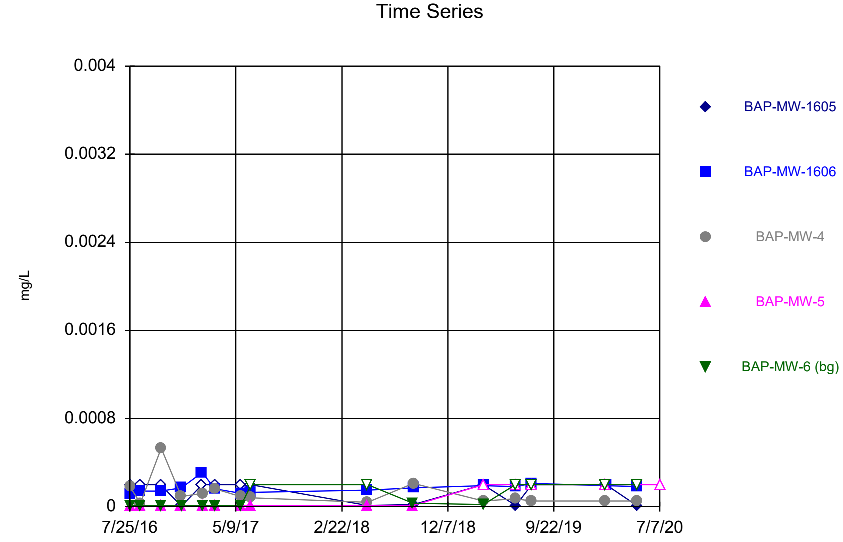
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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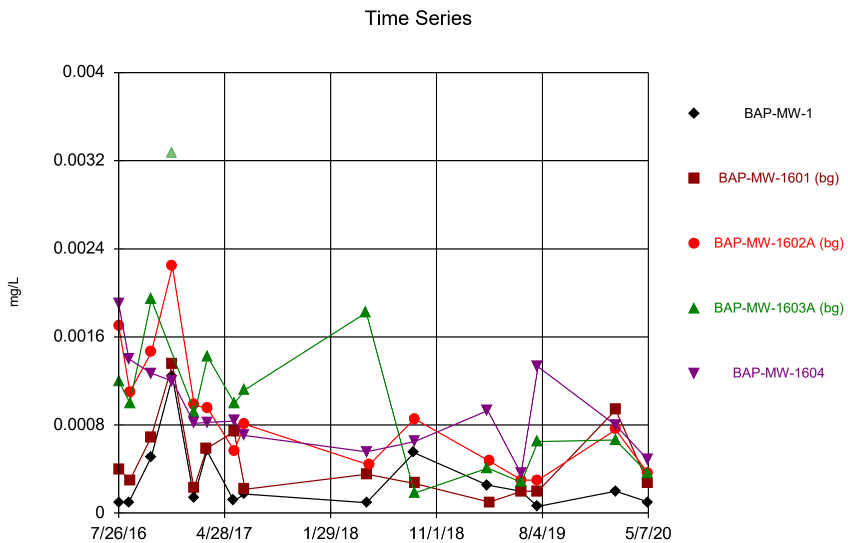
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



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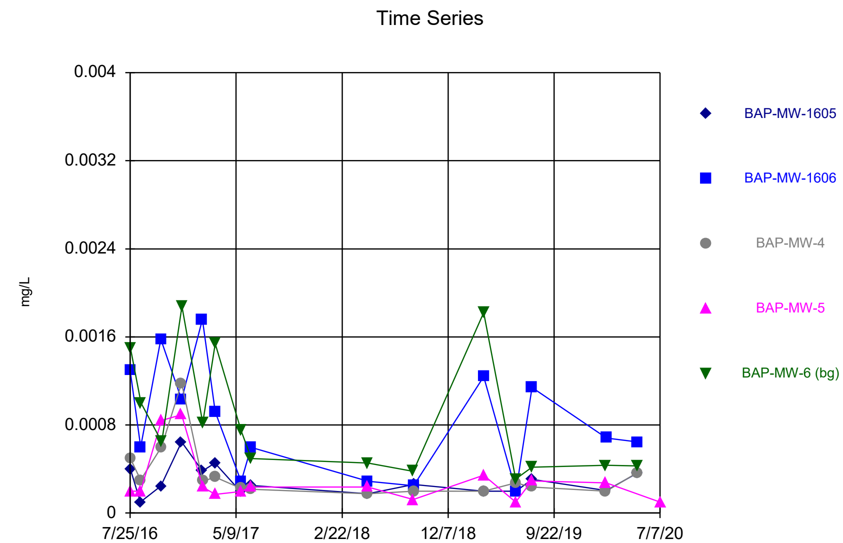

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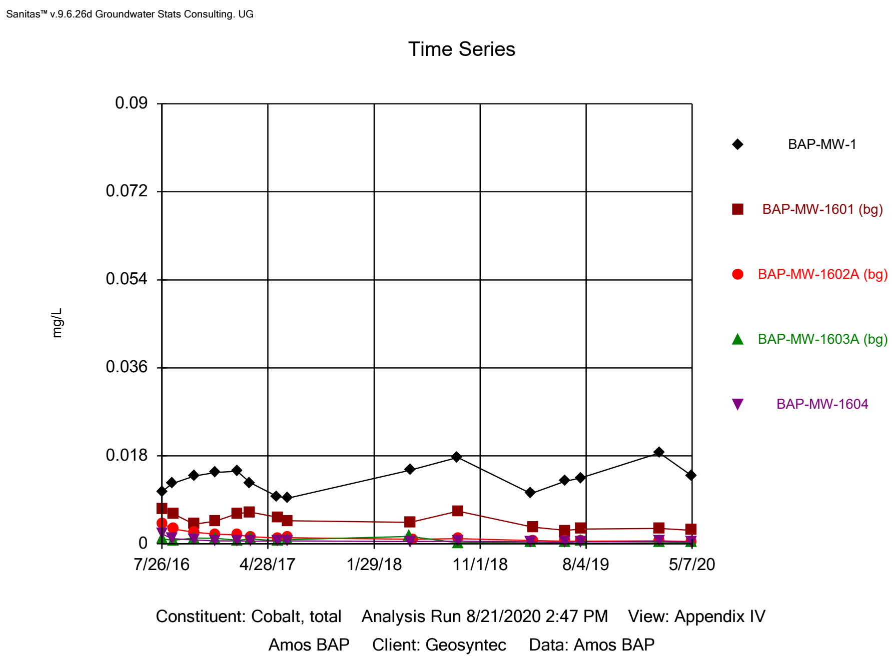

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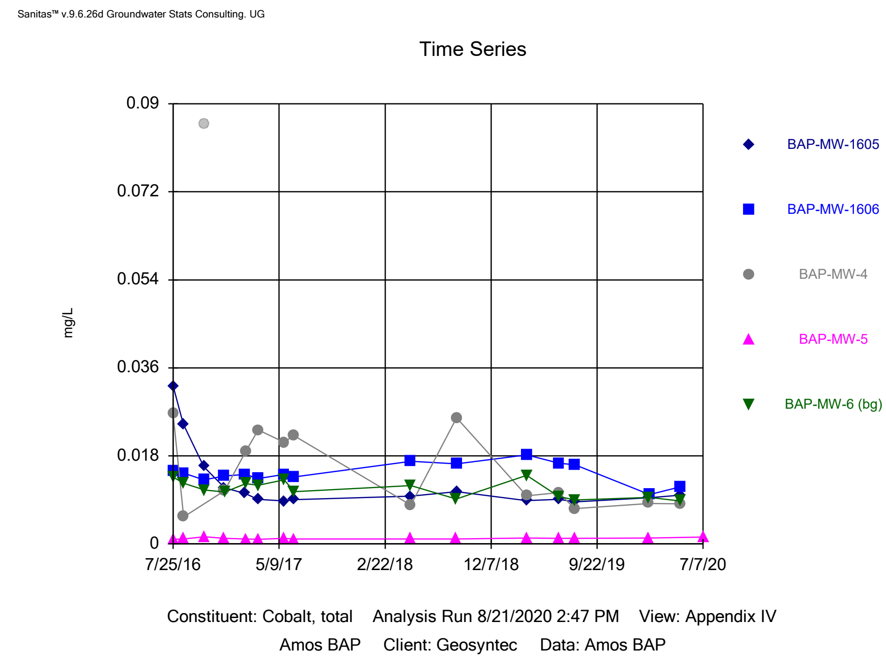
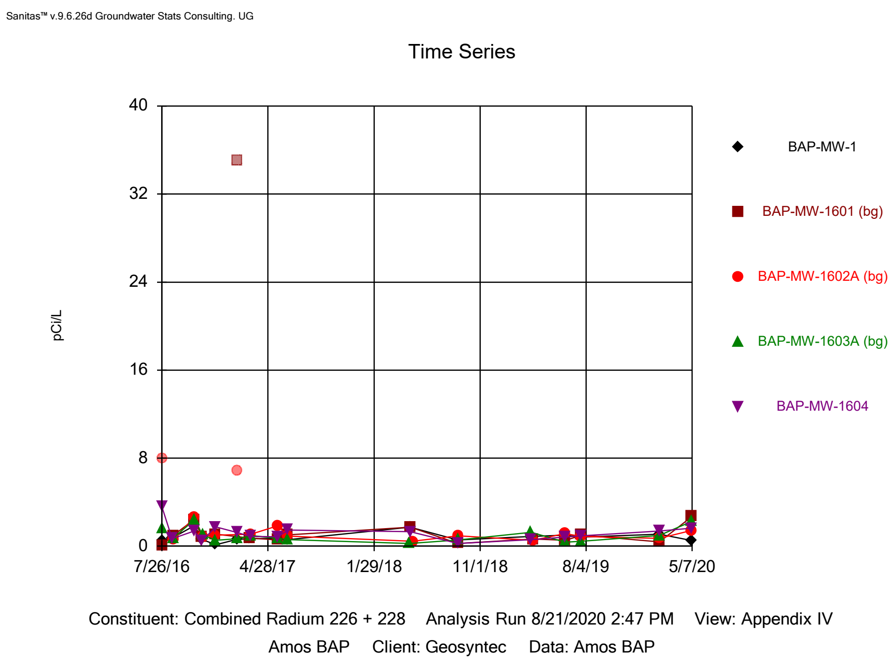
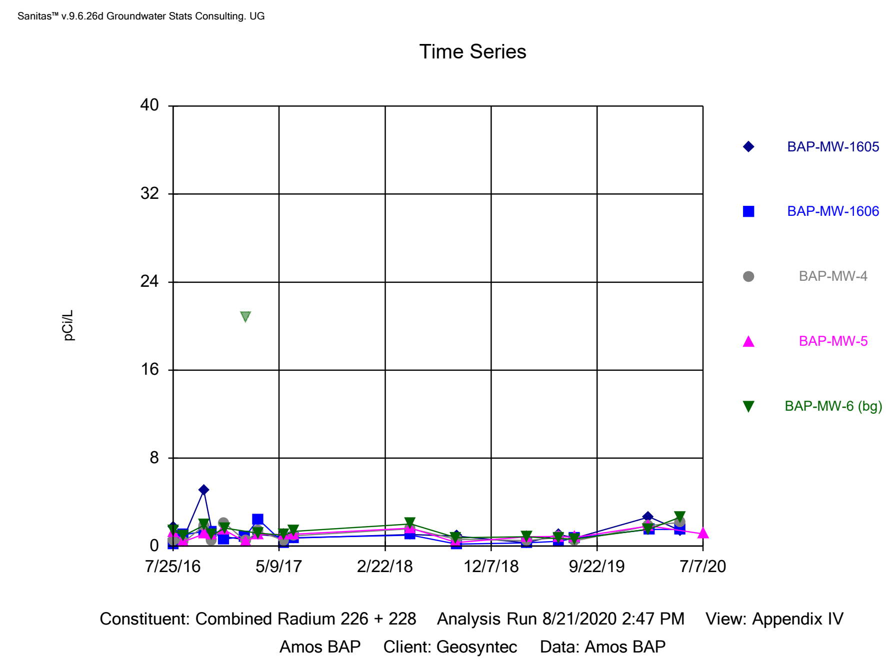
Time Series
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/26/16
4/28/17
1/29/18
11/1/18
8/4/19
5/7/20
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Cobalt, total Analysis Run 8/21/2020 2:47 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Time Series
0.09
0.072
0.054
0.036
0.018
0
mg/L
7/25/16
5/9/17
2/22/18
12/7/18
9/22/19
7/7/20
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Cobalt, total Analysis Run 8/21/2020 2:47 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

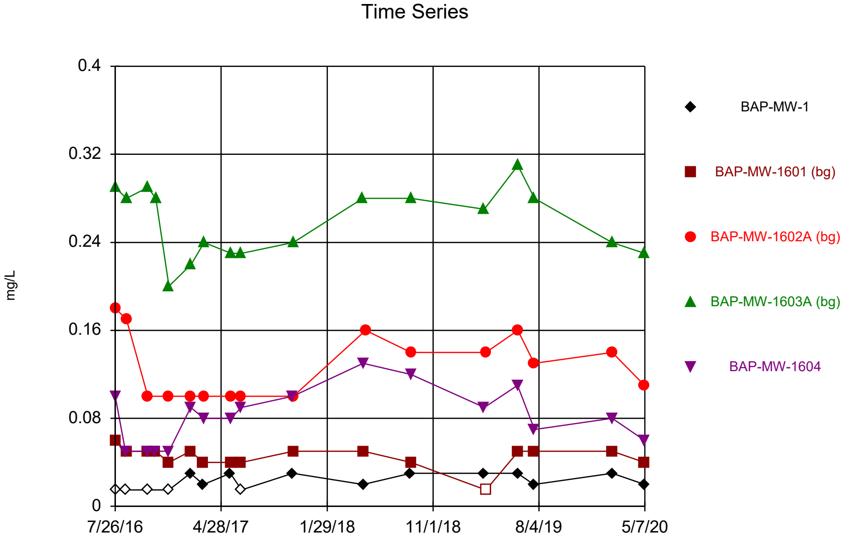


Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Time Series
40
32
24
16
8
0
pCi/L
7/26/16
4/28/17
1/29/18
11/1/18
8/4/19
5/7/20
BAP-MW-1
BAP-MW-1601 (bg)
BAP-MW-1602A (bg)
BAP-MW-1603A (bg)
BAP-MW-1604
Constituent: Combined Radium 226 + 228 Analysis Run 8/21/2020 2:47 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP



Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Time Series
40
32
24
16
8
0
pCi/L
7/25/16
5/9/17
2/22/18
12/7/18
9/22/19
7/7/20
BAP-MW-1605
BAP-MW-1606
BAP-MW-4
BAP-MW-5
BAP-MW-6 (bg)
Constituent: Combined Radium 226 + 228 Analysis Run 8/21/2020 2:47 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Fluoride, total Analysis Run 8/21/2020 2:47 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

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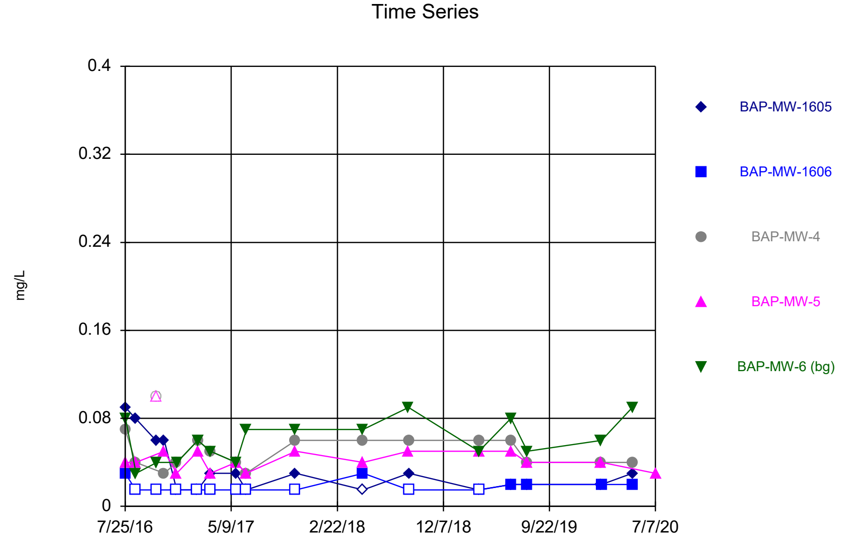
Hollow symbols indicate censored values.



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Amos BAP Client: Geosyntec Data: Amos BAP

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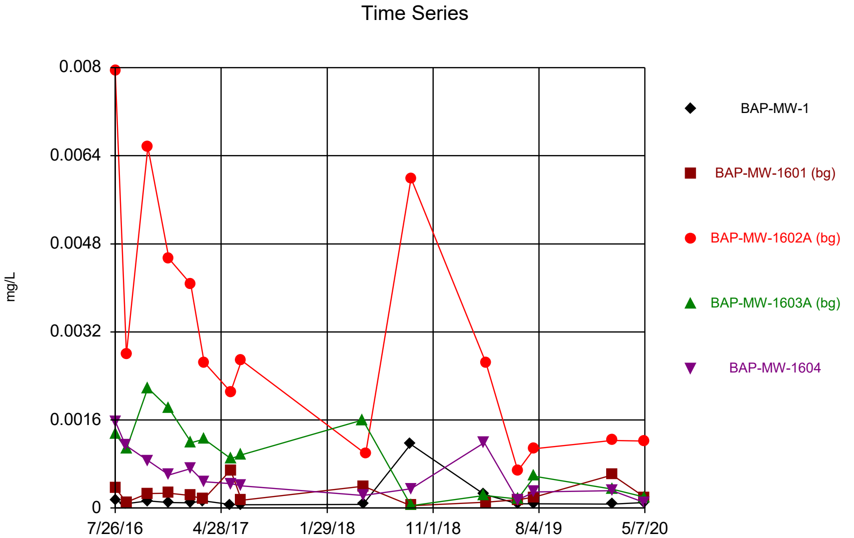

Constituent: Lead, total Analysis Run 8/21/2020 2:47 PM View: Appendix IV
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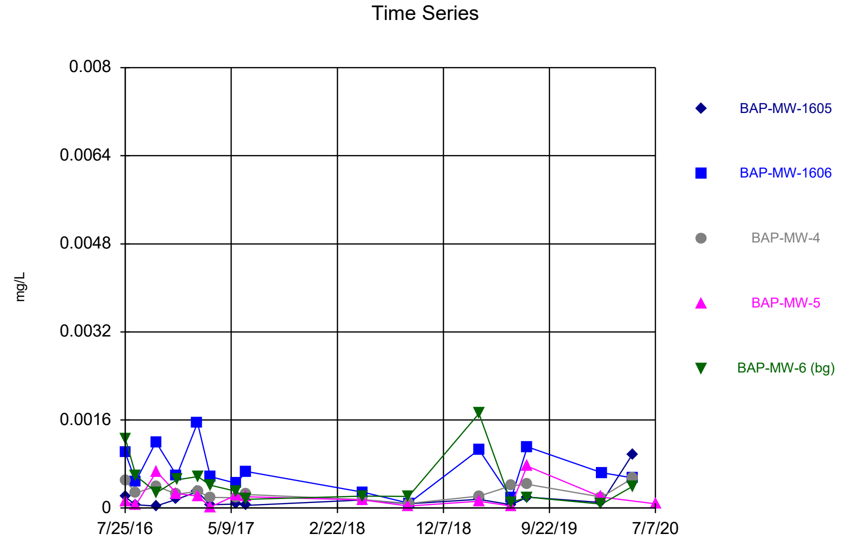

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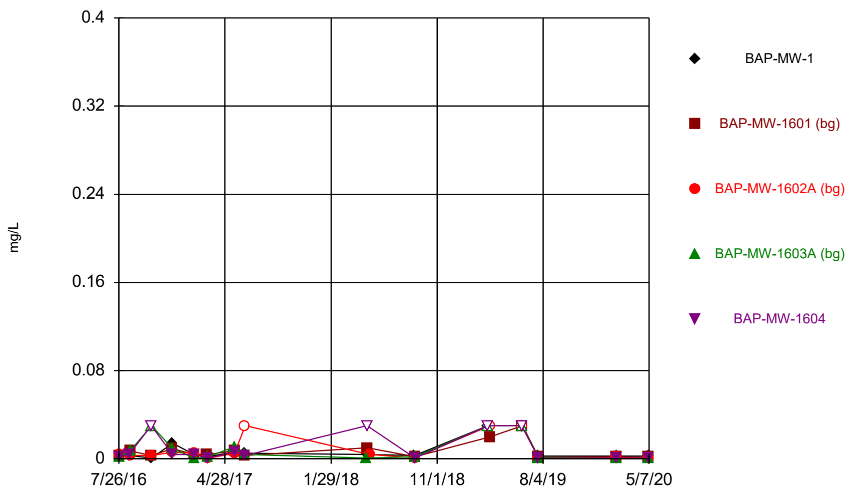
Hollow symbols indicate censored values.

Time Series



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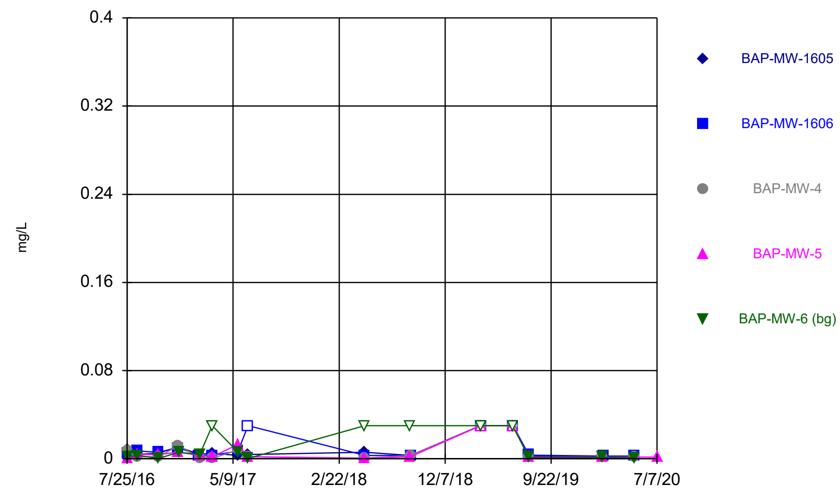
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



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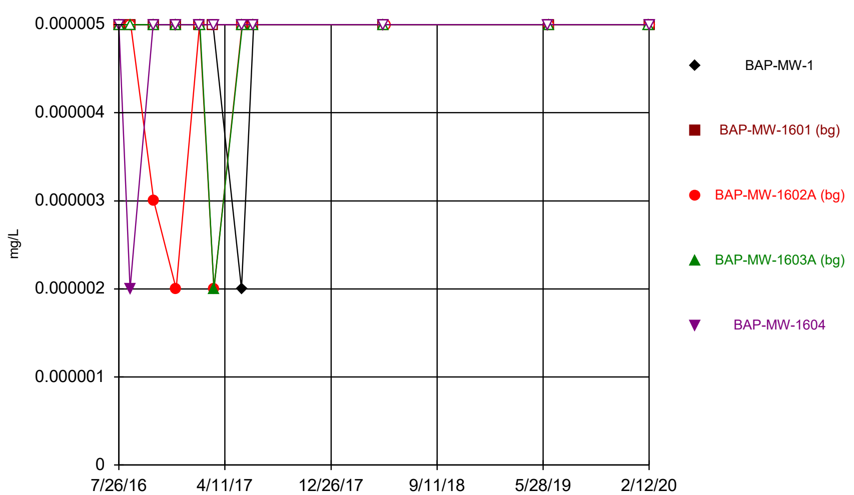
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

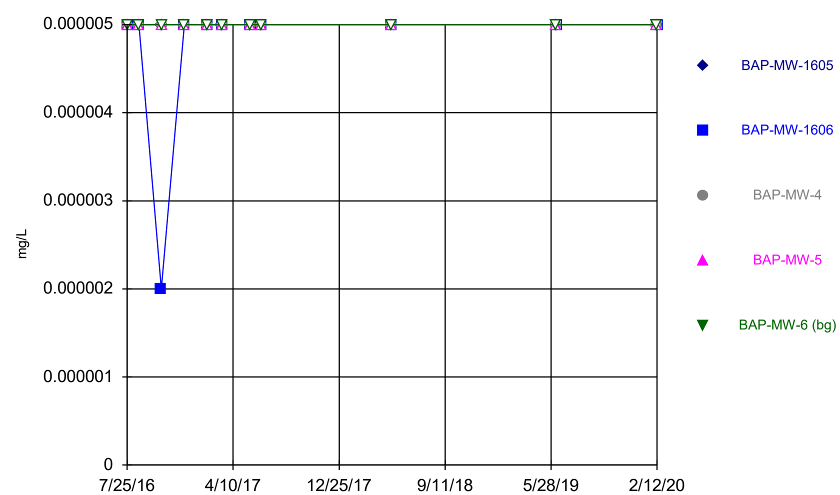
Time Series



Constituent: Mercury, total Analysis Run 8/21/2020 2:48 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

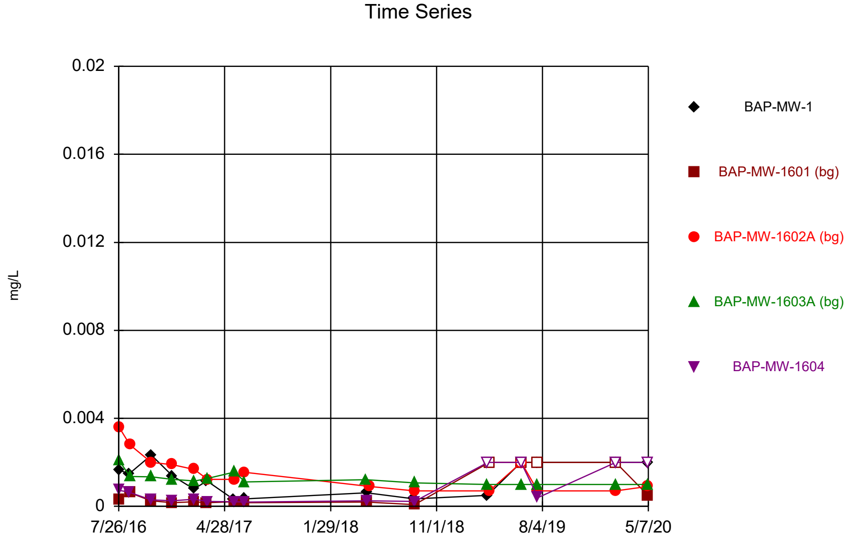
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.

Time Series



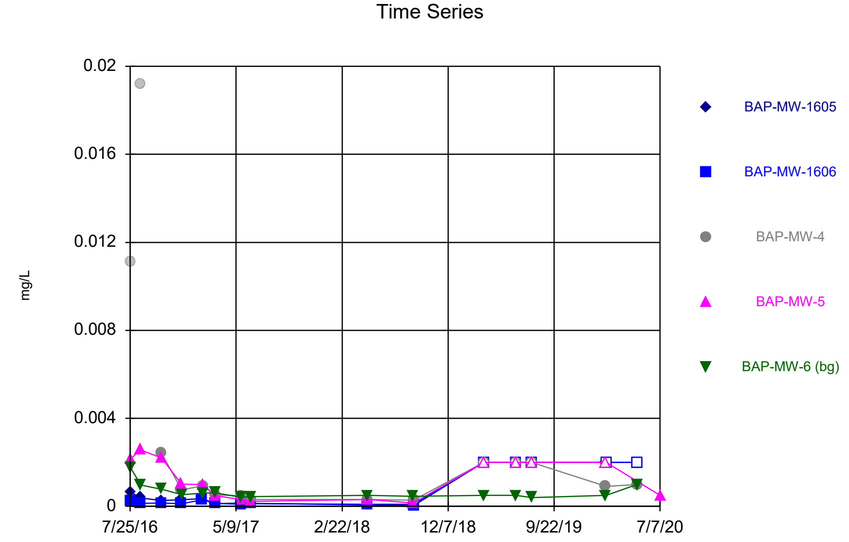
Constituent: Mercury, total Analysis Run 8/21/2020 2:48 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



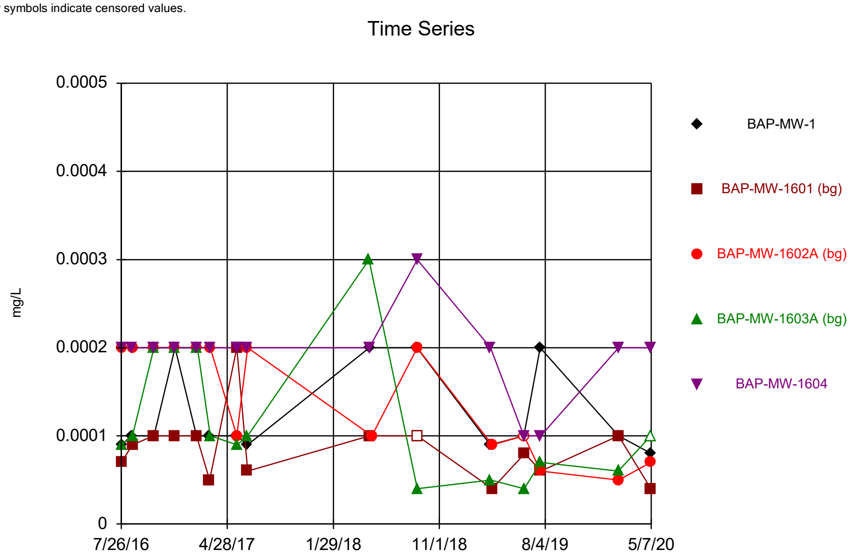
Constituent: Molybdenum, total Analysis Run 8/21/2020 2:48 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Molybdenum, total Analysis Run 8/21/2020 2:48 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



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Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
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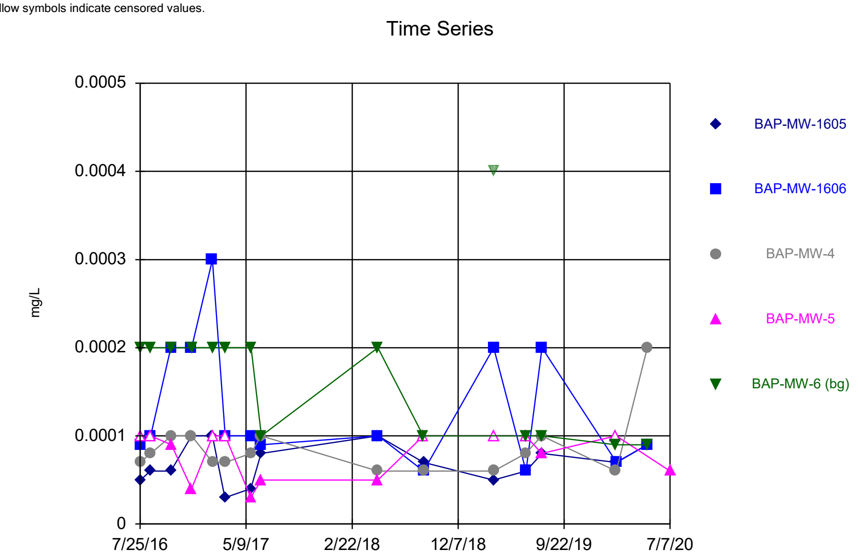

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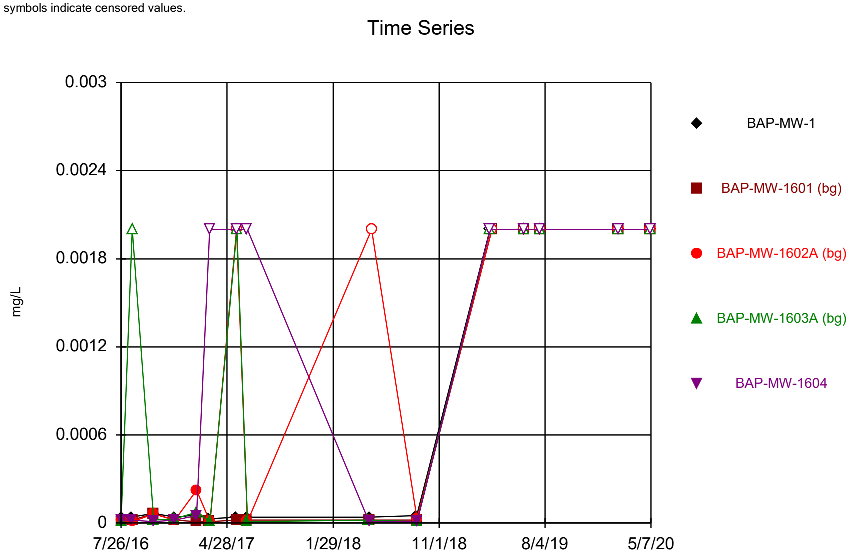
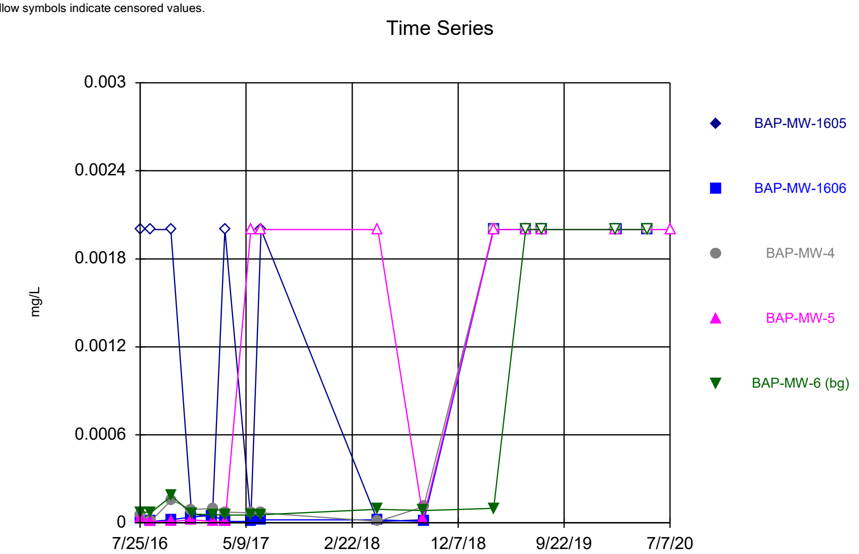
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Thallium, total Analysis Run 8/21/2020 2:48 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

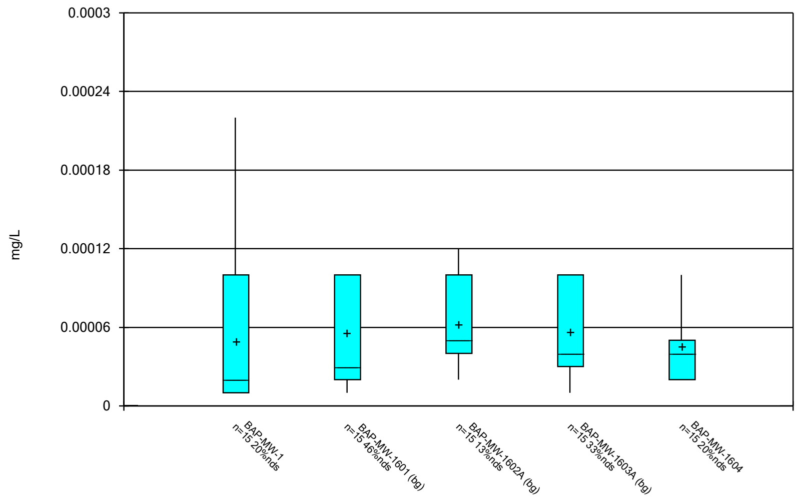
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



Constituent: Thallium, total Analysis Run 8/21/2020 2:48 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

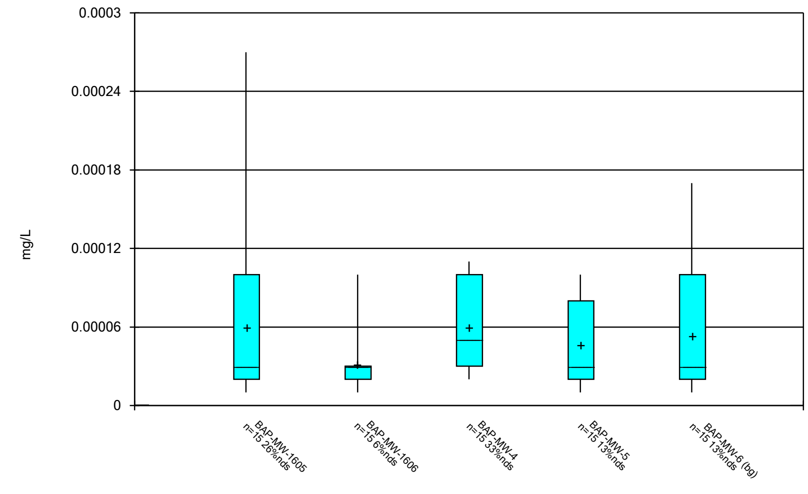
Box & Whiskers Plot



Constituent: Antimony, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

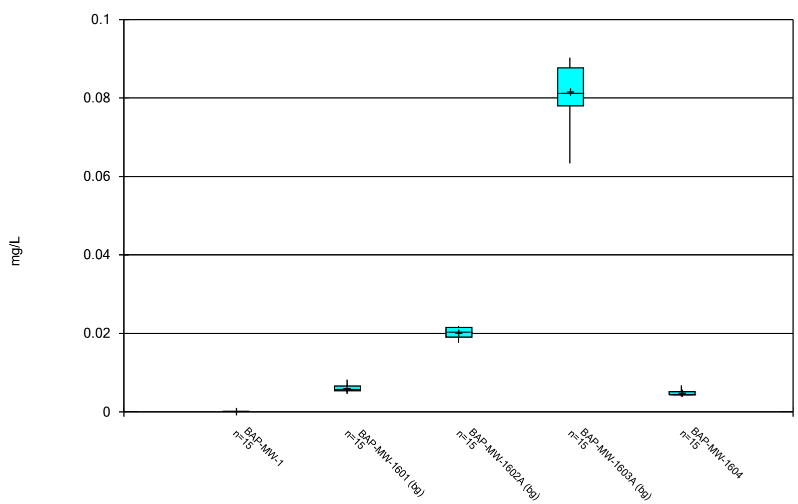
Box & Whiskers Plot



Constituent: Antimony, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

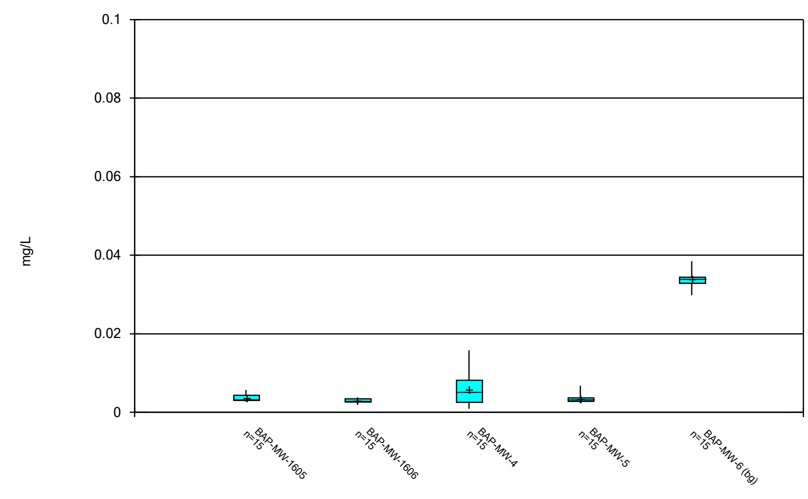
Box & Whiskers Plot



Constituent: Arsenic, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

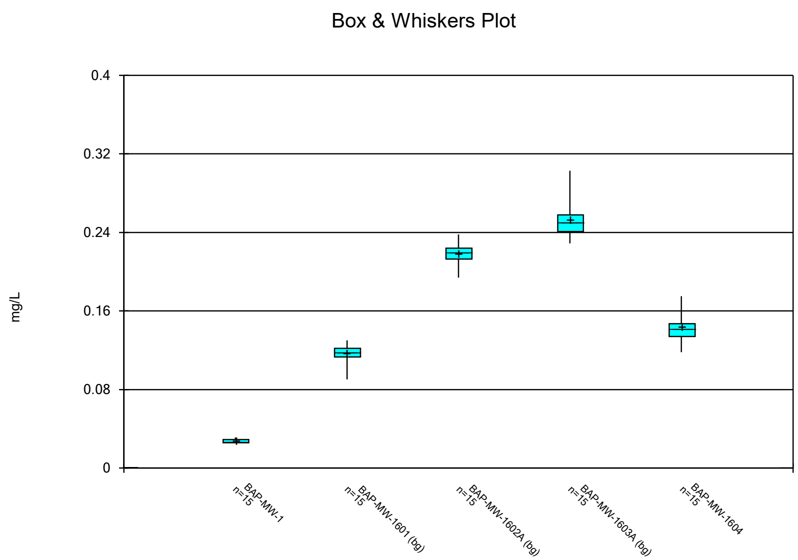
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Box & Whiskers Plot



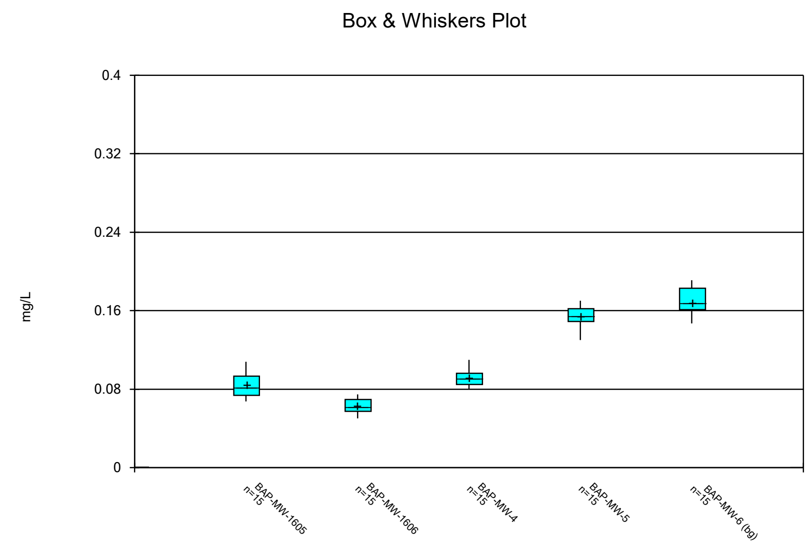
Constituent: Arsenic, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



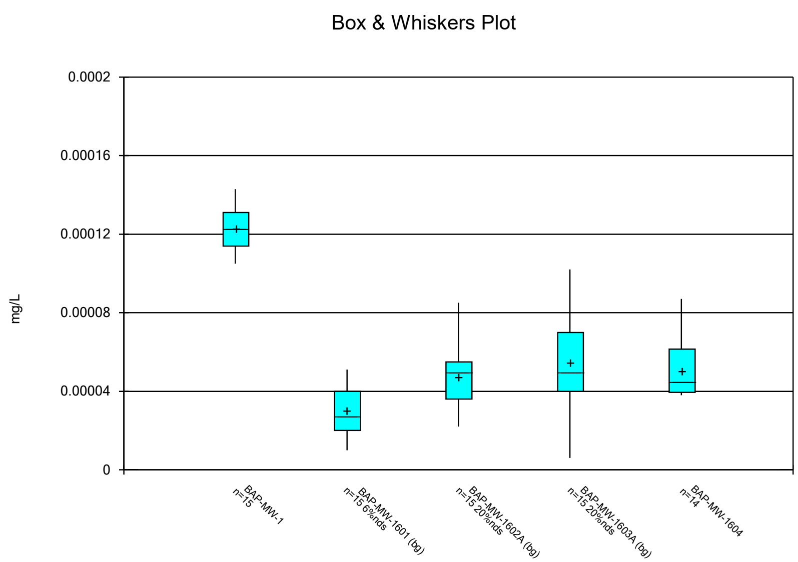
Constituent: Barium, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



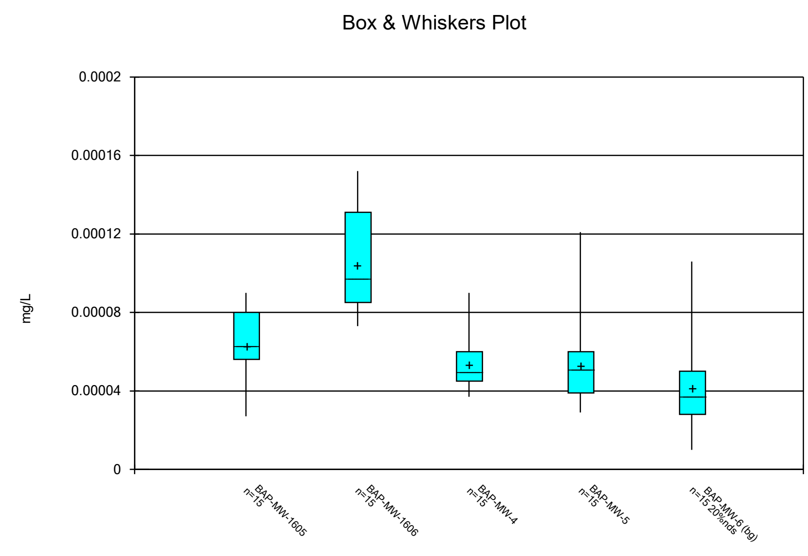
Constituent: Barium, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



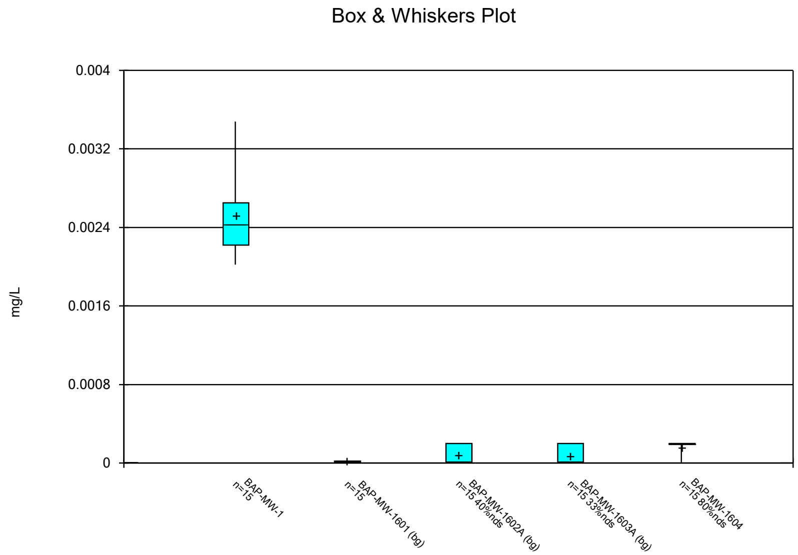
Constituent: Beryllium, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



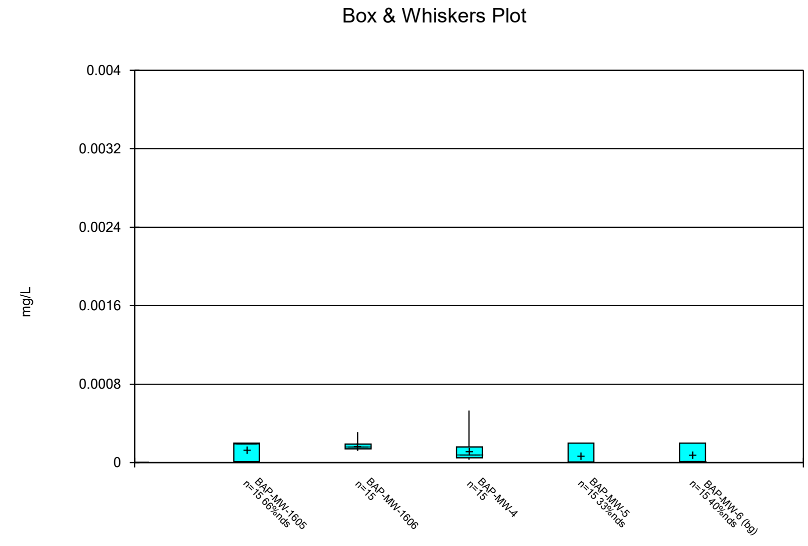
Constituent: Beryllium, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



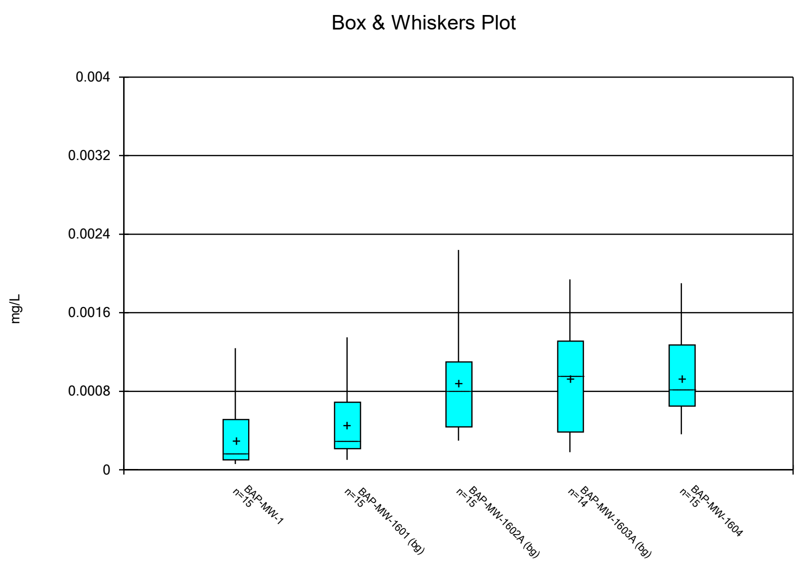
Constituent: Cadmium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



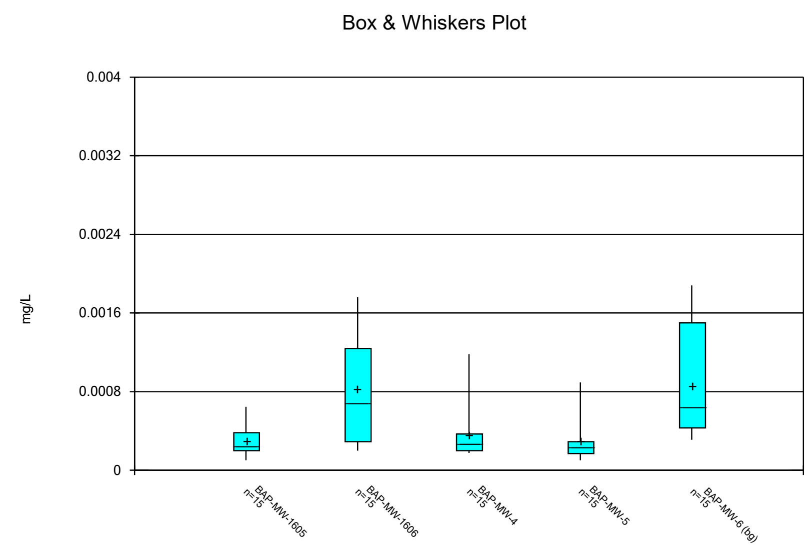
Constituent: Cadmium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



Constituent: Chromium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

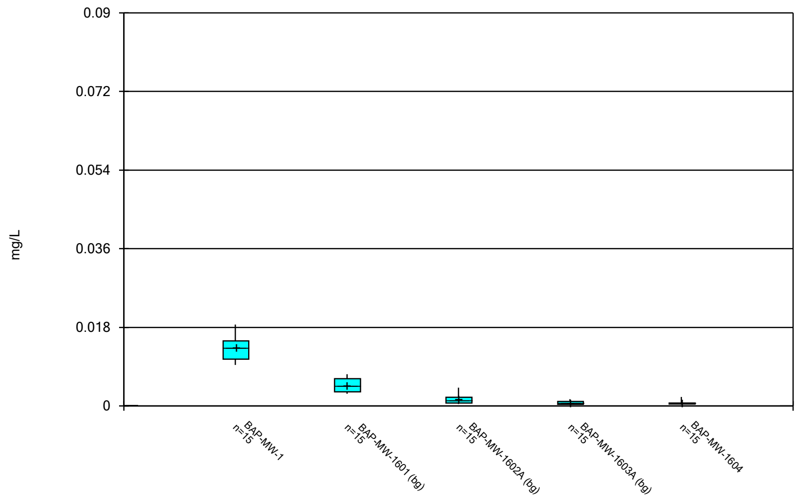
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



Constituent: Chromium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

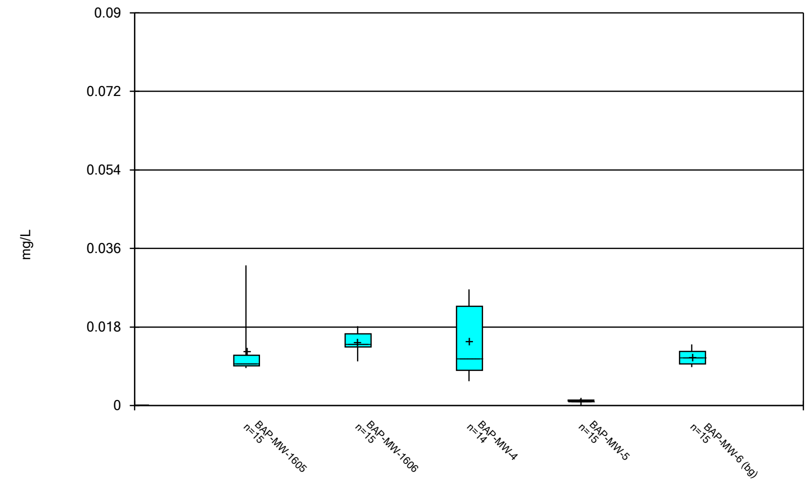
Box & Whiskers Plot



Constituent: Cobalt, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

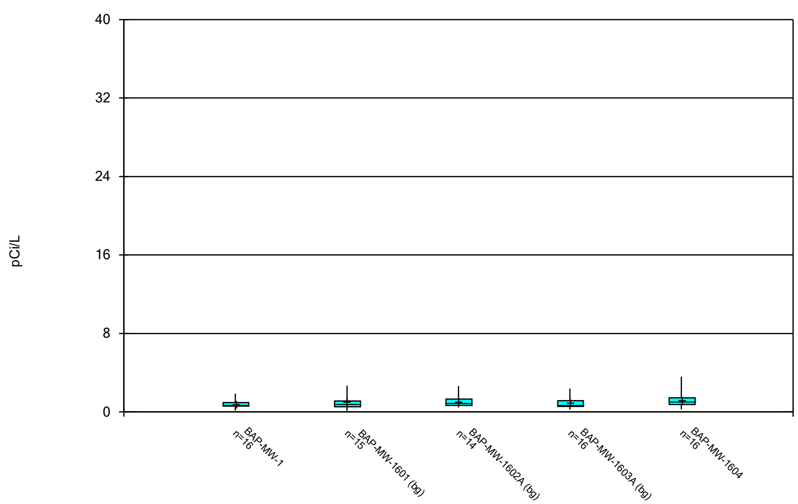
Box & Whiskers Plot



Constituent: Cobalt, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

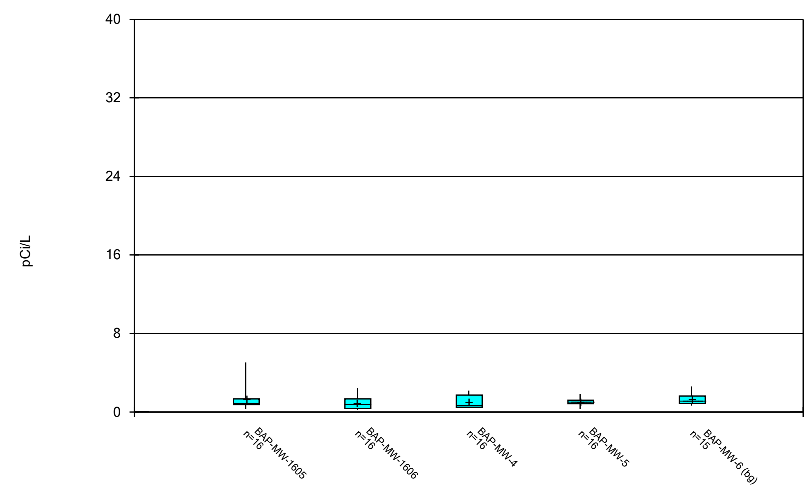
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

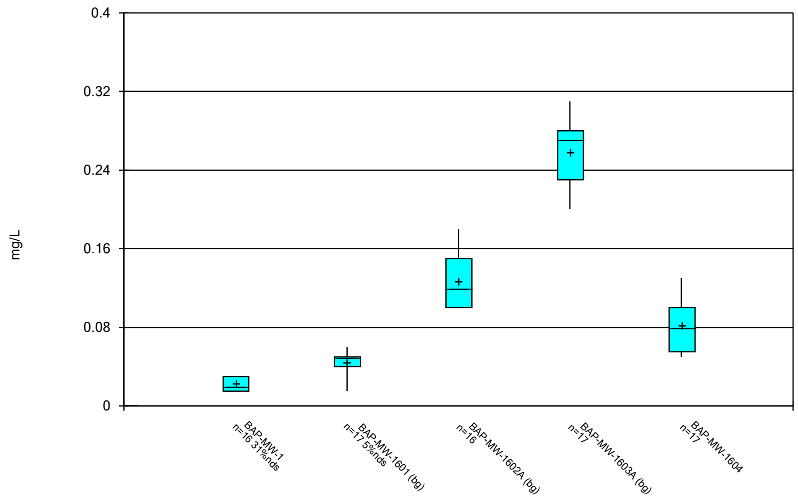
Box & Whiskers Plot



Constituent: Combined Radium 226 + 228   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

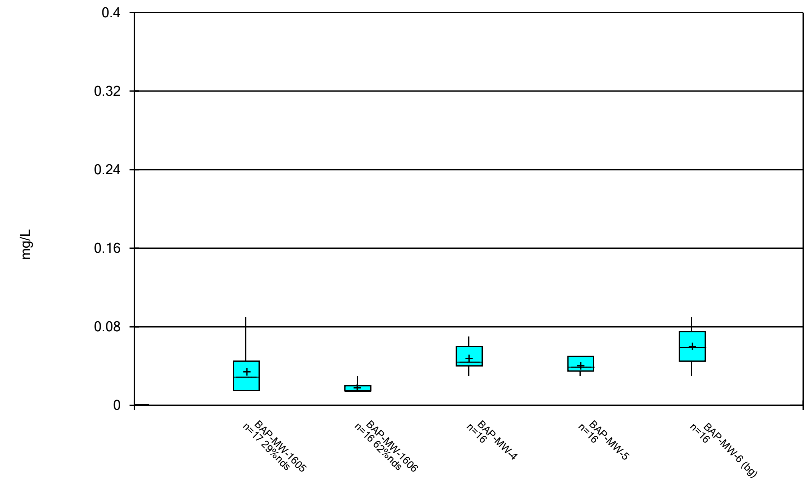
Box & Whiskers Plot



Constituent: Fluoride, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

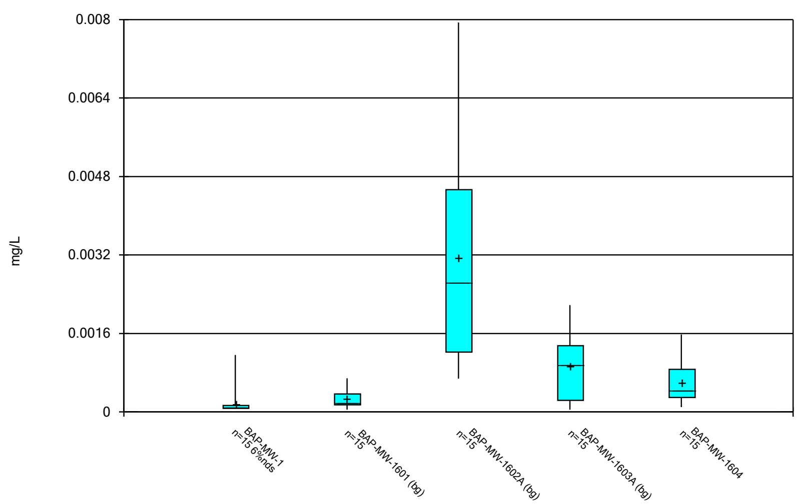
Box & Whiskers Plot



Constituent: Fluoride, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

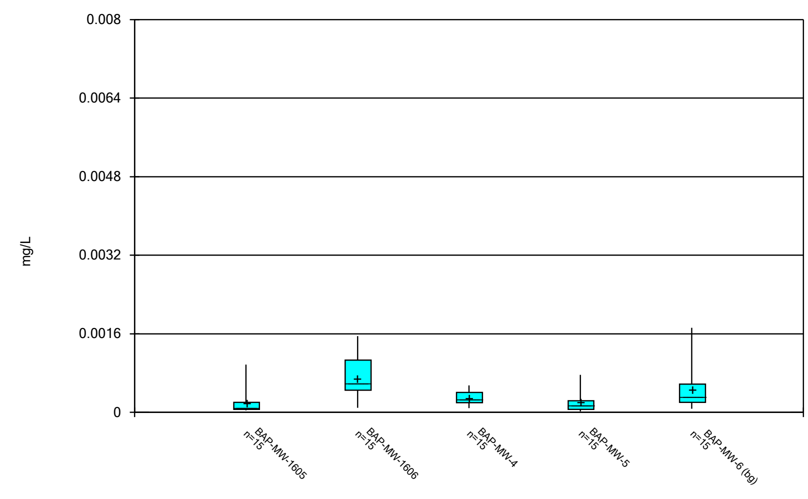
Box & Whiskers Plot



Constituent: Lead, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

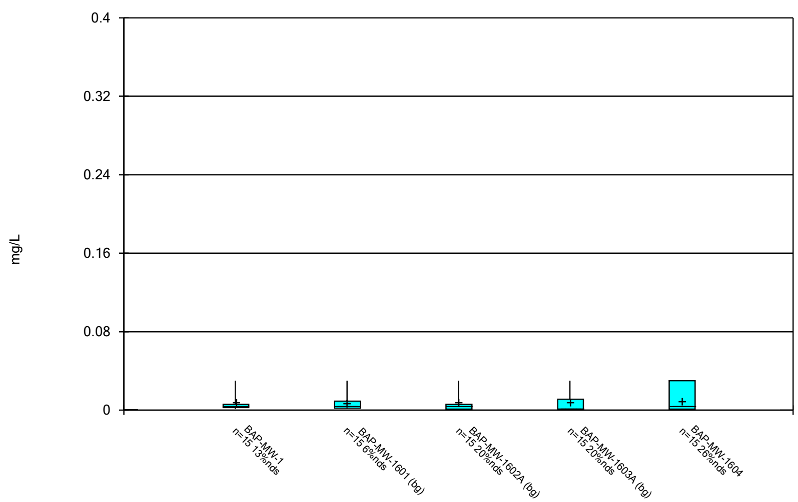
Box & Whiskers Plot



Constituent: Lead, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

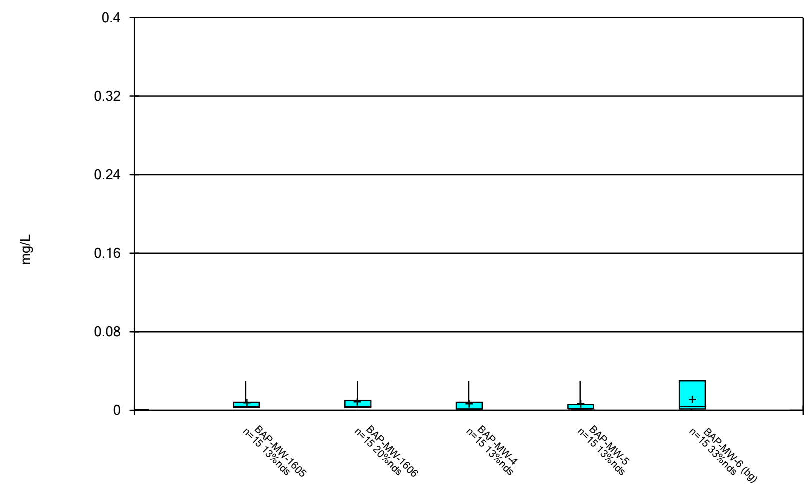
Box & Whiskers Plot



Constituent: Lithium, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

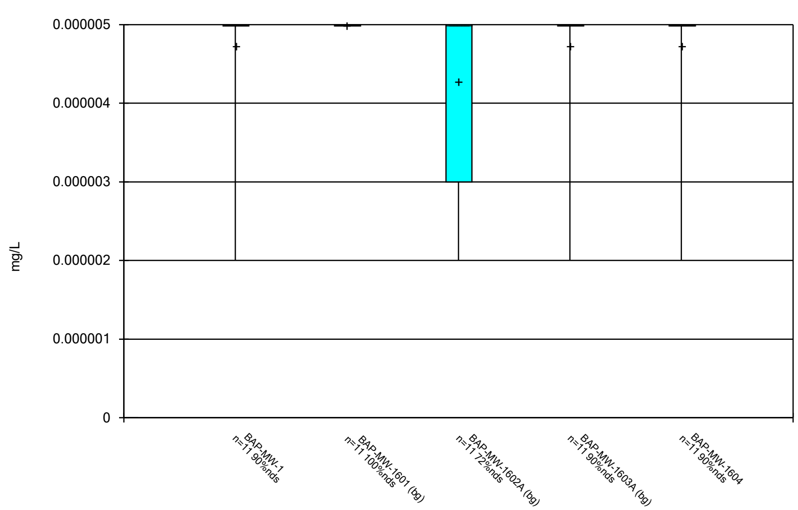
Box & Whiskers Plot



Constituent: Lithium, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

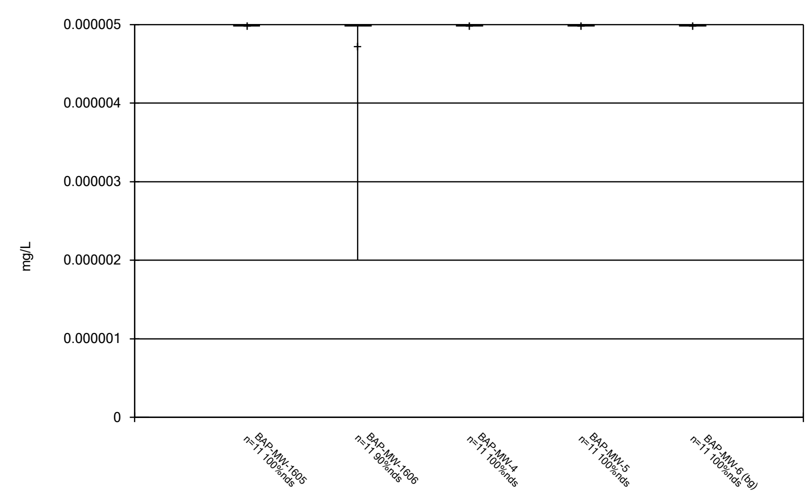
Box & Whiskers Plot



Constituent: Mercury, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

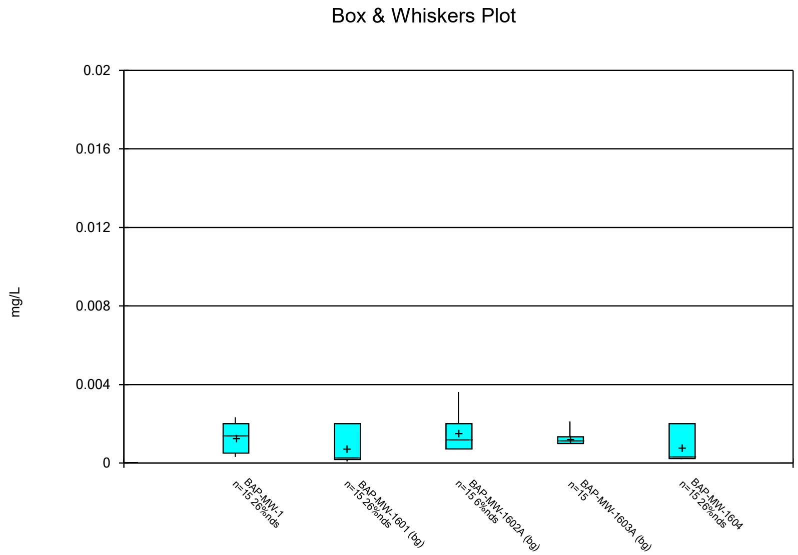
Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Box & Whiskers Plot



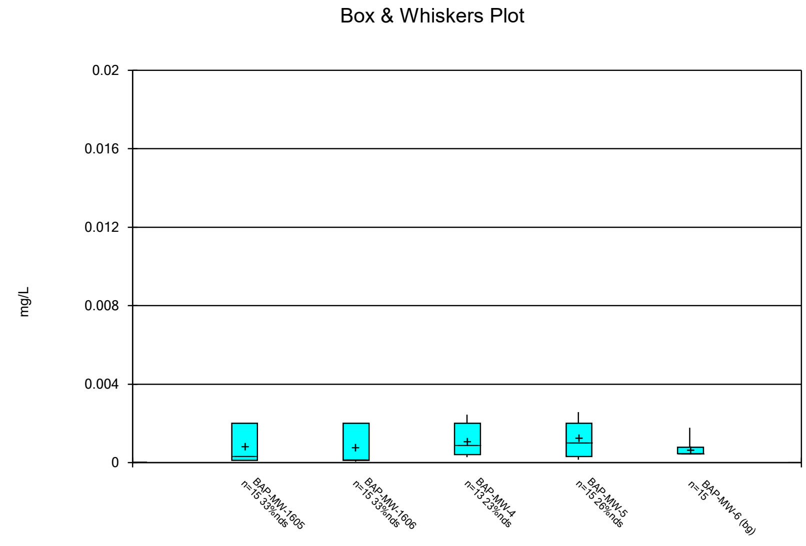
Constituent: Mercury, total   Analysis Run 8/21/2020 2:51 PM   View: Appendix IV
Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



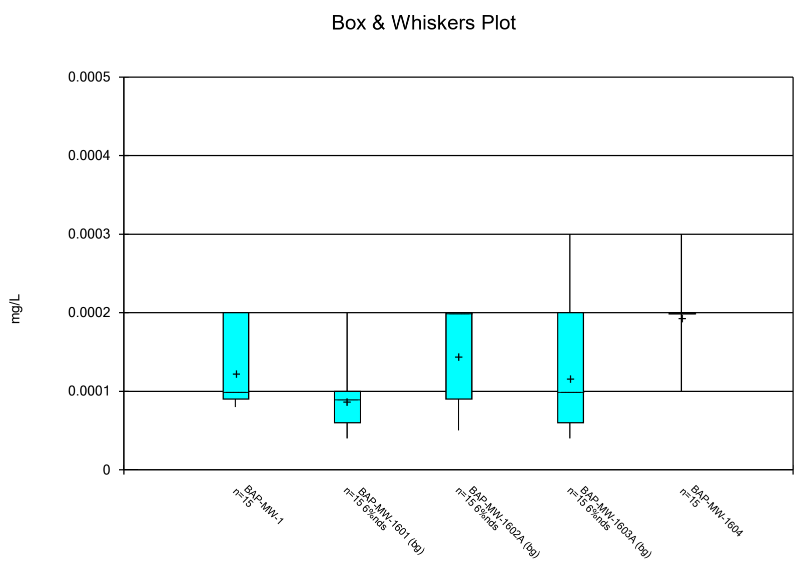
Constituent: Molybdenum, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



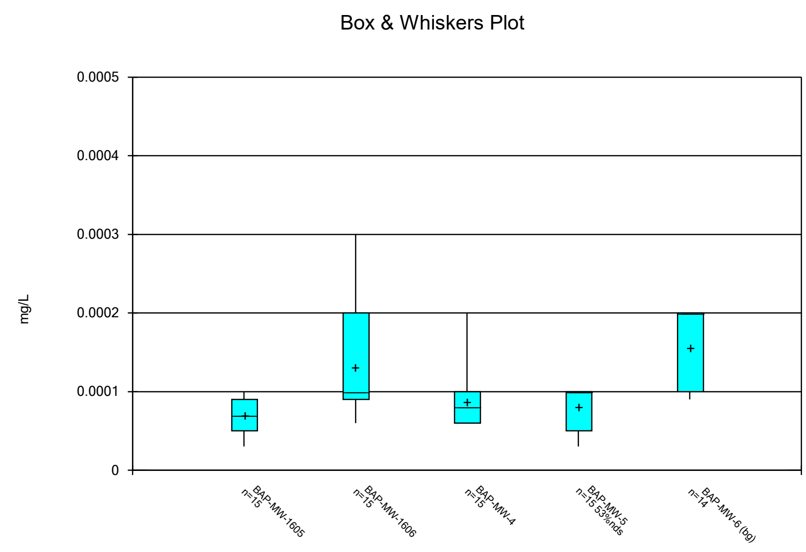
Constituent: Molybdenum, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



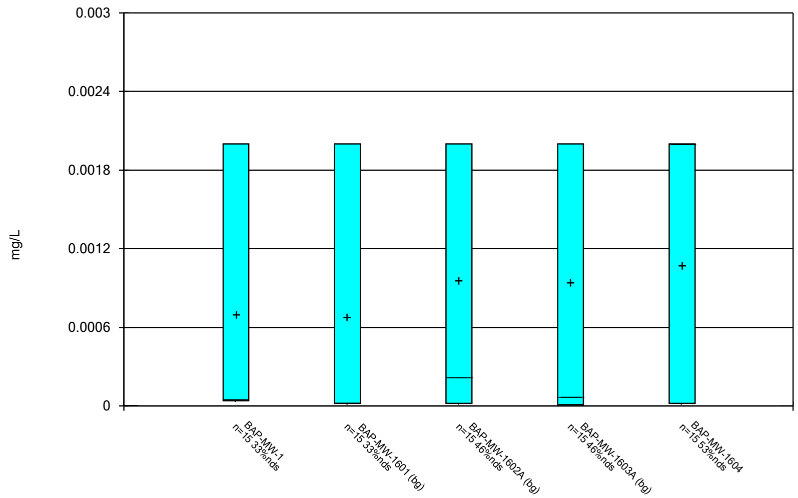
Constituent: Selenium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



Constituent: Selenium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

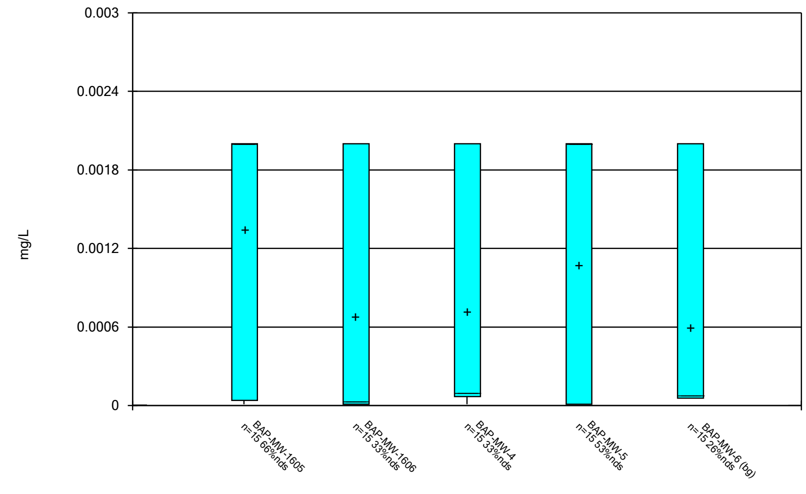
Box & Whiskers Plot



Constituent: Thallium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Thallium, total Analysis Run 8/21/2020 2:51 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Outlier Summary

Amos BAP Client: Geosyntec Data: Amos BAP Printed 8/20/2020, 9:22 AM

	BAP-MW-1604 Beryllium, total (mg/L)	BAP-MW-1603A Chromium, total (mg/L)	BAP-MW-4 Cobalt, total (mg/L)	BAP-MW-1601 Combined Radium 226 + 228 (pCi/L)	BAP-MW-1602A Combined Radium 226 + 228 (pCi/L)	BAP-MW-6 Combined Radium 226 + 228 (pCi/L)	BAP-MW-4 Fluoride, total (mg/L)	BAP-MW-5 Fluoride, total (mg/L)	BAP-MW-4 Molybdenum, total (mg/L)	BAP-MW-6 Selenium, total (mg/L)
7/25/2016									0.0111 (o)	
7/26/2016					7.914 (o)					
8/23/2016									0.0192 (o)	
10/18/2016			0.0859 (o)				<0.03 (o)	<0.03 (o)		
12/13/2016		0.00327 (o)								
2/7/2017				35.021 (o)						
2/8/2017					6.853 (o)	20.83 (o)				
3/15/2019										0.0004 (o)
6/10/2019	0.000142 (o)									

Tukey's Outlier Analysis - Upgradient Wells - Significant Results

Amos BAP   Client: Geosyntec   Data: Amos BAP   Printed 8/21/2020, 2:55 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Distribution	Normality Test
Chromium, total (mg/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**0.00327**	**n/a w/combined bg**	**NP**	**60**	**normal**	**ShapiroFrancia**
Combined Radium 226 + 228 (pCi/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**35.02,7.914,6.853,20.83**	**n/a w/combined bg**	**NP**	**64**	**normal**	**ShapiroFrancia**
Lead, total (mg/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**0.00794,0.00656,0.00599**	**n/a w/combined bg**	**NP**	**60**	**normal**	**ShapiroFrancia**
Molybdenum, total (mg/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**0.00362**	**n/a w/combined bg**	**NP**	**60**	**normal**	**ShapiroFrancia**

Tukey's Outlier Analysis - Upgradient Wells - All Results

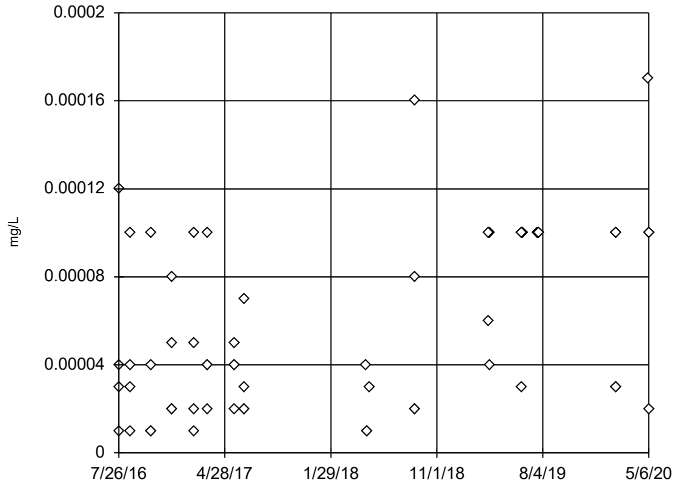
Amos BAP Client: Geosyntec Data: Amos BAP Printed 8/21/2020, 2:55 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Distribution	Normality Test
Antimony, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Arsenic, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Barium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Beryllium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Cadmium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Chromium, total (mg/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**0.00327**	**n/a w/combined bg**	**NP**	**60**	**normal**	**ShapiroFrancia**
Cobalt, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Combined Radium 226 + 228 (pCi/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**35.02,7.914,6.853,20.83**	**n/a w/combined bg**	**NP**	**64**	**normal**	**ShapiroFrancia**
Fluoride, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	66	normal	ShapiroFrancia
Lead, total (mg/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**0.00794,0.00656,0.00599**	**n/a w/combined bg**	**NP**	**60**	**normal**	**ShapiroFrancia**
Lithium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Mercury, total (mg/L)	BAP-MW-1601,BAP-M...	n/a	n/a	n/a w/combined bg	NP	44	unknown	ShapiroWilk
Molybdenum, total (mg/L)	**BAP-MW-1601,BAP-M...**	**Yes**	**0.00362**	**n/a w/combined bg**	**NP**	**60**	**normal**	**ShapiroFrancia**
Selenium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia
Thallium, total (mg/L)	BAP-MW-1601,BAP-M...	No	n/a	n/a w/combined bg	NP	60	normal	ShapiroFrancia

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 60

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

High cutoff = 0.00034, low cutoff = -0.00022, based on IQR multiplier of 3.

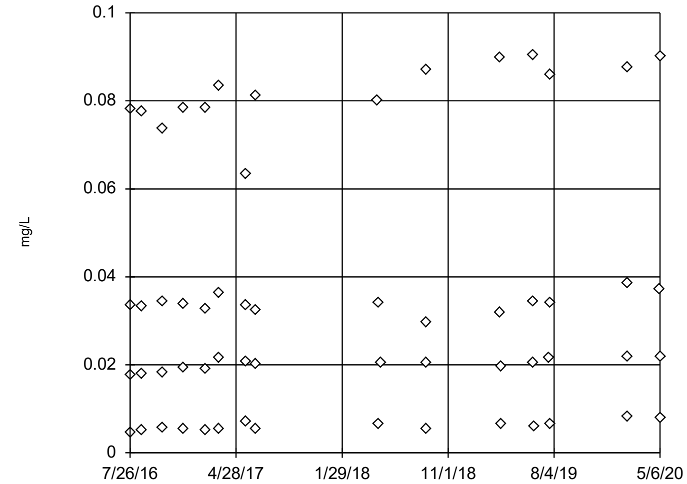
Constituent: Antimony, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 60

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

High cutoff = 0.1648, low cutoff = -0.101, based on IQR multiplier of 3.

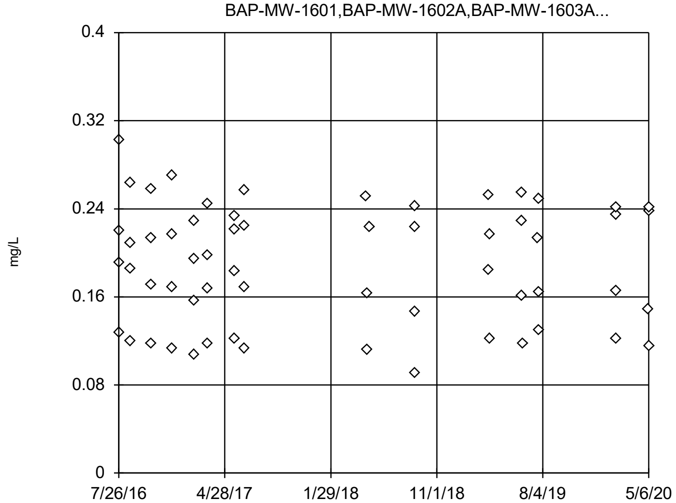
Constituent: Arsenic, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



n = 60

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

High cutoff = 0.5185, low cutoff = -0.1465, based on IQR multiplier of 3.

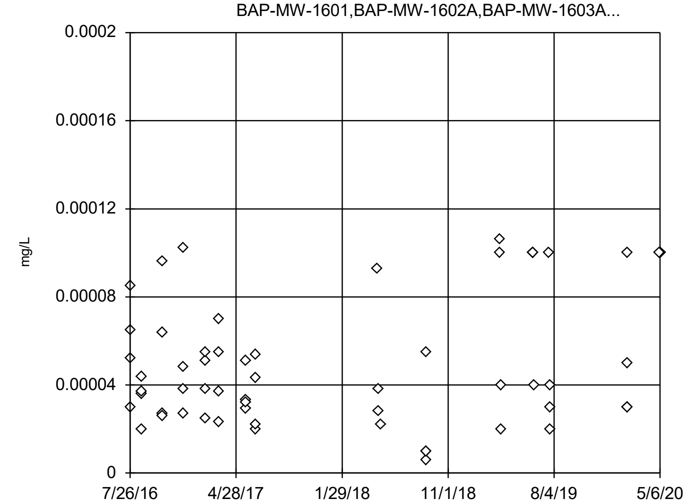
Constituent: Barium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



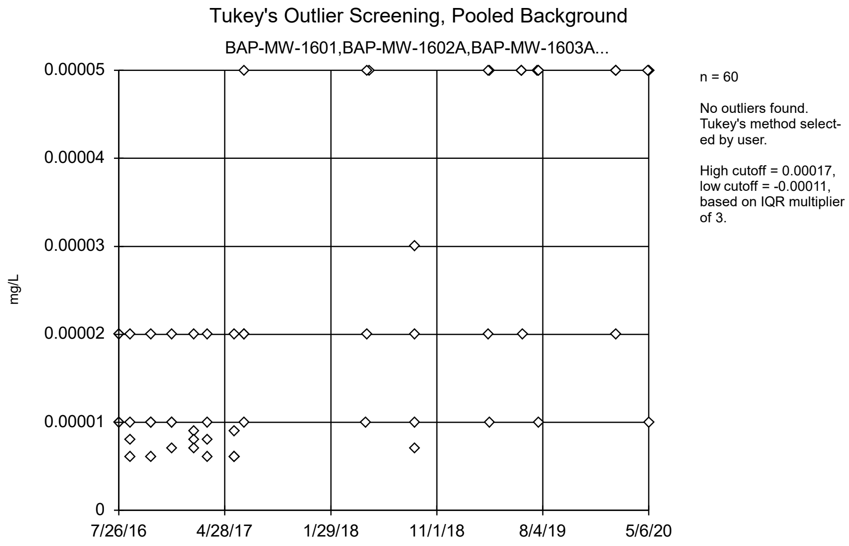
n = 60

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

High cutoff = 0.0002245, low cutoff = -0.0001185, based on IQR multiplier of 3.

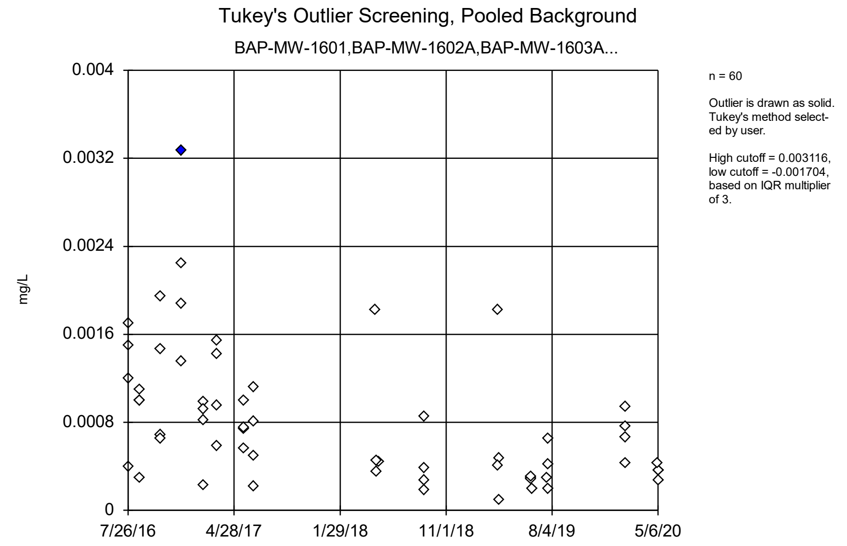
Constituent: Beryllium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP



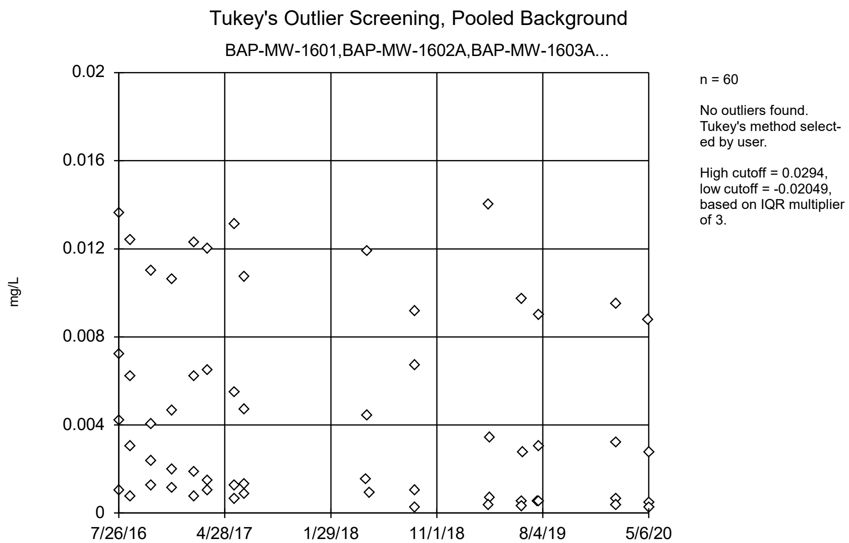
Constituent: Cadmium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



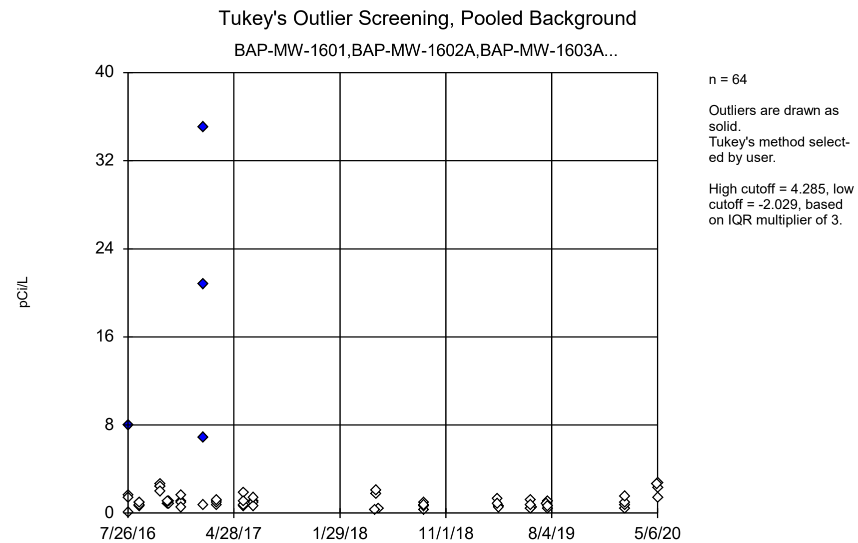
Constituent: Chromium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



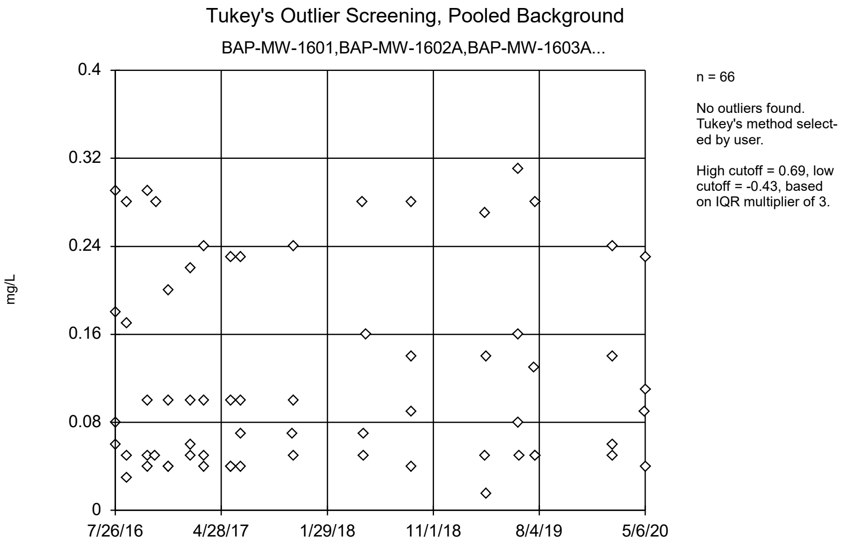
Constituent: Cobalt, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



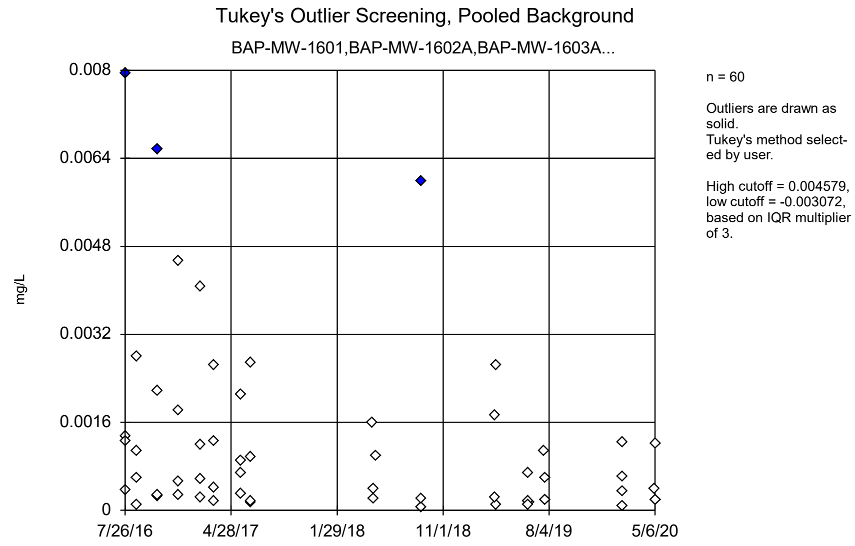
Constituent: Combined Radium 226 + 228 Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



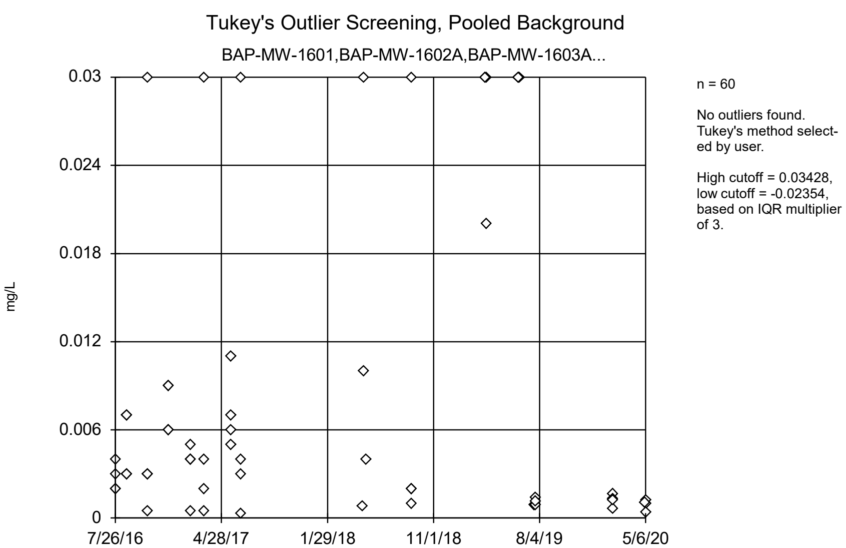
Constituent: Fluoride, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



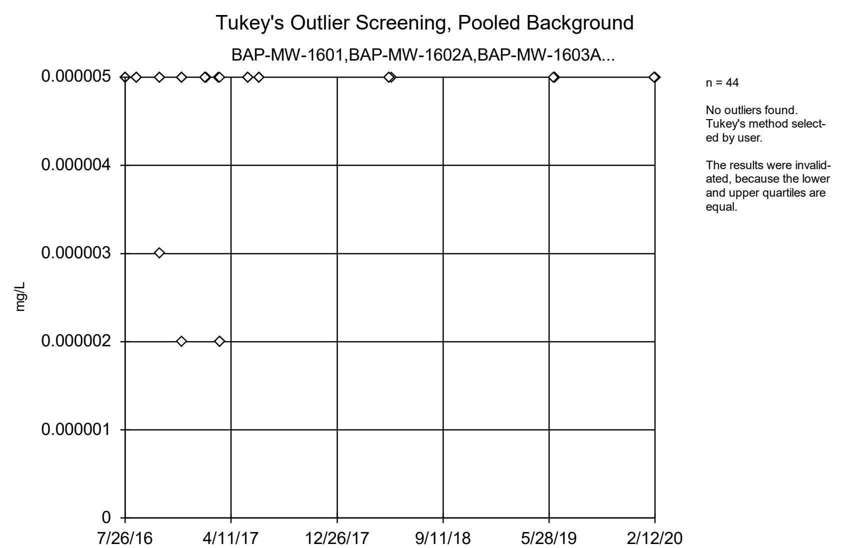
Constituent: Lead, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG



Constituent: Lithium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

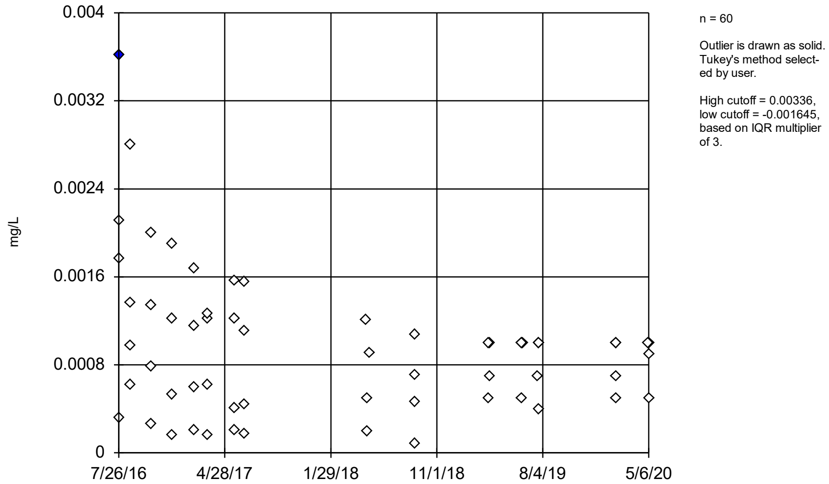


Constituent: Mercury, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



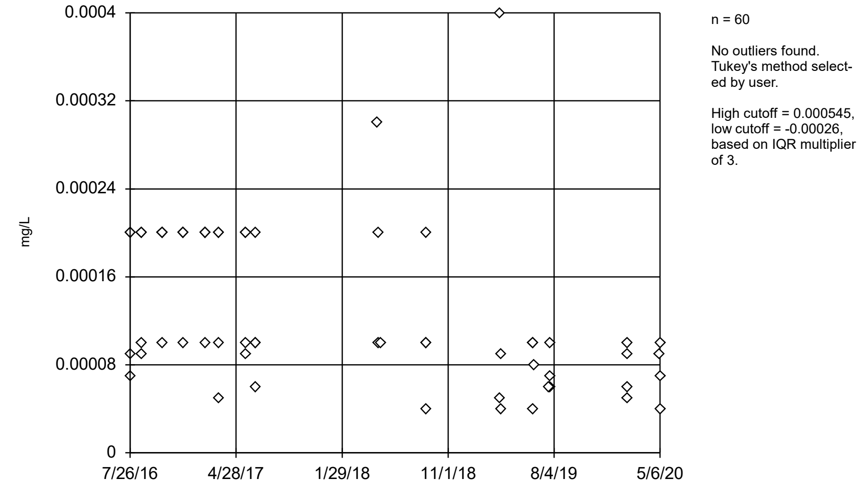
Constituent: Molybdenum, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



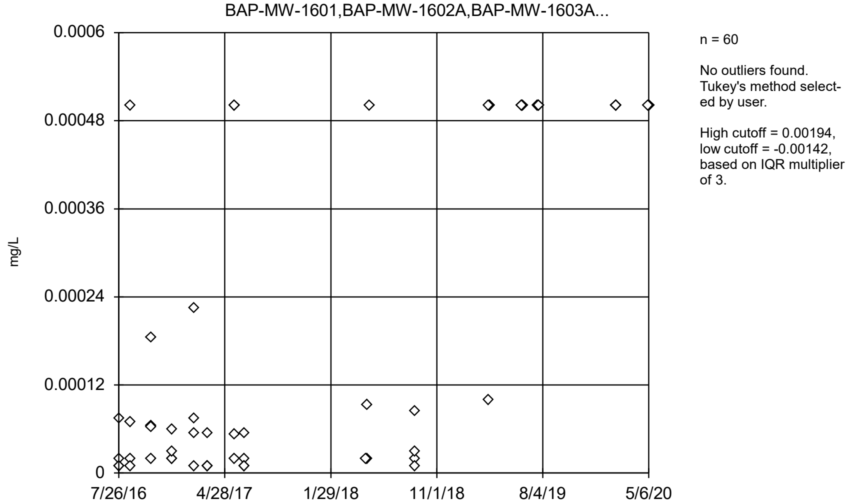
Constituent: Selenium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Tukey's Outlier Screening, Pooled Background

BAP-MW-1601,BAP-MW-1602A,BAP-MW-1603A...



Constituent: Thallium, total Analysis Run 8/21/2020 2:54 PM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Tolerance Limit Summary Table

Amos BAP Client: Geosyntec Data: Amos BAP Printed 8/21/2020, 2:53 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	n/a	0.00017	n/a	n/a	n/a	n/a	60	n/a	n/a	26.67	n/a	n/a	0.04607	NP Inter(normality)
Arsenic, total (mg/L)	n/a	0.090	n/a	n/a	n/a	n/a	60	n/a	n/a	0	n/a	n/a	0.04607	NP Inter(normality)
Barium, total (mg/L)	n/a	0.3	n/a	n/a	n/a	n/a	60	0.1889	0.05349	0	None	No	0.05	Inter
Beryllium, total (mg/L)	n/a	0.00011	n/a	n/a	n/a	n/a	60	0.03101	0.00813	16.67	Kaplan-Meier	x^(1/3)	0.05	Inter
Cadmium, total (mg/L)	n/a	0.000050	n/a	n/a	n/a	n/a	60	n/a	n/a	28.33	n/a	n/a	0.04607	NP Inter(normality)
Chromium, total (mg/L)	n/a	0.002	n/a	n/a	n/a	n/a	59	0.02636	0.009233	0	None	sqrt(x)	0.05	Inter
Cobalt, total (mg/L)	n/a	0.018	n/a	n/a	n/a	n/a	60	0.1463	0.05643	0	None	x^(1/3)	0.05	Inter
Combined Radium 226 + 228 (pCi/L)	n/a	2.5	n/a	n/a	n/a	n/a	60	0.999	0.2949	0	None	sqrt(x)	0.05	Inter
Fluoride, total (mg/L)	n/a	0.31	n/a	n/a	n/a	n/a	66	n/a	n/a	1.515	n/a	n/a	0.03387	NP Inter(normality)
Lead, total (mg/L)	n/a	0.0072	n/a	n/a	n/a	n/a	60	-7.471	1.261	0	None	ln(x)	0.05	Inter
Lithium, total (mg/L)	n/a	0.0088	n/a	n/a	n/a	n/a	60	-6.794	1.024	20	Kaplan-Meier	ln(x)	0.05	Inter
Mercury, total (mg/L)	n/a	0.0000050	n/a	n/a	n/a	n/a	44	n/a	n/a	90.91	n/a	n/a	0.1047	NP Inter(NDs)
Molybdenum, total (mg/L)	n/a	0.0024	n/a	n/a	n/a	n/a	60	0.02912	0.01009	8.333	None	sqrt(x)	0.05	Inter
Selenium, total (mg/L)	n/a	0.00030	n/a	n/a	n/a	n/a	59	n/a	n/a	5.085	n/a	n/a	0.04849	NP Inter(normality)
Thallium, total (mg/L)	n/a	0.00050	n/a	n/a	n/a	n/a	60	n/a	n/a	38.33	n/a	n/a	0.04607	NP Inter(normality)

AMOS BAP GWPS				
Constituent Name	**MCL**	**CCR Rule-Specified**	**Background**	**GWPS**
Antimony, Total (mg/L)	0.006		0.00017	0.006
Arsenic, Total (mg/L)	0.01		0.09	0.09
Barium, Total (mg/L)	2		0.3	2
Beryllium, Total (mg/L)	0.004		0.00011	0.004
Cadmium, Total (mg/L)	0.005		0.00005	0.005
Chromium, Total (mg/L)	0.1		0.002	0.1
Cobalt, Total (mg/L)		0.006	0.018	0.018
Combined Radium, Total (pCi/L)	5		2.5	5
Fluoride, Total (mg/L)	4		0.31	4
Lead, Total (mg/L)	0.015		0.0072	0.015
Lithium, Total (mg/L)		0.04	0.0088	0.04
Mercury, Total (mg/L)	0.002		0.000005	0.002
Molybdenum, Total (mg/L)		0.1	0.0024	0.1
Selenium, Total (mg/L)	0.05		0.0003	0.05
Thallium, Total (mg/L)	0.002		0.0005	0.002

Grey cell indicates Background is higher than MCL or CCR-Rule Specified Level

MCL = Maximum Contaminant Level

CCR = Coal Combustion Residual

GWPS - Groundwater Protection Standard

Confidence Intervals Summary Table - All Results (No Significant)

Amos BAP Client: Geosyntec Data: Amos BAP Printed 8/26/2020, 9:25 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Antimony, total (mg/L)	BAP-MW-1	0.0001	0.00001	0.006	No	15	0.00004933	0.00005837	20	None	No	0.01	NP (normality)
Antimony, total (mg/L)	BAP-MW-1604	0.0001	0.00002	0.006	No	15	0.00004533	0.00003021	20	None	No	0.01	NP (normality)
Antimony, total (mg/L)	BAP-MW-1605	0.00003169	0.000009577	0.006	No	15	0.00006	0.00006824	26.67	Kaplan-Meier	ln(x)	0.01	Param.
Antimony, total (mg/L)	BAP-MW-1606	0.00004	0.00002	0.006	No	15	0.00003133	0.000021	6.667	None	No	0.01	NP (normality)
Antimony, total (mg/L)	BAP-MW-4	0.0001	0.00002	0.006	No	15	0.00006	0.00003645	33.33	None	No	0.01	NP (normality)
Antimony, total (mg/L)	BAP-MW-5	0.00006191	0.0000233	0.006	No	15	0.000046	0.00003247	13.33	None	x^(1/3)	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1	0.00015	0.00009933	0.09	No	15	0.0001247	0.00003739	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1604	0.005373	0.00427	0.09	No	15	0.004857	0.00088	0	None	ln(x)	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1605	0.004331	0.003105	0.09	No	15	0.003718	0.000904	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-1606	0.003223	0.002638	0.09	No	15	0.002931	0.0004317	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-4	0.008905	0.002766	0.09	No	15	0.005835	0.00453	0	None	No	0.01	Param.
Arsenic, total (mg/L)	BAP-MW-5	0.004	0.00271	0.09	No	15	0.003363	0.001089	0	None	No	0.01	NP (normality)
Barium, total (mg/L)	BAP-MW-1	0.02875	0.02636	2	No	15	0.02755	0.001767	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1604	0.1556	0.1327	2	No	15	0.1441	0.0169	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1605	0.09248	0.07549	2	No	15	0.08399	0.01254	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-1606	0.06792	0.05775	2	No	15	0.06283	0.007505	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-4	0.09686	0.08643	2	No	15	0.09165	0.007697	0	None	No	0.01	Param.
Barium, total (mg/L)	BAP-MW-5	0.1612	0.1466	2	No	15	0.1539	0.01077	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1	0.0001305	0.0001148	0.004	No	15	0.0001227	0.00001157	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1604	0.000063	0.000039	0.004	No	14	0.00005036	0.0000146	0	None	No	0.01	NP (normality)
Beryllium, total (mg/L)	BAP-MW-1605	0.00007526	0.00005021	0.004	No	15	0.00006273	0.00001849	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-1606	0.0001209	0.00008733	0.004	No	15	0.0001041	0.0000248	0	None	No	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-4	0.00006206	0.00004467	0.004	No	15	0.00005373	0.00001366	0	None	sqrt(x)	0.01	Param.
Beryllium, total (mg/L)	BAP-MW-5	0.00006469	0.00003849	0.004	No	15	0.00005287	0.00002282	0	None	x^(1/3)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1	0.002792	0.002248	0.005	No	15	0.00252	0.0004011	0	None	No	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-1604	0.0002	0.00002	0.005	No	15	0.0001621	0.00007845	80	None	No	0.01	NP (NDs)
Cadmium, total (mg/L)	BAP-MW-1605	0.0002	0.00001	0.005	No	15	0.0001369	0.00009237	66.67	None	No	0.01	NP (NDs)
Cadmium, total (mg/L)	BAP-MW-1606	0.0001988	0.0001399	0.005	No	15	0.0001707	0.00004713	0	None	sqrt(x)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-4	0.000146	0.00005221	0.005	No	15	0.00012	0.0001258	0	None	ln(x)	0.01	Param.
Cadmium, total (mg/L)	BAP-MW-5	0.0002	0.000006	0.005	No	15	0.00007147	0.00009408	33.33	None	No	0.01	NP (normality)
Chromium, total (mg/L)	BAP-MW-1	0.0003562	0.0001113	0.1	No	15	0.0002933	0.0003137	0	None	ln(x)	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1604	0.001215	0.0006594	0.1	No	15	0.0009372	0.00041	0	None	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1605	0.0003853	0.0001985	0.1	No	15	0.0002919	0.0001379	0	None	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-1606	0.001171	0.000498	0.1	No	15	0.0008343	0.0004963	0	None	No	0.01	Param.
Chromium, total (mg/L)	BAP-MW-4	0.0005	0.0002	0.1	No	15	0.0003527	0.0002579	0	None	No	0.01	NP (normality)
Chromium, total (mg/L)	BAP-MW-5	0.0003665	0.0001544	0.1	No	15	0.0002959	0.0002416	0	None	ln(x)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1	0.01515	0.0115	0.018	No	15	0.01332	0.002696	0	None	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1604	0.0008165	0.0004404	0.018	No	15	0.0006741	0.0004246	0	None	ln(x)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-1605	0.0158	0.00883	0.018	No	15	0.01251	0.006807	0	None	No	0.01	NP (normality)
Cobalt, total (mg/L)	BAP-MW-1606	0.01595	0.0131	0.018	No	15	0.01453	0.002098	0	None	No	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-4	0.01956	0.008992	0.018	No	14	0.01471	0.007712	0	None	sqrt(x)	0.01	Param.
Cobalt, total (mg/L)	BAP-MW-5	0.001211	0.001014	0.018	No	15	0.001115	0.0001497	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1	1.057	0.5184	5	No	16	0.8166	0.4429	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1604	1.592	0.7227	5	No	16	1.209	0.763	0	None	sqrt(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1605	1.594	0.6943	5	No	16	1.313	1.138	0	None	ln(x)	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-1606	1.316	0.5129	5	No	16	0.9144	0.617	0	None	No	0.01	Param.
Combined Radium 226 + 228 (pCi/L)	BAP-MW-4	1.884	0.46	5	No	16	1.044	0.6663	0	None	No	0.01	NP (normality)
Combined Radium 226 + 228 (pCi/L)	BAP-MW-5	1.304	0.7497	5	No	16	1.027	0.4258	0	None	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1	0.06	0.02	4	No	16	0.03687	0.01662	31.25	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1604	0.0981	0.06661	4	No	17	0.08235	0.02513	0	None	No	0.01	Param.
Fluoride, total (mg/L)	BAP-MW-1605	0.06	0.02	4	No	17	0.04706	0.02201	29.41	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-1606	0.06	0.02	4	No	16	0.04625	0.01857	62.5	None	No	0.01	NP (NDs)
Fluoride, total (mg/L)	BAP-MW-4	0.06	0.03	4	No	16	0.04875	0.01258	0	None	No	0.01	NP (normality)
Fluoride, total (mg/L)	BAP-MW-5	0.05	0.03	4	No	16	0.04125	0.008062	0	None	No	0.01	NP (normality)
Lead, total (mg/L)	BAP-MW-1	0.000134	0.000068	0.015	No	15	0.000174	0.0002769	6.667	None	No	0.01	NP (normality)

Confidence Intervals Summary Table - All Results (No Significant)

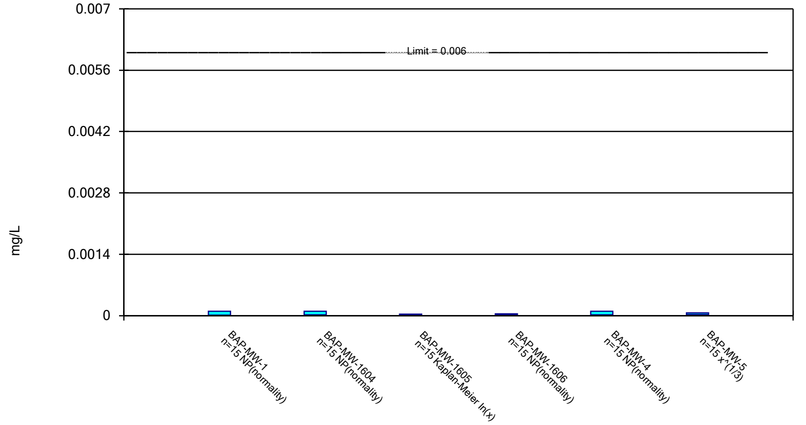
Amos BAP Client: Geosyntec Data: Amos BAP Printed 8/26/2020, 9:25 AM

Constituent	Well	Upper Lim.	Lower Lim.	Compliance	Sig.	N	Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Lead, total (mg/L)	BAP-MW-1604	0.0008829	0.0003002	0.015	No	15	0.0005915	0.00043	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-1605	0.0002068	0.00006611	0.015	No	15	0.0001773	0.000232	0	None	ln(x)	0.01	Param.
Lead, total (mg/L)	BAP-MW-1606	0.0009732	0.0004182	0.015	No	15	0.0006957	0.0004095	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-4	0.000384	0.0002021	0.015	No	15	0.0002931	0.0001342	0	None	No	0.01	Param.
Lead, total (mg/L)	BAP-MW-5	0.0003089	0.00007383	0.015	No	15	0.0002122	0.0002189	0	None	sqrt(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1	0.008705	0.002288	0.04	No	15	0.007557	0.0096	13.33	None	ln(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1604	0.001892	0.0005569	0.04	No	15	0.009743	0.01275	26.67	Kaplan-Meier	ln(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-1605	0.011	0.00259	0.04	No	15	0.008031	0.009213	13.33	None	No	0.01	NP (normality)
Lithium, total (mg/L)	BAP-MW-1606	0.03	0.00256	0.04	No	15	0.00969	0.01073	20	None	No	0.01	NP (normality)
Lithium, total (mg/L)	BAP-MW-4	0.007207	0.001303	0.04	No	15	0.006855	0.009935	13.33	None	ln(x)	0.01	Param.
Lithium, total (mg/L)	BAP-MW-5	0.007223	0.001294	0.04	No	15	0.006765	0.009925	13.33	None	ln(x)	0.01	Param.
Mercury, total (mg/L)	BAP-MW-1	0.000005	0.000005	0.002	No	11	0.000004727	9.0e-7	90.91	None	No	0.006	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1604	0.000005	0.000005	0.002	No	11	0.000004727	9.0e-7	90.91	None	No	0.006	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1605	0.000005	0.000005	0.002	No	11	0.000005	0	100	None	No	0.006	NP (NDs)
Mercury, total (mg/L)	BAP-MW-1606	0.000005	0.000005	0.002	No	11	0.000004727	9.0e-7	90.91	None	No	0.006	NP (NDs)
Mercury, total (mg/L)	BAP-MW-4	0.000005	0.000005	0.002	No	11	0.000005	0	100	None	No	0.006	NP (NDs)
Mercury, total (mg/L)	BAP-MW-5	0.000005	0.000005	0.002	No	11	0.000005	0	100	None	No	0.006	NP (NDs)
Molybdenum, total (mg/L)	BAP-MW-1	0.001363	0.0005438	0.1	No	15	0.001261	0.0007261	26.67	Kaplan-Meier	No	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-1604	0.002	0.00022	0.1	No	15	0.0007833	0.0007751	26.67	None	No	0.01	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-1605	0.002	0.00012	0.1	No	15	0.000838	0.0008626	33.33	None	No	0.01	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-1606	0.002	0.0001	0.1	No	15	0.0007627	0.0009078	33.33	None	No	0.01	NP (normality)
Molybdenum, total (mg/L)	BAP-MW-4	0.00105	0.000375	0.1	No	13	0.001071	0.0007668	23.08	Kaplan-Meier	sqrt(x)	0.01	Param.
Molybdenum, total (mg/L)	BAP-MW-5	0.00215	0.00031	0.1	No	15	0.00126	0.0008867	26.67	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-1	0.0002	0.00009	0.05	No	15	0.0001233	0.00004821	0	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-1604	0.0003	0.0001	0.05	No	15	0.0001933	0.00004577	0	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-1605	0.00008437	0.0000543	0.05	No	15	0.00006933	0.00002219	0	None	No	0.01	Param.
Selenium, total (mg/L)	BAP-MW-1606	0.0001622	0.00008241	0.05	No	15	0.0001307	0.00007086	0	None	ln(x)	0.01	Param.
Selenium, total (mg/L)	BAP-MW-4	0.0001	0.00006	0.05	No	15	0.000086	0.00003521	0	None	No	0.01	NP (normality)
Selenium, total (mg/L)	BAP-MW-5	0.0001	0.00005	0.05	No	15	0.00008	0.00002619	53.33	None	No	0.01	NP (NDs)
Thallium, total (mg/L)	BAP-MW-1	0.002	0.00004	0.002	No	15	0.0006961	0.0009544	33.33	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-1604	0.002	0.00001	0.002	No	15	0.001076	0.001023	53.33	None	No	0.01	NP (NDs)
Thallium, total (mg/L)	BAP-MW-1605	0.002	0.00002	0.002	No	15	0.001343	0.0009611	66.67	None	No	0.01	NP (NDs)
Thallium, total (mg/L)	BAP-MW-1606	0.002	0.00001	0.002	No	15	0.0006813	0.0009652	33.33	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-4	0.002	0.000055	0.002	No	15	0.0007159	0.0009406	33.33	None	No	0.01	NP (normality)
Thallium, total (mg/L)	BAP-MW-5	0.002	0.00001	0.002	No	15	0.001075	0.001023	53.33	None	No	0.01	NP (NDs)

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



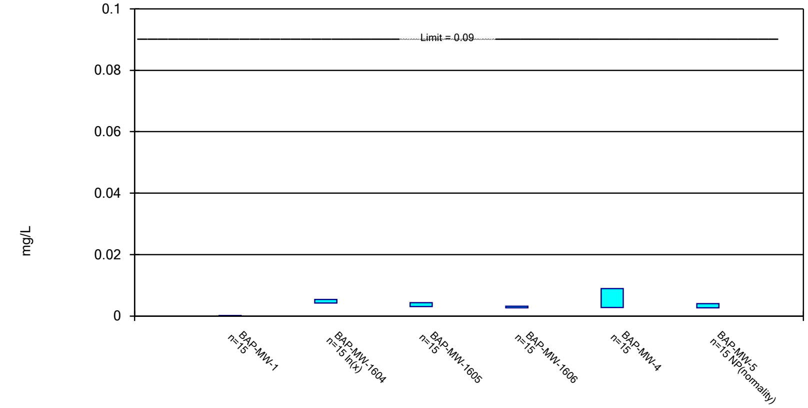
Constituent: Antimony, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



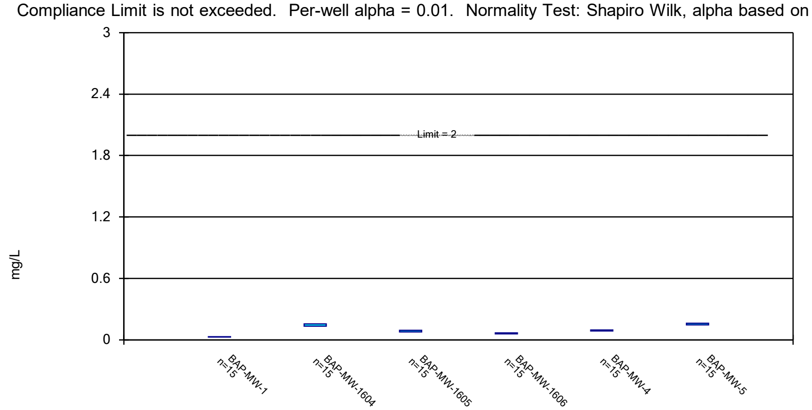
Constituent: Arsenic, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric Confidence Interval

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



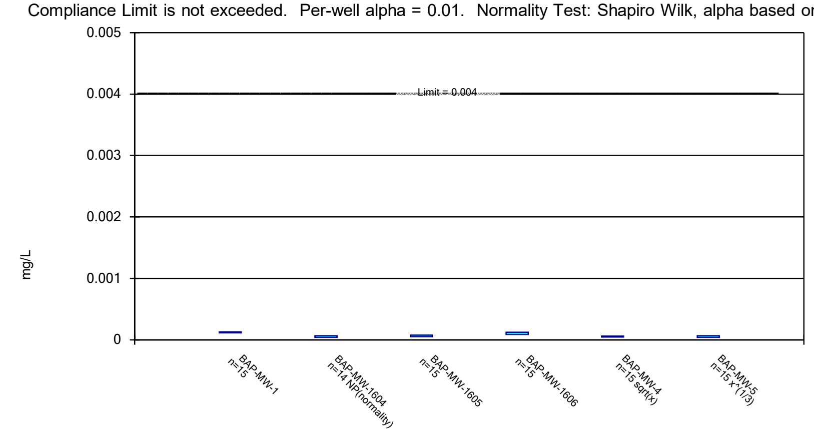
Constituent: Barium, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



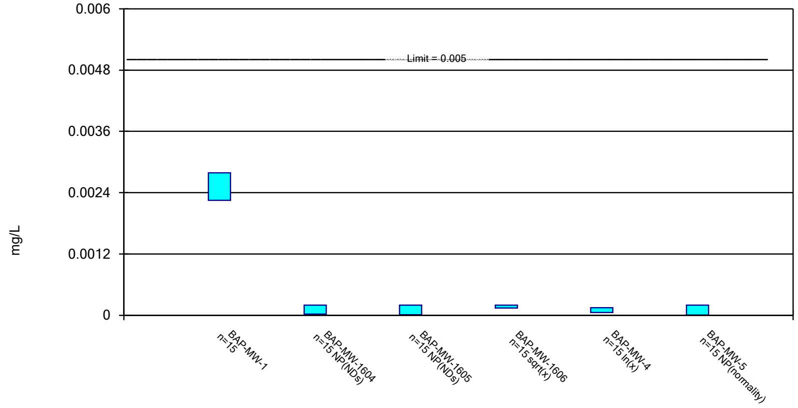
Constituent: Beryllium, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



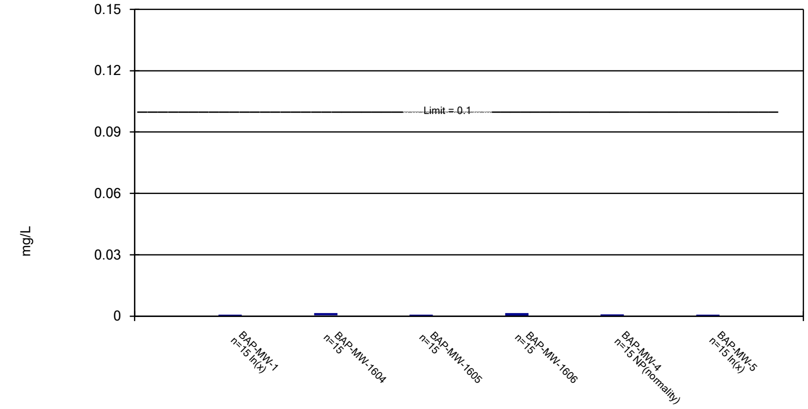
Constituent: Cadmium, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



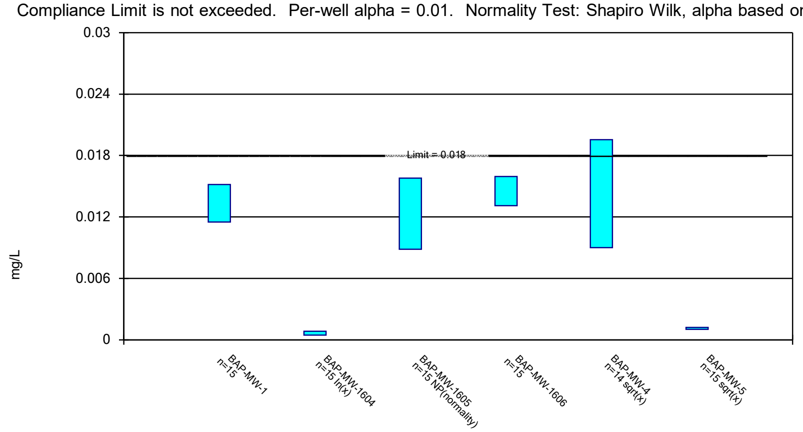
Constituent: Chromium, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



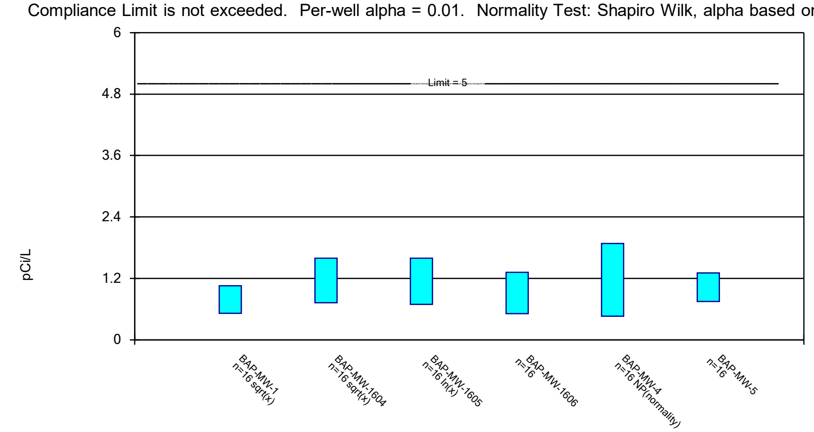
Constituent: Cobalt, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



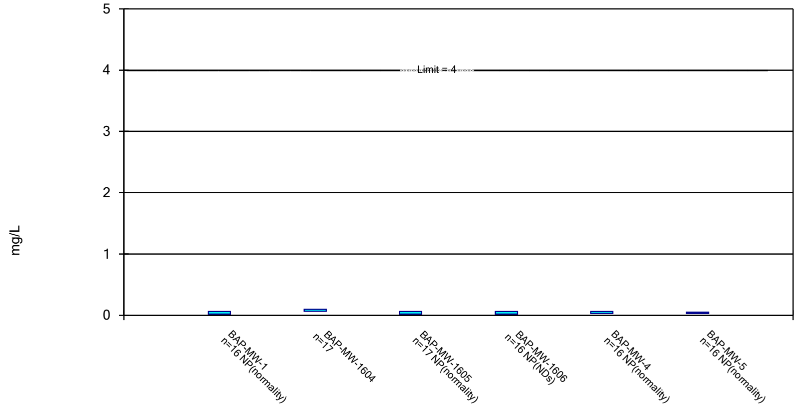
Constituent: Combined Radium 226 + 228 Analysis Run 8/26/2020 9:21 AM View: Appendix IV

Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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

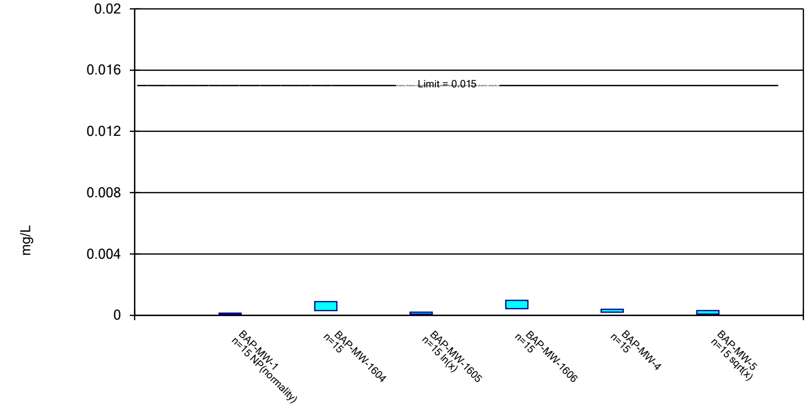


Constituent: Fluoride, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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

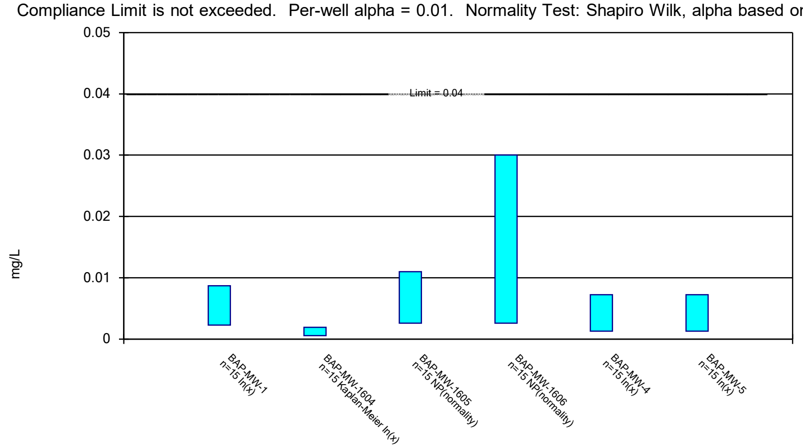


Constituent: Lead, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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

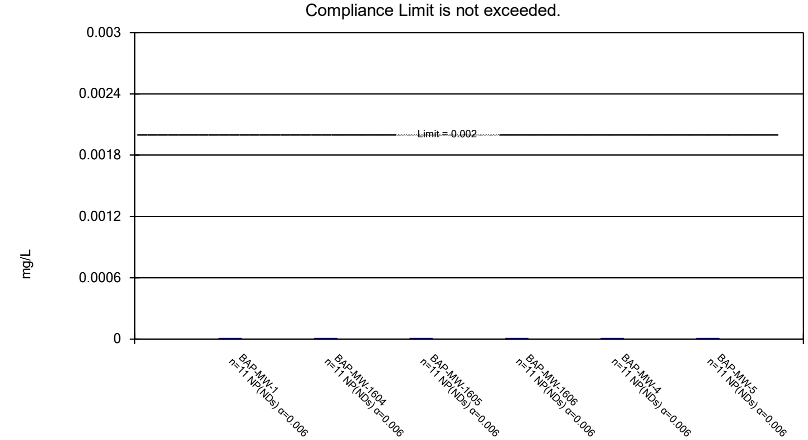


Constituent: Lithium, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

Compliance Limit is not exceeded.

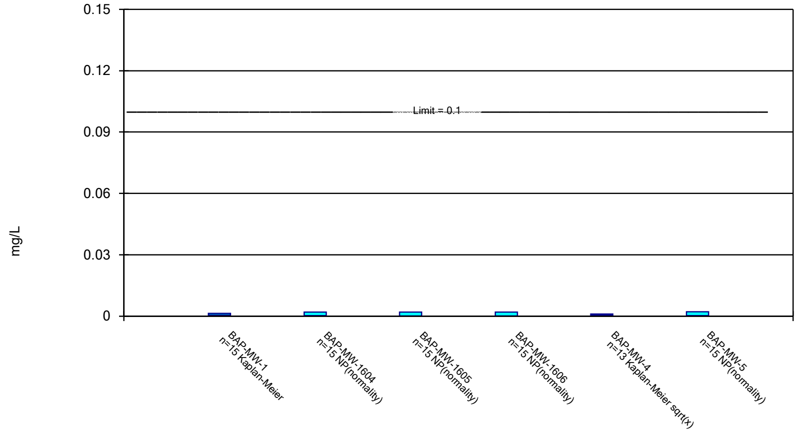


Constituent: Mercury, total Analysis Run 8/26/2020 9:21 AM View: Appendix IV
Amos BAP Client: Geosyntec Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



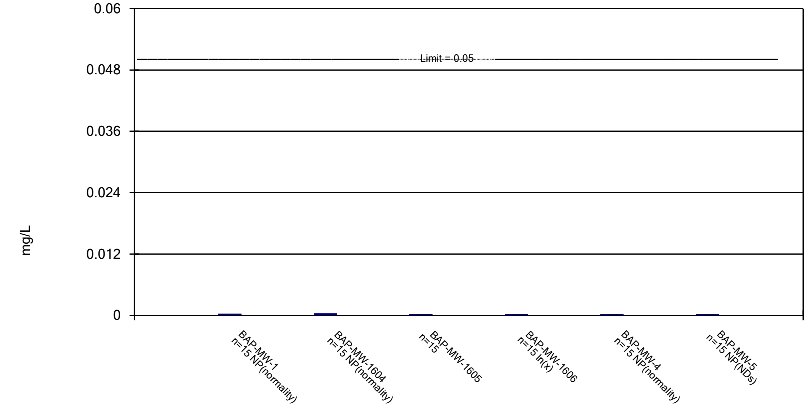
Constituent: Molybdenum, total   Analysis Run 8/26/2020 9:21 AM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Parametric and Non-Parametric (NP) Confidence Interval

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



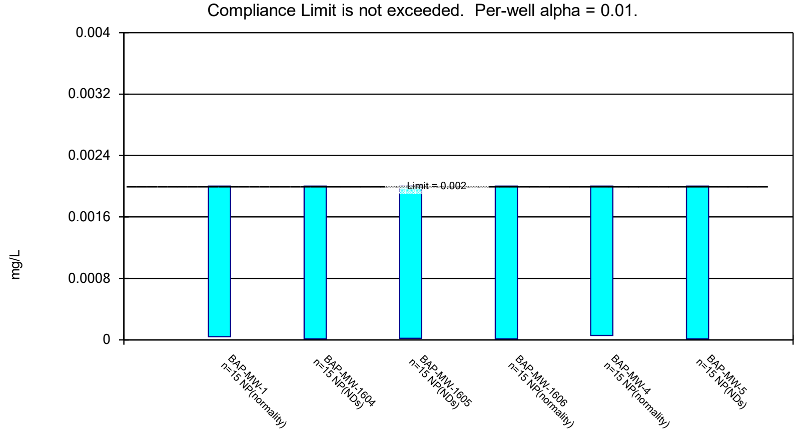
Constituent: Selenium, total   Analysis Run 8/26/2020 9:21 AM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

Sanitas™ v.9.6.26d Groundwater Stats Consulting. UG

Non-Parametric Confidence Interval

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



Constituent: Thallium, total   Analysis Run 8/26/2020 9:21 AM   View: Appendix IV

Amos BAP   Client: Geosyntec   Data: Amos BAP

APPENDIX 3 – Alternative Source Demonstrations

Not applicable.

APPENDIX 4 – Notice of Transition between Monitoring Programs

The notification of the establishment of an assessment monitoring program follows.

John Amos Plant

Notice of Assessment Monitoring Program Establishment

Bottom Ash Pond

On January 15, 2018, it was determined that Amos Plant's Bottom Ash Pond had statistically significant increases over background for Calcium, Chloride. Sulfate, and Total Dissolved Solids (TDS). An alternative source demonstration was not successful within the 90 day period as allowed for in 257.94(e)(2) prompting the initiation of an assessment monitoring program, which was established on April 13, 2018. Therefore this notice is being placed in the operating record in accordance with the requirement of 257.94(e)(3).

APPENDIX 5 – Well Installation/Decommissioning Logs

Not applicable.

EPA ADDITIONAL INFORMATION REQUEST

ATTACHMENT B

AMOS PLANT FLY ASH POND

2020 ANNUAL GROUNDWATER MONITORING REPORT

Annual Groundwater Monitoring Report

Appalachian Power Company

John E. Amos Plant

Fly Ash Pond CCR Management Unit

Winfield, West Virginia

January 2021

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

APPALACHIAN POWER

An AEP Company

BOUNDLESS ENERGY

Table of Contents Page

I. Overview

This *Annual Groundwater Monitoring and Corrective Action Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Appalachian Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), John E. Amos Power Plant. The USEPA's CCR rules require that the initial Annual Groundwater Monitoring and Corrective Action Report for inactive surface impoundments be posted to the operating record no later than August 1, 2019 and then annually, thereafter. This Annual Groundwater Monitoring and Corrective Action Report covers all activities required by the CCR Rule for all of 2020.

In general, the following activities were completed:

- The Amos Fly Ash Pond (AMFAP) CCR unit began 2020 in detection monitoring and remained in detection monitoring throughout all of 2020.
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- Statistically significant increases (SSI's) were observed during the November 2019 detection monitoring event. The monitoring well locations and potential SSI parameters were re-sampled in February 2020 in accordance with the statistical analysis plan. Statistical analysis for this detection monitoring event was completed in April 2020. The re-sampling event confirmed SSI's for the following:
    - MW-5: Calcium and sulfate
    - MW-1804A: Chloride and sulfate

  An alternative source demonstration (ASD) for the above parameters was successfully completed in June 2020.
- SSI's were observed during the May 2020 detection monitoring event. The monitoring well locations and potential SSI parameters were re-sampled in July 2020 in accordance with the statistical analysis plan. Statistical analysis for this detection monitoring event was completed in July 2020. The following were concluded to be confirmed SSI's:
    - MW-5: Calcium and sulfate

  An ASD for the above parameters was successfully completed in November 2020.
- A detection monitoring sampling event occurred in November 2020. Potential SSI's have been observed at the following locations:
    - MW-5: Calcium and sulfate
    - MW-6: Fluoride
    - MW-7: Calcium and fluoride

- MW-8: Calcium, chloride, sulfate, and total dissolved solids
- MW-1804A: Chloride and sulfate

A re-sampling event occurred in January 2021 for the above mentioned parameters and well locations in accordance with the statistical analysis plan. Statistical analysis is ongoing. If any of the above potential SSI's are confirmed following statistical analysis, an ASD will be completed to determine if the CCR unit can remain in detection monitoring or if it must transition to assessment monitoring in accordance with the CCR rule.

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

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers.
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs (**Appendix 1**).
- Results of the required statistical analysis of groundwater monitoring results (**Appendix 2**).
- Discussion of any alternative source demonstrations completed, if applicable (**Appendix 3**).
- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations, if applicable (Appendix 4). This is not applicable to this report.
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened, if applicable (Appendix 5). This is not applicable to this report.
- Other information required to be included in the annual report such as an alternate monitoring frequency or assessment of corrective measures, if applicable.

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

II. Groundwater Monitoring Well Locations and Identification Numbers

Figure 1 depicts the PE-certified groundwater monitoring network, the monitoring well locations and their corresponding identification numbers. The groundwater monitoring network has been determined to adequately monitor upgradient, downgradient, and background areas adjacent to the Fly Ash Pond, as detailed in the *Groundwater Monitoring System Design and Construction Certification* that was placed on the AEP CCR public internet site on May 1, 2019. The groundwater quality monitoring network includes the following:

- Five upgradient or sidegradient monitoring wells: MW-1807A, MW-1807B, MW-1808A, MW-1809A, and MW-1810A.
- Ten downgradient monitoring wells: MW-1, MW-2, MW-5, MW-6, MW-7, MW-8, MW-9, MW-1801A, MW-1804A, and MW-1806A.

MW-1807B is screened in the Clarksburg shale to provide background groundwater quality in a deeper secondary groundwater-bearing zone that is hydraulically connected to the uppermost aquifer. Since this monitoring well is not located within the uppermost aquifer but in a deeper groundwater bearing zone, it is shown only on the site figure and not included in the groundwater flow direction maps.

Legend
- Upgradient Sampling Location
- Downgradient Sampling Location
- Fly Ash Pond

Notes
- Monitoring well coordinates and site features provided by AEP.

1,000 500 0 1,000 Feet

Site Layout
Fly Ash Pond

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2019/07/30

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2018\AEP-Amos_FAP_Site_Layout.mxd. ARevezzo. 7/30/2019. CHA8423.

III. Monitoring Wells Installed or Decommissioned

No monitoring wells were installed or decommissioned in 2020.

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

Appendix 1 contains Table 1 which displays the groundwater quality data collected since initiating CCR background sampling through results received in 2020. **Appendix 1** also contains Table 2 which displays the groundwater velocity and residence time determinations for each completed sampling event, to date. Static water elevation data from each monitoring event are used to develop potentiometric maps and determine the groundwater flow direction for each respective sampling event.

V. Groundwater Quality Data Statistical Analysis

Statistical analysis of the November 2019 detection monitoring samples was completed in April 2020. SSI's in the Appendix III parameters of calcium and sulfate at MW-5 and chloride and sulfate and MW-1804A were documented in the April 6, 2020 *Evaluation of Detection Monitoring Data at Amos Plant's Fly Ash Pond* memorandum (**Appendix 2**). A successful alternative source demonstration was completed for these confirmed SSI's. That demonstration is discussed in the next section of this report.

Statistical analysis of the May 2020 detection monitoring samples was completed in July 2020. SSI's in the Appendix III parameters of calcium and sulfate at MW-5 were documented in the July 29, 2020 *Evaluation of Detection Monitoring Data at Amos Plant's Fly Ash Pond* memorandum (**Appendix 2**). A successful alternative source demonstration was completed for these confirmed SSI's. That demonstration is discussed in the next section of this report.

The November 2020 detection monitoring samples received indicate potential SSI's listed below.

- MW-5: Calcium and sulfate
- MW-6: Fluoride
- MW-7: Calcium and fluoride
- MW-8: Calcium, chloride, sulfate, and total dissolved solids
- MW-1804A: Chloride and sulfate

The re-sampling event in accordance with the statistical analysis plan was conducted in early January 2021. Statistical analysis of this event will be completed in early 2021. If any SSI's are confirmed, an ASD will be attempted. If successful, the AMFAP will remain in detection monitoring. However, if unsuccessful, the AMFAP will transition into assessment monitoring.

VI. Alternative Source Demonstration

An alternative source demonstration (ASD) relative to the Appendix III SSI's confirmed for the November 2019 detection monitoring event was successfully completed in June 2020. The demonstration concluded that groundwater quality and the Appendix III indicator parameter SSI's identified in the statistical evaluation is attributable to an alternative source. The successful ASD is attached in **Appendix 3**.

An ASD relative to the Appendix III SSI's confirmed for the May 2020 detection monitoring event was successfully completed in November 2020. The demonstration concluded that groundwater quality and the Appendix III indicator parameters SSI's identified in the statistical evaluation is attributable to an alternative. The successful ASD is attached in **Appendix 3**.

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

As of this annual groundwater report date there has been no transition between detection monitoring and assessment monitoring. Detection monitoring will continue throughout 2021 pending the results of the aforementioned statistical analysis regarding the November 2020 detection monitoring 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 is high enough at this facility that no modification of the twice-per-year detection monitoring effort 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 2020 and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support the 2020 annual groundwater report preparation.

X. A Projection of Key Activities for 2021

Key activities for the upcoming year include:

- Complete the statistical evaluation of the November 2020 detection monitoring results and subsequent verification sampling, looking for any confirmed statistically significant increases.
- Perform an ASD, if necessary, for the November 2020 detection monitoring event if any SSI's are confirmed. If the ASD if necessary and is unsuccessful, the CCR unit will transition into assessment monitoring. If it is successful or no SSI's are confirmed, the CCR unit will continue detection monitoring on a semi-annual basis.
- Respond to any new data received in light of what the CCR rule requires.
- Preparation of the 2021 annual groundwater report.

APPENDIX 1

Tables follow, showing a summary of the number of samples collected per monitoring well and the groundwater monitoring data collected, the groundwater velocity, and the direction of groundwater flow. The dates that the samples were collected also is shown.

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.182	2.83	11.7	0.42	8.2	30.6	473
8/28/2018	Background	0.135	2.80	11.3	0.45	8.5	31.6	435
10/3/2018	Background	0.138	2.95	11.1	0.40	8.3	30.8	457
10/22/2018	Background	0.180	2.36	11.4	0.42	8.3	30.7	434
11/13/2018	Background	0.209	3.03	11.5	0.45	8.0	32.2	444
12/19/2018	Background	0.117	2.71	10.7	0.43	8.1	30.9	428
1/23/2019	Background	0.115	2.29	14.6	0.41	8.2	55.9	453
2/19/2019	Background	0.126	2.36	10.9	0.44	8.5	31.3	457
3/12/2019	Detection	0.110	2.60	11.0	0.43	8.2	31.6	458
11/8/2019	Detection	0.114	2.38	11.2	0.42	8.2	33.7	461
5/13/2020	Detection	0.122	2.74	11.2	0.42	8.2	33.6	457
11/2/2020	Detection	0.097	2.70	10.5	0.48	8.4	33.6	434

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

Table 1 - Groundwater Data Summary: MW-1
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.02 J	7.65	52.9	< 0.004 U	0.008 J	0.075	0.031	1.086	0.42	0.041	0.012	< 0.002 U	1.94	< 0.03 U	0.03 J
8/28/2018	Background	0.02 J	7.90	49.5	< 0.004 U	< 0.005 U	0.092	0.039	0.261	0.45	0.047	0.009	< 0.002 U	1.48	< 0.03 U	0.01 J
10/3/2018	Background	< 0.02 U	7.98	51.5	< 0.02 U	< 0.01 U	0.1 J	0.03 J	1.782	0.40	0.02 J	< 0.009 U	< 0.002 U	1 J	< 0.03 U	< 0.1 U
10/22/2018	Background	< 0.02 U	6.84	44.7	< 0.02 U	< 0.01 U	0.1 J	0.05 J	0.608	0.42	0.07 J	< 0.009 U	< 0.002 U	1 J	< 0.03 U	< 0.1 U
11/13/2018	Background	< 0.02 U	8.04	51.9	< 0.02 U	< 0.01 U	0.583	0.03 J	0.4563	0.45	0.06 J	< 0.009 U	< 0.002 U	1 J	< 0.03 U	< 0.1 U
12/19/2018	Background	0.03 J	7.65	48.6	< 0.02 U	< 0.01 U	0.08 J	0.03 J	0.3156	0.43	0.02 J	0.02 J	< 0.002 U	1 J	< 0.03 U	< 0.1 U
1/23/2019	Background	0.06 J	7.64	43.7	< 0.02 U	< 0.01 U	0.09 J	0.03 J	0.688	0.41	0.03 J	< 0.009 U	< 0.002 U	1 J	< 0.03 U	< 0.1 U
2/19/2019	Background	0.05 J	7.83	44.7	< 0.02 U	< 0.01 U	0.1 J	0.03 J	0.00538	0.44	0.111	0.01 J	< 0.002 U	1 J	0.05 J	< 0.1 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/27/2018	Background	0.259	4.24	471	3.08	8.4	2.4	1,260
8/29/2018	Background	0.249	3.98	443	2.99	8.6	17.4	1,310
10/4/2018	Background	0.256	4.31	435	2.99	8.5	14.8	1,280
10/23/2018	Background	0.262	3.95	438	3.08	8.5	7.4	1,250
11/15/2018	Background	0.328	4.07	469	3.30	8.5	13.5	1,250
12/19/2018	Background	0.225	3.81	430	3.03	8.5	6.4	1,250
1/23/2019	Background	0.318	3.67	441	3.00	8.2	6.4	1,310
2/22/2019	Background	0.237	3.95	447	3.06	8.7	2.3	1,310
3/13/2019	Detection	0.230	3.98	441	3.02	8.7	1.8	1,300
11/12/2019	Detection	0.265	4.77	426	2.73	8.5	20.1	1,340
2/11/2020	Detection	--	4.31	--	--	8.3	--	--
5/12/2020	Detection	0.214	4.35	443	2.91	8.6	6 J	1,340
11/2/2020	Detection	0.194	4.13	435	3.24	8.6	6.6	1,310

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

Table 1 - Groundwater Data Summary: MW-2
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/27/2018	Background	0.06	1.68	202	0.008 J	0.02 J	0.312	0.102	1.354	3.08	0.406	0.019	< 0.002 U	27.2	0.04 J	0.02 J
8/29/2018	Background	0.02 J	1.62	178	< 0.004 U	< 0.005 U	0.129	0.034	1.7	2.99	0.033	0.023	< 0.002 U	34.5	< 0.03 U	0.02 J
10/4/2018	Background	< 0.02 U	1.76	192	< 0.02 U	< 0.01 U	0.2 J	0.05 J	1.288	2.99	0.1 J	< 0.009 U	< 0.002 U	30.8	< 0.03 U	< 0.1 U
10/23/2018	Background	< 0.02 U	1.24	181	< 0.02 U	< 0.01 U	0.2 J	0.055	0.594	3.08	0.214	0.03 J	< 0.002 U	26.1	< 0.03 U	< 0.1 U
11/15/2018	Background	< 0.02 U	1.66	185	< 0.02 U	< 0.01 U	0.2 J	0.04 J	0.953	3.30	0.110	0.02 J	< 0.002 U	29.2	< 0.03 U	< 0.1 U
12/19/2018	Background	0.03 J	1.33	182	< 0.02 U	0.03 J	0.967	0.04 J	1.058	3.03	0.290	0.02 J	< 0.002 U	25.5	< 0.03 U	< 0.1 U
1/23/2019	Background	< 0.02 U	1.55	178	< 0.02 U	< 0.01 U	0.382	0.050	0.725	3.00	0.166	0.01 J	< 0.002 U	29.2	0.04 J	< 0.1 U
2/22/2019	Background	< 0.1 U	1.35	169	< 0.1 U	< 0.05 U	< 0.2 U	< 0.1 U	0.2747	3.06	< 0.1 U	0.02 J	< 0.002 U	21.9	< 0.2 U	< 0.5 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.252	6.75	793	3.32	8.1	0.2	1,890
8/29/2018	Background	0.240	6.71	780	3.33	8.2	0.2	1,880
10/3/2018	Background	0.276	7.03	776	3.33	8.1	0.1 J	1,860
10/24/2018	Background	0.249	7.09	811	3.44	8.1	< 0.06 U	1,840
11/13/2018	Background	0.264	6.79	832	3.63	8.0	0.1 J	1,880
12/19/2018	Background	0.221	6.48	783	3.43	7.9	< 0.06 U	1,890
1/23/2019	Background	0.323	5.98	782	3.36	8.1	< 0.06 U	1,910
2/19/2019	Background	0.239	6.79	793	3.38	8.2	< 0.06 U	1,920
3/13/2019	Detection	0.229	6.85	804	3.44	8.0	0.08 J	1,930
11/8/2019	Detection	0.182	21.0	663	3.04	8.0	32.0	1,840
2/11/2020	Detection	--	11.3	713	--	7.8	18.6	--
5/11/2020	Detection	0.211	9.85	746	2.97	7.9	11.0	1,820
7/7/2020	Detection	--	8.77	--	--	8.1	22.8	--
10/27/2020	Detection	0.207	9.50	729	3.24	8.2	25.1	1,770

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

Table 1 - Groundwater Data Summary: MW-5
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/24/2018	Background	0.06	4.89	356	0.004 J	0.006 J	0.152	0.046	1.37	3.32	0.222	0.032	< 0.002 U	36.5	< 0.03 U	0.05 J
8/29/2018	Background	0.18	5.08	359	< 0.004 U	0.01 J	0.278	0.085	1.805	3.33	0.284	0.030	< 0.002 U	38.4	< 0.03 U	0.02 J
10/3/2018	Background	< 0.02 U	4.86	373	< 0.02 U	< 0.01 U	0.626	0.053	1.63	3.33	0.03 J	< 0.009 U	< 0.002 U	35.7	< 0.03 U	< 0.1 U
10/24/2018	Background	0.02 J	4.34	363	< 0.02 U	< 0.01 U	0.219	0.516	0.731	3.44	0.06 J	0.03 J	< 0.002 U	35.1	0.04 J	< 0.1 U
11/13/2018	Background	< 0.02 U	4.37	353	< 0.02 U	< 0.01 U	0.1 J	0.04 J	1.824	3.63	0.03 J	0.02 J	< 0.002 U	34.7	< 0.03 U	< 0.1 U
12/19/2018	Background	< 0.02 U	4.39	364	< 0.02 U	< 0.01 U	0.07 J	0.04 J	1.514	3.43	< 0.02 U	0.03 J	< 0.002 U	34.8	< 0.03 U	< 0.1 U
1/23/2019	Background	< 0.04 U	4.35	351	< 0.04 U	< 0.02 U	0.532	< 0.04 U	1.052	3.36	< 0.04 U	0.02 J	< 0.002 U	35.0	< 0.06 U	< 0.2 U
2/19/2019	Background	< 0.06 U	5.25	349	< 0.06 U	< 0.03 U	0.2 J	< 0.06 U	1.454	3.38	< 0.06 U	0.034	< 0.002 U	33.6	< 0.09 U	< 0.3 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.120	61.0	19.3	0.22	6.9	44.4	392
8/28/2018	Background	0.096	59.7	19.4	0.24	6.9	44.6	398
10/3/2018	Background	0.125	60.7	18.9	0.21	6.8	43.4	402
10/24/2018	Background	0.1 J	61.5	18.4	0.23	6.9	42.0	400
11/13/2018	Background	0.111	64.9	19.8	0.24	6.7	44.6	390
12/19/2018	Background	0.07 J	55.8	17.7	0.23	6.7	41.7	376
1/23/2019	Background	0.08 J	54.1	17.8	0.22	6.6	41.3	411
2/19/2019	Background	0.09 J	55.8	17.3	0.24	7.0	40.4	406
3/12/2019	Detection	0.08 J	57.9	17.4	0.23	6.9	39.8	390
11/8/2019	Detection	0.079	56.6	17.2	0.24	6.9	41.7	368
5/11/2020	Detection	0.088	55.8	15.9	0.25	7.0	32.6	416
10/27/2020	Detection	0.089	53.4	16.5	0.28	7.1	38.6	384

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

Table 1 - Groundwater Data Summary: MW-6
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.01 J	1.81	536	0.009 J	0.01 J	0.094	0.242	2.73	0.22	0.02 J	0.012	< 0.002 U	0.58	< 0.03 U	0.03 J
8/28/2018	Background	0.02 J	1.82	527	0.008 J	0.02	0.663	0.323	2.439	0.24	0.167	0.009	< 0.002 U	0.60	< 0.03 U	0.02 J
10/3/2018	Background	< 0.02 U	1.91	523	< 0.02 U	0.01 J	0.09 J	0.260	4.59	0.21	< 0.02 U	< 0.009 U	< 0.002 U	0.5 J	< 0.03 U	< 0.1 U
10/24/2018	Background	< 0.02 U	1.72	494	0.03 J	< 0.01 U	0.07 J	0.258	2.202	0.23	0.03 J	0.01 J	< 0.002 U	0.6 J	< 0.03 U	< 0.1 U
11/13/2018	Background	< 0.02 U	2.12	524	< 0.02 U	< 0.01 U	0.08 J	0.233	2.325	0.24	0.03 J	< 0.009 U	< 0.002 U	0.7 J	< 0.03 U	< 0.1 U
12/19/2018	Background	< 0.02 U	1.88	510	< 0.02 U	0.01 J	0.06 J	0.234	2.53	0.23	0.02 J	0.01 J	< 0.002 U	0.7 J	< 0.03 U	< 0.1 U
1/23/2019	Background	0.04 J	1.89	486	< 0.02 U	< 0.01 U	0.04 J	0.220	1.82	0.22	< 0.02 U	< 0.009 U	< 0.002 U	0.6 J	< 0.03 U	< 0.1 U
2/19/2019	Background	< 0.02 U	1.53	482	< 0.02 U	< 0.01 U	0.277	0.219	2.136	0.24	< 0.02 U	0.02 J	< 0.002 U	0.6 J	0.04 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-7
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.087	1.33	5.41	0.27	8.5	32.0	368
8/29/2018	Background	0.112	1.29	5.32	0.27	8.8	31.5	387
10/3/2018	Background	0.156	1.44	5.23	0.26	8.8	31.8	376
10/24/2018	Background	0.09 J	1.40	5.37	0.27	8.8	31.7	344
11/13/2018	Background	0.192	1.49	5.65	0.29	8.4	33.2	379
12/17/2018	Background	0.1 J	1.24	5.29	0.27	8.6	32.0	387
1/23/2019	Background	0.127	1.41	5.18	0.25	8.4	32.0	389
2/18/2019	Background	0.06 J	1.37	5.39	0.26	9.0	32.1	401
3/12/2019	Detection	0.06 J	1.47	5.49	0.27	8.9	32.5	385
11/11/2019	Detection	0.066	2.18	5.36	0.25	8.7	32.3	390
2/11/2020	Detection	--	1.39	--	--	8.5	--	--
5/11/2020	Detection	0.067	1.59	5.30	0.27	8.4	23.6	395
10/28/2020	Detection	0.065	1.81	5.34	0.31	8.9	31.2	387

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

Table 1 - Groundwater Data Summary: MW-7
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.04 J	5.31	34.0	< 0.004 U	0.01 J	0.082	0.038	1.958	0.27	0.211	0.009	< 0.002 U	1.12	< 0.03 U	0.01 J
8/29/2018	Background	0.05 J	5.51	32.3	< 0.004 U	0.01 J	0.190	0.023	0.745	0.27	0.121	0.010	< 0.002 U	1.06	< 0.03 U	0.02 J
10/3/2018	Background	0.07 J	5.65	33.9	< 0.02 U	< 0.01 U	0.07 J	< 0.02 U	2.391	0.26	0.111	< 0.009 U	< 0.002 U	1 J	0.03 J	< 0.1 U
10/24/2018	Background	0.18	5.13	37.0	< 0.02 U	0.02 J	0.296	0.134	0.1126	0.27	0.476	< 0.009 U	< 0.002 U	1 J	0.05 J	< 0.1 U
11/13/2018	Background	0.12	5.24	32.7	< 0.02 U	< 0.01 U	0.1 J	0.03 J	0.9538	0.29	0.146	< 0.009 U	< 0.002 U	1 J	< 0.03 U	< 0.1 U
12/17/2018	Background	0.06 J	5.21	33.5	< 0.02 U	< 0.01 U	0.1 J	< 0.02 U	1.236	0.27	0.1 J	< 0.009 U	< 0.002 U	1 J	0.04 J	< 0.1 U
1/23/2019	Background	0.44	5.86	36.8	< 0.02 U	0.02 J	0.221	0.068	0.558	0.25	0.420	< 0.009 U	< 0.002 U	1 J	0.05 J	< 0.1 U
2/18/2019	Background	0.27	5.33	34.3	0.03 J	0.02 J	0.1 J	0.057	0.543	0.26	0.230	0.01 J	< 0.002 U	1 J	< 0.03 U	< 0.1 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.233	2.15	--	--	--	--	--
8/2/2018	Background	--	--	105	2.70	8.2	21.6	690
8/30/2018	Background	0.225	1.99	109	2.66	8.9	24.2	727
10/3/2018	Background	0.259	2.74	108	2.58	7.9	31.6	729
10/23/2018	Background	0.278	2.32	108	2.74	8.5	26.3	717
11/13/2018	Background	0.254	2.46	116	2.93	8.2	27.2	711
12/19/2018	Background	0.224	2.28	110	2.78	8.5	26.4	696
1/23/2019	Background	0.213	2.39	111	2.62	8.1	30.1	739
2/20/2019	Background	0.195	2.49	111	2.87	9.2	26.4	740
3/12/2019	Detection	0.192	2.32	110	2.87	8.5	27.4	716
11/8/2019	Detection	0.197	1.98	109	2.97	8.3	22.5	717
5/12/2020	Detection	0.191	1.83	108	2.73	7.3	19.9	720
10/26/2020	Detection	0.215	8.47	508	3.07	8.4	37.4	1,400

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

Table 1 - Groundwater Data Summary: MW-8
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.04 J	3.02	63.7	0.005 J	< 0.005 U	0.114	0.210	1.5625	--	0.237	0.013	< 0.002 U	11.7	0.05 J	0.02 J
8/2/2018	Background	--	--	--	--	--	--	--	--	2.70	--	--	--	--	--	--
8/30/2018	Background	0.85	5.71	58.2	0.049	0.05	1.89	1.69	0.655	2.66	2.78	0.012	0.004 J	20.6	0.2	0.076
10/3/2018	Background	0.20	5.18	86.2	< 0.02 U	0.02 J	0.2 J	0.270	3.981	2.58	0.427	< 0.009 U	< 0.002 U	8.76	0.08 J	< 0.1 U
10/23/2018	Background	0.15	4.26	70.9	< 0.02 U	< 0.01 U	0.229	0.284	0.294	2.74	0.491	0.02 J	< 0.002 U	10.2	0.08 J	< 0.1 U
11/13/2018	Background	0.14	3.49	71.5	< 0.02 U	< 0.01 U	0.2 J	0.253	0.691	2.93	0.352	< 0.009 U	< 0.002 U	7.64	0.08 J	< 0.1 U
12/19/2018	Background	0.26	2.91	73.3	< 0.02 U	< 0.01 U	0.264	0.231	0.956	2.78	0.357	0.02 J	< 0.002 U	6.93	0.1 J	< 0.1 U
1/23/2019	Background	0.27	3.49	76.8	< 0.02 U	< 0.01 U	0.463	0.513	0.3857	2.62	0.990	< 0.009 U	< 0.002 U	11.0	0.09 J	< 0.1 U
2/20/2019	Background	0.4 J	2.41	71.9	< 0.1 U	< 0.05 U	0.4 J	0.538	0.736	2.87	0.770	0.009 J	< 0.002 U	8 J	0.4 J	< 0.5 U

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

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

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.157	1.03	--	--	--	--	--
8/2/2018	Background	--	--	7.22	0.87	8.3	12.9	421
8/30/2018	Background	0.128	1.04	7.21	0.86	8.0	12.2	468
10/2/2018	Background	0.145	1.44	7.60	0.83	7.1	12.6	513
10/23/2018	Background	0.141	1.07	7.26	0.87	9.3	12.8	460
11/13/2018	Background	0.166	1.24	7.29	0.91	9.1	11.9	449
12/20/2018	Background	0.114	1.03	7.11	0.84	9.2	15.7	435
1/23/2019	Background	0.134	1.01	7.45	0.77	9.7	20.1	484
2/20/2019	Background	0.128	1.26	7.70	0.84	9.2	28.5	505
3/12/2019	Detection	0.122	1.18	7.50	0.91	9.0	24.0	463
11/8/2019	Detection	0.133	1.02	7.72	0.83	8.8	19.1	440
5/13/2020	Detection	0.122	0.959	7.27	0.82	9.0	12.0	459
10/29/2020	Detection	0.128	1.44	6.93	0.90	7.1	11.1	459

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

Table 1 - Groundwater Data Summary: MW-9
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.21	5.23	46.8	0.004 J	0.01 J	0.218	1.00	0.912	--	1.12	0.010	< 0.002 U	7.31	0.06 J	0.060
8/2/2018	Background	--	--	--	--	--	--	--	--	0.87	--	--	--	--	--	--
8/30/2018	Background	0.91	5.87	46.8	0.02 J	0.35	1.17	2.15	1.162	0.86	5.23	0.010	0.012	6.28	0.2	0.209
10/2/2018	Background	0.59	7.04	66.0	0.192	0.07	4.52	3.70	0.543	0.83	8.66	0.009 J	0.016	6.07	0.9	0.4 J
10/23/2018	Background	1.28	4.58	45.4	0.08 J	0.02 J	1.90	1.39	0.658	0.87	2.68	0.01 J	0.008	5.93	0.4	0.3 J
11/13/2018	Background	0.35	5.83	51.1	0.115	0.02 J	2.54	1.92	0.635	0.91	3.44	< 0.009 U	0.004 J	6.06	0.6	0.2 J
12/20/2018	Background	0.33	4.47	35.8	< 0.02 U	0.10	0.725	0.393	0.847	0.84	1.03	< 0.009 U	0.010	6.51	0.4	0.1 J
1/23/2019	Background	1.08	5.84	44.6	0.09 J	0.03 J	2.46	1.43	1.464	0.77	2.45	< 0.009 U	0.009	6.49	0.5	0.2 J
2/20/2019	Background	0.4 J	5.45	41.5	< 0.1 U	< 0.05 U	0.7 J	0.349	0.2514	0.84	0.955	0.01 J	0.006	6 J	0.3 J	< 0.5 U

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

Table 1 - Groundwater Data Summary: MW-1801A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/24/2018	Background	0.274	62.5	9.64	0.1 J	7.6	49.4	372
8/29/2018	Background	0.288	64.0	10.8	0.11	7.4	54.8	420
10/2/2018	Background	0.137	61.0	7.48	0.1 J	7.4	46.7	356
10/24/2018	Background	0.105	63.1	8.14	0.1 J	7.5	41.8	357
11/14/2018	Background	0.236	65.4	9.86	0.1 J	7.3	49.3	386
12/19/2018	Background	0.289	62.8	9.08	0.12	7.3	45.5	361
1/24/2019	Background	0.168	53.4	9.18	0.14	6.3	46.3	365
2/20/2019	Background	0.09 J	53.3	8.96	0.13	8.0	40.0	343
3/12/2019	Detection	0.09 J	51.2	9.40	0.16	7.5	41.7	306
11/11/2019	Detection	0.229	61.6	9.76	0.12	7.4	45.3	385
5/13/2020	Detection	0.105	52.6	9.93	0.13	7.6	34.6	353
10/29/2020	Detection	0.216	61.6	9.06	0.11	--	40.5	367
11/4/2020	Detection	0.244	62.4	8.84	0.12	7.3	41.5	385

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

Table 1 - Groundwater Data Summary: MW-1801A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/24/2018	Background	0.13	0.36	54.4	< 0.004 U	0.01 J	0.113	0.194	0.602	0.1 J	0.042	0.009	< 0.002 U	4.97	0.09 J	0.04 J
8/29/2018	Background	0.05 J	0.57	56.5	< 0.004 U	< 0.005 U	0.143	0.260	1.222	0.11	0.024	0.007	< 0.002 U	3.07	0.05 J	0.04 J
10/2/2018	Background	0.14	0.82	47.1	< 0.02 U	< 0.01 U	0.09 J	0.422	0.254	0.1 J	0.04 J	0.02 J	< 0.002 U	4.79	0.1 J	< 0.1 U
10/24/2018	Background	0.06 J	0.72	51.3	< 0.02 U	< 0.01 U	0.08 J	0.380	0.654	0.1 J	0.02 J	0.009 J	< 0.002 U	2.08	0.2 J	< 0.1 U
11/14/2018	Background	0.08 J	1.01	51.3	< 0.02 U	0.03 J	0.08 J	0.414	0.6902	0.1 J	0.05 J	< 0.009 U	< 0.002 U	2.34	0.1 J	< 0.1 U
12/19/2018	Background	0.04 J	1.11	56.0	< 0.02 U	0.02 J	0.1 J	0.349	0.836	0.12	0.03 J	0.01 J	< 0.002 U	2.77	0.09 J	< 0.1 U
1/24/2019	Background	0.06 J	1.57	55.3	< 0.02 U	< 0.01 U	0.07 J	0.326	0.595	0.14	< 0.02 U	< 0.009 U	< 0.002 U	2.22	0.1 J	< 0.1 U
2/20/2019	Background	0.09 J	1.52	56.6	< 0.02 U	< 0.01 U	0.1 J	0.290	0.588	0.13	< 0.02 U	< 0.009 U	< 0.002 U	3.57	0.2 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1804A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/27/2018	Background	0.672	28.1	--	--	--	--	--
8/1/2018	Background	--	--	3.87	0.70	7.4	35.2	423
8/28/2018	Background	0.779	15.9	5.27	0.84	8.3	44.7	452
10/2/2018	Background	0.629	38.8	3.63	0.61	7.9	35.7	458
10/23/2018	Background	0.675	12.9	4.79	0.78	7.6	36.9	452
11/13/2018	Background	0.846	8.90	5.32	0.91	7.8	46.0	498
12/19/2018	Background	0.772	10.1	4.51	0.78	7.9	40.1	433
1/24/2019	Background	0.673	12.1	3.14	0.71	7.4	32.3	414
2/21/2019	Background	0.611	7.43	3.29	0.89	8.0	33.8	461
3/12/2019	Detection	0.568	10.2	3.55	0.85	7.9	34.0	411
11/11/2019	Detection	0.730	6.77	11.2	0.64	8.0	85.4	582
2/12/2020	Detection	--	--	9.59	--	7.8	69.0	--
5/14/2020	Detection	0.739	4.51	6.20	0.85	8.1	51.4	484
11/3/2020	Detection	0.549	4.70	7.12	0.86	8.0	57.0	517

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

Table 1 - Groundwater Data Summary: MW-1804A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/27/2018	Background	0.54	2.48	245	0.008 J	< 0.005 U	0.185	0.458	1.814	--	0.445	0.018	< 0.002 U	136	1.8	0.069
8/1/2018	Background	--	--	--	--	--	--	--	--	0.70	--	--	--	--	--	--
8/28/2018	Background	0.15	3.59	204	< 0.004 U	< 0.005 U	0.304	0.314	1.559	0.84	0.031	0.015	< 0.002 U	136	0.2	0.05 J
10/2/2018	Background	0.53	2.35	390	< 0.02 U	< 0.01 U	0.1 J	0.693	1.664	0.61	0.05 J	0.032	< 0.002 U	111	3.1	< 0.1 U
10/23/2018	Background	0.18	3.36	131	< 0.02 U	< 0.01 U	0.1 J	0.137	0.444	0.78	0.114	0.01 J	< 0.002 U	116	0.7	< 0.1 U
11/13/2018	Background	0.09 J	4.16	135	< 0.02 U	< 0.01 U	0.2 J	0.160	0.523	0.91	0.133	0.02 J	< 0.002 U	129	0.2	< 0.1 U
12/19/2018	Background	0.13	4.00	169	< 0.02 U	< 0.01 U	0.1 J	0.176	1.089	0.78	0.111	0.01 J	< 0.002 U	130	0.5	< 0.1 U
1/24/2019	Background	0.30	3.32	183	< 0.02 U	< 0.01 U	0.2 J	0.137	1.424	0.71	0.140	< 0.009 U	< 0.002 U	110	1.7	< 0.1 U
2/21/2019	Background	0.19	4.48	116	< 0.02 U	< 0.01 U	0.2 J	0.096	0.894	0.89	0.219	< 0.009 U	< 0.002 U	115	0.6	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1806A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/27/2018	Background	0.164	12.9	--	--	--	--	--
8/1/2018	Background	--	--	17.7	0.56	7.6	48.4	426
8/29/2018	Background	0.162	12.0	16.2	0.55	8.0	45.6	445
10/2/2018	Background	0.150	5.81	7.21	0.80	8.5	36.2	435
10/23/2018	Background	0.158	7.43	8.62	0.77	8.4	40.8	423
11/13/2018	Background	0.213	7.51	8.15	0.85	8.1	40.1	442
12/19/2018	Background	0.162	5.14	5.29	0.85	8.5	30.9	409
1/24/2019	Background	0.168	12.2	11.7	0.59	8.1	48.1	445
2/18/2019	Background	0.133	5.67	6.24	0.81	8.6	33.0	460
3/12/2019	Detection	0.130	4.98	5.51	0.83	8.8	32.9	430
11/12/2019	Detection	0.156	13.5	11.1	0.48	7.9	42.8	423
5/15/2020	Detection	0.127	2.32	8.45	0.86	8.8	35.2	456
10/29/2020	Detection	0.153	7.38	10.2	0.85	8.7	49.7	480

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

Table 1 - Groundwater Data Summary: MW-1806A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/27/2018	Background	1.16	2.65	163	0.01 J	0.01 J	0.416	0.240	0.998	--	0.368	0.012	< 0.002 U	17.0	0.1	0.03 J
8/1/2018	Background	--	--	--	--	--	--	--	--	0.56	--	--	--	--	--	--
8/29/2018	Background	0.89	3.29	148	< 0.004 U	0.008 J	1.54	0.161	1.533	0.55	0.154	0.010	< 0.002 U	14.2	0.09 J	0.02 J
10/2/2018	Background	0.28	5.30	65.4	< 0.02 U	< 0.01 U	0.1 J	0.080	0.9	0.80	0.158	0.02 J	< 0.002 U	7.73	0.07 J	< 0.1 U
10/23/2018	Background	0.19	5.16	88.3	< 0.02 U	< 0.01 U	0.252	0.152	0.469	0.77	0.195	0.02 J	< 0.002 U	6.66	0.07 J	< 0.1 U
11/13/2018	Background	0.11	5.91	98.7	< 0.02 U	< 0.01 U	0.1 J	0.163	0.3442	0.85	0.137	< 0.009 U	< 0.002 U	7.44	0.05 J	< 0.1 U
12/19/2018	Background	0.17	5.65	65.6	< 0.02 U	< 0.01 U	0.1 J	0.071	0.8606	0.85	0.122	< 0.009 U	< 0.002 U	6.02	0.06 J	< 0.1 U
1/24/2019	Background	0.15	3.97	168	< 0.02 U	< 0.01 U	0.08 J	0.159	1.164	0.59	0.06 J	0.02 J	< 0.002 U	5.62	0.04 J	< 0.1 U
2/18/2019	Background	0.1 J	4.21	78.8	< 0.02 U	< 0.01 U	0.2 J	0.050	0.419	0.81	0.110	0.01 J	< 0.002 U	4.74	0.03 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1807A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.170	146	9.57	0.21	7.5	334	929
8/28/2018	Background	0.137	136	11.8	0.21	6.9	356	953
10/4/2018	Background	0.129	166	12.5	0.16	6.7	367	985
10/24/2018	Background	0.199	144	10.3	0.20	6.9	308	838
11/14/2018	Background	0.175	155	10.5	0.21	6.8	326	904
12/20/2018	Background	0.208	151	9.68	0.19	7.2	315	931
1/25/2019	Background	0.183	156	11.3	0.15	8.2	361	876
2/21/2019	Background	0.08 J	150	12.0	0.14	7.2	396	1,050
3/14/2019	Detection	0.09 J	160	11.1	0.15	6.7	363	1,020
11/11/2019	Detection	0.074	173	11.9	0.13	6.9	392	1,070
5/12/2020	Detection	0.088	159	10.8	0.12	6.7	358	1,040
10/28/2020	Detection	0.069	170	12.4	0.13	7.0	392	1,020

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

Table 1 - Groundwater Data Summary: MW-1807A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/26/2018	Background	0.13	0.99	32.6	0.006 J	0.02	0.098	0.629	1.366	0.21	0.046	0.020	< 0.002 U	1.65	0.3	0.03 J
8/28/2018	Background	0.87	1.13	32.6	0.005 J	0.06	0.253	0.565	1.507	0.21	0.300	0.018	0.002 J	9.07	0.6	0.054
10/4/2018	Background	0.14	1.10	30.1	< 0.02 U	0.05 J	0.205	0.918	1.127	0.16	0.142	< 0.009 U	< 0.002 U	11.1	0.2 J	< 0.1 U
10/24/2018	Background	0.18	0.84	27.8	< 0.02 U	0.03 J	0.2 J	0.579	0.38891	0.20	0.105	0.02 J	< 0.002 U	2 J	0.2 J	< 0.1 U
11/14/2018	Background	0.17	0.96	28.8	< 0.02 U	0.03 J	0.09 J	0.614	0.985	0.21	0.09 J	0.01 J	< 0.002 U	2 J	0.2	< 0.1 U
12/20/2018	Background	0.17	0.94	29.5	< 0.02 U	0.03 J	0.403	0.616	1.016	0.19	0.251	0.02 J	< 0.002 U	1 J	0.3	< 0.1 U
1/25/2019	Background	0.12	0.92	27.4	< 0.02 U	0.03 J	0.1 J	0.733	1.269	0.15	0.126	0.030	< 0.002 U	1 J	0.1 J	< 0.1 U
2/21/2019	Background	0.08 J	0.82	24.1	< 0.02 U	0.03 J	0.1 J	0.811	0.735	0.14	0.118	0.01 J	< 0.002 U	0.6 J	0.1 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1807B
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.195	8.76	8.46	0.75	8.3	218	732
8/28/2018	Background	0.178	8.39	10.8	1.13	8.1	219	706
10/5/2018	Background	0.201	9.21	9.94	1.01	7.9	219	752
10/24/2018	Background	0.176	8.92	7.93	0.81	8.3	220	735
11/14/2018	Background	0.211	8.87	8.52	0.91	7.7	230	732
12/20/2018	Background	0.164	11.6	9.88	1.16	8.2	230	738
1/25/2019	Background	0.277	9.33	7.68	0.79	6.9	227	742
2/21/2019	Background	0.168	11.0	9.53	1.06	8.4	238	791
3/14/2019	Detection	0.163	12.7	10.8	1.19	7.9	249	793
11/11/2019	Detection	0.189	12.7	13.3	1.40	8.0	247	807
5/13/2020	Detection	0.170	8.70	10.5	1.13	7.7	224	783
11/3/2020	Detection	0.079	168	10.9	0.18	6.7	343	1,020

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

Table 1 - Groundwater Data Summary: MW-1807B
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.27	1.93	49.6	0.049	0.01 J	1.40	0.525	0.719	0.75	0.756	0.021	< 0.002 U	4.22	0.3	0.03 J
8/28/2018	Background	0.23	1.94	56.3	< 0.004 U	< 0.005 U	0.134	0.046	1.31	1.13	0.035	0.010	< 0.002 U	23.9	0.08 J	0.01 J
10/5/2018	Background	0.15	1.70	59.6	0.03 J	< 0.01 U	0.263	0.179	2.079	1.01	0.310	< 0.009 U	< 0.002 U	12.5	0.2 J	< 0.1 U
10/24/2018	Background	0.25	1.26	42.3	< 0.02 U	< 0.01 U	0.381	0.139	0.305	0.81	0.203	0.02 J	< 0.002 U	5.59	0.07 J	< 0.1 U
11/14/2018	Background	0.16	1.28	41.4	< 0.02 U	< 0.01 U	0.247	0.073	0.348	0.91	0.08 J	0.02 J	< 0.002 U	5.62	0.05 J	< 0.1 U
12/20/2018	Background	0.43	1.75	73.7	< 0.02 U	< 0.01 U	0.335	0.114	0.2672	1.16	0.145	0.02 J	< 0.002 U	13.5	0.1 J	< 0.1 U
1/25/2019	Background	0.09 J	1.23	43.0	< 0.02 U	< 0.01 U	0.08 J	0.05 J	1.003	0.79	0.04 J	0.02 J	< 0.002 U	4.21	0.06 J	< 0.1 U
2/21/2019	Background	0.35	1.48	66.9	< 0.02 U	< 0.01 U	0.1 J	0.051	0.291	1.06	0.04 J	< 0.009 U	< 0.002 U	9.27	0.08 J	< 0.1 U

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

Table 1 - Groundwater Data Summary: MW-1808A
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/25/2018	Background	0.182	40.4	19.6	0.52	7.7	184	734
8/28/2018	Background	0.142	38.5	19.4	0.57	7.6	227	740
10/4/2018	Background	0.135	38.6	16.7	0.41	7.4	216	790
10/24/2018	Background	0.103	41.5	17.1	0.55	7.7	126	614
11/13/2018	Background	0.152	40.2	18.4	0.51	7.4	210	770
12/20/2018	Background	0.172	40.3	21.6	0.47	7.6	242	834
1/25/2019	Background	0.173	47.4	18.3	0.40	6.1	231	840
2/21/2019	Background	0.122	39.4	17.4	0.40	7.2	213	821
3/14/2019	Detection	0.112	62.9	20.9	0.33	7.7	290	912
11/11/2019	Detection	0.131	29.3	17.1	0.45	7.6	235	887
5/13/2020	Detection	0.124	69.6	23.3	0.29	7.0	321	1,010
11/3/2020	Detection	0.119	54.3	25.6	0.44	7.2	300	1,050

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

Table 1 - Groundwater Data Summary: MW-1808A
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/25/2018	Background	0.29	2.47	86.2	0.299	0.007 J	0.831	0.544	1.892	0.52	2.28	0.024	0.006	6.46	0.5	0.04 J
8/28/2018	Background	0.14	5.34	105	0.251	0.01 J	1.25	0.821	4.96	0.57	2.06	0.025	0.005 J	11.7	0.4	0.083
10/4/2018	Background	0.14	2.84	78.1	0.05 J	< 0.01 U	0.500	0.231	2.082	0.41	0.392	< 0.009 U	< 0.002 U	4.56	0.07 J	< 0.1 U
10/24/2018	Background	0.03 J	1.86	86.2	0.05 J	< 0.01 U	0.443	0.117	1.04	0.55	0.397	0.02 J	< 0.002 U	3.06	0.07 J	< 0.1 U
11/13/2018	Background	0.04 J	3.83	74.1	0.03 J	< 0.01 U	0.381	0.160	0.47	0.51	0.245	0.02 J	0.002 J	2.75	0.05 J	< 0.1 U
12/20/2018	Background	0.05 J	4.37	71.0	0.04 J	< 0.01 U	0.293	0.119	1.048	0.47	0.227	0.03 J	0.003 J	2 J	0.08 J	< 0.1 U
1/25/2019	Background	0.06 J	2.27	80.3	0.102	< 0.01 U	0.415	0.149	2.76	0.40	0.717	0.035	< 0.002 U	1 J	0.2 J	< 0.1 U
2/21/2019	Background	0.02 J	1.99	78.9	0.05 J	< 0.01 U	0.213	0.076	0.535	0.40	0.316	0.01 J	< 0.002 U	1 J	0.09 J	< 0.1 U

Notes:
μg/L: micrograms per liter
mg/L: milligrams per liter
<: 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-1809
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.085	173	26.1	0.16	7.2	386	1,020
8/28/2018	Background	0.091	179	28.8	0.17	7.1	386	1,020
10/3/2018	Background	0.09 J	191	26.8	0.14	7.1	388	1,070
10/23/2018	Background	0.114	181	26.6	0.14	7.1	390	1,050
11/14/2018	Background	0.09 J	188	28.4	0.16	7.2	403	1,050
12/19/2018	Background	0.06 J	182	27.7	0.15	7.0	384	1,040
1/25/2019	Background	0.08 J	188	28.1	0.14	5.1	390	1,080
2/22/2019	Background	0.08 J	184	30.2	0.14	7.2	403	1,080
3/12/2019	Detection	0.05 J	189	31.0	0.14	7.2	396	1,090
11/8/2019	Detection	0.096	195	37.6	0.15	7.0	393	1,110
5/13/2020	Detection	0.081	179	34.9	0.11	7.3	400	1,100
11/5/2020	Detection	0.055	196	33.8	0.13	6.9	391	1,100

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-1809
Amos - FAP
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
7/26/2018	Background	0.05	2.30	60.2	0.004 J	< 0.005 U	0.119	0.555	1.561	0.16	0.035	0.020	< 0.002 U	7.18	0.04 J	0.01 J
8/28/2018	Background	0.03 J	2.83	67.3	0.004 J	< 0.005 U	0.200	0.754	1.193	0.17	0.01 J	0.024	< 0.002 U	3.01	0.06 J	0.02 J
10/3/2018	Background	0.03 J	2.87	61.4	< 0.02 U	< 0.01 U	0.1 J	0.533	4.22	0.14	< 0.02 U	< 0.009 U	< 0.002 U	2.27	0.05 J	< 0.1 U
10/23/2018	Background	< 0.02 U	2.59	53.0	< 0.02 U	< 0.01 U	0.09 J	0.424	1.501	0.14	< 0.02 U	0.043	< 0.002 U	2 J	0.03 J	< 0.1 U
11/14/2018	Background	< 0.02 U	3.10	58.0	< 0.02 U	< 0.01 U	0.08 J	0.447	1.717	0.16	< 0.02 U	0.01 J	< 0.002 U	2 J	< 0.03 U	< 0.1 U
12/19/2018	Background	< 0.02 U	3.51	63.4	< 0.02 U	< 0.01 U	0.212	0.504	1.417	0.15	< 0.02 U	0.032	< 0.002 U	2.88	< 0.03 U	< 0.1 U
1/25/2019	Background	< 0.02 U	3.39	57.2	< 0.02 U	< 0.01 U	0.06 J	0.375	2.99	0.14	< 0.02 U	0.046	< 0.002 U	2 J	< 0.03 U	< 0.1 U
2/22/2019	Background	< 0.1 U	4.57	64.5	< 0.1 U	< 0.05 U	< 0.2 U	0.559	1.56	0.14	< 0.1 U	0.038	< 0.002 U	2 J	< 0.2 U	< 0.5 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: 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-1810
Amos - FAP
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
7/26/2018	Background	0.220	23.0	--	--	--	--	--
8/2/2018	Background	--	--	23.4	0.93	7.4	170	565
8/27/2018	Background	0.271	25.9	21.6	0.93	7.5	129	525
10/3/2018	Background	0.245	28.0	19.0	0.89	7.3	114	542
10/24/2018	Background	0.211	23.7	18.6	0.86	7.7	93.1	473
11/13/2018	Background	0.238	30.2	19.5	1.04	7.3	160	544
12/20/2018	Background	0.210	30.1	17.0	0.98	7.1	160	548
1/23/2019	Background	0.319	24.8	16.3	0.90	7.5	112	494
2/22/2019	Background	0.245	32.3	15.4	1.01	7.4	170	580
3/12/2019	Detection	0.228	30.5	15.4	1.00	7.3	153	548
11/8/2019	Detection	0.249	44.5	15.2	0.94	7.1	256	692
5/12/2020	Detection	0.226	67.5	17.2	0.78	7.4	379	993
11/3/2020	Detection	0.194	53.7	15.8	0.91	7.0	341	802

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-1810
Amos - FAP
Appendix IV Constituents

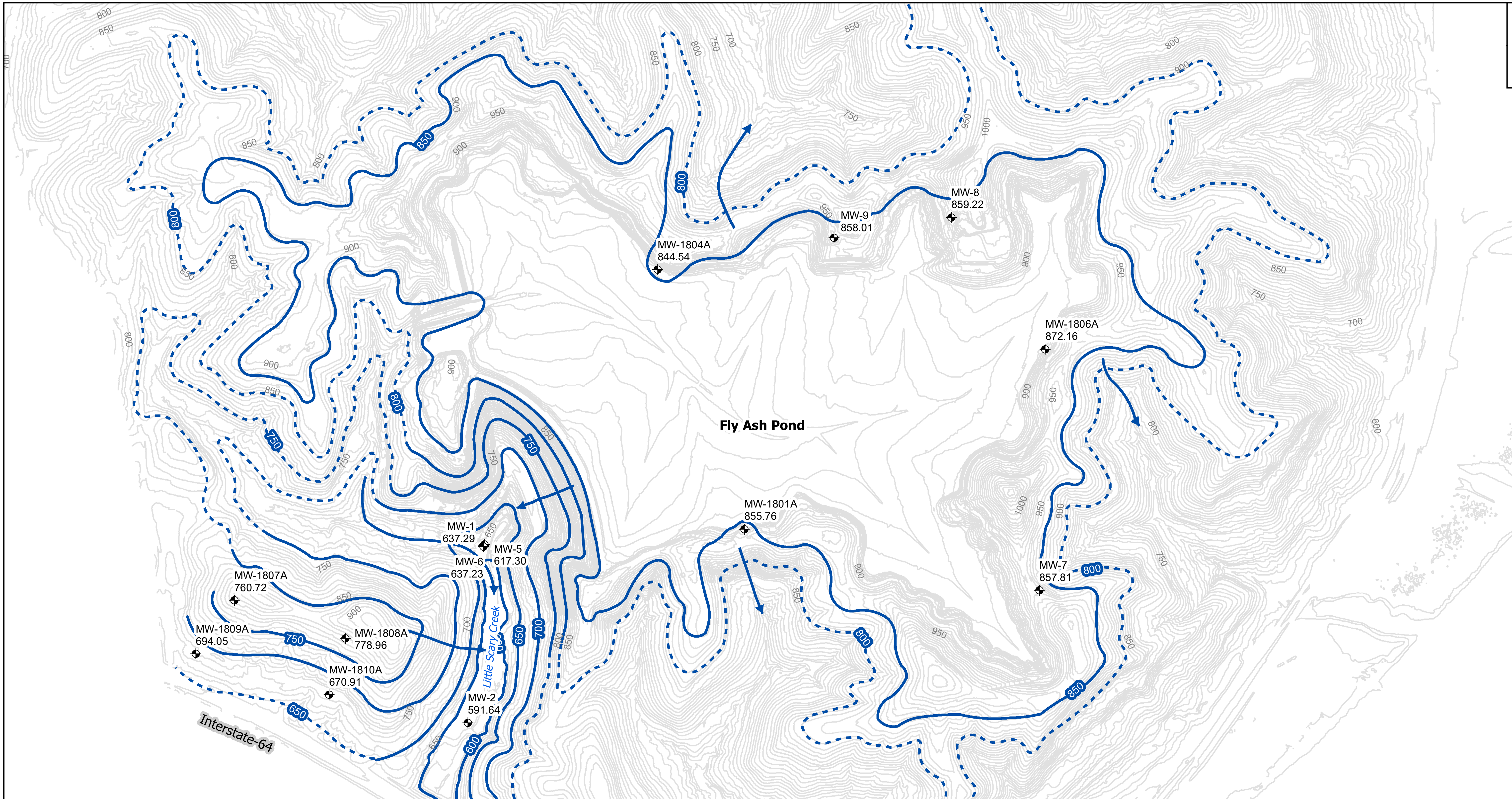
Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
7/26/2018	Background	0.13	0.88	124	0.009 J	< 0.005 U	0.442	0.150	0.382	--	0.149	0.018	< 0.002 U	9.26	0.06 J	0.051
8/2/2018	Background	--	--	--	--	--	--	--	--	0.93	--	--	--	--	--	--
8/27/2018	Background	0.10	0.51	83.4	< 0.004 U	< 0.005 U	0.229	0.048	0.842	0.93	0.057	0.015	< 0.002 U	8.52	0.04 J	0.02 J
10/3/2018	Background	0.11	0.49	83.0	< 0.02 U	< 0.01 U	0.2 J	0.03 J	1.218	0.89	0.09 J	< 0.009 U	< 0.002 U	7.06	0.05 J	< 0.1 U
10/24/2018	Background	0.07 J	0.54	88.5	< 0.02 U	< 0.01 U	0.1 J	0.02 J	0.992	0.86	0.03 J	0.02 J	< 0.002 U	6.28	0.04 J	< 0.1 U
11/13/2018	Background	0.09 J	0.40	83.5	< 0.02 U	< 0.01 U	0.1 J	0.02 J	0.24	1.04	0.04 J	< 0.009 U	< 0.002 U	6.03	0.03 J	< 0.1 U
12/20/2018	Background	0.08 J	0.43	87.9	< 0.02 U	< 0.01 U	0.1 J	0.03 J	0.5648	0.98	0.05 J	0.02 J	< 0.002 U	5.24	0.03 J	< 0.1 U
1/23/2019	Background	0.07 J	0.45	84.2	< 0.02 U	< 0.01 U	0.08 J	0.02 J	0.768	0.90	0.03 J	0.01 J	< 0.002 U	5.94	0.03 J	< 0.1 U
2/22/2019	Background	< 0.1 U	0.4 J	87.8	< 0.1 U	< 0.05 U	0.3 J	< 0.1 U	0.65	1.01	0.1 J	0.02 J	< 0.002 U	4 J	< 0.2 U	< 0.5 U

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

Table 2: Residence Time Calculation Summary
Amos Fly Ash Pond

			2020-05		2020-10	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Fly Ash Pond	MW-1801A[1]	2.0	11.6	5.2	35.7	1.7
	MW-1804A[1]	2.0	14.5	4.2	26.8	2.3
	MW-1806A[1]	2.0	14.7	4.1	10.4	5.9
	MW-1807A[2]	2.0	11.9	5.1	6.9	8.9
	MW-1808A[2]	2.0	40.4	1.5	34.4	1.8
	MW-1809A[2]	2.0	9.9	6.1	14.1	4.3
	MW-1810A[2]	2.0	37.5	1.6	32.4	1.9
	MW-1 [1]	2.0	18.6	3.3	19.1	3.2
	MW-2 [1]	2.0	85.3	0.7	113.3	0.5
	MW-5 [1]	2.0	62.6	1.0	32.0	1.9
	MW-6 [1]	2.0	12.3	4.9	12.5	4.9
	MW-7 [1]	2.0	7.4	8.2	36.8	1.7
	MW-8 [1]	2.0	10.1	6.0	10.2	6.0
	MW-9 [1]	2.0	11.4	5.3	6.7	9.1

Notes:
[1] - Upgradient/Sidegradient Well
[2] - Downgradient Well



Legend

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

Notes

- Monitoring well coordinates and water level data (collected on May 7, 2020) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

700 350 0 700 Feet

Potentioetric Surface Map - Uppermost Aquifer
May 2020

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

Geosyntec consultants

Columbus, Ohio | 2020/09/10

Figure **2**

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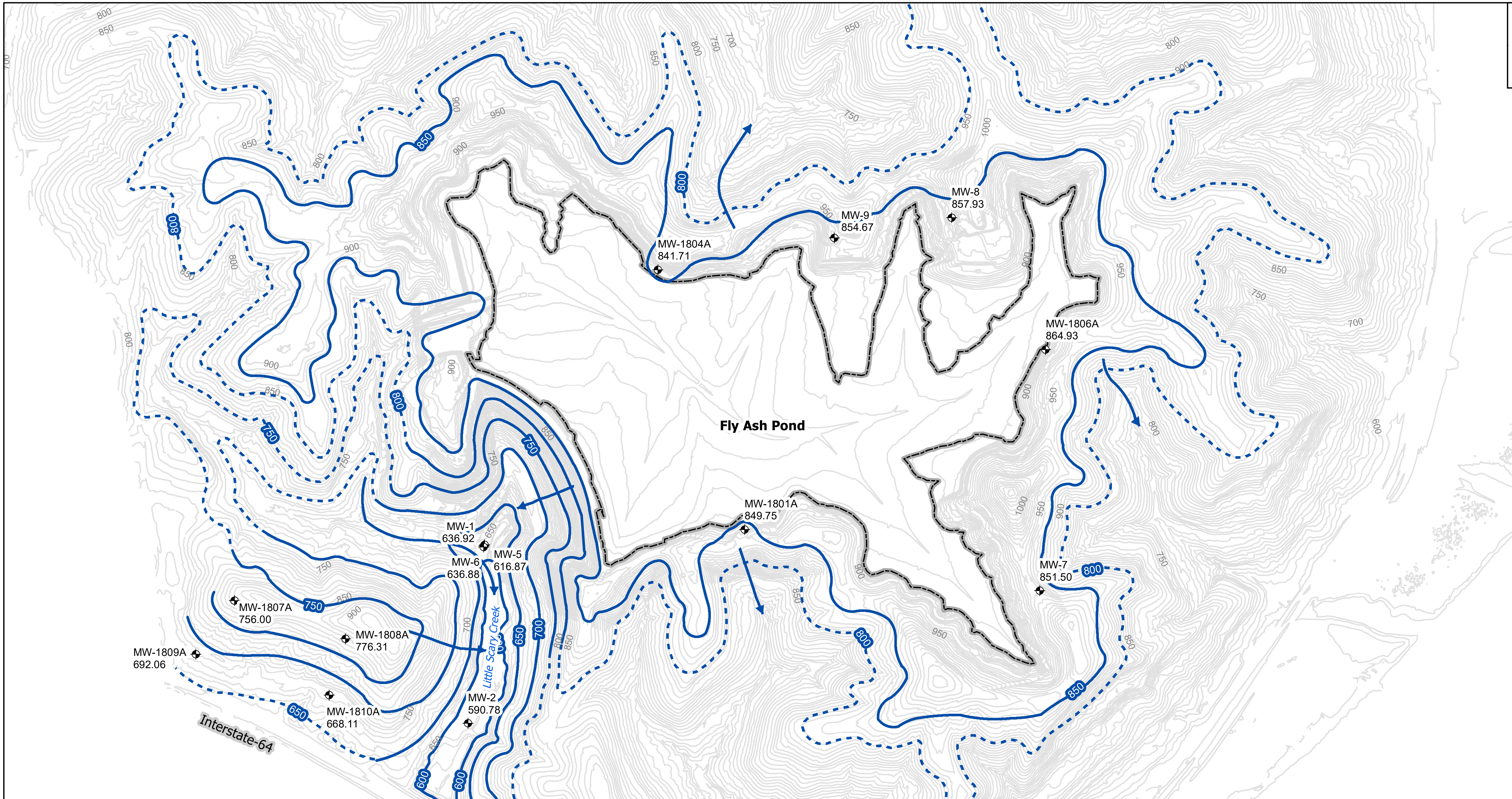

Legend

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

Notes

- Monitoring well coordinates and water level data (collected on October 26, 2020) provided by AEP.
- Potentiometric surface contour interval is 50 feet.
- Topography basemap from AEP Drawing No. 13-30705-0 (topographic contour interval: 10 feet).
- Site features based on information available in the Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation - Amos Plant report (Arcadis, 2019) provided by AEP.
- Groundwater elevation units are in feet above mean sea level.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
October 2020

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

Geosyntec consultants

Columbus, Ohio | 2021/01/28

Figure 3

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APPENDIX 2

The statistical analysis reports completed in 2020 follow.

Geosyntec consultants

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Memorandum

Date: April 6, 2020

To: David Miller (AEP)

Copies to: Ben Kepchar (AEP)

From: Allison Kreinberg (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Amos Plant's Fly Ash Pond (FAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the second semi-annual detection monitoring event of 2019 at the Fly Ash Pond (FAP), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia was completed on November 8-12, 2019. Based on the results, verification sampling was completed on February 11-12, 2020.

Eight background monitoring events were conducted at the Amos FAP prior to this detection monitoring event, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated July 15, 2019 and revised on March 3, 2020.

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 concluded only if both samples in a series of two exceed the UPL (or are below the LPL for pH). 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.

- Calcium concentrations exceeded the intrawell UPL of 7.79 mg/L in both the initial (21.0 mg/L) and second (11.3 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for calcium at MW-5.

- Chloride concentrations exceeded the intrawell UPL of 6.93 mg/L in both the initial (11.2 mg/L) and second (9.59 mg/L) samples collected at MW-1804A. Therefore, an SSI over background is concluded for chloride at MW-1804A.

- Sulfate concentrations exceeded the intrawell UPL of 0.200 mg/L in both the initial (32.0 mg/L) and second (18.6 mg/L) samples collected at MW-5. Sulfate concentrations also exceeded the intrawell UPL of 53.9 mg/L in both the initial (85.4 mg/L) and second (69.0 mg/L) samples collected at MW-1804A. Therefore, SSIs over background are concluded for sulfate at MW-5 and MW-1804A.

In response to the exceedances noted above, the Amos FAP CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for calcium, chloride, and sulfate will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Amos FAP will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Fly Ash Pond

Parameter	Unit	Description	MW-1	MW-2		MW-5		MW-6	MW-7		MW-8	MW-9	MW-1801A	MW-1804A		MW-1806A
			11/8/2019	11/12/2019	2/11/2020	11/8/2019	2/11/2020	11/8/2019	11/11/2019	2/11/2020	11/8/2019	11/8/2019	11/11/2019	11/11/2019	2/12/2020	11/12/2019
Boron	mg/L	Intrawell Background Value (UPL)	0.261	0.382		0.355		0.159	0.248		0.320	0.192	0.459	0.965		0.235
		Detection Monitoring Result	0.114	0.265	-	0.182	-	0.0790	0.0660	-	0.197	0.133	0.229	0.730	-	0.156
Calcium	mg/L	Intrawell Background Value (UPL)	3.58	4.66		7.79		70.6	1.63		3.06	1.63	75.4	51.2		18.8
		Detection Monitoring Result	2.38	**4.77**	4.31	**21.0**	**11.3**	56.6	**2.18**	1.39	1.98	1.02	61.6	6.77	-	13.5
Chloride	mg/L	Intrawell Background Value (UPL)	14.6	495		853		21.4	5.80		120	8.00	12.4	6.93		24.6
		Detection Monitoring Result	11.2	426	-	663	713	17.2	5.36	-	109	7.72	9.76	**11.2**	**9.59**	11.1
Fluoride	mg/L	Intrawell Background Value (UPL)	0.485	3.39		3.72		0.264	0.304		3.11	0.976	0.162	1.10		1.14
		Detection Monitoring Result	0.420	2.73	-	3.04	-	0.240	0.250	-	2.97	0.830	0.120	0.640	-	0.480
pH	SU	Intrawell Background Value (UPL)	8.8	8.9		8.4		7.3	9.3		9.8	11.4	8.8	8.8		9.3
		Intrawell Background Value (LPL)	7.7	8.0		7.8		6.3	8.0		7.0	6.1	5.9	6.8		7.2
		Detection Monitoring Result	8.2	8.5	-	8.0	-	6.9	8.7	-	8.3	8.8	7.4	8.0	-	7.9
Sulfate	mg/L	Intrawell Background Value (UPL)	55.9	26.7		0.200		48.0	33.6		36.5	36.2	61.2	53.9		61.4
		Detection Monitoring Result	33.7	20.1	-	**32.0**	**18.6**	41.7	32.3	-	22.5	19.1	45.3	**85.4**	**69.0**	42.8
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	536	1410		1980		424	458		798	640	518	599		485
		Detection Monitoring Result	461	1340	-	1840	-	368	390	-	717	440	385	582	-	423

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
-: Not analyzed

ATTACHMENT A

Certification by Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the July 15, 2019 *Statistical Analysis Summary* report (revised March 3, 2020), is appropriate for evaluating the groundwater monitoring data for the Amos FAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER REGISTERED 22663 STATE OF WEST VIRGINIA PROFESSIONAL ENGINEER

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

22663	WEST VIRGINIA	04.06.2020
License Number	Licensing State	Date

Geosyntec consultants

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Memorandum

Date: July 29, 2020

To: David Miller (AEP)

Copies to: Ben Kepchar (AEP)

From: Allison Kreinberg (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Amos Plant's Fly Ash Pond (FAP)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the first semi-annual detection monitoring event of 2020 at the Fly Ash Pond (FAP), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia, was completed on May 11-15, 2020. Based on the results, verification sampling was completed on July 7, 2020.

Eight background monitoring events were conducted at the Amos FAP prior to this detection monitoring event, and upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these background values are described in Geosyntec's *Statistical Analysis Summary* report, dated July 15, 2019 and revised on March 3, 2020.

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 concluded only if both samples in a series of two exceed the UPL (or are below the LPL for pH). 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.

- Calcium concentrations exceeded the intrawell UPL of 7.79 mg/L in both the initial (9.85 mg/L) and second (8.77 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for calcium at MW-5.

- Sulfate concentrations exceeded the intrawell UPL of 0.20 mg/L in both the initial (11.0 mg/L) and second (22.8 mg/L) samples collected at MW-5. Therefore, an SSI over background is concluded for sulfate at MW-5.

In response to the exceedances noted above, the Amos FAP CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for calcium and sulfate will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Amos FAP will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evalation
Amos Plant - Fly Ash Pond

Geosyntec Consultants, Inc.

Parameter	Unit	Description	MW-1	MW-2	MW-5		MW-6	MW-7	MW-8	MW-9	MW-1801A	MW-1804A	MW-1806A
			5/13/2020	5/12/2020	5/11/2020	7/7/2020	5/11/2020	5/11/2020	5/12/2020	5/13/2020	5/13/2020	5/14/2020	5/15/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.261	0.382	0.355		0.159	0.248	0.32	0.192	0.459	0.965	0.235
		Detection Monitoring Result	0.122	0.214	0.211	--	0.088	0.067	0.191	0.122	0.086	0.739	0.127
Calcium	mg/L	Intrawell Background Value (UPL)	3.58	4.66	7.79		70.6	1.63	3.06	1.63	75.4	51.2	18.8
		Detection Monitoring Result	2.74	4.35	**9.85**	**8.77**	55.8	1.59	1.89	0.959	52.8	4.51	2.32
Chloride	mg/L	Intrawell Background Value (UPL)	14.6	495	853		21.4	5.80	120	8.00	12.4	6.93	24.6
		Detection Monitoring Result	11.2	443	746	--	15.9	5.30	109	7.27	10.3	6.20	8.45
Fluoride	mg/L	Intrawell Background Value (UPL)	0.485	3.39	3.72		0.264	0.304	3.11	0.976	0.162	1.1	1.14
		Detection Monitoring Result	0.42	2.91	2.97	--	0.25	0.27	2.74	0.82	0.15	0.85	0.86
pH	SU	Intrawell Background Value (UPL)	8.8	9.0	8.4		7.3	9.3	9.8	11.4	8.8	8.8	9.3
		Intrawell Background Value (LPL)	7.7	8.0	7.8		6.3	8.0	7.0	6.1	5.9	6.8	7.2
		Detection Monitoring Result	8.2	8.6	7.9	--	7.0	8.4	7.3	9.0	7.6	8.1	8.8
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	536	1410	1980		424	458	798	640	518	599	485
		Detection Monitoring Result	457	1340	1820	--	416	395	715	459	365	484	456
Sulfate	mg/L	Intrawell Background Value (UPL)	55.9	26.7	0.20		48	33.6	36.5	36.2	61.2	53.9	61.4
		Detection Monitoring Result	33.6	6.0	**11.0**	**22.8**	32.6	23.6	20.1	12.0	34.4	51.4	35.2

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

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the July 15, 2019 *Statistical Analysis Summary* report (revised March 3, 2020), is appropriate for evaluating the groundwater monitoring data for the Amos FAP CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

22663	WEST VIRGINIA	08.03.2020
License Number	Licensing State	Date

APPENDIX 3

The alternative source demonstrations completed in 2020 follow.

Addendum Report to Alternative Source Demonstration Report for Calcium and Sulfate

John E. Amos Plant Fly Ash Pond
Winfield, West Virginia

Prepared for:

American Electric Power

Prepared by:

EHS Support LLC and EnviroProbe Integrated Solutions, Inc.

November 2020

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Acronyms

amsl	above mean sea level
ASD	alternative source demonstration
bgs	below ground surface
Ca	calcium
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	feet
JAFAP	John E. Amos Plant Fly Ash Pond
Mg	manganese
mg/L	milligrams per liter
MSL	mean sea level
NaCl	sodium chloride
$Na\text{-}HC0_3$	sodium bicarbonate
SRF	stress relief fracturing
SSI	statistically significant increases
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency

Certification by Qualified Professional Engineer

I certify that the alternative source demonstration (ASD) conducted and presented within this addendum report is appropriate for evaluating the groundwater monitoring data for the John E. Amos Plant Fly Ash Pond Coal Combustion Residual (CCR) management area associated with the John E. Amos Plant Power Plant located in Winfield. West Virginia. This ASD meets the requirements of the United States Environmental Protection Agency CCR Rule defined at 40 Code of Federal Regulations 257.94(e)(2).

Roderic E. Moore
Printed Name of Licensed Professional Engineer

Signature

RODERIC E. MOORE
REGISTERED
16390
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

16390
License Number

West Virginia
Licensing State

November 2, 2020
Date

1 Introduction

EHS Support LLC ("EHS Support") was retained by Appalachian Power Company, doing business as American Electric Power ("AEP") to conduct a second alternative source demonstration (ASD) investigation for coal combustion residual (CCR) constituents at the John E. Amos Plant Fly Ash Pond (JAFAP) located in Putnam County, Winfield, West Virginia (**Appendix A**). An initial ASD investigation was completed on 2019 detection monitoring data and reported in *Alternative Source Demonstration Report for Calcium, Chloride, and Sulfate John E. Amos Plant Fly Ash Pond, Winfield, West Virginia* dated June 2020 (EHS Support, 2020). This ASD investigation has been prepared as an addendum to the initial investigation.

EHS Support has teamed with EnviroProbe Integrated Solutions, Inc. of Nitro, West Virginia to complete this ASD investigation addendum per the requirements of the United States Environmental Protection Agency (USEPA) CCR Rule (40 Code of Federal Regulations [CFR] 257.94).

1.1 Objectives

The objective for this ASD investigation addendum is to assess groundwater monitoring data collected in compliance with the CCR Rule as allowed under paragraph 40 CFR 257.94(e)(2) of the CCR Rule. This part of the rule allows AEP to determine whether the source(s) for statistically significant increases (SSIs) reported from groundwater monitoring are associated with the CCR unit, or if the SSIs resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The focus of this JAFAP ASD investigation addendum is specifically on calcium and sulfate, the constituents which demonstrated SSIs at monitoring well MW-5 during the May 2020 detection monitoring event and subsequent July 2020 confirmation sampling event.

1.2 Lines of Evidence

This ASD investigation addendum for the JAFAP has been conducted to evaluate potential alternate sources or reasons for the SSIs of calcium and sulfate in MW-5. A potential alternate source is evident, when based on the following lines of evidence:

- Lack of exceedances and increasing trends of primary indicators of CCR
- JAFAP pore water concentrations are lower than those of the corresponding constituent observed in groundwater
- Major ion chemistry does not indicate mixing between JAFAP water and groundwater

For the purposes of this ASD investigation addendum, constituents were identified that would serve as a primary indicator for coal ash leachate. A primary indicator must meet **both** of the following criteria:

- Constituent that typically has high concentration in leachate, relative to background, such that it is expected to have elevated concentration in the event of a release.
- Constituent is not reactive and has high mobility in groundwater such that it is expected to be at the leading edge of the plume, meaning that it will have elevated concentrations relative to background across the entire area of the plume.

As sulfate is a primary indicator for coal ash leachate (Electric Power Research Institute [EPRI], 2012) it has been evaluated in this ASD investigation addendum. Calcium is one other potential indicator that was evaluated in this ASD investigation addendum. Calcium is considered to only have a potential direct association with fly ash leachate and has abundant natural sources in the Site vicinity, specifically significant thicknesses of various limestone formations (EPRI 2017).

2 Project Background

Details about the site location and history, geology, groundwater geochemistry, and monitoring well network details are provided in the *Alternative Source Demonstration Report for Calcium, Chloride, and Sulfate John E. Amos Plant Fly Ash Pond, Winfield, West Virginia* dated June 2020 (EHS Support, 2020). Pertinent details to this ASD investigation addendum are summarized as follows.

Appalachian Plateau groundwater geochemistry, including the JAFAP site area in West Virginia, is established through several regional studies (Piper, 1933, Trap and Horn, 1997; Warner et al., 2012; Siegel et al., 2015). Groundwater recharge generally occurs on hill tops and circulates along hill slopes to shallow depths in Appalachian Plateau sedimentary bedrock aquifers. Saline (connate) water is frequently encountered beneath a thin (a few feet [ft]) transitional mixing zone with the overlying "fresh" (low total dissolved solids [TDS]) water (Trap and Horn, 1997; Siegel et al., 2015). The chemistry of groundwater in recharge areas on hilltops is characterized by low TDS calcium bicarbonate ($Ca-HCO_3$-type) water, that evolves to low TDS sodium bicarbonate ($Na-HCO_3$-type) groundwater as groundwater percolates down slopes owing to calcium (Ca) and manganese (Mg) ion exchange with sodium (Na) in Na-bearing clay minerals. Saline sodium chloride (NaCl-type) high TDS waters are naturally occurring connate brines that are found in "restricted flow zones" where recharge waters do not flush the host lithology (Siegel et al., 2015). The NaCl-type water is further characterized by low to non-detectable sulfate, due to reducing conditions that promote sulfide as the predominant sulfur species. The compositional evolution of these water types is shown on a Piper plot in **Figure 2-1** taken from Siegel et al., (2015)**.**

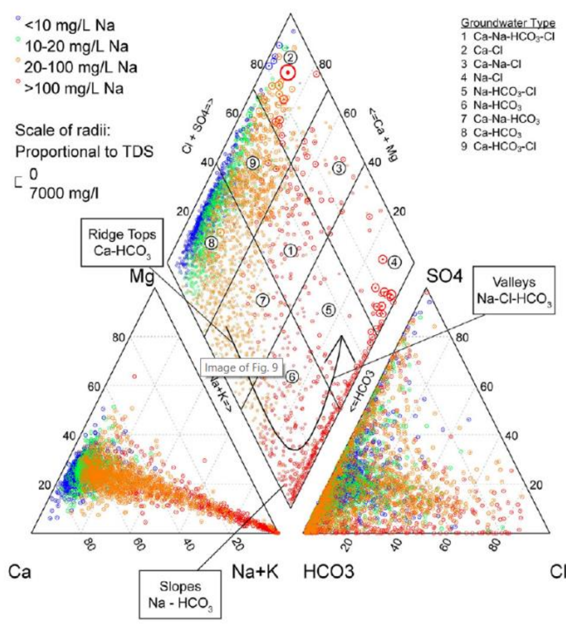


Figure 2-1 Generalized Groundwater Major Ion Chemistry within the Appalachian Plateau

(Siegel et al., 2015).

Regionally throughout the Appalachian Plateau, NaCl-type water is typically encountered at low elevations in valley centers at approximately 100 ft beneath the level of the nearest major stream (Trap and Horn, 1997; Warner et al., 2012; Siegel et al., 2015). In West Virginia, NaCl-type groundwater is frequently encountered at even shallower depths beneath streams in valley bottoms owing to the overall lower topographic elevation and associated lower potential groundwater head available to depress underlying saline water (Siegel et al., 2015).

An additional control on regional groundwater chemistry is the occurrence of natural coal intervals and laminations within bedrock formations. Where coal occurs, oxygenated groundwater leads to oxidation of sulfide minerals (principally the iron sulfide pyrite) in the coal, which leads to elevated concentrations of iron and sulfate in groundwater (Siegel et al., 2015).

2.1 Groundwater Monitoring Network

Four of the monitoring wells (MW-1807A, MW-1808A, MW-1809A, and MW-1810A) are installed upgradient of the JAFAP to support background monitoring. Ten monitoring wells (MW-1, MW-2, MW-5, MW-6, MW-1801A, MW-1804A, MW-1806A, MW-7, MW-8, and MW-9) are located downgradient of the JAFAP and used for compliance monitoring.

The details of each groundwater monitoring location used for water quality sampling are summarized in Error! Reference source not found. and the location of the monitoring wells within the uppermost aquifer is shown on Figure 3 (Arcadis 2019) in **Appendix A**.

2.2 ASD Investigation Monitoring Well - MW-5

MW-5 was the only monitoring well with constituents that showed SSIs (calcium and sulfate) in May 2020 groundwater monitoring data. These SSIs were confirmed in a verification sampling event in July 2020. The details of this monitoring well are provided in the following sections to support the ASD investigation addendum.

MW-5 is installed near the base of the incised valley of Little Scary Creek where the ground surface (648.03 ft above mean sea level [amsl]) and piezometric surface are within the Morgantown Sandstone and stratigraphically lower than the base of the JAFAP. In deepening stratigraphic succession, the 114.8-foot boring intercepted approximately 23 ft of predominantly clay unconsolidated deposits, 11 ft of Morgantown Sandstone, 69.5 ft of variably weathered Birmingham Shale (shale and clay shale), 7 ft of sandstone (Interpreted as Grafton Sandstone) before terminating within approximately 4 ft of shale (See cross section A-A' [Arcadis 2019] in **Appendix B** and MW-5 boring log in **Appendix C**). The MW-5 sand pack and screen extends over the Grafton Sandstone and includes several ft of the over- and under-lying shale. The following lines of evidence indicate that groundwater in MW-5 includes a component of deep brine:

- MW-5 is located at the base of the Little Scary Creek stream valley and is screened at a lower elevation (546.43 to 537.03 ft amsl) than all other site wells.
- MW-5 screen is set at 101.6 to 111.0 ft below ground surface (bgs), which is approximately 100 ft lower in elevation than the adjacent Little Scary Creek bed, corresponding to the depth beneath Appalachian Plateau streams where NaCl-type connate water is typically encountered in the Appalachian Plateau.
- The screen for MW-5 is vertically lower and laterally distal to the base of the JAFAP. According to the stress relief fracturing (SRF) model, groundwater from the JAFAP would migrate through

coal-bearing strata (specifically the Elk Lick Coal within Birmingham Shale) prior to entering the screened interval for MW-5 with concomitant geochemical effects on groundwater composition. We do not see the expected effects on groundwater composition, indicating JAFAP water has not reached MW-5.

- TDS values for MW-5 historically exceed values in the JAFAP by nearly an order of magnitude (AEP, 2020). Additionally, sulfate is historically near or below the laboratory reporting limit in MW-5. The geochemistry of MW-5 historically corresponds with the composition of Appalachian Plateau NaCl-type connate water.
- The NaCl-type groundwater in MW-5 is distinct from the Na-HCO_3-type water typically encountered in site wells screened in the SRF at higher elevations and located on the hilltops surrounding the site, and is distinct from porewater in the JAFAP (**Section 4**). The exception is MW-2, the only site well that is also at the base of Little Scary Creek alluvial valley and is screened at a similar elevation (549.10 to 540.20) to MW-5.
- During packer testing, MW-5 did not accept flow with up to 100 pounds per square inch pressure (Arcadis, 2019), indicating the presence of low permeability units typical of those that are not regularly flushed with groundwater and that may host NaCl connate waters.
- Wells co-located with MW-5, MW-6 (screen = 619.00 to 614.00 ft amsl) and MW-1 (screen = 606.47 to 597.57 ft amsl), are screened at higher elevations and exhibit lower TDS and a $NaHCO_3$-type water, which is expected with the fresher shallower groundwater being present in these shallower wells versus the deeper connate (brine) groundwater.

2.3 JAFAP Porewater Piezometer

AEP installed a multi-level port piezometer (STN-12-4) within the JAFAP to evaluate fly ash porewater. This multi-port piezometer has seven screened intervals, as detailed in the boring log (Stantec, 2012) provided in **Appendix C**.

Fly ash porewater was sampled during five events: September 28, 2017, December 11, 2017, November 16, 2018, March 12, 2019, November 11, 2019, and May 11 through May 14, 2020. Water quality results for CCR constituents in the fly ash, with the geometric mean of each constituent over the seven interval ports, are presented in Error! Reference source not found.. These data will be used in this ASD investigation to represent the JAFAP porewater when comparing to CCR constituent concentrations in the monitoring well network.

2.4 Groundwater Monitoring

AEP has conducted groundwater monitoring of the uppermost aquifer to meet the requirements of the CCR Rules. These monitoring activities generally included the following activities:

- Collection of groundwater samples and analysis for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan* (AEP, 2019)
- Completion of validation tests for groundwater data, including tests for completeness, valid values, transcription errors, and consistent units
- Establishment of background values for each Appendix III and Appendix IV constituent (eight sampling events conducted over a seven-month period between July 25, 2018 and February 18, 2019) (AEP, 2020)

- Evaluation of the groundwater data using a statistical process in accordance with 40 CFR 257.93, which was prepared and certified in April 2019 in AEP's *Statistical Analysis Plan* (Geosyntec, 2019), and most recently posted to AEP's CCR website in May 2019. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009).
- Completion of the initial detection monitoring sampling event (March 2019), which resulted in no SSIs of Appendix III parameters.
- Completion of a second detection monitoring event (November 2019), which resulted in potential SSIs for Appendix III parameters in MW-2 (calcium), MW-5 (calcium and sulfate), MW-7 (calcium), and MW-1804A (chloride and sulfate).
- Completion of confirmation sampling (February 2020) for constituents identified as potentially exhibiting SSIs per AEP's *Statistical Methods Selection Certification* (AEP, 2019), which confirmed SSI's for Appendix III parameters at MW-5 (calcium and sulfate) and MW-1804A (chloride and sulfate).
- An ASD investigation (between April and June 2020) for the JAFAP was conducted to evaluate potential alternate sources or reasons for the SSIs of calcium and sulfate in MW-5 and chloride and sulfate in MW-1804A (EHS Support, 2020).
- Completion of a third detection monitoring event (May 2020), which resulted in potential SSIs for Appendix III parameters in MW-5 (calcium and sulfate).
- Completion of confirmation sampling (February 2020) for constituents identified as potentially exhibiting SSIs per AEP's *Statistical Methods Selection Certification* (AEP, 2019), which confirmed SSI's for Appendix III parameters at MW-5 (calcium and sulfate).

A table summarizing monitoring data for key wells analyzed during this ASD investigation addendum, including the background sampling events through the May 2020 monitoring event, and the July 2020 verification sampling event is included in Error! Reference source not found..

3 Alternative Source Demonstration Assessment

As identified in **Section 1.1**, SSIs in the concentration of calcium and sulfate in MW-5 have been reported for the May 2020 detection monitoring event.

Per the CCR Rule at 40 CFR 257.94(e)(2), "The owner or operator may demonstrate that a source other than the CCR unit caused the SSI over background levels for a constituent or that the SSI 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 an SSI over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report."

EPRI (2017) guidelines for developing an ASD indicates potential causes that support the ASD may include, but are not limited to:

1. sampling causes (ASD Type I),
2. laboratory causes (ASD Type II),
3. statistical evaluation causes (ASD Type III),
4. natural variation causes (ASD Type IV), and/or
5. alternative sources (natural) (ASD Type V).

This ASD investigation addendum for the JAFAP is focused on assessing whether Type I, Type III and/or Type IV causes identified in the initial ASD investigation (EHS Support, 2020) could be the reason for SSIs for calcium and sulfate in MW-5 in the May 2020 detection monitoring event**.**

EPRI (2012) describes three tiers of investigation for evaluation of water quality signatures to determine if elevated concentrations represent a release from a CCR facility. Conversely, these tools can also be used to evaluate whether or not sources other than CCR are contributing to groundwater quality degradation. The three tiers defined by EPRI (2012) are:

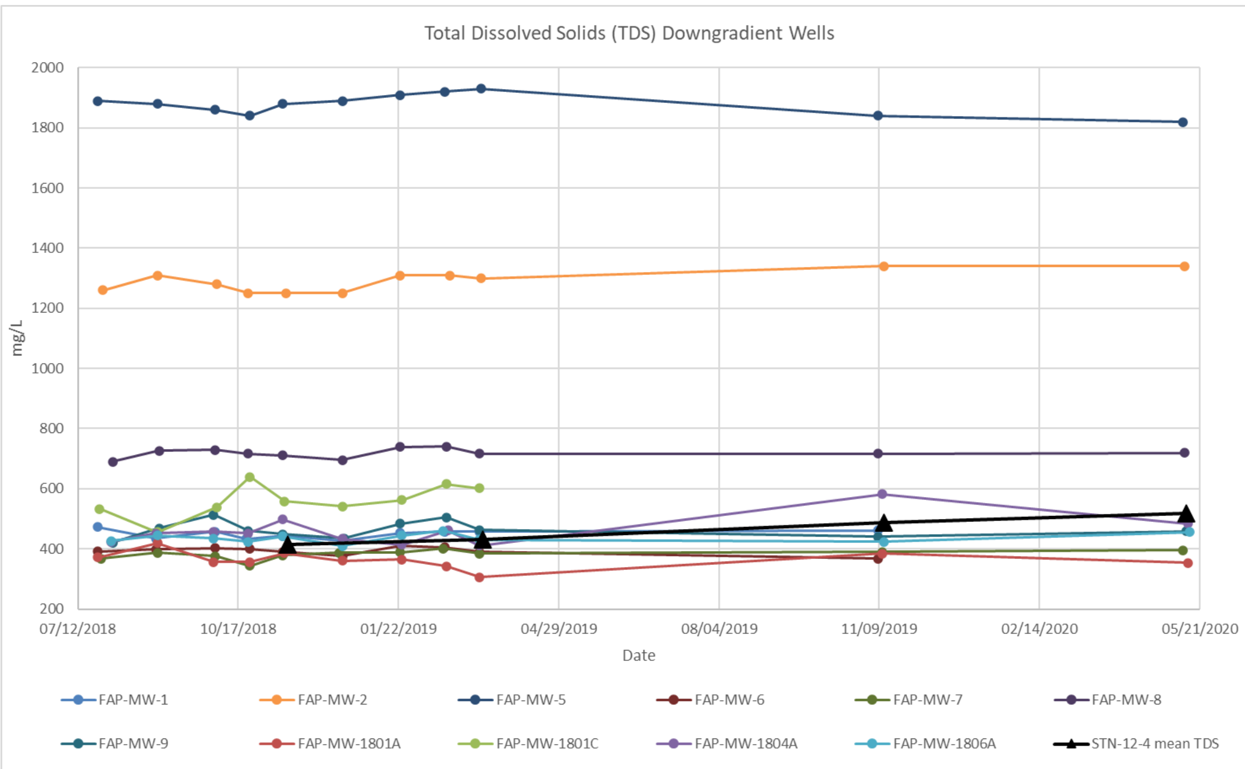
- Tier I: Trend Analysis and Statistics (**Section 3.1** and **Section 3.2**)
- Tier II: Advanced Geochemical Evaluation Methods (**Section 3.1**, **Section 3.3** and **3.4**)
- Tier III: Isotopic Analyses (not conducted as part of this ASD)

These assessments are presented in the following sections. Additionally, an analysis of potential variation due to sampling techniques (ASD Type I) is included in **Section 3.5** and statistical evaluations (ASD Type III) is included in **Section 3.6**.

3.1 Groundwater Data Analysis

3.1.1 Site Groundwater Sources

Total dissolved solids measurements provide a robust means to distinguish groundwater with a connate brine and/or low TDS precipitation source. Consistent with a brine origin, historical TDS data for MW-2, MW-5 and MW-8 are notably elevated (almost by an order of magnitude in MW-5) compared with other site wells that produce sodium/calcium bicarbonate-type waters (**Figure 3-1**). TDS in the majority of site wells is below about 600 to 650 milligrams per Liter (mg/L), in comparison to a range of 174 to 840 mg/L (geometric mean 474 mg/L) for JAFAP porewater measured in all seven ports of STN-12-4 between September 2017 and May 2020. Clearly, the TDS data (coupled with historical boron, fluoride, and chloride systematics for these wells) rule out JAFAP porewater as the origin of the high TDS measurements in MW-2, MW-5 and MW-8. Whereas a connate brine component is expected to be the source of high TDS concentrations for MW-2 and MW-5 based on the location of the wells at the base of the Little Scary Creek valley and deep (>100 ft bgs) well screen/sand pack depths (**Section 2.3**), MW-8 is situated on a ridge with a sand pack/screen interval over a higher elevation (sand pack from 797 to 821.21 ft amsl in MW-8 compared to 534.20 to 560.50 and 535.93 and 557.03 ft amsl in MW-2 and MW-5, respectively; Error! Reference source not found.). As discussed by Siegel et al., (2015), connate brine is periodically encountered along ridgelines in formations with low throughput of groundwater in the Appalachian Plateau of West Virginia, thus, MW-8 conceivably also contains a brine component that is responsible for the elevated TDS in this well.



Note: MW-1801C has not been sampled since March 2019

Figure 3-1 Total Dissolved Solids in Downgradient Monitoring Wells

3.1.2 MW-5 Evaluation

A temporal plot for the primary indicator sulfate reported in groundwater monitoring well MW-5 is presented in **Figure 3-2**, and a temporal plot for the elevated ASD constituent calcium is presented in **Figure 3-3**. Data for the geometrical mean of JAFAP porewater (Error! Reference source not found.) is provided for comparison.

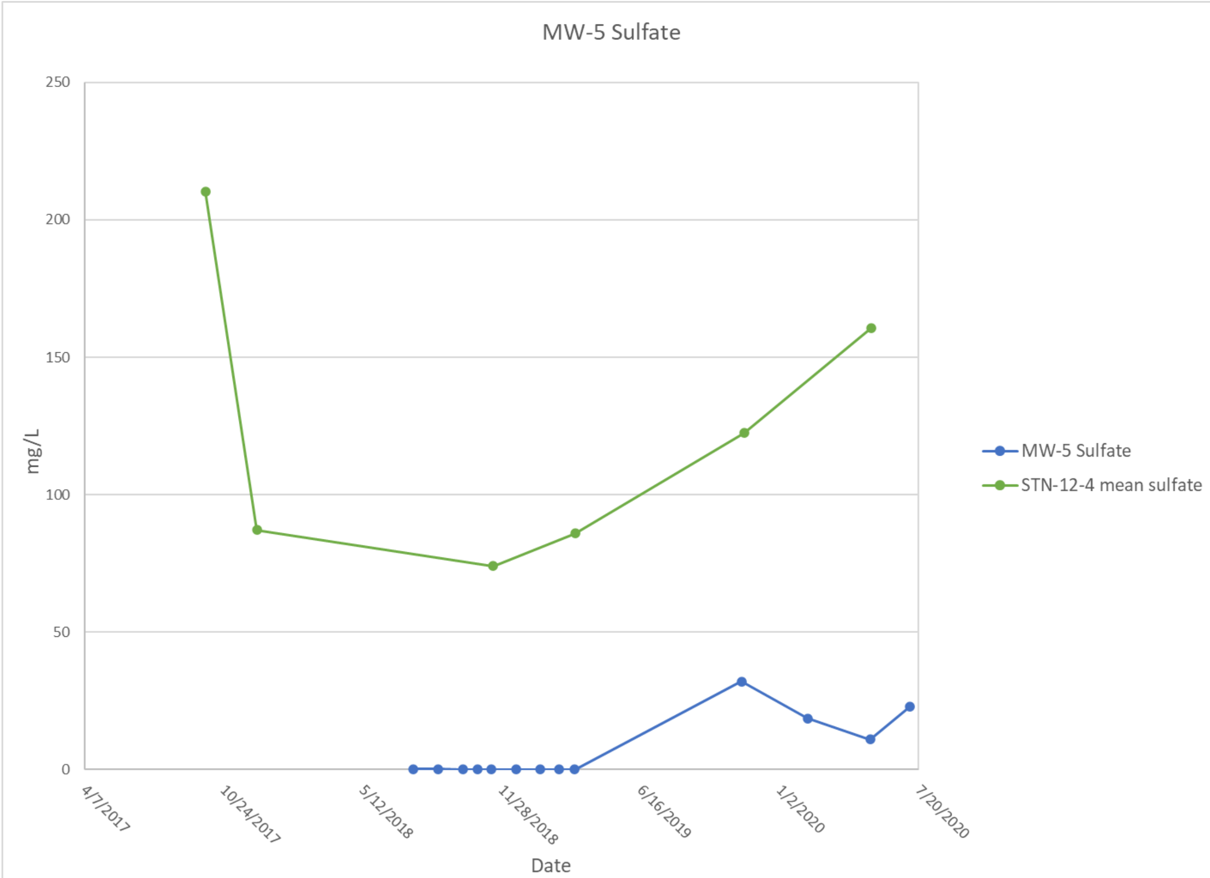


Figure 3-2 MW-5 Sulfate Concentrations

Sulfate concentrations in MW-5 have remained relatively constant up until the last two groundwater monitoring events in November 2019 and May 2020 (geometric mean = 0.1 mg SO4/L). Sulfate concentrations measured in November 2019 and May 2020 were approximately two orders of magnitude higher (32 mg/L and 11 mg/L, respectively) than those reported historically. Comparing the concentrations in MW-5 groundwater to the JAFAP, sulfate concentrations in groundwater are 100 times lower than the concentrations reported in the JAFAP porewater. Sulfate is typically absent or at low concentrations in Appalachian Plateau connate brines due to overall reducing conditions that favor sulfide (Siegel et al., 2015). In contrast, sulfate is present at higher concentrations in oxygenated groundwater sourced from more recent precipitation, particularly following interaction with pyrite, which is documented in the Birmingham Shale and Grafton Sandstone rock matrix in the logs for MW-1802C, MW-1803C, MW-1805C; rock units that are within and directly overlying the sand pack interval for MW-5.

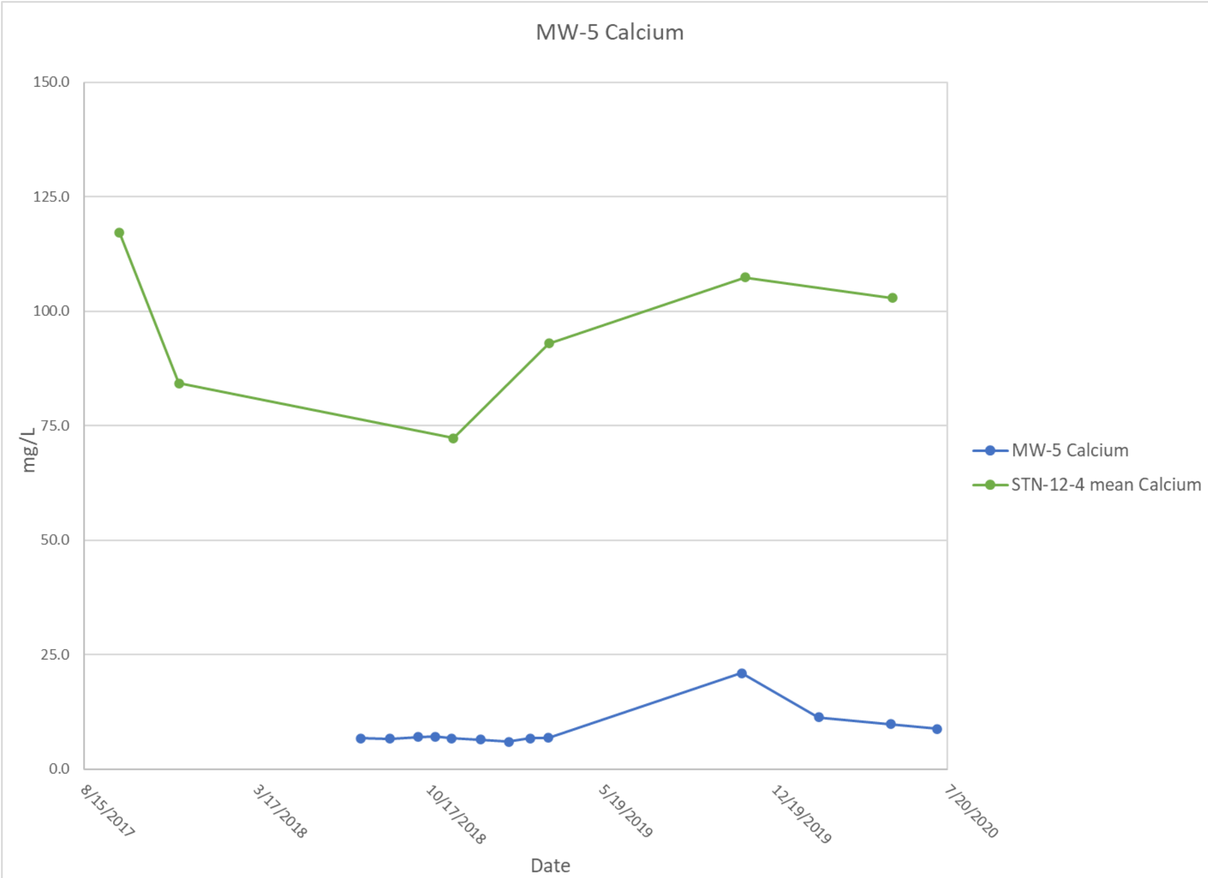


Figure 3-3 MW-5 Calcium Concentrations

Calcium concentrations in MW-5 have remained relatively constant up until the November 2019 groundwater monitoring event (geometric mean = 6.7 mg/L). In November 2019 and May 2020, the calcium concentration of groundwater sampled from MW-5 was 21 mg/L and 9.85 mg/L, respectively. The range of calcium concentrations in MW-5 in November 2019 and May 2020 were approximately 10 times lower than the concentrations reported in the JAFAP porewater (**Figure 3-3**). The relative sodium: calcium concentration ratios reported from groundwater at MW-5 in November 2019 and May 2020 was lower than all previous sampling events (**Table 3-1**). The relative changes in calcium and sodium suggests mixing between different groundwater types with distinct aqueous sodium:calcium ratios set through ion exchange reactions with distinctive rock types or secondary minerals within formations.

Table 3-1 MW-5 Relative Sodium and Calcium Concentrations

Date	Sodium (mg/L)	Calcium (mg/L)	Sodium/Calcium Ratio
7/24/2018	777	6.75	115
8/29/2018	714	6.71	106
10/3/2018	742	7.03	106
10/24/2018	735	7.09	104
11/13/2018	586	6.79	86
12/19/2018	595	6.48	92
1/23/2019	599	5.98	100

Date	Sodium (mg/L)	Calcium (mg/L)	Sodium/Calcium Ratio
2/19/2019	687	6.79	101
3/13/2019	660	6.85	96
11/8/2019	**571**	**21**	**27**
5/11/2020	**694**	**9.85**	**70**

The increase in dissolved calcium and sulfate may be attributed to a change in the proportion of mixing between sodium chloride and calcium/sodium bicarbonate water types; with the November 2019 result reflecting a higher proportion of more Ca- and SO4-rich, low TDS sodium bicarbonate water type. Groundwater in the vicinity of MW-5 is identified as a sodium chloride water type (further discussed in **Section 3.1.1**) and the elevation of the screened section of MW-5 is very close to the expected mixing interface between sodium bicarbonate and sodium chloride (connate brine) water types, as discussed in **Section 2.3**. External influences such as pumping rates or intense and extended rainfall events can perturb the transition between the connate aquifer and the overlying sodium bicarbonate aquifer.

Boron, another primary indicator, has historically fluctuated in MW-5 between 0.22 to 0.32 mg/L, whereas the November 2019 concentration was notably lower at 0.18 mg/L (**Figure 3-4**). Boron is typically elevated in groundwater that has contacted aquifer rock for extended periods of time or that has experienced elevated temperatures; therefore, elevated boron in connate brine is expected. The observation of decreased boron during the November 2019 sampling event supports dilution by a younger sodium bicarbonate water type in MW-5.

Figure 3-4 MW-5 Boron Concentrations

Temporal plots for potential indicators bromide, fluoride, molybdenum, potassium, and sodium reported in groundwater monitoring well MW-5 are provided in **Figure 3-5**, **Figure 3-6**, **Figure 3-7**, **Figure**

3-8 and **Figure 3-9**, respectively, with geometrical mean data for the JAFAP porewater presented for comparison. Molybdenum and potassium are present in groundwater at concentrations below the concentrations within the JAFAP for MW-5. For MW-5, bromide, fluoride and sodium concentrations in groundwater are elevated in comparison to the JAFAP.

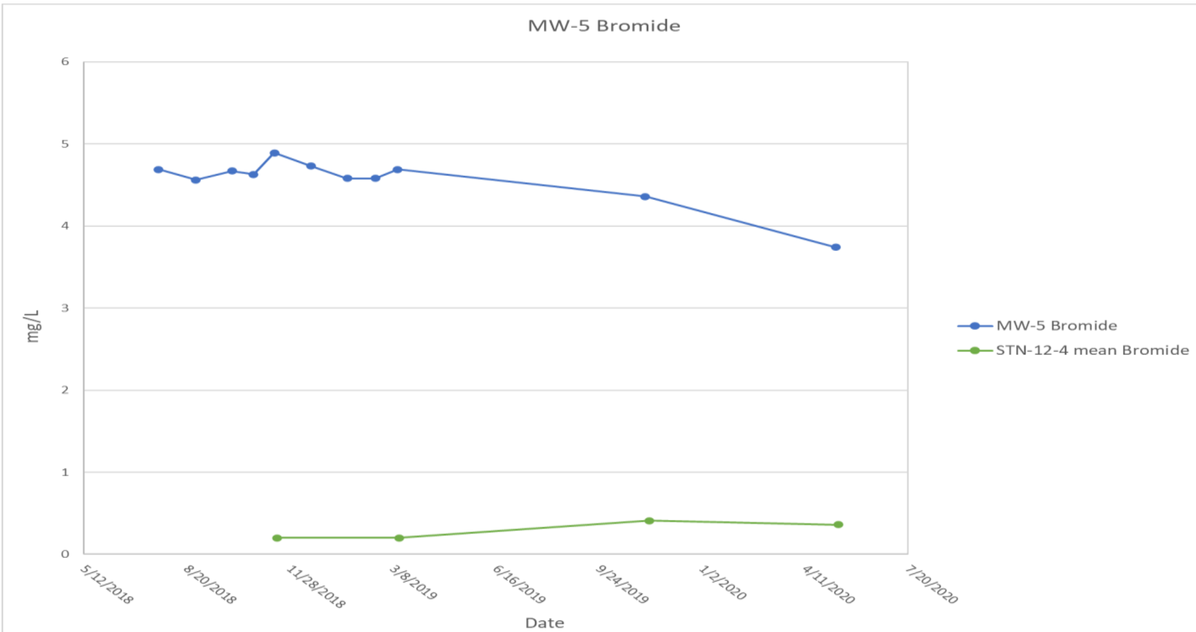


Figure 3-5 MW-5 Bromide Concentrations

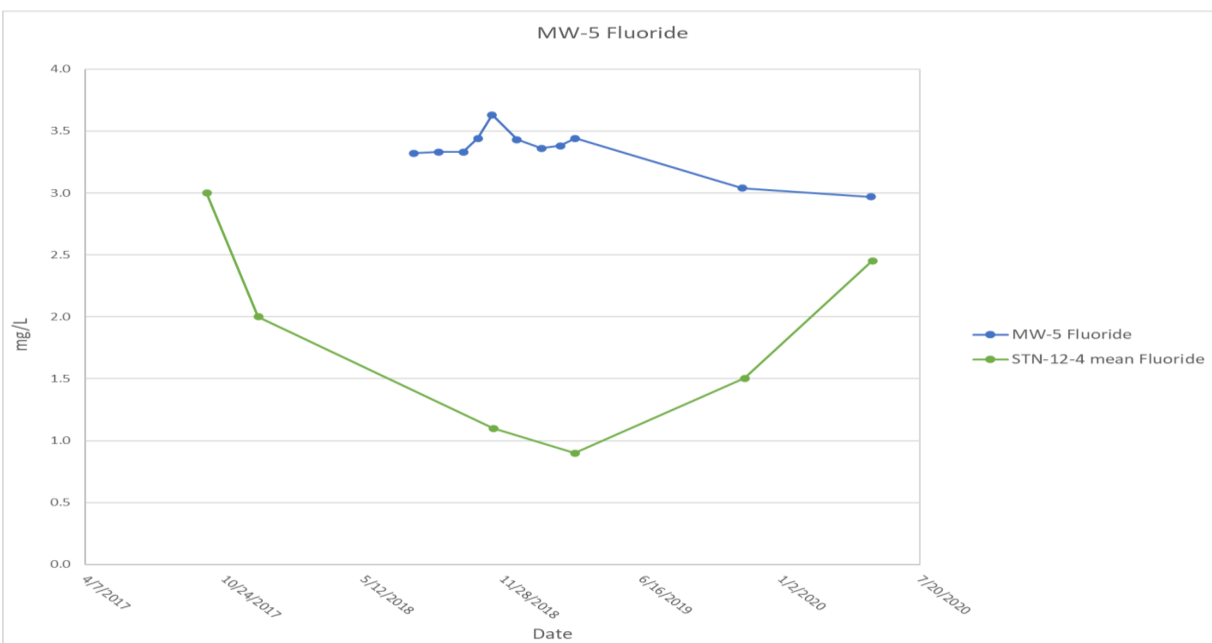


Figure 3-6 MW-5 Fluoride Concentrations

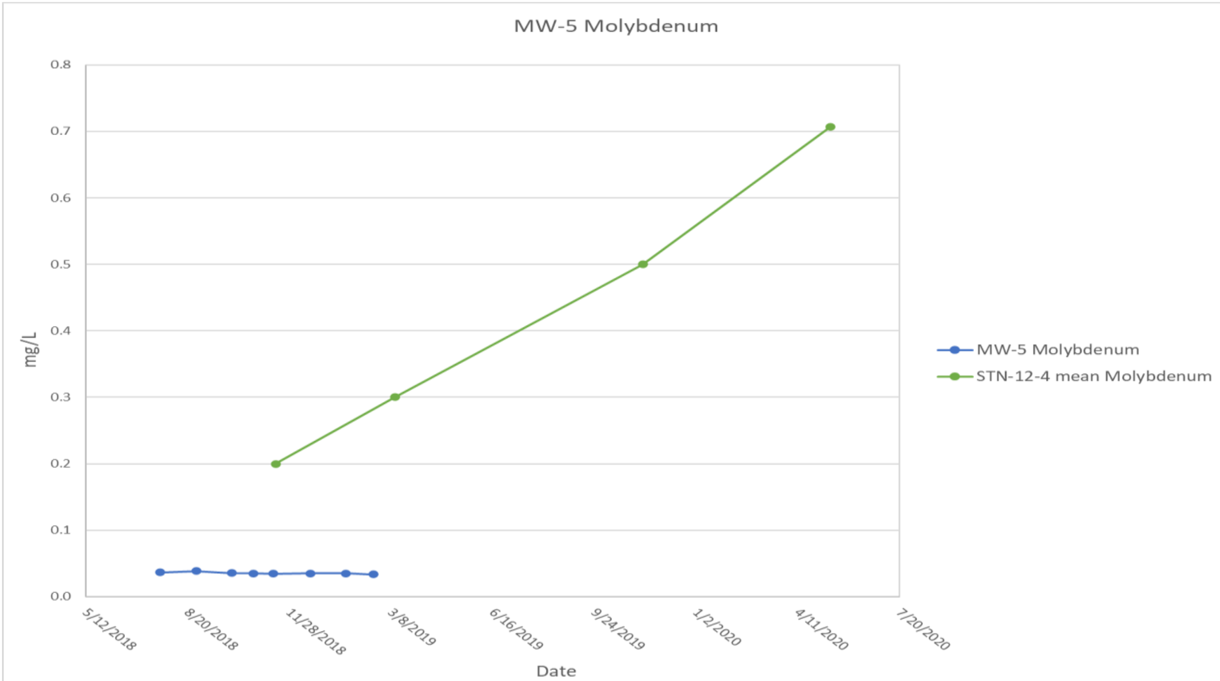


Figure 3-7 MW-5 Molybdenum Concentrations

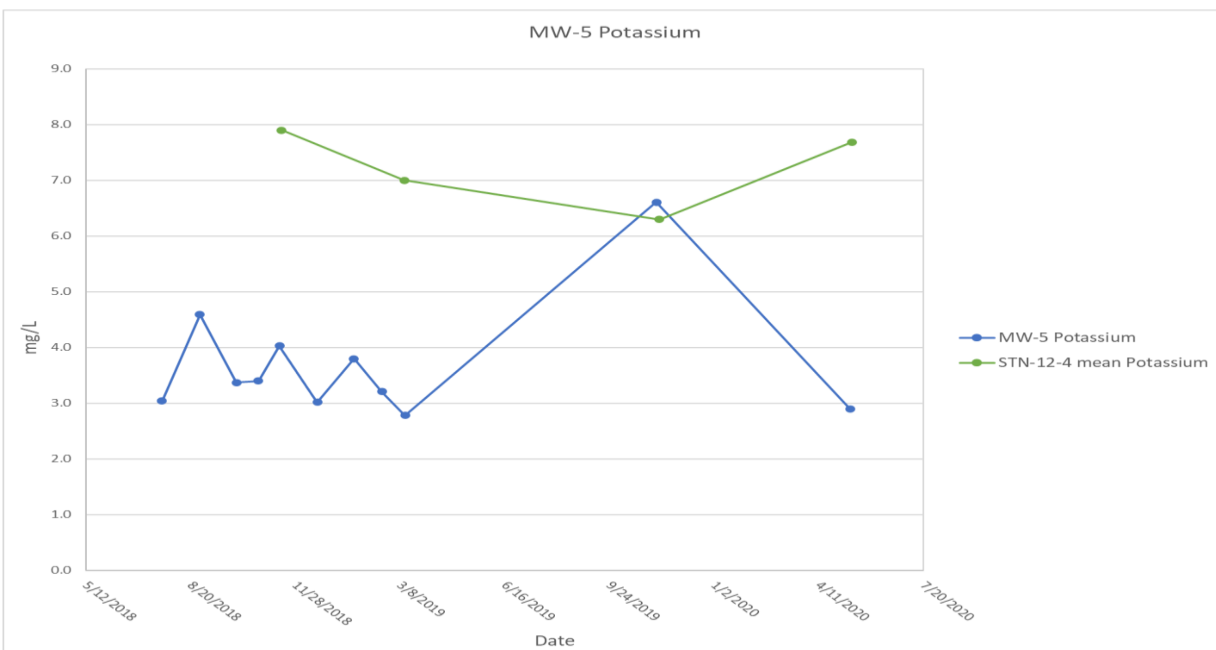


Figure 3-8 MW-5 Potassium Concentrations

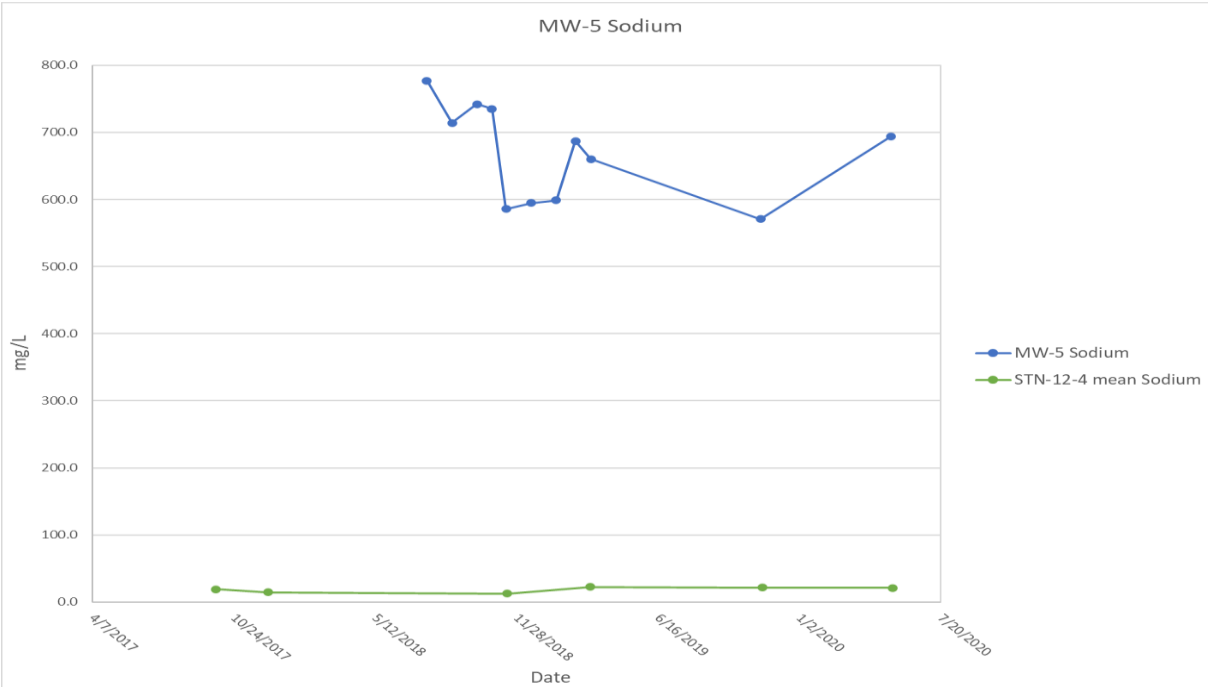


Figure 3-9 MW-5 Sodium Concentrations

3.2 Statistical Evaluation

Mann Kendall analysis was used to compare the temporal variation in MW-5 sulfate and calcium. Results for these analytes were investigated by reviewing the entire 2018 through 2020 dataset (including confirmation sampling event data) and the dataset omitting the November 2019 and May 2020 groundwater monitoring and confirmation sampling results (**Table 3-2**). Non-detect values for sulfate in MW-5 were evaluated by using half the reported detection limit.

Table 3-2 Mann Kendall Statistics

Monitoring Well ID	Type	Trend 2018 - 2020	Trend (excluding Nov 2019 and May 2020)
MW-5	Sulfate	No trend	Decreasing
MW-5	Calcium	Increasing	Stable

For the entire dataset, sulfate had no trend and calcium had an increasing trend. With the November 2019 and May 2020 results omitted, sulfate had a decreasing trend and calcium concentrations were stable. Based on the trend analysis, the set of results that triggered the SSI evaluation do not appear to be contributing towards any statistically significant temporal change in sulfate concentrations, the primary coal ash leachate indicator. Whereas the overall dataset indicates a statistically significant temporal increase in calcium concentrations, this result is attributed to the outcome of mixing between two distinct water types that was triggered by a change in sample practices as described in **Section 3.4**. Additionally, calcium is a secondary indicator that may be attributed to dissolution of the abundant limestone (calcium carbonate) formations and hydrogeochemical maturity of a likely groundwater mixing endmember in the broader Appalachian area.

3.3 Ion Ratios and Conservative Ion Binary Plots

3.3.1 Ion Ratios

EPRI (2012) recommends the use of ion ratios to identify source waters, or to determine that an additional source water is being added along a flow path. The premise is that the concentration of two constituents in groundwater is maintained unless mixing with a water source that has different ion concentration ratios occurs. Care must be taken to select unreactive constituents (conservative ions) to support this analysis. Conservative ions are generally not volatile, largely do not participate in ion exchange or redox reactions, generally form minerals with high solubilities, and are not typically leached from or incorporated into reactive minerals along groundwater paths in appreciable concentrations. These characteristics result in preservation of conservative ion ratios through binary mixing, dilution, and evaporation processes. Sulfate should be assessed with caution using the conservative ion ratio approach, since sulfate is typically a conservative ion in oxygenated waters, however, oxidation of sulfide or reduction of sulfate on mixing between anoxic and oxygenated waters can shift the sulfate concentration substantially from an expected binary mixing result.

Ion ratios for key constituents in groundwater and JAFAP porewater samples from the May 2020 sampling round are provided in Error! Reference source not found.. Notably, the SO_4/Cl and F/Cl ratios for most groundwater samples are indistinguishable from JAFAP porewater; therefore, these SO_4/Cl and F/Cl ratios are not useful for distinguishing JAFAP porewater influence for the majority of locations in the monitoring network. The exception is for wells MW-5, MW-2 and MW-8, which have distinct SO_4/Cl and F/Cl ratios that likely reflect a connate brine component. In contrast, Ca/Cl and B/Cl ion ratios are distinct for most groundwater and JAFAP porewater samples and provide useful indicators of mixing relationships between different water types. To better assess mixing relationships based on ion ratios, ion ratio plots were developed following the method and rationale described below.

Ion ratio plots were developed from historical and current data for MW-5 (**Figure 3-10**). These plots illustrate SSI benchmark exceedances in November 2019 and May 2020 in the context of historical and current JAFAP porewater samples. Ion ratio plots for MW-5 show that the water in both historical and the November 2019/May 2020 samples show a distinct ion composition compared to shallower co-located wells (MW-1 and MW-6) and JAFAP porewater. This result supports an Appalachian Plateau connate brine origin. Indeed, the composition of MW-5 groundwater on these plots is sufficiently unique that no clear mixing relationship between the November 2019 sampling result and other water sources is clear based on ion ratios. For this reason, absolute conservative ion concentrations (not ratios) are used to better assess mixing between MW-5 and alternative sources, as discussed below (**Section 3.3.2**).

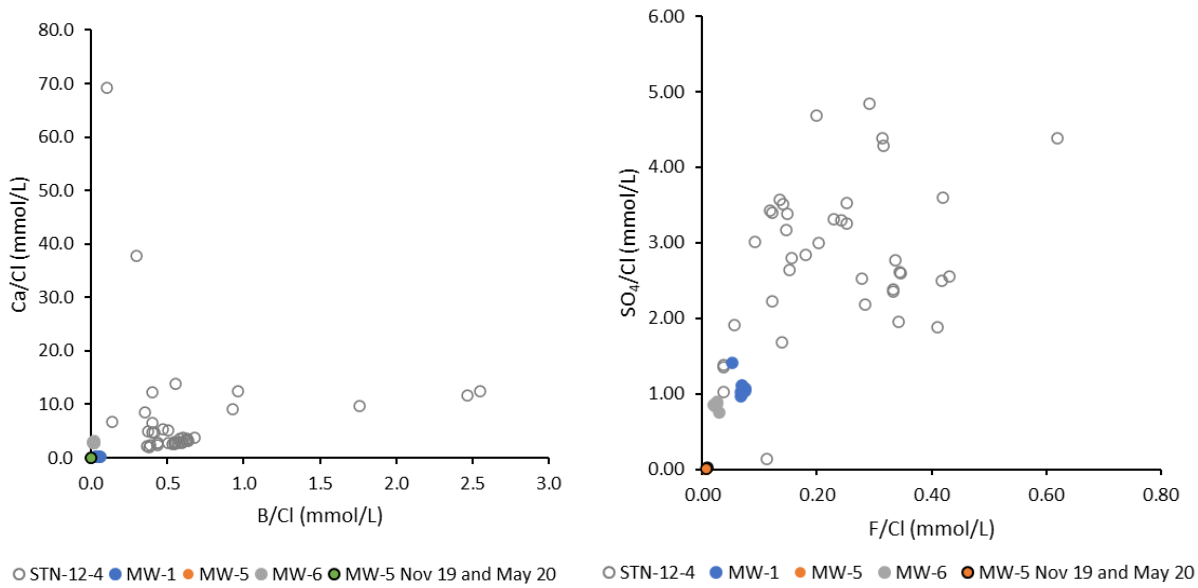


Figure 3-10 Ion Ratio Plots of Historical and Current Data from MW-5, MW-1, MW-6, and STN-12-4 JAFAP Porewater

Note: the MW-5 data from November 2019 and May 2020 plot in the same location as historical MW-5 data.

3.3.2 Conservative Ion binary plots

Binary plots of the molar concentrations of conservative ions in waters that have undergone binary mixing or dilution trace a straight line between the mixing endmembers, and the intermediate (resulting) water falls on the mixing line. Molal concentrations are preferred in this type of diagram as mineral precipitation effects are more readily apparent. Dissolved elements broadly considered as conservative for this purpose include the halides (e.g. chloride and fluoride) and boron.

Binary conservative ion plots (B-Cl, F-Cl, and B-F) were constructed for MW-5 (**Figure 3-11**). Data for each well from nine sampling events between July 2018 and March 2019 were compared to the data points showing SSI exceedances from November 2019. Data for JAFAP porewater from the seven ports in multilevel well STN-12-4 from September 2017 through November 2019, representing JAFAP porewater, were included on the charts as a possible mixing endmember. For MW-5, co-located and shallower wells MW-1 and MW-6 were included as possible mixing endmembers.

For well MW-5, the November 2019 and May 2020 samples fall on a mixing line between historical MW-5 waters and $NaHCO_3$-type waters in the shallower co-located wells MW-1 and MW-6 for all conservative ion plots, and does not indicate mixing with JAFAP porewater (**Figure 3-11**). This relationship indicates that mixing between Appalachian Plateau NaCl-type connate water and overlying more dilute $NaHCO_3$-type water best explains the May 2020 sampling result and mixing with JAFAP porewater is not supported.

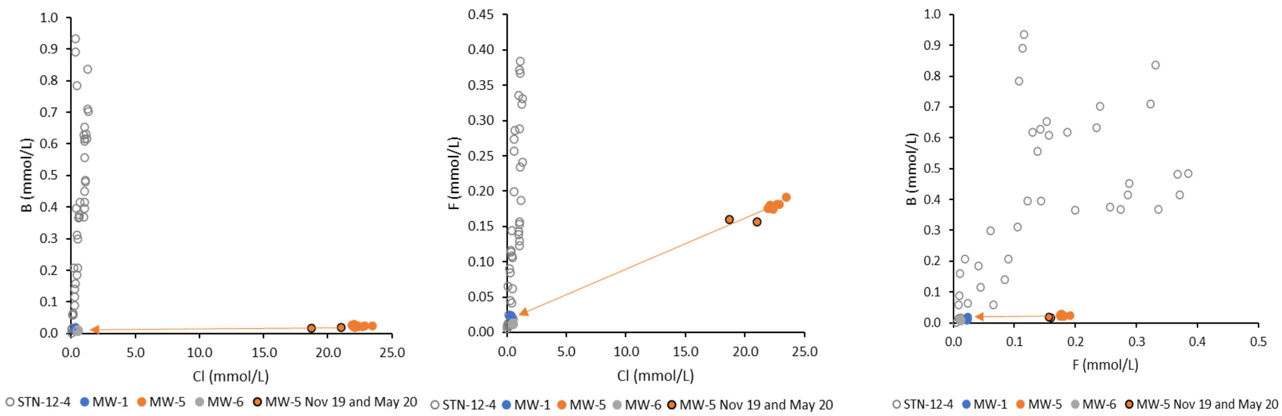


Figure 3-11 Conservative Ion Binary Plots for MW-5

3.4 Tier II Evaluation - Geochemical Evaluation

A simple analysis of primary and potential indicator constituents (as performed in **Section 3.1**) may not provide the lines of evidence required for a robust ASD investigation. It is recognized that naturally occurring indicator constituents and upgradient sources may have an additional influence on groundwater quality. Spatially across a site, groundwater quality may be observed to change due to chemical interactions with the aquifer matrix. EPRI (2012) recommends more sophisticated methods that can be used for multiple parameters over multiple locations.

Piper plots are used to classify groundwater types based on the major ion ratios of calcium, magnesium, sodium (and potassium), alkalinity, chloride, and sulfate. They can be used to visually illustrate ion exchange and mixing between different water chemistries.

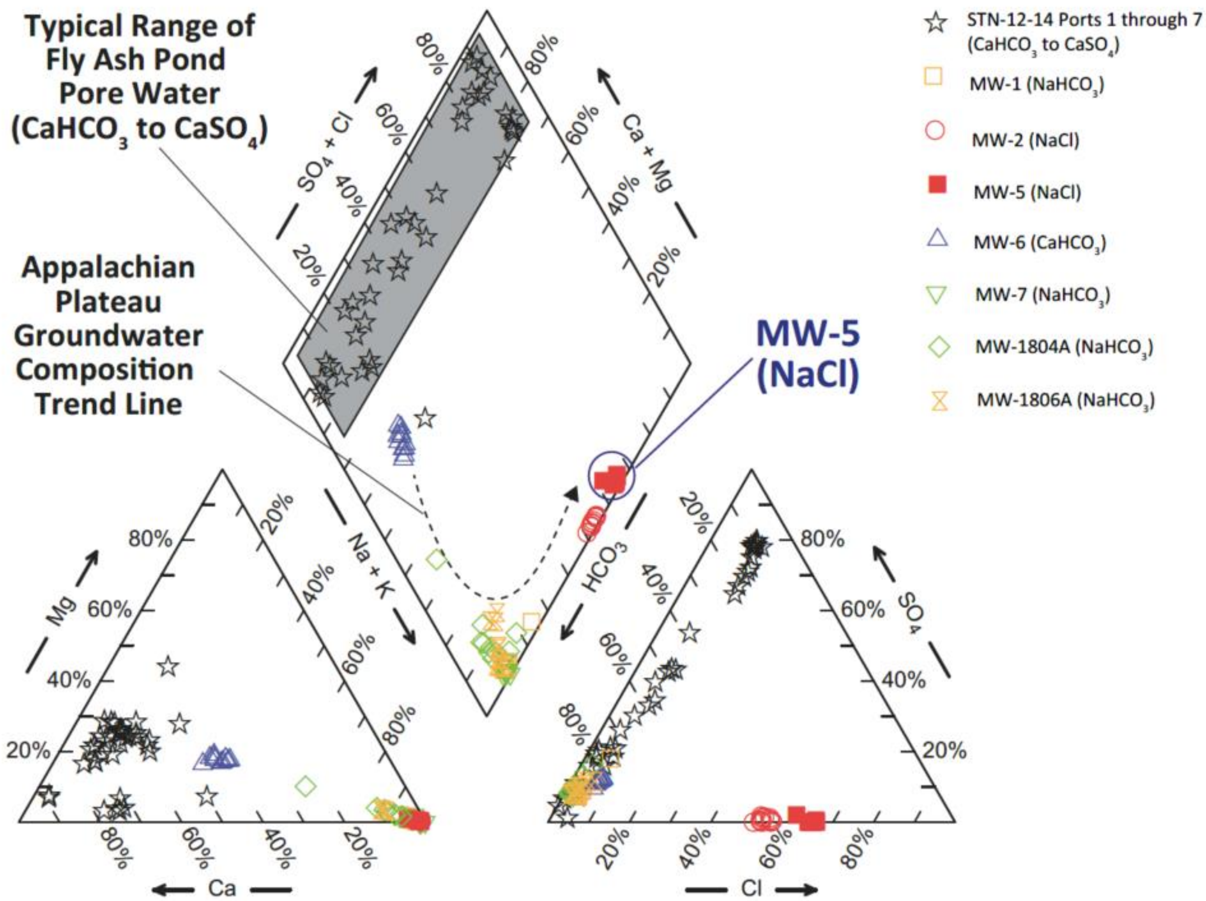


Figure 3-12 JAFAP and Groundwater Piper Plot (water types)

Not all site monitoring wells are shown.

Ash porewater and groundwater are represented by different water types. In **Figure 3-12** above, the water types related to the JAFAP porewater are dominated by calcium, bicarbonate, and sulfate.

The groundwater composition of MW-5 is largely distinct from other JAFAP wells (except MW-2) and is a sodium chloride water type. Groundwater samples collected in the vicinity of MW-5 between July 2018 and May 2020 consistently report a sodium chloride water type. This water type is typically indicative of connate brines that are relict within the aquifer. This groundwater type is also consistent with the construction of well MW-5, which monitors a deeper section of the bedrock aquifer than other site wells (except MW-2) where a connate brine is expected to be encountered, as discussed in **Section 2.3**.

In summary, based on the geochemical evaluation there is insufficient evidence to support the presence of CCR constituents, as derived from the JAFAP, in groundwater sampled in the vicinity of MW-5. The Piper plot does not support mixing between groundwater and JAFAP water at any of the groundwater monitoring locations reviewed. The JAFAP water type is calcium bicarbonate (shallow porewater) and calcium sulfate (deeper porewater). Only four other groundwater locations report these two water types – MW-1801A and MW-6 (calcium bicarbonate); and MW-1807A and MW1809A (calcium sulfate).

Bicarbonate concentrations are generally more elevated in groundwater in comparison to JAFAP porewater. Sulfate concentrations are mostly higher within groundwater compared to JAFAP, except for MW-6. Additionally, bromide, fluoride and sodium are all present at higher concentrations in MW-5 groundwater compared to the JAFAP water. These concentration imbalances indicate an alternate source of these constituents. Based on this evidence, it is considered that porewater from JAFAP is unlikely to be influencing the surrounding groundwater chemistry in MW-5 where the November 2019 and May 2020 SSIs were identified. Any compositional similarity between JAFAP pore water and the monitoring locations mentioned reflects the local groundwater origin for JAFAP pore water.

3.5 ASD Type I – Natural Variation due to Sampling Causes

EPRI (2012) describes sampling anomalies as a defensible cause for an SSI. Review of field documents indicates a notable change in the sampling technique at MW-5 during the November 2019 and May 2020 sampling compared to the eight background monitoring events, in that the maximum purge rate was between one half and one quarter the rate used historically (**Figure 3-13**). Additionally, the total volume purged during the November 2019 and May 2020 sampling and verification events at MW-5 was lower than all previous instances (**Figure 3-13**).

Sampling events used to establish benchmark values for evaluating SSIs were formulated through statistical analysis of the historical samples that were collected at higher purge rates and purge volumes. In the case of MW-5, the excess pumping in the associated low-yield formation during SSI benchmark calibration sampling is expected to result in incursion of reducing, low sulfate, high TDS NaCl-type connate water into the well screen. Subsequent sampling at a lower purge rate and purge volume on November 2019 is expected to have minimized connate water incursion into the well and facilitated sampling of low TDS and sulfate bearing water with elevated Ca from above the connate water mixing interface.

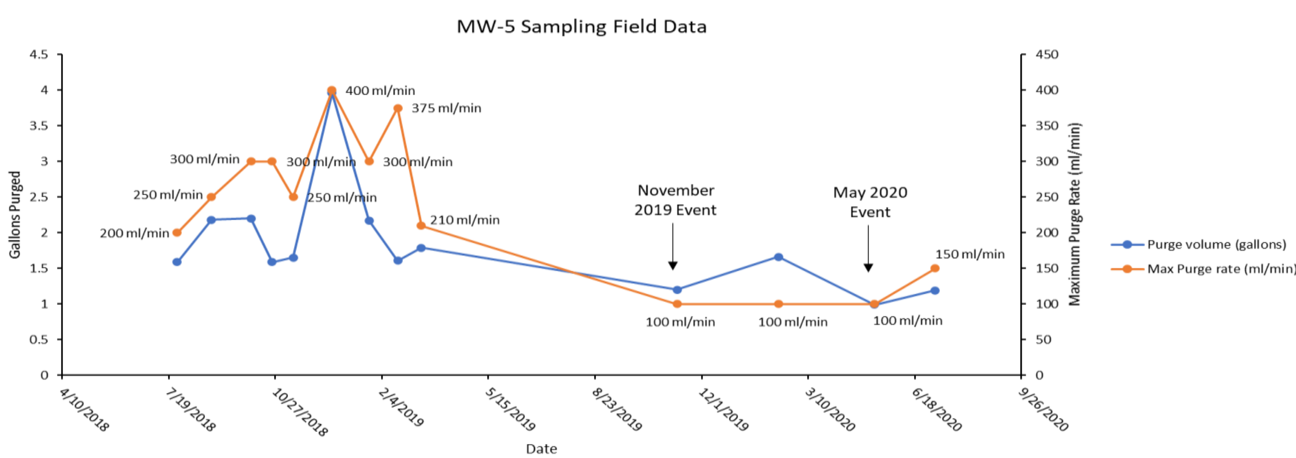


Figure 3-13 Historical Well Purge Rates and Volume Purged for MW-5

3.6 ASD Type III – Statistical Evaluation Causes

Samples to establish SSI benchmarks were obtained over a seven month period between July 25, 2018 to February 18, 2019. For this reason, benchmark statistical calulations are qualified with "Insufficient data to test for seasonality: data were not deseasonalized" (AEP, 2020). Additionally, annual variations owing to high rainfall years (**Section 3.6**) are not accounted for, as detection monitoring began immediately following the establishment of SSI benchmarks. Therefore, periodic SSI exceedences related to seasonal and/or annual weather variations should be expected until a broader dataset is available that incorporates seasonal and annual weather patterns.

3.7 ASD Type IV – Natural Variation

Historical groundwater geochemistry data for MW-5 show that it is screened close to a mixing zone between low TDS and comparatively young recharge water and high TDS and comparatively ancient connate brine. Regionally, the mixing interface between these two disparate water types is known to be only a few ft thick. The two water types constitute two natural groundwater sources with distinct groundwater geochemistry that may periodically contribute water to the saturated zone within the MW-5 screen/sand pack zone. Given that SSI benchmarks were established over approximately a seven-month period, seasonality and longer timescale natural variations in the location of the mixing interface are unlikely captured in the benchmark dataset.

4 Summary and Conclusions

Table 4-1 (Table 6-1 in EPRI, 2017) highlights the potential causes of SSIs at MW-5 during the November 2019 and May 2020 detection monitoring events that have been identified during this ASD investigation.

Table 4-1 Summary of Potential Causes Identified by ASD Investigation

Table 6-1
Potential Causes for an SSI/SSL

Sampling Causes (ASD Type I)	Laboratory Causes (ASD Type II)	Statistical Evaluation Causes (ASD Type III)	Natural Variation (ASD Type IV)	Alternative Sources (ASD Type V - Natural and Anthropogenic)
• Sample mislabeling • Contamination • Change in technique • Excessive suspended solids or turbidity • Other sampling anomalies	• Analytical method • Calibration • Analytical technique • Contamination • Interference • Recording • Dilution errors • Digestion methods	• Lack of statistical independence • Outliers • Trends • Non-detect Processing • False positives • New background data	• Geology • Precipitation • Seasonality • Water level • Changes in pH and/or ORP • Biological activity • Time of travel	• See Appendix A, Tables A-3 and A-4

Using the EPRI (2017) guidance for completing an ASD, the conclusions that are based on the lines of evidence presented and discussed within **Sections 3** indicate that groundwater in the vicinity of the JAFAP is not being influenced by CCR constituents from the JAFAP. Concentrations of the constituents calcium and sulfate in MW-5 that led to SSIs in November 2019 and May 2020 are primarily caused by a change in the sampling procedure (ASD Type I – Sampling Causes), which led to a difference in where sampled water originated in the formation, as detailed in **Table 4-2.** Additionally, ASD Type III – Statistical Evaluation Causes, ASD Type IV Natural Variation Causes, and Type V – Alternatives Source Causes at MW-5 were identified, as discussed below.

Table 4-2 Evidence of ASD for SSIs at the John Amos Fly Ash Pond

MW-5 Evidence
MW-5: Calcium SSI
1. High purge rates and purge volumes during background sampling resulted in intrusion of sodium chloride water, setting an unrealistically low calcium SSI value for future comparison. 2. Mixing of shallower calcium-rich groundwater occurred during the November 2019 sampling event due to a substantially lower purge rate and volume, which led to the SSI as evidenced by: a. Calcium was 5.7 times lower in MW-5 than calcium in the shallower, co-located well MW-6. b. Shallow groundwater mixing is supported by Ca/Cl and B/Cl ratios in MW-5 similar to shallow groundwater and notably different than JAFAP porewater. c. Shallow groundwater mixing with brine is supported by conservative element (B, Cl, F) concentrations.
MW-5: Sulfate SSI
1. High purge rates and purge volumes during background sampling resulted in intrusion of sodium chloride water, with essentially no sulfate, setting an unrealistically low SSI value for future comparison (sulfate SSI benchmark is over 100 times lower than typical groundwater sulfate concentrations due to incursion of reducing, sulfide-bearing and sulfate-free brine) 2. Mixing of shallower sulfate-rich groundwater occurred during the November 2019 and May 2020 sampling events due to substantially lower purge rates and volumes, as evidenced by: a. Sulfate in MW-5 was lower than in co-located and shallower wells MW-1 and MW-6. b. SO_4/Cl ratios were substantially lower than JAFAP porewater and closer to those in shallow groundwater wells. c. Piper plot relationships that show MW-5 is compositionally distinct from JAFAP porewater

An ASD Type III – Statistical evaluation cause could also be the reason for SSIs in the November 2019 and May 2020 detection monitoring events. SSI benchmarks were established over approximately a seven-month period preceding three quarters of detection monitoring. The November 2019 and May 2020 events were the second and third of three monitoring events following establishment of SSI benchmark values. The eight-month background period does not fully capture seasonal and annual weather variations, and future reevaluation of benchmarks may be required to ensure a background data set which accurately reflects the natural variation in groundwater chemistry across the hydrogeologic units surrounding the JAFAP.

ASD Type V – Alternative sources (Natural) is also a potential contributing factor to explain MW-5 groundwater composition, in addition to ASD Type I – Sampling Causes and ASD Type III – Statistical Evaluation Causes. Historical groundwater geochemistry data for MW-5 show that it is screened close to a mixing zone between low TDS and comparatively young recharge water and high TDS and comparatively ancient connate brine. Regionally, the mixing interface between these two disparate water types is known to be only a few ft thick. The two water types constitute two natural groundwater sources with distinct groundwater geochemistry that may periodically contribute water to the saturated zone within the MW-5 screen/sand pack zone.

5 References

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Tables

Table 1
Screened Interval of Monitoring Wells
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos Plant, Winfield, WV
November 2019

Well/ Boring	Hydraulic Location	Hydrolitho-stratigraphic Unit	Surface Elevation (ft amsl)	Screened Interval (ft amsl)	Sand Pack Interval (ft amsl)	Geologic Formation
MW-1807A	Upgradient/ Background	SRF	861.99	766.99 – 746.99	745.99 – 769.99	Unnamed clay shale/ Lower Connellsville SS
MW-1808A	Upgradient/ Background	SRF	857.55	733.73 – 748.35	746.55 – 776.55	Unnamed clay shale/ Lower Connellsville SS
MW-1809A	Upgradient/ Background	SRF	738.09	666.09 – 681.09	664.09 – 683.69	Clarksburg Shale
MW-1810A	Upgradient/ Background	SRF	735.26	655.26 – 675.26	653.26 – 681.26	Clarksburg Shale
MW-1	Downgradient	SRF	647.57	587.57 – 606.47	569.47 – 609.57	Birmingham Shale
MW-2	Downgradient	SRF	645.20	540.20 – 549.10	534.20 – 560.50	Birmingham Shale
MW-5	Downgradient	SRF	648.03	537.03 – 546.43	535.93 – 557.03	Birmingham Shale /Grafton SS
MW-6	Downgradient	SRF	647.50	614.00 – 619.00	613.30 – 620.30	Morgantown SS/ Birmingham Shale
MW-7	Downgradient	U/SRF	953.00	823.00 – 843.00	820.50 – 845.00	Conemaugh Shale/ Upper Connellsville SS
MW-8	Downgradient	U/SRF	963.01	800.01 – 819.01	797.01 – 821.21	Conemaugh Shale/ Upper Connellsville SS
MW-9	Downgradient	U/SRF	944.66	805.56 – 824.56	804.56 – 824.56	Conemaugh Shale/ Upper Connellsville SS
MW-1801A	Downgradient	U/SRF	901.12	826.12 – 846.12	824.12 – 849.12	Conemaugh Shale/ Upper Connellsville SS
MW-1804A	Downgradient	U/SRF	858.53	811.03 – 831.03	809.53 – 838.63	Conemaugh Shale/ Upper Connellsville SS/ Unnamed clay shale
MW-1806A	Downgradient	U/SRF	889.63	809.23 – 829.23	808.63 – 832.63	Conemaugh Shale/ Upper Connellsville SS/ Unnamed clay shale

--- = Boring advanced below the coal interval
~ = Approximate
ft = feet
amsl = above mean sea level
U=Upper Connellsville Sandstone
SRF=Stress Relief Fracture System
SS=Sandstone

Table 2
Multi-Port Piezometer STN-12-4 Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos Plant, Winfield, WV
May 2020

Multi-Port Interval	Sampling Date	Major Ions					Minor Ions						TDS	pH
		Bicarbonate (Alkalinity as CaCO3)	Calcium	Chloride	Magnesium	Sulfate	Boron	Bromide	Fluoride	Molybdenum	Potassium	Sodium		
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.
1	9/29/2017	630	182	13	41.7	151	10.1	--	2.2	--	--	75.6	810	--
2	9/28/2017	181	84.9	15.8	23.1	129	2	--	0.78	--	--	10.2	394	--
3	9/28/2017	108	69.2	16.3	11.9	146	3.36	--	2	--	--	16.1	344	--
4	9/28/2017	187	103	24.3	25.3	164	4.48	--	5.43	--	--	23.5	458	--
5	9/28/2017	62	122	39.5	22.9	280	5.23	--	7.3	--	--	15.7	582	--
6	9/28/2017	44	134	35.9	3.59	341	6.79	--	2.71	--	--	38.5	612	--
7	9/28/2017	51	168	46.4	29.3	409	9.05	--	6.28	--	--	19.9	740	--
GeoMean	September 2017	118.1	117.1	24.5	18.3	210.3	5.2	--	3.0	--	--	23.1	539.2	--
1	12/12/2017	597	170	12.8	22.6	152	9.63	--	2.16	--	--	20.1	816	--
2	12/12/2017	122	30.7	3.98	19.9	1.4	0.169	--	0.24	--	--	12.6	174	--
3	12/12/2017	102	34.5	6.18	3.06	28.1	0.698	--	0.46	--	--	33.7	224	--
4	12/11/2017	185	91.9	22.5	25.1	156	3.98	--	5.2	--	--	16.2	446	--
5	12/11/2017	67.1	105	38.1	38.5	268	4.5	--	7.05	--	--	66.6	550	--
6	12/11/2017	50.6	122	36.3	6.36	351	6.02	--	2.62	--	--	6.01	608	--
7	12/11/2017	49.6	143	45.6	6.81	435	7.67	--	6.14	--	--	7.42	774	--
GeoMean	December 2017	112.7	84.3	17.2	12.8	87.1	2.7	--	2.0	--	--	17.0	448.9	--
1	11/15/2018	360	58.5	3.74	15.3	44.4	0.634	0.1	1.24	0.0375	8.76	13.6	406	7.57
2	11/14/2018	289	67.9	1.59	17.4	20.2	0.145	0.1	0.17	0.0158	7.36	10.5	320	7.32
3	11/15/2018	181	50	0.64	12.6	8.4	<0.02	0.1	0.1	0.00892	7.6	7.78	217	7.47
4	11/15/2018	229	63.6	10.6	15.1	62.8	1.52	0.2	1.61	0.231	8.26	12.1	330	4.48
5	11/15/2018	80.4	86	35.8	17.9	229	3.98	0.508	6.38	1.62	6.34	10.6	440	7.65
6	11/15/2018	38.7	82.7	36.8	4.82	342	4.27	0.5	2.32	2.52	10.8	22.2	840	8.92
7	11/16/2018	55.8	115	40.8	19.3	332	6.83	0.502	4.45	3.17	7.83	16.1	600	8.01
GeoMean	November 2018	133.3	72.3	8.0	13.6	74.1	1.6	0.2	1.1	0.2	8.0	12.6	413.4	7.2
1	3/12/2019	392	107	7.59	26.8	74.1	2.23	0.1	1.71	0.0924	8.47	39.9	508	7.76
2	3/13/2019	281	73	5.24	19.1	27.1	0.643	<0.1	0.16	0.101	5.43	13	314	7.28
5	3/14/2019	213	75.3	10.3	19	78.2	1.25	<0.1	0.86	0.45	4.67	13.6	346	7.26
6	3/15/2019	47.4	127	37.6	3.98	346	6.67	0.548	2.46	2.5	11.2	37.8	628	9.52
GeoMean	March 2019	182.6	93.0	11.1	14.0	85.9	1.9	0.2	0.9	0.3	7.0	22.7	431.5	7.9
1	11/11/2019	627	173	15.8	36.8	141	8.47	0.311	2.05	0.146	10.4	70.8	816	7.55
2	11/11/2019	314	86.5	8.95	19.5	24.7	0.955	0.224	0.18	0.0714	6.14	12	361	7.25
3	11/11/2019	211	64.6	11.2	13.8	41.8	1.72	0.263	0.22	0.114	4.9	13.4	285	7.46
4	11/11/2019	201	83.4	20.6	20.5	109	3.95	0.423	3.79	0.551	6.01	20.4	391	7.68
5	11/11/2019	75.7	114	36.6	21.6	250	4.88	0.634	5.47	1.69	3.86	12.3	512	7.82
6	11/12/2019	47.7	132	36.8	3.7	337	7.05	0.584	2.91	2.68	10	42	632	9.26
7	11/12/2019	62	136	43.3	19.5	310	6.67	0.657	3.54	2.81	5.58	18.7	625	7.64
GeoMean	November 2019	151.9	107.4	21.2	16.4	122.5	3.9	0.4	1.5	0.5	6.3	21.7	488.5	7.8
1	5/11/2020	568	155	15.1	38.7	113	4.28	0.2	2.73	0.186	11.4	61.4	758	7.82
2	5/11/2020	281	101	18.4	27.6	67.6	2.23	0.297	0.36	0.202	6.89	11.9	457	7.24
3	5/13/2020	120	56.8	17.8	14.3	107	3.24	0.294	1.17	0.315	7.83	14.6	336	7.4
4	5/13/2020	192	75.9	22.2	23.2	113	4.06	0.336	4.88	0.543	6.22	18.8	368	7.67
5	5/13/2020	555	104	39	22.7	252	5.2	0.534	6.97	1.67	5.14	11	555	7.76
6	5/14/2020	46.1	123	38	4.32	327	6.58	0.455	2.98	2.49	11.9	40	624	9.34
7	5/14/2020	40.6	142	47.1	20.5	363	7.6	0.546	4.57	3.3	6.76	19.3	676	7.69
GeoMean	May 2020	168.3	103.0	25.8	18.4	160.7	4.4	0.4	2.5	0.7	7.7	20.8	518.2	7.8

Notes:
mg/L : milligrams per Liter
TDS : total dissolved solids
s.u. : standard units
- - : not analyzed
< : value less than reporting limit

EHS Support

Table 3
Monitoring Well Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos, Winfield, WV
May 2020

			Major Ions					**Minor Ions**							
Monitoring Well	**Collection Date**	**Monitoring Program**	**Bicarbonate (Alkalinity as CaCO3)**	**Calcium**	**Chloride**	**Magnesium**	**Sulfate**	**Boron**	**Bromide**	**Fluoride**	**Molybdenum**	**Potassium**	**Sodium**	**TDS**	**pH**
			mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**s.u.**
MW-1	7/24/2018	Background	382	2.83	11.7	0.466	30.6	0.182	0.106	0.42	1.94	1.75	159	473	8.2
	8/28/2018	Background	371	2.80	11.3	0.502	31.6	0.135	0.121	0.45	1.48	1.63	168	435	8.5
	10/3/2018	Background	385	2.95	11.1	0.456	30.8	0.138	0.100	0.40	1.00	1.40	172	457	8.3
	10/22/2018	Background	380	2.36	11.4	0.396	30.7	0.180	0.100	0.42	1.00	1.49	170	434	8.3
	11/13/2018	Background	388	3.03	11.5	0.424	32.2	0.209	0.100	0.45	1.00	2.27	159	444	8.0
	12/19/2018	Background	372	2.71	10.7	0.441	30.9	0.117	0.0900	0.43	1.00	1.31	162	428	8.1
	1/23/2019	Background	242	2.29	14.6	0.404	55.9	0.115	0.0400	0.41	1.00	1.41	148	453	8.2
	2/19/2019	Background	367	2.36	10.9	0.371	31.3	0.126	0.0900	0.44	1.00	1.22	175	457	8.5
	MW-1 Intrawell Prediction Limit		- -	**3.58**	**14.6**	- -	**55.9**	**0.261**	- -	**4.85**	- -	- -	- -	**536**	**8.8**
	3/12/2019	Detection	390	2.60	11.0	0.383	31.6	0.110	0.080	0.43	- -	1.14	170.0	458	8.2
	11/8/2019	Detection	353	2.38	11.2	0.413	33.7	0.114	0.100	0.42	- -	1.42	165.0	461	8.2
	5/13/2020	Detection	335	2.74	11.2	0.410	33.6	0.122	0.070	0.42	- -	1.38	163.0	457	8.2
MW-2	07/27/2018	Background	545	4.24	471	0.924	2.40	0.259	2.60	3.08	27.2	1.97	427	1260	8.4
	08/29/2018	Background	547	3.98	443	0.891	17.4	0.249	2.49	2.99	34.5	3.05	426	1310	8.6
	10/04/2018	Background	550	4.31	435	0.870	14.8	0.256	2.55	2.99	30.8	2.33	532	1280	8.5
	10/23/2018	Background	561	3.95	438	0.866	7.40	0.262	2.41	3.08	26.1	2.47	516	1250	8.5
	11/15/2018	Background	546	4.07	469	0.861	13.5	0.328	2.67	3.30	29.2	2.69	482	1250	8.5
	12/19/2018	Background	551	3.81	430	0.822	6.40	0.225	2.34	3.03	25.5	2.03	443	1250	8.5
	01/23/2019	Background	513	3.67	441	0.903	6.40	0.318	2.22	3.00	29.2	2.40	447	1310	8.2
	02/22/2019	Background	568	3.95	447	0.855	2.30	0.237	2.26	3.06	21.9	2.02	461	1310	8.7
	MW-2 Intrawell Prediction Limit		- -	**4.66**	**495**	- -	**26.7**	**0.382**	- -	**3.39**	- -	- -	- -	**1410**	**8.9**
	3/13/2019	Detection	605	3.98	441	0.826	1.8	2.300	2.38	3.02	26.2	1.86	470	1300	8.7
	11/8/2019	Detection	543	4.77	426	1.08	20.1	0.265	2.39	2.73	- -	2.91	481	1340	8.5
	2/11/2020	Verification	- -	4.31	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
	5/12/2020	Detection	505	4.35	443	1.05	6.0	0.214	2.1	2.91	- -	2.06	471	1340	8.6
MW-5	7/24/2018	Background	599	6.75	793	1.60	0.2	0.252	4.69	3.32	36.5	3.04	777	1890	8.1
	8/29/2018	Background	601	6.71	780	1.63	0.2	0.240	4.56	3.33	38.4	4.59	714	1880	8.2
	10/3/2018	Background	581	7.03	776	1.56	0.1	0.276	4.67	3.33	35.7	3.37	742	1860	8.1
	10/24/2018	Background	623	7.09	811	1.61	<0.06	0.249	4.63	3.44	35.1	3.40	735	1840	8.1
	11/13/2018	Background	600	6.79	832	1.38	0.1	0.264	4.89	3.63	34.7	4.03	586	1880	8.0
	12/19/2018	Background	609	6.48	783	1.53	<0.06	0.221	4.73	3.43	34.8	3.02	595	1890	7.9
	1/23/2019	Background	619	5.98	782	1.60	<0.06	0.323	4.58	3.36	35.0	3.80	599	1910	8.1
	2/19/2019	Background	599	6.79	793	1.69	<0.06	0.239	4.58	3.38	33.6	3.21	687	1920	8.2
	MW-5 Intrawell Prediction Limit		- -	**7.79**	**853**	- -	**0.2**	**0.355**	- -	**3.72**	- -	- -	- -	**1980**	**7.8**
	3/13/2019	Detection	609	6.85	804	1.60	0.08	0.229	4.69	3.44	- -	2.78	660	1930	8.0
	11/8/2019	Detection	588	21.00	663	2.61	32	0.182	4.36	3.04	- -	6.61	571	1840	8.0
	2/11/2020	Verification	- -	11.30	713	- -	18.6	- -	- -	- -	- -	- -	- -	- -	7.8
	5/11/2020	Detection	540	9.85	746	2.32	11	0.211	3.74	2.97	- -	2.9	694	1820	7.9
	7/7/2020	Verification	- -	8.77	- -	- -	22.8	- -	- -	- -	- -	- -	- -	- -	8.1

Table 3
Monitoring Well Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos, Winfield, WV
May 2020

Monitoring Well	Collection Date	Monitoring Program	Major Ions					Minor Ions						TDS	pH
			Bicarbonate (Alkalinity as CaCO3)	Calcium	Chloride	Magnesium	Sulfate	Boron	Bromide	Fluoride	Molybdenum	Potassium	Sodium		
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.
MW-6	7/24/2018	Background	294	61.0	19.3	15.5	44.4	0.120	0.168	0.22	0.580	2.73	59.0	392	6.9
	8/28/2018	Background	310	59.7	19.4	15.6	44.6	0.096	0.203	0.24	0.600	2.87	60.8	398	6.9
	10/3/2018	Background	309	60.7	18.9	15.3	43.4	0.125	0.200	0.21	0.500	2.72	62.5	402	6.8
	10/24/2018	Background	302	61.5	18.4	15.0	42.0	0.1	0.200	0.23	0.600	2.76	68.3	400	6.9
	11/13/2018	Background	304	64.9	19.8	14.0	44.6	0.111	0.200	0.24	0.700	3.24	57.4	390	6.7
	12/19/2018	Background	324	55.8	17.7	14.1	41.7	0.07	0.100	0.23	0.700	2.80	57.4	376	6.7
	1/23/2019	Background	309	54.1	17.8	15.0	41.3	0.08	0.100	0.22	0.600	2.77	54.8	411	6.6
	2/19/2019	Background	325	55.8	17.3	15.1	40.4	0.09	0.100	0.24	0.600	2.92	67.4	406	7.0
	MW-6 Intrawell Prediction Limit		- -	**70.6**	**21.4**	- -	**48.0**	**0.159**	- -	**0.26**	- -	- -	- -	**424**	**6.3**
	3/12/2019	Detection	314	57.9	17.4	14.7	39.8	0.08	0.1	0.23	- -	2.69	65.5	390	6.9
	11/8/2019	Detection	308	56.6	17.2	15.3	41.7	0.079	0.201	0.24	- -	2.84	66.1	368	6.9
	5/11/2020	Detection	295	55.8	15.9	15.3	32.6	0.088	0.1	0.25	- -	2.65	69.0	416	7.0
MW-7	07/26/2018	Background	314	1.33	5.41	0.175	32.0	0.0870	0.0960	0.270	1.12	0.590	138	368	8.53
	08/29/2018	Background	306	1.29	5.32	0.159	31.5	0.112	0.0900	0.270	1.06	1.15	133	387	8.75
	10/03/2018	Background	312	1.44	5.23	0.162	31.8	0.156	0.100	0.260	<1.00	0.910	147	376	8.75
	10/24/2018	Background	309	1.40	5.37	0.203	31.7	0.0900	0.100	0.270	<1.00	0.940	154	344	8.82
	11/13/2018	Background	318	1.49	5.65	0.169	33.2	0.192	0.100	0.290	<1.00	1.45	135	379	8.36
	12/17/2018	Background	323	1.24	5.29	0.173	32.0	0.100	0.0900	0.270	<1.00	0.730	155	387	8.62
	01/23/2019	Background	330	1.41	5.18	0.191	32.0	0.127	0.0800	0.250	<1.00	1.04	128	389	8.44
	02/18/2019	Background	325	1.37	5.39	0.181	32.1	0.0600	0.0900	0.260	<1.00	0.780	154	401	8.96
	MW-7 Intrawell Prediction Limit		- -	**1.63**	**5.80**	- -	**33.6**	**0.248**	- -	**0.34**	- -	- -	- -	**458**	**9.3**
	3/13/2019	Detection	308	1,47	5.5	0.185	32.5	0.060	0.090	0.270	- -	0.650	162	385	
	11/8/2019	Detection	295	2.18	5.4	1.54	32.3	0.066	0.100	0.250	- -	1.760	139	390	8.7
	2/11/2020	Verification	- -	1.39	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -	- -
	5/11/2020	Detection	284	1.59	5.3	0.286	23.6	0.067	0.08	0.27	- -	0.7	143	395	8.4
MW-1804A	7/27/2018	Background	< 1	28.1	- -	7.61	- -	0.672	0.5	- -	136	2.45	113	- -	- -
	8/1/2018	Background	367	- -	3.87	- -	35.2	- -	0.0400	0.70	- -	- -	- -	423	7.4
	8/28/2018	Background	395	15.9	5.27	4.03	44.7	0.779	0.0800	0.84	136	2.82	157	452	8.3
	10/2/2018	Background	377	38.8	3.63	10.00	35.7	0.629	0.0400	0.61	111	3.18	118	458	7.9
	10/23/2018	Background	423	12.9	4.79	3.22	36.9	0.675	0.0500	0.78	116	1.90	167	452	7.6
	11/13/2018	Background	425	8.90	5.32	1.72	46	0.846	0.0600	0.91	129	1.58	187	498	7.8
	12/19/2018	Background	446	10.1	4.51	2.14	40.1	0.772	0.0400	0.78	130	1.91	170	433	7.9
	1/24/2019	Background	367	12.1	3.14	3.09	32.3	0.673	0.04	0.71	110	1.86	146	414	7.4
	2/21/2019	Background	362	7.43	3.29	1.74	33.8	0.611	0.04	0.89	115	1.29	164	461	8.0
	MW-1804A Intrawell Prediction Limit		- -	**51.20**	**6.93**	- -	**53.9**	**0.965**	- -	**1.10**	- -	- -	- -	**599**	**6.8**
	3/12/2019	Detection	329	10.2	3.55	2.27	34.0	0.568	<0.04	0.85	- -	1.37	165.0	411	7.9
	11/11/2019	Detection	438	6.8	11.20	1.16	85.4	0.730	0.203	0.64	- -	0.80	211.0	582	8.0
	2/12/2020	Verification	- -	- -	9.59	- -	69	- -	- -	- -	- -	- -	- -	- -	7.8
	5/14/2020	Detection	357	4.51	6.2	0.767	51.4	0.739	0.04	0.85	- -	1.13	180	484	8.1

Table 3
Monitoring Well Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos, Winfield, WV
May 2020

Monitoring Well	Collection Date	Monitoring Program	Major Ions					Minor Ions							TDS	pH
			Bicarbonate (Alkalinity as CaCO3)	Calcium	Chloride	Magnesium	Sulfate	Boron	Bromide	Fluoride	Molybdenum	Potassium	Sodium			
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.
MW-1806A	7/27/2018	Background	328	12.9	- -	3.19	- -	0.164	0.0700	- -	17	1.63	129	- -	- -
	8/1/2018	Background	331	- -	17.7	- -	48.4	- -	0.0600	0.56	- -	- -	- -	426	7.6
	8/29/2018	Background	333	12.0	16.2	2.9	45.6	0.162	0.0630	0.55	14.2	2.01	139	445	8.0
	10/2/2018	Background	380	5.81	7.21	1.3	36.2	0.15	0.04	0.80	7.73	1.31	160	435	8.5
	10/23/2018	Background	363	7.43	8.62	1.72	40.8	0.158	0.04	0.77	6.66	1.30	158	423	8.4
	11/13/2018	Background	371	7.51	8.15	1.67	40.1	0.213	0.04	0.85	7.44	1.32	159	442	8.1
	12/19/2018	Background	369	5.14	5.29	1.12	30.9	0.162	0.04	0.85	6.02	1.20	161	409	8.5
	1/24/2019	Background	360	12.2	11.7	2.89	48.1	0.168	0.0500	0.59	5.62	2.17	153	445	8.1
	2/18/2019	Background	351	5.67	6.24	1.3	33.0	0.133	0.04	0.81	4.74	1.14	159	460	8.6
	MW-1806A Intrawell Prediction Limit		- -	**18.80**	**24.60**	- -	**61.4**	**0.235**	- -	**1.14**	- -	- -	- -	**485**	**7.2**
	3/12/2019	Detection	375	4.98	5.51	1.10	32.9	0.130	0.040	0.83	- -	0.98	180.0	430	8.8
	11/12/2019	Detection	351	13.50	11.10	3.26	42.8	0.156	0.100	0.48	- -	1.78	149.0	423	7.9
	5/15/2020	Detection	363	2.32	8.45	0.451	35.2	0.127	<0.04	0.86	- -	0.90	175.0	456	8.8

Notes:

Intrawell Prediction Limits are "Lower" for pH and "Upper" for all other consitutents (AEP, 2020)

- - : not analyzed

TDS : total disolved solids

mg/L : milligrams per Liter

s.u. : standard units

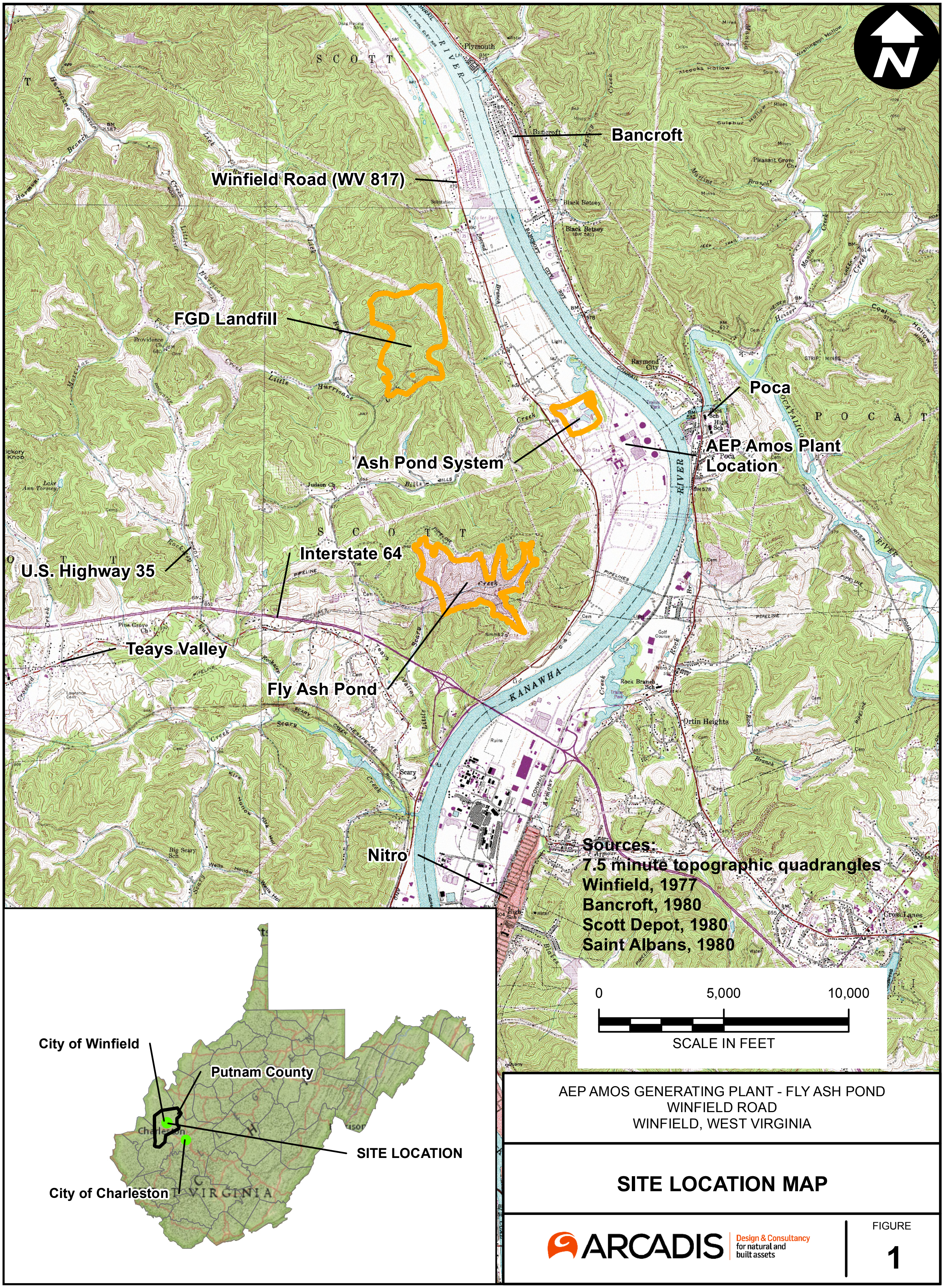
< - Non-detect value, less than the Method Detection Limit

Table 4
Ion Ratios for Key Constituents in Groundwater
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos Plant, Winfield, WV
May 2020

	Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	Sulfate	B/Cl *100	Ca/Cl	F/Cl *1000	SO_4/Cl *1000
			mg/L	mg/L	mg/L	mg/L	mg/L				
JAFAP Pore Water											
STN-12-4 Port 1	5/11/2020	Fly Ash	4.28	155	15.1	2.73	113	283	10.3	0.18	7,483
STN-12-4 Port 2	5/11/2020	Fly Ash	2.23	101	18.4	0.36	67.6	121	5.5	0.02	3,674
STN-12-4 Port 3	5/13/2020	Fly Ash	3.24	56.8	17.8	1.17	107	182	3.2	0.07	6,011
STN-12-4 Port 4	5/13/2020	Fly Ash	4.06	75.9	22.2	4.88	113	183	3.4	0.22	5,090
STN-12-4 Port 5	5/13/2020	Fly Ash	5.20	104	39	6.97	252	133	2.7	0.18	6,462
STN-12-4 Port 6	5/14/2020	Fly Ash	6.58	123	38	2.98	327	173	3.2	0.08	8,605
STN-12-4 Port 7	5/14/2020	Fly Ash	7.60	142	47.1	4.57	363	161	3.0	0.10	7,707
Benchmark SSI Exceedences											
MW-5	5/11/2020	Detection	0.211	**9.85**	746	2.97	**11**	0.3	0.01	0.004	15
Downgradient Wells											
MW-1	5/13/2020	Detection	0.122	2.74	11.2	0.42	33.6	11	0.2	0.04	3,000
MW-2	5/12/2020	Detection	0.214	4.35	443	2.91	6.0	0	0.01	0.01	14
MW-6	5/11/2020	Detection	0.088	55.8	15.9	0.25	32.6	6	3.5	0.02	2,050
MW-7	5/11/2020	Detection	0.067	1.59	5.3	0.27	23.6	13	0.3	0.05	4,453
MW-8	5/12/2020	Detection	0.191	1.83	108	2.73	19.9	2	0.02	0.03	184
MW-9	5/13/2020	Detection	0.122	0.959	7.27	0.82	12.0	17	0.1	0.11	1,651
MW-1801A	5/13/2020	Detection	0.105	52.6	9.93	0.13	34.6	11	5.3	0.01	3,484
MW-1804A	5/14/2020	Detection	0.739	4.51	6.20	0.85	51.4	119	0.7	0.14	8,290
MW-1806A	5/15/2020	Detection	0.127	2.32	8.45	0.86	35.2	15	0.3	0.10	4,166

Notes:
mg/L : milligrams per Liter
B/Cl : Boron/Chloride
Ca/Cl : Calcium/Chloride
F/Cl : Fluoride/Chloride
SO_4/Cl : Sulfate/Chloride

Appendix A Site Maps



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

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

Document Path: Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F1_ site map.mxd

LEGEND:

- Coal Combustion Residual (CCR) Unit
- Rivers and Streams
- Streamflow Direction

NOTES:
1. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. WEST VIRGINIA 1983 STATE PLANAR COORDINATES

0 3,000 6,000 Feet

GRAPHIC SCALE

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

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
2

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\ImpoundmentReport\F2_AmosRegionalMap.mxd 1/14/2019 9:27:48 AM

LEGEND:

- CCR Unit Boundary
- 2014 Soil and Rock Boring Location
- Oil & Gas Well
- 2008 Soil Boring and/or Rock Core
- Dewatering Well Converted to Piezometer
- Dewatering Well - Abandoned
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- 2012 Direct Push Boring with Cone Penetration Test (SCPTU)
- 2012 Direct Push Boring
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- 2012 Soil Boring with Standard Penetration Tests and Rock Core
- Rivers and Streams
- Stream Flow Direction
- Access Road

NOTES:
1. 2018 aerial imagery obtained from AEP.
2. FAP monitor well, STN boring, B-1401, and B-1402 coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer and 2008 soil boring coordinate source: AEP-provided boring logs
4. Oil and gas well coordinate source: WVDEP Oil and Gas Well Database
5. West Virginia 1983 State Planar Coordinates

0 600 1,200 Feet
GRAPHIC SCALE

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

FLY ASH POND LAYOUT AND WELL LOCATIONS MAP

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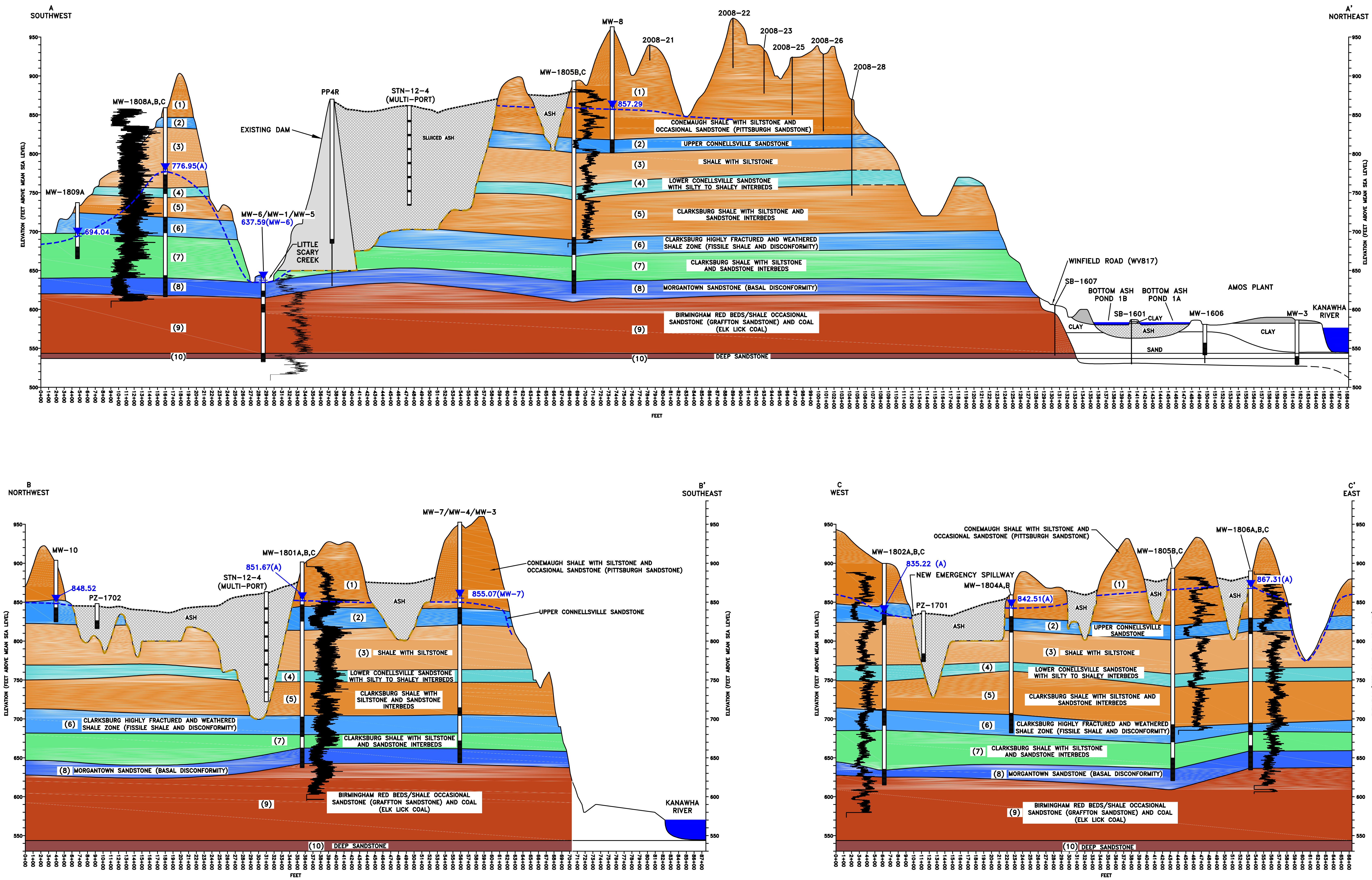
FIGURE
3

City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\ImpoundmentReport\F3_Layout_WellLocations_v4.mxd 4/11/2019 10:36:50 AM

Appendix B Geologic Cross-Sections



LEGEND

MW-9 — WELL OR BORING IDENTIFICATION

— WELL

— WELL SCREEN

— BORING

CAP CONSTRUCTION (BOTTOM TO TOP):

- SUBGRADE PREPARATION (IN-PLACE FLY ASH AND ONSITE BORROW MATERIAL DEWATERING, EXCAVATING, GRADING)
- 40-MIL LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) FLEXIBLE MEMBRANE LINER
- 8oz. GEOTEXTILE CUSHION LAYER
- 18 INCHES OF PROTECTIVE SOIL COVER LAYER
- 6 INCHES OF VEGETATIVE COVER LAYER
- DRAINAGE STRUCTURES
- SEEDING AND MULCHING

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) MONITORING WELL WATER LEVEL OCTOBER 22, 2018

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) POTENTIOMETRIC SURFACE

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) TOP BELOW SATURATED ASH

NATURAL GAMMA LOG

0 100 200 300 COUNTS PER SECOND

(1) CONEMAUGH SHALE WITH SILTSTONE AND OCCASIONAL SANDSTONE (PITTSBURGH SANDSTONE)

(2) UPPER CONNELLSVILLE SANDSTONE

(3) SHALE WITH SILTSTONE

(4) LOWER CONNELLSVILLE SANDSTONE WITH SILTY TO SHALEY INTERBEDS

(5) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS

(6) CLARKSBURG HIGHLY FRACTURED AND WEATHERED SHALE ZONE (FISSILE SHALE AND DISCONFORMITY)

(7) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS

(8) MORGANTOWN SANDSTONE (BASAL DISCONFORMITY)

(9) BIRMINGHAM RED BEDS/SHALE OCCASIONAL SANDSTONE (GRAFFTON SANDSTONE) AND COAL (ELK LICK COAL)

(10) DEEP SANDSTONE

VERTICAL SCALE: 1" = 100'

HORIZONTAL SCALE: 1" = 1000'

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

CROSS SECTIONS A-A', B-B' AND C-C'

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FIGURE 6

CITY:(COLUMBUS, OHIO) DIV/GROUP:(ENV) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(T. FORTNER) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\AMERICAN ELECTRIC POWER\AEP AMOS FAP\2019\WV015976.0005\01-DWG\0001E\WV015976-0005-0001E-FAP-CS01.dwg LAYOUT: CS ALL SAVED: 2/1/2019 8:34 AM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB
PLOTTED: 2/1/2019 12:57 PM BY: SMITH, BOB
XREFS:

LEGEND:

- CCR Unit Boundary
- Stormwater Pond
- 2014 Soil and Rock Boring Location
- Oil & Gas Well
- 2008 Soil Boring and/or Rock Core
- Dewatering Well Converted to Piezometer
- Dewatering Well - Abandoned
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Monitoring wells for the Ash Pond CCR Unit
- 2012 Direct Push Boring with Cone Penetration Test (SCPTU)
- 2012 Direct Push Boring
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- 2012 Soil Boring with Standard Penetration Tests and Rock Core
- Rivers and Streams
- Stream Flow Direction
- Access Road
- Cross Section Location

NOTES:

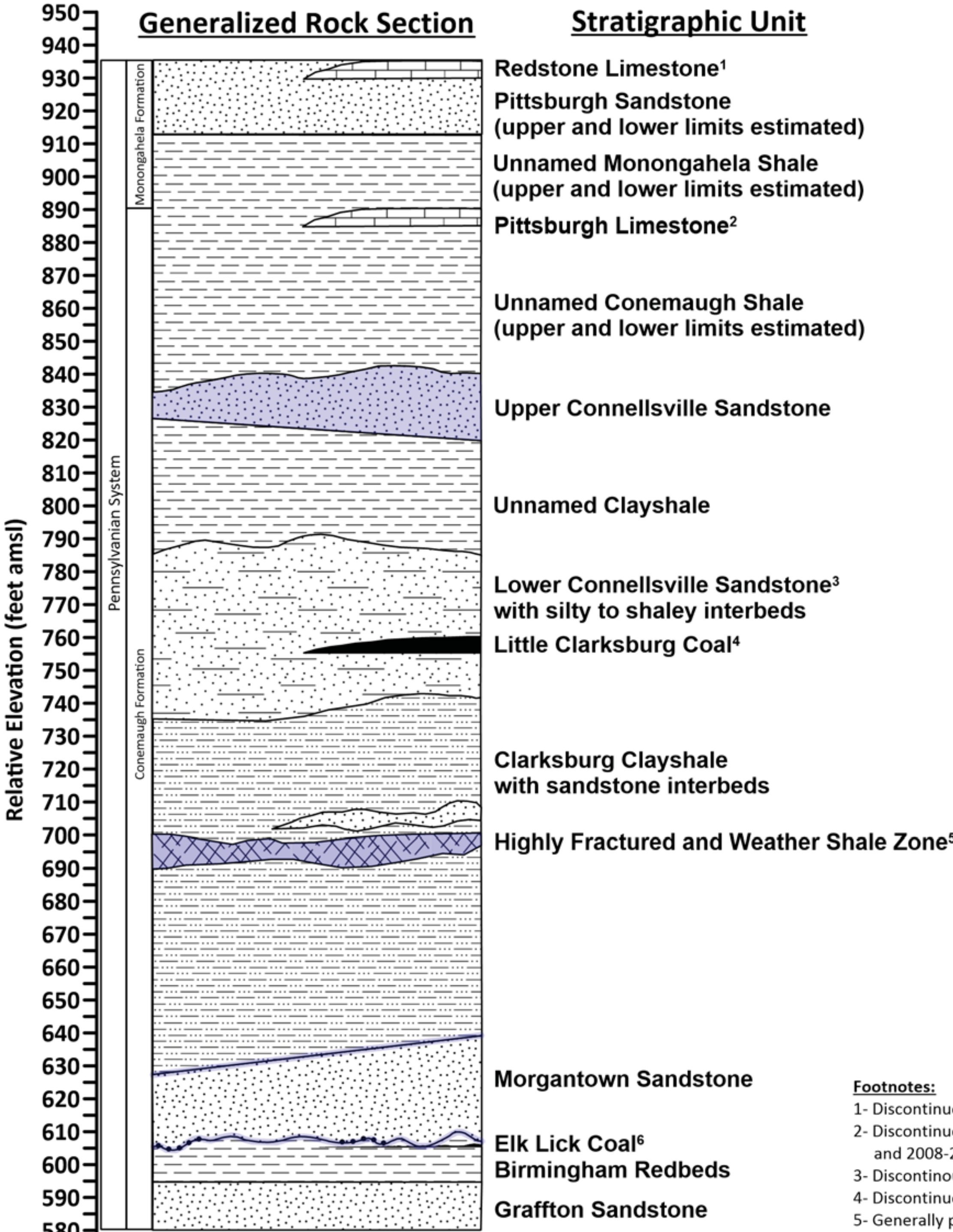
1. Topography from AEP dwg no. 13-30705-0 and 3dAMtopo_FAP11_aerial05.dgn. Contour Interval: 10 feet (2 feet within CCR unit boundary)
2. FAP monitor well, STN boring, B-1401, and B-1402 coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer and 2008 soil boring coordinate source: AEP-provided boring logs
4. Oil and gas well coordinate source: WVDEP Oil and Gas Well Database
5. Amos Generating Plant monitor well, piezometer, and soil boring coordinate source: June 2016 AEP survey and EPRI, April 1999, Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia
6. West Virginia 1983 State Planar Coordinates
7. CSM = Conceptual Site Model

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

CROSS SECTION LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
5



Footnotes:

1- Discontinuous - only present at boring MW-3

2- Discontinuous - only present at borings MW-3 and 2008-26

3- Discontinous - interbeds of sandstone

4- Discontinuous - only present at boring B-0608

5- Generally present at borings MW-1801, MW-1802, MW-1803, and MW-1805

6- Discontinuous and thin - present at MW-1802, MW-1803, MW-1805

Blue highlighted areas designate groundwater-bearing fracture zones

References:

- Site stratigraphic and geophysics from current data collection and historical reports.
- Cross, A.T and M.P. Shemel. 1956. *Geology and Economic Resources of the Ohio River Valley in West Virginia, Part I Geology.* West Virginia Geological Survey Volume XXII.
- Latimer, W.J., et al. 1911. *Jackson, Mason and Putnam Counties, Volume 1, County Reports and Maps*. Wheeling News Litho. Company.
- Orsborn, N.P. 2008. *Deposition and Structural Features of the Basal Morgantown Sandstone of the Casselman Formation (Pennsylvanian) of the Greater Pittsburgh Region*. MS Thesis.
- Reger, D.B., et al. 1918. *Barbour and Upshur Counties and Western Portion of Randolph, Volume 1, County Reports and Maps.* Wheeling News Litho. Company.

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

GENERALIZED STRATIGRAPHIC COLUMN

ARCADIS Design & Consultancy for natural and built assets

FIGURE 4

Appendix C Boring Logs

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER			
COMPANY		BORING NO. **D=MW-05** DATE **8/27/07**	SHEET **1** OF **5**
PROJECT	**EPRI GROUND WATER STUDY - AMOS**	BORING START **7/11/95**	BORING FINISH **7/26/95**
COORDINATES	**N 531,282.0 E 1,724,360.0**	PIEZOMETER TYPE	WELL TYPE **OW**
GROUND ELEVATION **648.0**	SYSTEM **STATE PLANE**	HGT. RISER ABOVE GROUND **1.9**	DIA **2.0**
		DEPTH TO TOP OF WELL SCREEN **101.6**	BOTTOM **111.0**
		WELL DEVELOPMENT **YES**	BACKFILL **QUICK GROUT**
		FIELD PARTY **MCR-RLY=TJH-REB**	RIG **BK-81 CME-75**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										AUGERED TO 2'		
1	SS	2.0	3.5	??-28-19	15"				GM	**GRAY ROCK FRAGMENTS, GRAVEL, SILT,** DRY, (FILL).		
									ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 3\4), Moist. AUGERED TO 7.0'		
							5					
2	SS	7.0	22.0	10-9-9	7.5"				ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 4\8) LIGHT BROWN (5YR 5\6 AND MODERATE BROWN (5YR 3\4), TRACE FELDSPAR, MOIST. AUGERED TO 12.0'		
							10					
3	SS	12.0	13.5	13-8-5	17"				ML	**SAME AS ABOVE**		
									CL	**SILTY CLAY**, PALE YELLOWISH BROWN (12YR 6\2) AND LIGHT OLIVE GRAY (5YR 5\2), LOW TO MEDIUM PLASTICITY, MOIST. AUGERED TO 17.0'		
							15					
4	SS	17.0	18.5	3-3-3	18"				SC	**CLAYEY-SILTY FINE SAND**, DUSKY YELLOWISH BROWN (10 YR 2\2),MOIST TO WET.		
										AUGERED TO 22.0'		

TYPE OF CASING USED

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

Continued Next Page

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

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

RECORDER **D.BENNETT**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER ______

COMPANY ______

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **2** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	SAMPLE DEPTH IN FEET TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
5	SS	22.0	23.2	7-7-50/3"	13"			SC	**SAME AS SAMPLE No. 4**	
								SW	**MEDIUM TO COARSE SAND**, LIGHT BLUISH GRAY (5B 7\1), MOIST.	
1	NQ	24.0	29.8		5.0	60			AUGERED TO 23.9' - AUGERED THROUGH OBSTRUCTION (ROCK?)	
							25		**MORGANTOWN SANDSTONE?**, GRAY. 24.0 - 25.0' Solid, light gray, (N-7) 25.0 - 26.0' Fractured, brown clay lined fractures, light gray (N-7). 26.0 - 27.0' Minimal fractures 27.0 - 27.7' Fractured, weathered, very fine dark gray (N-3) bedding. 27.7 - 29.8' Light gray (N-7) sandstone	25.0 Fracture = 8 26.0 Fracture = 3 26.5 Lost water 27.0 Fracture = 5
2	NQ	29.8	39.8		10.0	93	30		29.8 - 33.8' Light gray (N-7) sandstone	
									CLAY SHALE, MEDIUM GRAY (N4) MOIST, VERY SOFT.	
							35		**CLAY SHALE**, GRAYISH BROWN (5YR 3\2), MOIST, VERY SOFT.	35.2 Fracture = 3
									CLAY SHALE, LIGHT OLIVE GRAY (5Y 5\2) MEDIUM LIGHT GRAY (N6), SOFT, MODERATE WEATHERING.	36.3 Fracture = 3
									SHALE, MEDIUM BLUISH GRAY (5B 5\1), TRACE IRREGULAR BEDDING PLANES, SOFT.	37.3 Fracture = 2
3	NQ	39.8	49.8		9.8	67	40		**SAME AS ABOVE**	39.8 Fracture = 6
									SAME, WITH MODERATE BROWN (5YR 3\4) BEDDING PLANES, MEDIUM TO HIGHLY FRACTURED, MODERATE WEATHERING.	42.5 Fracture = 8
									SHALE, MEDIUM BLUISH GRAY 5Y 5\2), SLIGHT TO MODERATE WEATHERED	
							45		**CLAY SHALE**, PALE BROWN (5YR 5/2), TO DARK YELLOWISH BROWN (10YR 4/2) AND	44.6 numerous fractures.

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **3** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										LIGHT OLIVE GRAY (5YR 4/2), SOFT, SOME IRREGULAR BEDDING PLANES		
4	NQ	49.8	56.5		4.7	54	50					
												51.0 Regained drill water
							55					
5	NQ	56.5	59.8		2.55	50				**SAME EXCEPT VERY SOFT**		56.5 Fracture = 7
6	NQ	59.8	67.3		7.5	96	60			**CLAYEY SILT**, DARK YELLOWISH BROWN (10yr 4\2), MOIST - WET		
										SAME, VERY WEATHERED, SOFT		
										CLAY SHALE, PALE BROWN (5YR 5\2), SLIGHTLY WEATHERED		
							65					
										SAME, SOME MODERATELY WEATHERED, SOFT		
7	NQ	67.3	69.8		2.5	40				**SAME**, VERY WEATHERED, VERY SOFT		
										SAME, MODERATELY WEATHERED, SOFT		68.0 Fracture = 5
										SHALE, MEDIUM GRAY (N5), SOFT.		
8	NQ	69.8	78.8		6.8	64	70			**SAME**		
										CLAY SHALE, PALE BROWN (YR 5\2) AND		71.6 Fracture = 12

Continued Next Page

JOB NUMBER
COMPANY
PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **4** OF **5**
BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM GRAY (N5), MODERATELY WEATHERED, SOFT.		
							75					
9	NQ	78.8	79.8		1.0	40				**SHALE**, PALE BROWN (5YR 5\2) AND LIGHT OLIVE GRAY (5Y 5\2), IRREGULAR BEDDING, WEATHERED, SOFT.		78.8 numerous fracture.
10	NQ	79.8	87.8		6.3	48	80			**SAME**, SOME SEDIMENT FILLED FRACTURES		
							85					86.0 Top of seal.
11	NQ	87.8	89.8		2.0	75				**SHALE**, GRAYISH OLIVE (10 YR 4\2) AND MODERATE BROWN (5YR 3\4), INTERBEDDED LAYERS, SOFT, SLIGHTLY WEATHERED.		
12	NQ	89.8	90.8		.75	0	90			**SAME**, EXCEPT WEATHERED		
13	NQ	90.8	99.8		9.0	100				**SHALE**, MEDIUM BLUISH GRAY (5B 5\1), WITH SOME INTERBEDDED BROWNISH GRAY (5YR 4\1) COLOR, SLIGHTLY WEATHERED, SOFT		91.0 Top sand.
							95					

Continued Next Page

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

AEP

JOB NUMBER ______

COMPANY ______

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **5** OF **5**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
14	NQ	99.8	100.3		.25	0	100			**SAME**, EXCEPT WEATHERED		Lost water return on run #14.
15	NQ	100.3	109.8		9.5	95				**SHALE**, MEDIUM BLUISH GRAY 5B 5\1), SLIGHTLY WEATHERED, SOFT		101.6 Top of screen.
										SANDSTONE, MEDIUM BLUISH GRAY (5B 5\1), SLIGHTLY WEATHERED AT 104', SOFT.		
							105					
16	NQ	109.8	114.8		4.4	40	110			**SAME**, SOFT		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), SOFT.		111.0 Bottom of screen.
										SHALE, MEDIUM DARK GRAY, SOFT, WEATHERED, VERY FRACTURED.		112.0 Fracture = 7 112.1 Bottom of sand.
										CLAY SHALE, GRAYISH BROWN (5YB 3\2), WEATHERED, SOFT TO VERY SOFT, FRACTURED.		
										114.8 BOTTOM OF HOLE		114.7 Bottom of seal.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

MONITORING WELL CONSTRUCTION

JOB NUMBER

COMPANY

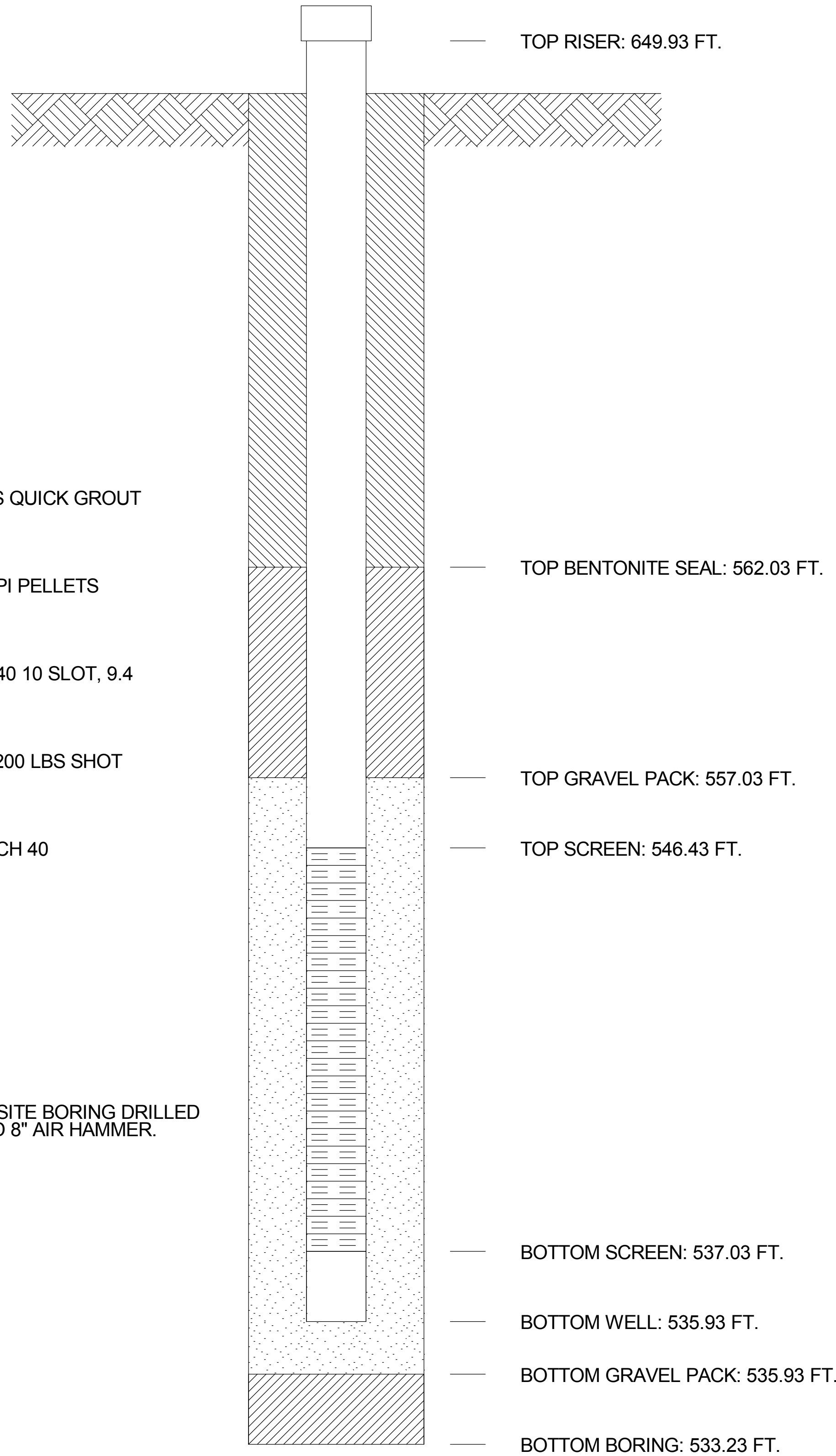
WELL No. **MW-5** BORING No. **D=MW-05** INSTALLED **7/26/95**

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 531,282.0 E 1,724,360.0**

SYSTEM **STATE PLANE**

GROUND ELEVATION 648.03 FT.



GROUT SEAL: 600 GALLONS QUICK GROUT

BENTONITE SEAL: 100 LBS PI PELLETS

SCREEN: 2.0 dia., PVC SCH 40 10 SLOT, 9.4

GRAVEL PACK: 500 LBS #5 200 LBS SHOT

RISER PIPE: 2.0, dia., PVC SCH 40

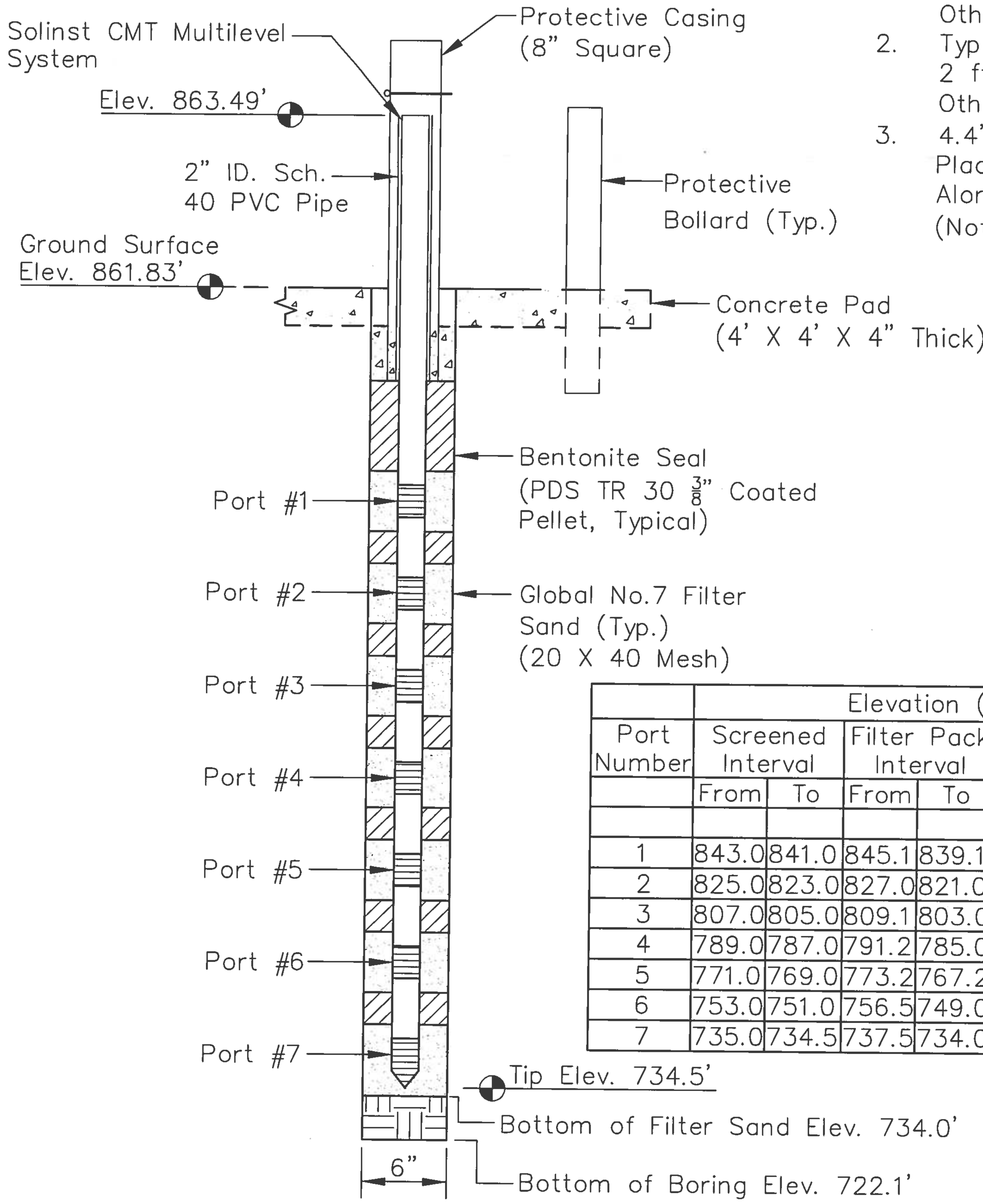
SPACERS, DEPTH:

FLY ASH DAM CLUSTERED SITE BORING DRILLED
USING 10" CASING AND 8" AIR HAMMER.

GEOMCNST EPRI_AMOS.GPJ AEP.GDT 6/14/13

NOTES:

1. All Units Are in Feet Unless Noted Otherwise.
2. Typical Port Length is 2 ft. Unless Noted Otherwise.
3. 4.4" Dia. Centralizers Placed at 10ft. Spacing Along Well Tubing (Not Shown).



Port Number	Elevation (ft.) Screened Interval From	Screened Interval To	Filter Pack Interval From	Filter Pack Interval To	Bentonite Seal Interval From	Bentonite Seal Interval To
					861.5	845.1
1	843.0	841.0	845.1	839.1	839.1	827.0
2	825.0	823.0	827.0	821.0	821.0	809.1
3	807.0	805.0	809.1	803.0	803.0	791.2
4	789.0	787.0	791.2	785.0	785.0	773.2
5	771.0	769.0	773.2	767.2	767.2	756.5
6	753.0	751.0	756.5	749.0	749.4	737.5
7	735.0	734.5	737.5	734.0		

PLOT DATE: 04/27/2012 USER: JENNINGS, MATTHEW
U:\1756\175661014\ENVIRONMENTAL\DRAWING\SHEET_FILES\MONITORING WELLS\STN-12-4-WELL-LOG.DWG

LOCATION:

Northing: 531,882.29
Easting: 1,726,127.18
Ground Elevation: 861.83'
Installation Date: 3/8/12
Horizontal Datum: NAD 83 WV. South
Vertical Datum: NAVD 88

PIEZOMETER DETAIL
AEP AMOS POWER PLANT, FLY ASH DAM COMPLEX
STN-12-4, WEST VIRGINIA WELL ID WV00054-0003-12

Stantec

Stantec Consulting Services Inc.
11687 Lebanon Rd.
Cincinnati, Ohio
45241-2012
513-842-8200
www.stantec.com

DRAWN BY	MSJ	DATE	4/25/12	REVISED		SHEET
CHECKED BY	JMM	PROJ. NO.	175661014	1.	3.	1 OF 1
CHECKED BY	JSD	SCALE	NTS	2.	4.	

Alternative Source Demonstration Report for Calcium, Chloride and Sulfate

John E. Amos Plant Fly Ash Pond
Winfield, West Virginia

Prepared for:

American Electric Power

Prepared by:

EHS Support LLC and EnviroProbe Integrated Solutions, Inc.

June 2020

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Acronyms

amsl	above mean sea level
ASD	alternative source demonstration
bgs	below ground surface
Ca	calcium
$CaCO_3$	alkalinity
$Ca\text{-}HC0_3$	calcium bicarbonate
$CaS0_4$	gypsum
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
ft	feet
JAFAP	John E. Amos Plant Fly Ash Pond
Mg	manganese
mg/L	milligrams per liter
MSL	mean sea level
NaCl	sodium chloride
$Na\text{-}HC0_3$	sodium bicarbonate
SRF	stress relief fracturing
SSI	statistically significant increases
TDS	total dissolved solids
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey

Certification by Qualified Professional Engineer

I certify that the alternative source demonstration (ASD) conducted and presented within this report is appropriate for evaluating the groundwater monitoring data for the John E. Amos Plant Fly Ash Pond Coal Combustion Residual (CCR) management area associated with the John E. Amos Plant Power Plant located in Winfield. West Virginia. This ASD meets the requirements of the United States Environmental Protection Agency CCR Rule defined at 40 Code of Federal Regulations 257.94(e)(2).

Roderic E. Moore, P.E.
Printed Name of Licensed Professional Engineer

Signature

RODERIC E. MOORE
REGISTERED
16390
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER
RSM
6/25/20

16390	West Virginia	June 25, 2020
License Number	Licensing State	Date

1 Introduction

EHS Support LLC ("EHS Support") was retained by Appalachian Power Company, doing business as American Electric Power (AEP) to conduct an alternative source demonstration (ASD) investigation for coal combustion residual (CCR) constituents at the John E. Amos Plant Fly Ash Pond (JAFAP) located in Putnam County, Winfield, West Virginia (**Appendix A**). EHS Support has teamed with EnviroProbe Integrated Solutions, Inc. of Nitro, West Virginia to complete this ASD investigation per the requirements of the United States Environmental Protection Agency (USEPA) CCR Rule (40 Code of Federal Regulations [CFR] 257.94).

1.1 Objectives

The objective for this ASD investigation is to assess groundwater monitoring data collected in compliance with the CCR Rule as allowed under paragraph 40 CFR 257.94(e)(2) of the CCR Rule. This part of the rule allows AEP to determine whether the source(s) for statistically significant increases (SSIs) reported from groundwater monitoring are associated with the CCR unit, or if the SSIs resulted from an error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. The focus of this JAFAP ASD investigation is specifically on the constituents which demonstrated SSIs at the following two monitoring wells during the November 2019 detection monitoring event (and subsequent February 2020 confirmation sampling event):

- MW-5: Calcium and Sulfate
- MW-1804A: Chloride and Sulfate

1.2 Lines of Evidence

This ASD investigation for the JAFAP has been conducted to evaluate potential alternate sources or reasons for the SSIs of calcium and sulfate in MW-5 and chloride and sulfate in MW-1804A. A potential alternate source is evident, when based on the following lines of evidence:

- Lack of exceedances and increasing trends of primary indicators of CCR
- JAFAP pore water concentrations are lower than those of the corresponding constituent observed in groundwater
- Major ion chemistry does not indicate mixing between JAFAP water and groundwater

For the purposes of this ASD investigation, constituents were identified that would serve as a primary indicator for coal ash leachate. A primary indicator must meet **both** of the following criteria:

- Constituent that typically has high concentration in leachate, relative to background, such that it is expected to have elevated concentration in the event of a release.
- Constituent is not reactive and has high mobility in groundwater such that it is expected to be at the leading edge of the plume, meaning that it will have elevated concentrations relative to background across the entire area of the plume.

As sulfate is a primary indicator for coal ash leachate (Electric Power Research Institute [EPRI], 2012) it has been evaluated in this ASD investigation. Other potential indicators that were evaluated in this ASD investigation include calcium and chloride. Calcium is considered to only have a potential direct association with fly ash leachate and chloride a negligible direct association (EPRI 2017).

2 Project Background

2.1 Site Location and History

The JAFAP is located in Putnam County approximately 1.5 miles southwest of the power plant and approximately 0.5 miles west of Winfield Road (WV 817) (**Appendix A**). The site occupies approximately 170 total acres (Terracon, 2017a).

The JAFAP is in a valley at the headwaters of Little Scary Creek and is surrounded by ridges on most sides (Stantec, 2012). The southwestern corner of the JAFAP consists of an earthen dam that is approximately 220 feet (ft) tall with a crest elevation of 875 ft above mean sea level (amsl). The dam is approximately 30 ft wide and 2,000 ft long.

The JAFAP began receiving fly ash in October 1971. The final of three construction stages for the unlined impoundment was completed in 1978 (EPRI, 1999), and operations continued until 2010. In 2010, the JAFAP reached its maximum capacity, Unit 3 at the power plant had been converted to a dry system, and fly ash was being disposed at the Amos FGD Landfill. As a result, operation of the JAFAP for placement of CCR waste ceased in 2010.

The surface of the JAFAP impoundment is covered with an engineered cover consisting of subgrade fill (fly ash and onsite borrow material), flexible membrane and geotextile layers, and soil/vegetative layers. General construction of the landfill and landfill closure is further detailed in the Phase I, Phase II, and Phase III *Construction Certification Reports* (Terracon, 2016; 2017a; 2017b) and the *Design Basis Report* for the site (Stantec, 2012).

2.2 Site Geology

The site is located in the Appalachian Plateau physiographic province, which is composed of Paleozoic sedimentary sandstones, conglomerates, and shales with locally significant coal beds (Fenneman and Johnson, 1946). To support a review of the site geology as it relates to this ASD investigation, cross sections from the Arcadis U.S., Inc. (“Arcadis”) 2019 Fly Ash Pond CCR Groundwater Monitoring Well Network Evaluation report are provided in **Appendix B**.

The sedimentary rocks in the Appalachian Plateau are largely present as horizontal beds that have been incised by streams to form mountainous terrain. Unconsolidated deposits are virtually absent on ridges surrounding the JAFAP except for a veneer of colluvium (Arcadis, 2019). Unconsolidated deposits are not considered a water-bearing unit on the ridges as groundwater is typically encountered within bedrock (Arcadis, 2019). Arcadis (2019) found that the soil-rock interface on the ridges is abrupt with little to no occurrence of weathered bedrock. Unconsolidated alluvium deposits occur southwest of the JAFAP and dam in the Little Scary Creek where they are 8.5 ft-thick at boring 2008-1 and 43 ft-thick at MW-6. The unconsolidated deposits consist of four zones of alluvium that include an upper surficial gravel zone, a clay zone with discontinuous sand lenses, a sand zone with interbedded clay, and a basal gravel (EPRI, 1999).

Pennsylvanian-age bedrock of the Monongahela Group and Conemaugh Group form the ridges surrounding and the basement directly beneath the site. Whereas both the Monongahela Group and Conemaugh Group are present regionally in West Virginia, Maryland, Pennsylvania, and Ohio, there are local variations in the presence of geologic formations and members of the groups (Trap and Horn, 1997; Sweezy, 2002). Members of the Monongahela Group and Conemaugh Group that are present at the site are described by EPRI (1999) and included on the generalized cross sections presented in **Appendix B** (Arcadis, 2019).

The Monongahela Group consists of cyclic sequences of non-marine sandstone, siltstone, limestone, and coal (Krebs, 1911; Cardwell et al., 1968). The base of the Pittsburgh Coal (i.e. No. 8 Coal) is typically used to mark the transition from the Monongahela to the underlying Conemaugh Group (Cardwell et al., 1968; EPRI, 1999). Consistent with regional studies of northern West Virginia (Krebs and Teets, 1914), the Pittsburgh Coal is not identified in site borings. However, the Pittsburgh Limestone, (the uppermost member of the Casselman Group of the Conemaugh Formation) has been identified in two borings at the JAFAP, MW-3 and 2008-26, and is used to mark the Monongahela-Conemaugh transition at the site. The Monongahela-Conemaugh transition is identified at elevations above about 880 ft amsl, therefore, Monongahela Group rocks are present only at the highest elevations on ridges surrounding the JAFAP.

The Conemaugh Group forms the majority of basement rocks beneath the site. The Conemaugh Group consists of cyclic sequences of marine and non-marine shale, siltstone, sandstone, red beds, impure limestone, and thin non-persistent coal beds. The Conemaugh Group is divided into the Casselman Formation that is separated from the underlying Glenshaw Formation by the top of the Ames Limestone (Cardwell et al., 1968). The Ames Limestone has not been identified in site borings or wells, therefore only the Casselman Formation of the Conemaugh Group is identified at the JAFAP (EPRI, 1999). Several coal horizons present in the region serve as marker beds for unit identification (Fonner et al., 1981). The Little Clarksburg Coal has been identified at JAFAP boring B-0608 to the northeast of the JAFAP and is used to mark the base of the Lower Connellsville Sandstone member of the Conemaugh Group. The Elk Lick Coal has been identified at JAFAP borings MW-1802, MW-1803, and MW-1805 and is used to mark the base of the Morgantown Sandstone and top of the Birmingham Red Shale members of the Conemaugh Group.

Studies of bedrock geologic structure by Arcadis (2019), suggest that bedrock in the vicinity of the site strikes primarily north-northeast and dips to the west-northwest. Fractures or joints within the sandstone are near vertical and strike east-northeast. The formation of subvertical fractures in Appalachian Plateau Valleys are attributed to reduced lithostatic stress following erosion and valley formation (Wyrick and Borchers, 1981; Sheets and Kozar, 2000). The stress relief fracturing (SRF) process provides secondary porosity that controls groundwater flow in shallow bedrock in the Appalachian Plateau (Wyrick and Borchers, 1981; Sheets and Kozar, 2000). SRF is more pronounced in resistant lithologic units (e.g. sandstone and limestone) than shale units. As a result, groundwater flow in shallow bedrock is largely controlled by fracture interconnectivity and to a lesser extent by lithologic variations. A conceptual model of shallow groundwater flow in Appalachian Plateau bedrock aquifers by Sheets and Kozar (2000) is provided as **Figure 2-1**.

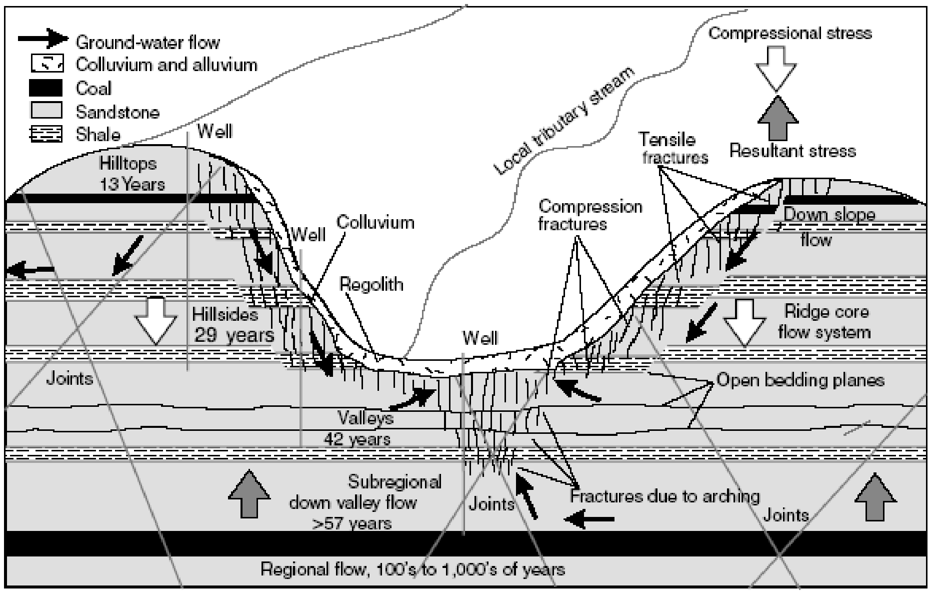

Figure 2-1 Conceptual model of groundwater flow in Appalachian Plateau fractured bedrock aquifers (Sheets and Kozar, 2000). The stress relief fracture (SRF) system is termed "tensile fractures".

2.3 Regional Groundwater Geochemistry

Appalachian Plateau groundwater geochemistry, including the JAFAP site area in West Virginia, is established through several regional studies (Piper, 1933, Trap and Horn, 1997; Warner et al., 2012; Siegel et al., 2015). A generalized model of the regional groundwater geochemistry is summarized in **Figure 2-2** (Siegel et al., 2015).

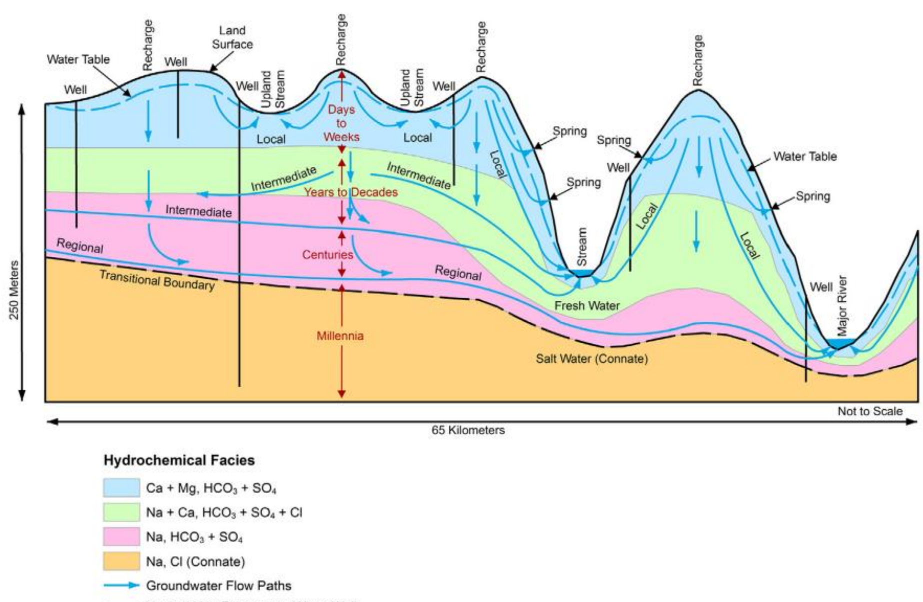

Figure 2-2 Generalized Model of the Regional Groundwater Geochemistry (Siegel et al., 2015)

Groundwater recharge generally occurs on hill tops and circulates along hill slopes to shallow depths in Appalachian Plateau sedimentary bedrock aquifers. Saline (connate) water is frequently encountered beneath a thin (a few ft) transitional mixing zone with the overlying "fresh" (low total dissolved solids [TDS]) water (Trap and Horn, 1997; Siegel et al., 2015). The chemistry of groundwater in recharge areas on hilltops is characterized by low TDS calcium bicarbonate (Ca-HCO_3-type) water, that evolves to low TDS sodium bicarbonate (Na-HCO_3-type) groundwater as groundwater percolates down slopes owing to calcium (Ca) and manganese (Mg) ion exchange with sodium (Na) in Na-bearing clay minerals. Saline sodium chloride (NaCl-type) high TDS waters are naturally occurring connate brines that are found in "restricted flow zones" where recharge waters do not flush the host lithology (Siegel et al., 2015). The NaCl-type water is further characterized by low to non-detectable sulfate, due to reducing conditions that promote sulfide as the predominant sulfur species. Differences in the major ion chemistry of Appalachian Plateau waters are illustrated on the Piper diagram in **Figure 2-3**.

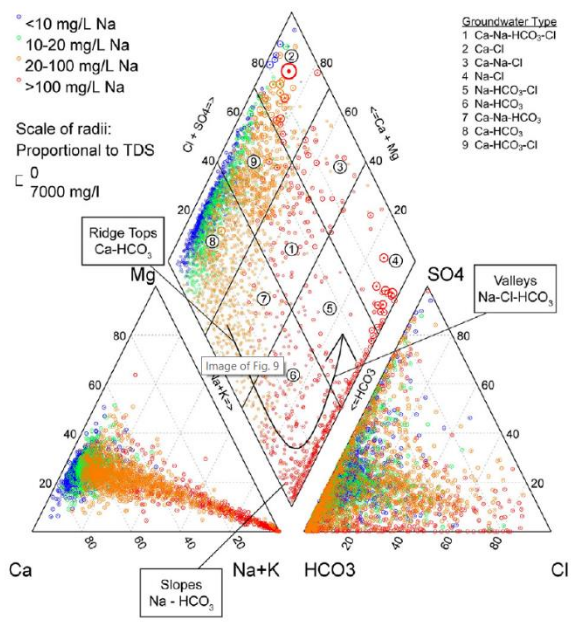

Figure 2-3 Generalized Groundwater Major Ion Chemistry within the Appalachian Plateau (Siegel et al., 2015).

Regionally in the Appalachian Plateau, NaCl-type water is typically encountered at low elevations in valley centers at approximately 100 ft beneath the level of the nearest major stream (Trap and Horn, 1997; Warner et al., 2012; Siegel et al., 2015). In West Virginia, NaCl-type groundwater is frequently encountered at even shallower depths beneath streams in valley bottoms owing to the overall lower topographic elevation and associated lower potential groundwater head available to depress underlying saline water (Siegel et al., 2015).

An additional control on regional groundwater chemistry is the occurrence of natural coal intervals and laminations within bedrock formations. Where coal occurs, oxygenated groundwater leads to oxidation of sulfide minerals (principally the iron sulfide pyrite) in the coal, which leads to elevated concentrations of iron and sulfate in groundwater (Siegel et al., 2015).

2.4 Groundwater Monitoring Network Evaluation

2.4.1 Monitoring Network Details

The groundwater monitoring network in the uppermost aquifer associated with the JAFAP was assessed on behalf of AEP by Arcadis (2019). Arcadis determined that an interconnected water-bearing system (the uppermost shallow aquifer) composed of Pennsylvanian-aged Upper Connellsville Sandstone bedrock combined with the saturated portion of the SRF system laterally surrounds the JAFAP. The SRF system is independent of lithology and is suggested to provide a hydraulic connection between bedrock on the ridge and in the valley.

The uppermost water-bearing aquifer was evaluated in accordance with 40 CFR 257.91, which resulted in additional well installations and redevelopment of existing wells (Arcadis, 2019). The existing groundwater monitoring network consists of 14 groundwater monitoring wells used for water quality sampling to provide detection monitoring in the uppermost shallow aquifer (Upper Connellsville and SRF):

- Six monitoring wells screened in Upper Connellsville Sandstone/SRF (MW-1801A, MW-1804A, MW-1806A, MW-7, MW-8, and MW-9)
- Eight monitoring wells screened in the SRF only (MW-1, MW-2, MW-5, MW-6, MW-1807A, MW-1808A, MW-1809A and MW-1810A)

Four of the network monitoring wells (MW-1807A, MW-1808A, MW-1809A, and MW-1810A) are installed upgradient of the JAFAP to support background monitoring. The remaining ten monitoring wells (MW-1, MW-2, MW-5, MW-6, MW-1801A, MW-1804A, MW-1806A, MW-7, MW-8, and MW-9) are located downgradient of the JAFAP and used for compliance monitoring.

The details of each groundwater monitoring location used for water quality sampling are summarized in **Table 1** and the location of the monitoring wells within the uppermost aquifer is shown on Figure 3 (Arcadis 2019) in **Appendix A**.

Arcadis (2019) determined that the groundwater monitoring well network described above meets the requirements of 40 CFR §257.91, as it consists of a sufficient number of wells installed at the appropriate locations and depths to yield groundwater samples from the uppermost shallow aquifer that accurately represent the quality of background groundwater and groundwater passing the waste boundary of the JAFAP.

2.4.2 ASD Investigation Monitoring Wells

MW-5 and MW-1804A were the two monitoring wells with constituents that showed a SSI in November 2019 groundwater monitoring data which was then confirmed in a verification sampling event in February 2020. The details of these specific monitoring wells are provided in the following sections to support the ASD investigation.

2.4.2.1 MW-5

MW-5 is installed near the base of the incised valley of Little Scary Creek where the ground surface (648.03 ft amsl) and piezometric surface are within the Morgantown Sandstone and stratigraphically lower than the base of the JAFAP. In deepening stratigraphic succession, the 114.8-foot boring intercepted approximately 23 ft of predominantly clay unconsolidated deposits, 11 ft of Morgantown Sandstone, 69.5 ft of variably weathered Birmingham Shale (shale and clay shale), 7 ft of sandstone (Interpreted as Grafton Sandstone) before terminating within approximately 4 ft of shale (See MW-5 boring log in **Appendix C** and cross section A-A' [Arcadis 2019] in **Appendix B**). The MW-5 sand pack and screen extends over the Grafton Sandstone and includes several ft of the over- and under-lying shale. The following lines of evidence indicate that groundwater in MW-5 includes a component of deep brine:

- MW-5 is located at the base of the Little Scary Creek stream valley and is screened at a lower elevation (546.43 to 537.03 ft amsl) than all other site wells.
- MW-5 screen is set at 101.6 to 111.0 ft below ground surface (bgs), which is approximately 100 ft lower in elevation than the adjacent Little Scary Creek bed, corresponding to the depth beneath Appalachian Plateau streams where NaCl-type connate water is typically encountered in the Appalachian Plateau.
- The screen for MW-5 is vertically lower and laterally distal to the base of the JAFAP. According to the SRF model, groundwater from the JAFAP would migrate through coal-bearing strata (specifically the Elk Lick Coal within Birmingham Shale) prior to entering the screened interval for MW-5 with concomitant geochemical effects on groundwater composition. We do not see the expected effects on groundwater composition, indicating JAFAP water has not reached MW-5.
- TDS values for MW-5 historically exceed values in the JAFAP by nearly an order of magnitude (AEP, 2020). Additionally, sulfate is historically near or below the laboratory reporting limit in MW-5. The geochemistry of MW-5 historically corresponds with the composition of Appalachian Plateau NaCl-type connate water.
- The NaCl-type groundwater in MW-5 is distinct from the Na-HCO_3-type water typically encountered in site wells screened in the SRF at higher elevations and located on the hilltops surrounding the site, and is distinct from porewater in the JAFAP (**Section 4**). The exception is MW-2, the only site well that is also at the base of Little Scary Creek alluvial valley and is screened at a similar elevation (549.10 to 540.20).
- During packer testing, MW-5 did not accept flow with up to 100 pounds per square inch pressure (Arcadis, 2019), indicating the presence of low permeability units typical of those that are not regularly flushed with groundwater and that may host NaCl connate waters.
- Wells co-located with MW-5, MW-6 (screen = 619.00 to 614.00 ft amsl) and MW-1 (screen = 606.47 to 597.57 ft amsl), are screened at higher elevations and exhibit lower TDS and a $NaHCO_3$-type water, which is expected with the fresher shallower groundwater versus the deeper connate (brine) groundwater.

2.4.2.2 MW-1804A

MW-1804A is installed on the inside edge of the northern JAFAP berm where the ground surface (858.53 ft amsl) and piezometric surface are stratigraphically within the Pittsburgh Sandstone/Conemaugh Shale members of the upper interval of the Conemaugh Formation. In deepening stratigraphic succession, the boring for MW-1804A intercepted approximately 14 ft of overburden, 16 ft of interbedded sandstone and shale (Pittsburgh Sandstone/Conemaugh Shale), approximately 15 ft of upper Connellsville Sandstone, before terminating within approximately 4 ft of shale. The MW-1804A sand pack and screen extends across the Conemaugh Shale, Upper Connellsville Sandstone, and an unnamed shale/siltstone unit (See boring log in **Appendix C** and cross section B-B' [Arcadis 2019] in **Appendix B**). The following places MW-1804A in the context of the groundwater monitoring network:

- MW-1804A is primarily screened over the Upper Connellsville Sandstone, similar to wells MW-7, MW-8, MW-9, MW-1801A, and MW-1806A (as presented in **Table 1**).
- MW-1806A provides a convenient comparison for potential groundwater compositional variations in MW-1804A, as it is the only other site well with a sand pack that extends across the same combination of units (substantial interval of the Conemaugh Shale and the Upper Connellsville Sandstone and an unnamed shale/siltstone unit).

2.5 JAFAP Porewater Piezometer

AEP installed a multi-level port piezometer (STN-12-4) within the JAFAP to evaluate fly ash porewater. This multi-port piezometer has seven screened intervals, as detailed in the boring log (Stantec, 2012) provided in **Appendix C**.

Fly ash porewater was sampled during five events: September 28, 2017, December 11, 2017, November 16, 2018, March 12, 2019, and November 11, 2019. Water quality results for CCR constituents in the fly ash, with the geometric mean of each constituent over the seven interval ports, are presented in **Table 2**. These data will be used in this ASD investigation to represent the JAFAP porewater when comparing to CCR constituent concentrations in the monitoring well network. It should be noted that based on the multi-port screen elevations, multi-port intervals 1 and 2, with a filter pack elevation range from 845.1 amsl to 821 amsl are the only intervals at higher elevations than the well screen and sand pack for MW-1804A.

2.6 Groundwater Monitoring

AEP has conducted groundwater monitoring of the uppermost aquifer to meet the requirements of the CCR Rules. These monitoring activities generally included the following activities:

- Collection of groundwater samples and analysis for Appendix III and Appendix IV constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan* (AEP, 2019)
- Completion of validation tests for groundwater data, including tests for completeness, valid values, transcription errors, and consistent units
- Establishment of background values for each Appendix III and Appendix IV constituent (eight sampling events conducted over a seven-month period between July 25, 2018 and February 18, 2019) (AEP, 2020)
- Evaluation of the groundwater data using a statistical process in accordance with 40 CFR 257.93, which was prepared and certified in April 2019 in AEP's *Statistical Analysis Plan* (Geosyntec, 2019), and most recently posted to AEP's CCR website in May 2019. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance", USEPA, 2009).
- Completion of the initial detection monitoring sampling event (March 2019), which resulted in no SSIs of Appendix III parameters

- Completion of a second detection monitoring event (November 2019), which resulted in potential SSIs for Appendix III parameters in MW-2 (calcium), MW-5 (calcium and sulfate), MW-7 (calcium), and MW-1804A (chloride and sulfate)
- Completion of confirmation sampling (February 2020) for constituents identified as potentially exhibiting SSIs per AEP's *Statistical Methods Selection Certification* (AEP, 2019), which confirmed SSI's for Appendix III parameters at MW-5 (calcium and sulfate) and MW-1804A (chloride and sulfate)

A table summarizing monitoring data for key wells analyzed during this ASD investigation, including the background sampling events through the November 2019 monitoring event, and the February 2020 verification sampling event is included in **Table 3**.

3 Alternative Source Demonstration Assessment

As identified in **Section 1.1**, SSIs in the concentration of calcium and sulfate in MW-5 and chloride and sulfate in MW-1804A have been reported for the November 2019 detection monitoring event.

Per the CCR Rule at 40 CFR 257.94(e)(2), "The owner or operator may demonstrate that a source other than the CCR unit caused the SSI over background levels for a constituent or that the SSI 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 SSI over background levels to include obtaining a certification from a qualified professional engineer verifying the accuracy of the information in the report."

EPRI (2017) guidelines for developing an ASD indicates potential causes that support the ASD may include, but are not limited to:

1. sampling causes (ASD Type I),
2. laboratory causes (ASD Type II),
3. statistical evaluation causes (Type III) and/or
4. natural variation causes (Type IV).

This ASD investigation for the JAFAP will be focused on assessing whether Type I, Type III and/or Type IV causes could be the reason for SSIs for calcium and sulfate in MW-5 and chloride and sulfate in MW-1804A**.**

EPRI (2012) describes three tiers of investigation for evaluation of water quality signatures to determine if elevated concentrations represent a release from a CCR facility. Conversely, these tools can also be used to evaluate whether or not sources other than CCR are contributing to groundwater quality degradation. The three tiers defined by EPRI (2012) are:

- Tier I: Trend Analysis and Statistics (**Section 3.1** and **Section 3.2**)
- Tier II: Advanced Geochemical Evaluation Methods (**Section 3.1**, **Section 3.3** and **3.4**)
- Tier III: Isotopic Analyses (not conducted as part of this ASD)

These assessments are presented in the following sections. Additionally, an analysis of potential variation due to sampling techniques (ASD Type I) is included in **Section 3.5** and statistical evaluations (ASD Type III) is included in **Section 3.6**.

3.1 Groundwater Data Analysis

3.1.1 Site Groundwater Sources

Total dissolved solids measurements provide a robust means to distinguish groundwater with a connate brine and/or low TDS precipitation source. Consistent with a brine origin, historical TDS data for MW-2, MW-5 and MW-8 are notably elevated (almost by an order of magnitude in MW-5) compared with other site wells that produce sodium/calcium bicarbonate-type waters (**Figure 3-1**). TDS in the majority of Site wells is below about 600 to 650 milligrams per Liter (mg/L), in comparison to a range of 174 to 840 mg/L (geometric mean 465 mg/L) for JAFAP porewater measured in all seven ports of STN-12-4 between

September 2017 and November 2019. Clearly, the TDS data (coupled with historical boron, fluoride, and chloride systematics for these wells) rule out JAFAP porewater as the origin of the high TDS measurements in MW-2, MW-5 and MW8. Whereas a connate brine component is expected for MW-2 and MW-5 based on the location of the wells at the base of the Little Scary Creek valley and deep (>100 feet bgs) well screen/sand pack depths (**Section 2.3**), MW-8 is situated on a ridge with a sand pack/screen interval over a higher elevation (sand pack from 797 to 821.21 ft amsl in MW-8 compared to 534.20 to 560.50 and 535.93 and 557.03 ft amsl in MW-2 and MW-5, respectively; **Table 1**). As discussed by Siegel et al., (2015), connate brine is periodically encountered along ridgelines in formations with low throughput of groundwater in the Appalachian Plateau of West Virginia, thus, MW-8 conceivably also contains a brine component.

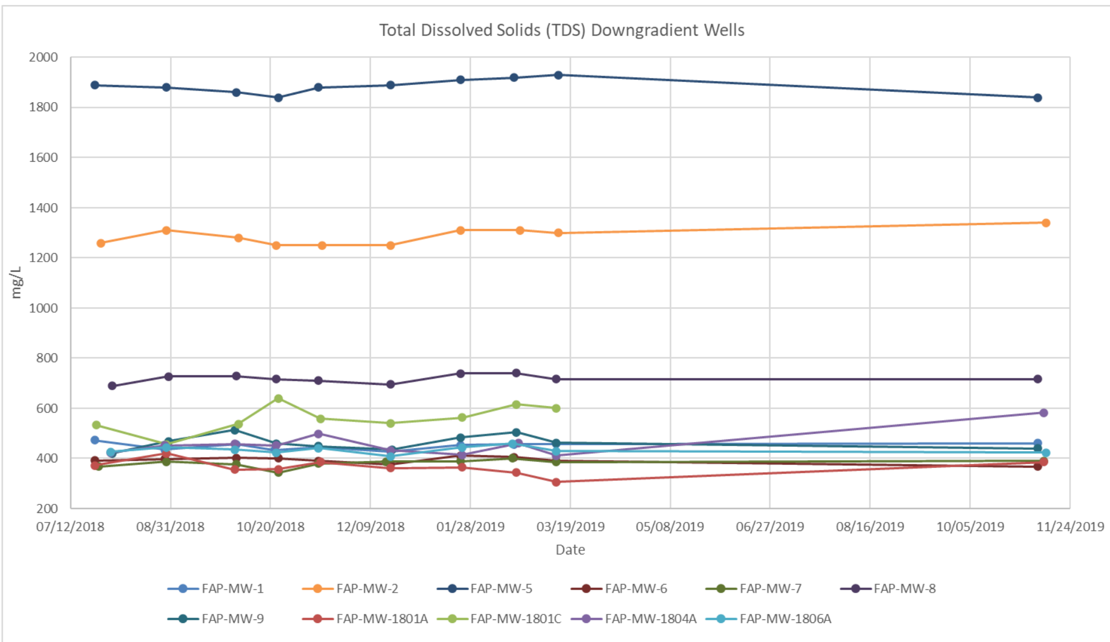

Figure 3-1 Total Dissolved Solids in Downgradient Monitoring Wells

The comparison of pH between groundwater in MW-5, MW-1804A and JAFAP porewater is provided in **Figure 3-2**. This shows that the pH increases as water moves from the porewater into the shallow water represented by MW-1804A and increases even further in MW-5 groundwater. This increasing pH trend outside of the JAFAP, demonstrates the influence of the various hydrogeologic formations represented by MW-1804A and MW-5, as well as potential mixing of groundwater across these formations during sampling events where the pH lines for these monitoring wells cross.

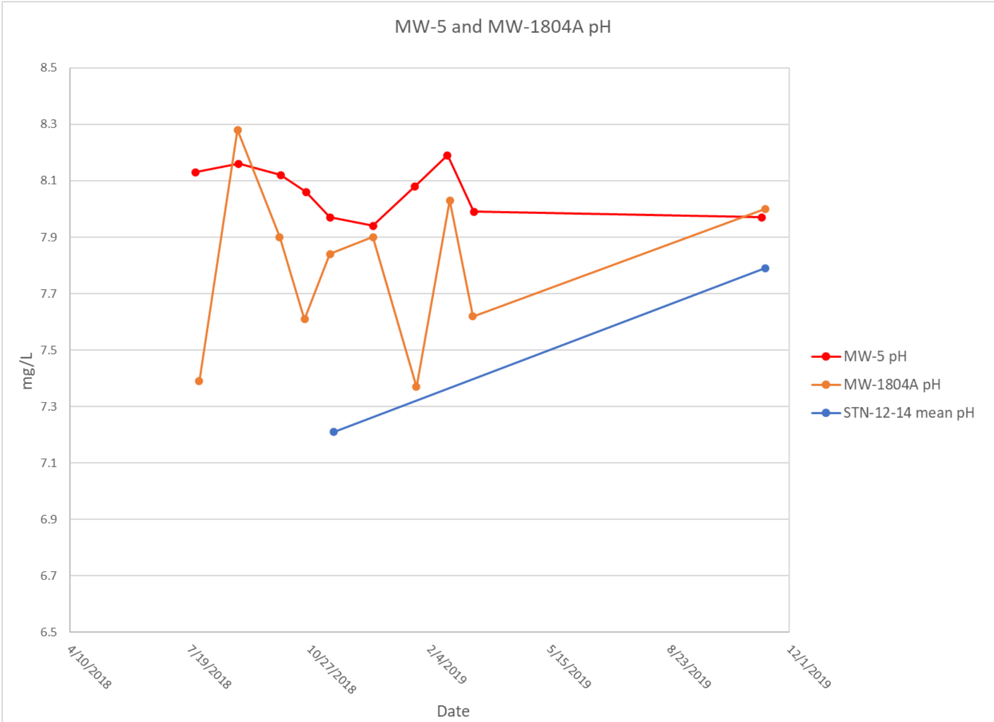

Figure 3-2 MW-5 and MW-1804A pH values

3.1.2 MW-5 Evaluation

A temporal plot for the primary indicator sulfate reported in groundwater monitoring well MW-5 is presented in **Figure 3-3**, and a temporal plot for the elevated ASD constituent calcium is presented in **Figure 3-4**. Data for the geometrical mean of JAFAP porewater (**Table 2**) is provided for comparison.

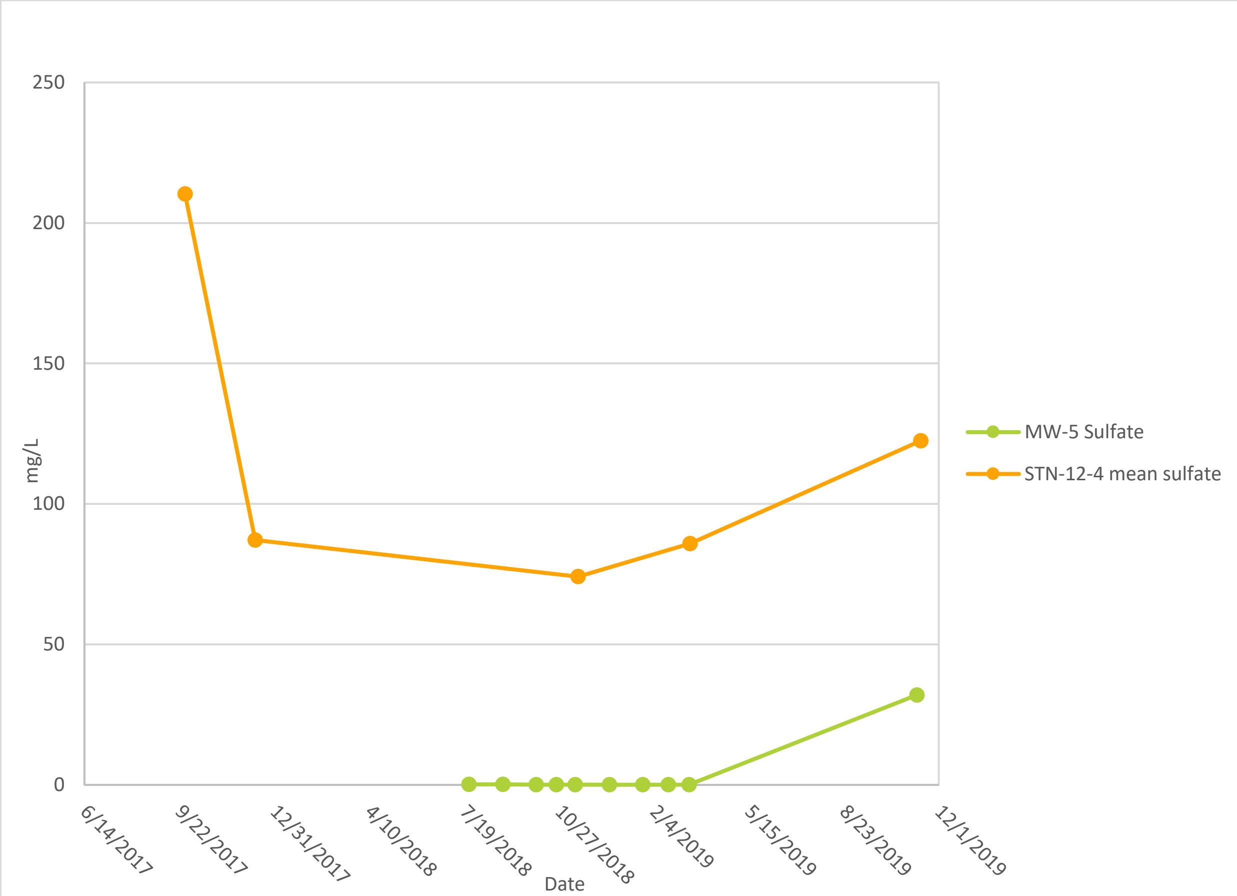

Figure 3-3 MW-5 Sulfate Concentrations

Sulfate concentrations in MW-5 have remained relatively constant up until the last groundwater monitoring event in November 2019 (geometric mean = 0.1 mg SO_4/L). Sulfate concentrations measured in November 2019 were approximately two orders of magnitude higher (32 mg/L) than those reported historically. Comparing the concentrations in MW-5 groundwater to the JAFAP, sulfate concentrations in groundwater are 100 times lower than the concentrations reported in the JAFAP porewater. Sulfate is typically absent or at low concentrations in Appalachian Plateau connate brines due to overall reducing conditions that favor sulfide (Siegel et al., 2015). In contrast, sulfate is present at higher concentrations in oxygenated groundwater sourced from more recent precipitation, particularly following interaction with pyrite, which is documented in the Birmingham Shale and Grafton Sandstone rock matrix in the logs for MW-1802C, MW-1803C, MW-1805C that are within and directly overlying the sand pack interval for MW-5.

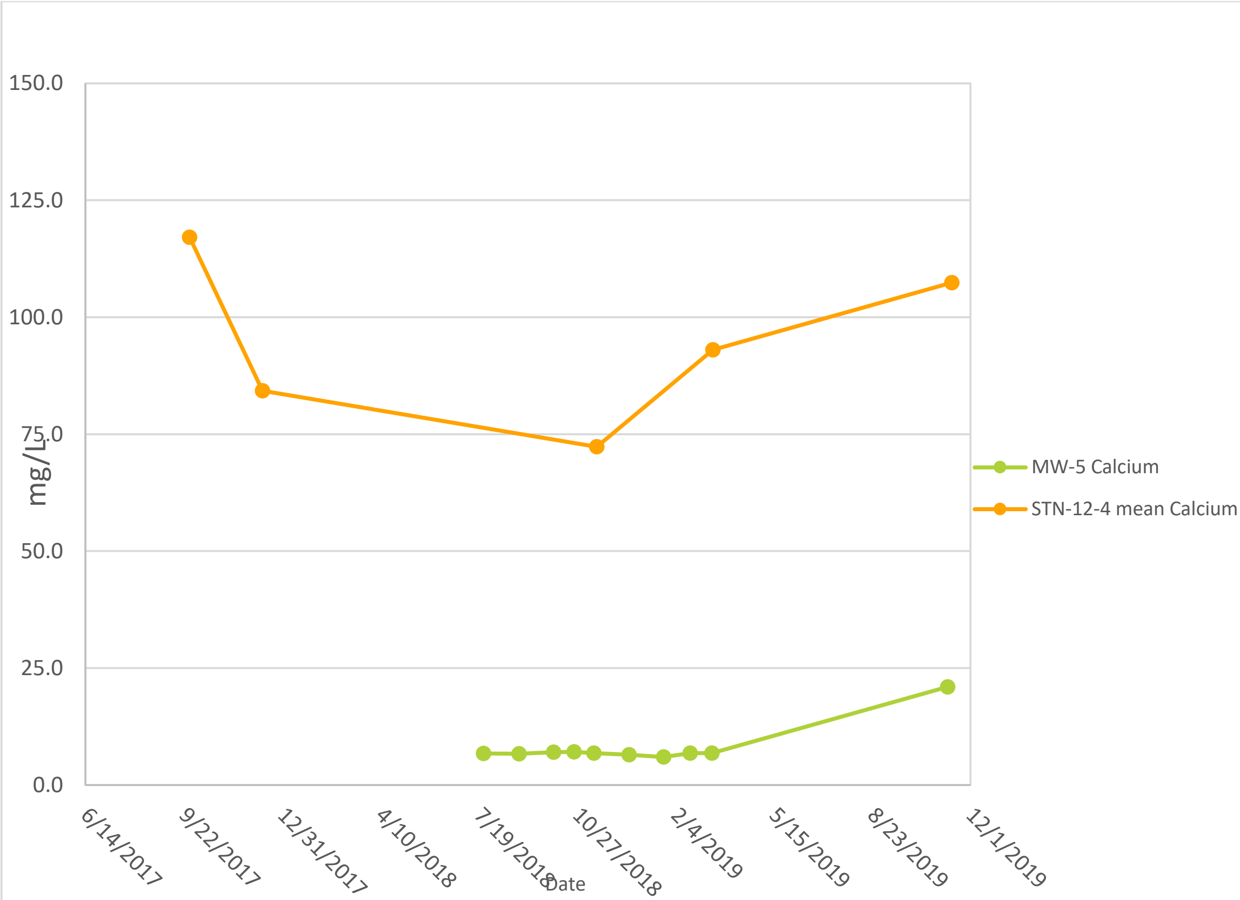

Figure 3-4 MW-5 Calcium Concentrations

Calcium concentrations in MW-5 have remained relatively constant up until the November 2019 groundwater monitoring event (geometric mean = 6.7 mg Ca/L). In November 2019, groundwater sampled from MW-5 reported a calcium concentration of 21 mg/L, approximately three times higher than previous sampling events, but this concentration of calcium in MW-5 is approximately 20 times lower than the concentrations reported in the JAFAP porewater (**Figure 3-4**). The sodium concentration reported from groundwater at this location was approximately 100 mg/L lower than previous sampling events. The relative changes in calcium and sodium suggests mixing between different groundwater types with distinct aqueous Ca/Na ratios set through ion exchange reactions with distinctive rock types or secondary minerals within formations.

The increase in dissolved calcium and sulfate may be attributed to a change in the proportion of mixing between sodium chloride and sodium bicarbonate water types; with the November 2019 result reflecting a higher proportion of more Ca- and SO_4-rich, low TDS sodium bicarbonate water type. Groundwater in the vicinity of MW-5 is identified as a sodium chloride water type (further discussed in **Section 3.1.1**) and the elevation of the screened section of MW-5 is very close to the expected mixing interface between sodium bicarbonate and sodium chloride (connate brine) water types, as discussed in **Section 2.3**. External influences such as pumping rates or intense and extended rainfall events can perturb the transition between the connate aquifer and the overlying sodium bicarbonate aquifer.

Boron, another primary indicator, has historically fluctuated in MW-5 between 0.22 to 0.32 mg/L, whereas the November 2019 concentration was notably lower at 0.18 mg/L (**Figure 3-5**). Boron is typically elevated in groundwater that has contacted aquifer rock for extended periods of time or that has experienced elevated temperatures; therefore, elevated boron in connate brine is expected. The observation of decreased boron during the November 2019 sampling event supports dilution by a younger sodium bicarbonate water type in MW-5.

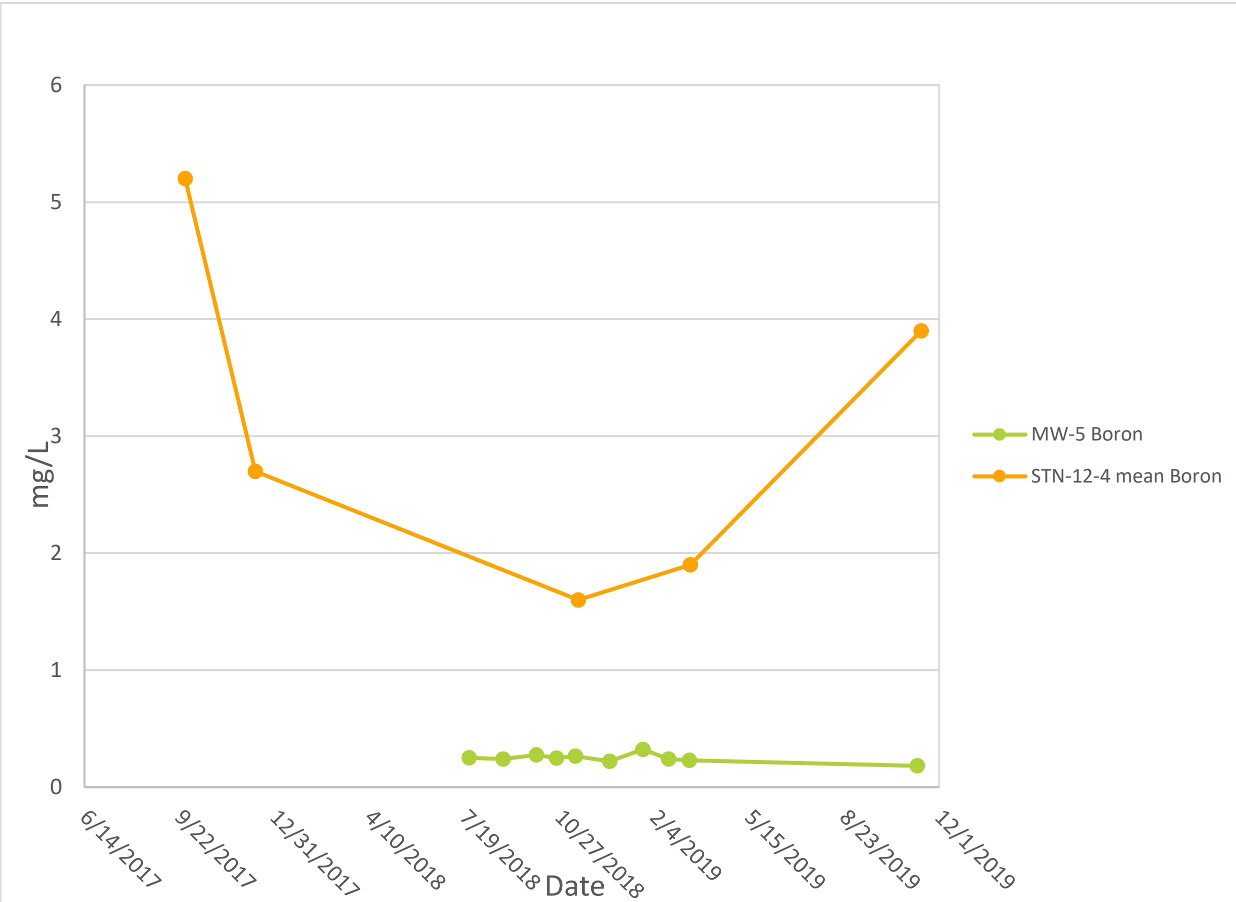

Figure 3-5 MW-5 Boron Concentrations

Temporal plots for potential indicators bromide, fluoride, molybdenum, potassium, and sodium reported in groundwater monitoring well MW-5 are provided in **Figure 3-6** to **Figure 3-10**, respectively, with geometrical mean data for the JAFAP porewater presented for comparison. Molybdenum and potassium are present in groundwater at concentrations below the concentrations within the JAFAP for MW-5. For MW-5, bromide, fluoride and sodium concentrations in groundwater are elevated in comparison to the JAFAP.

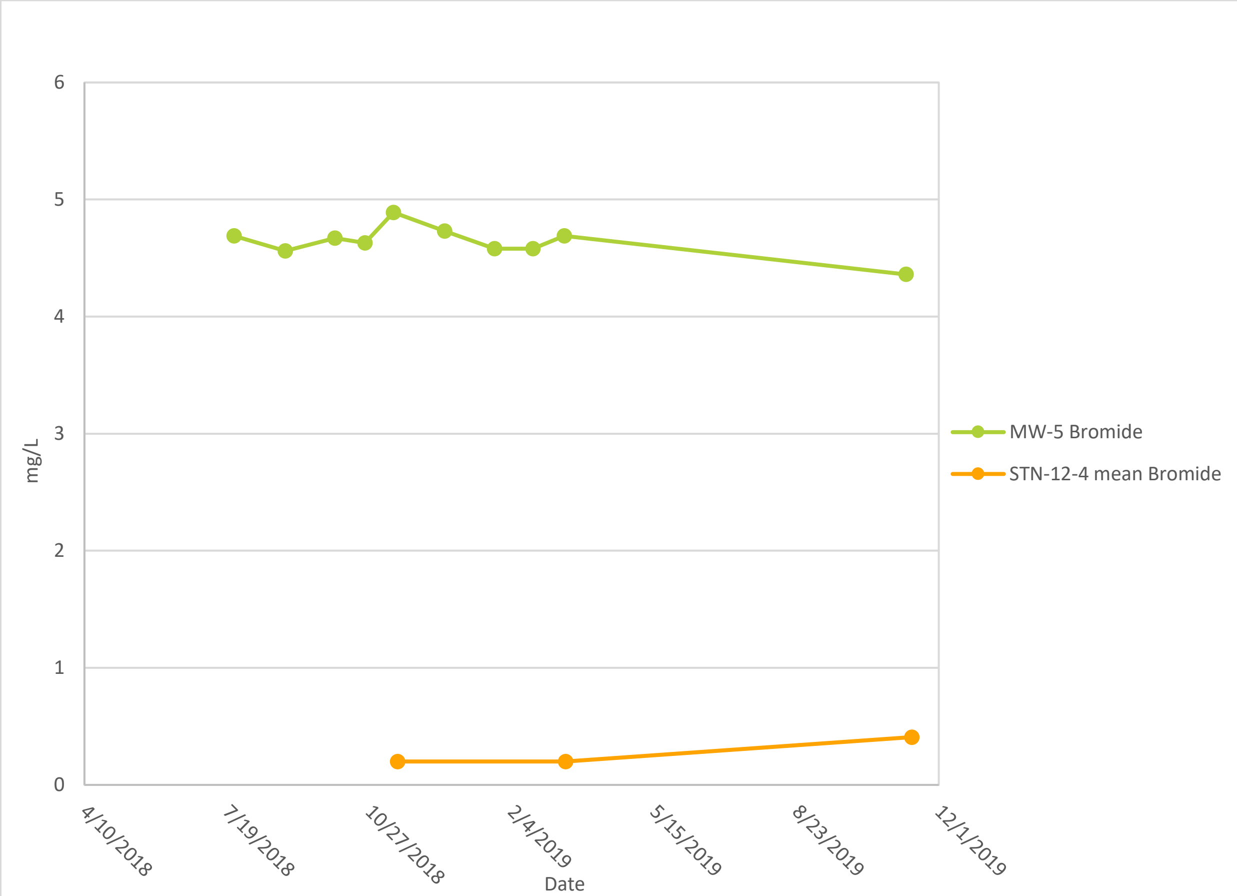

Figure 3-6 MW-5 Bromide Concentrations

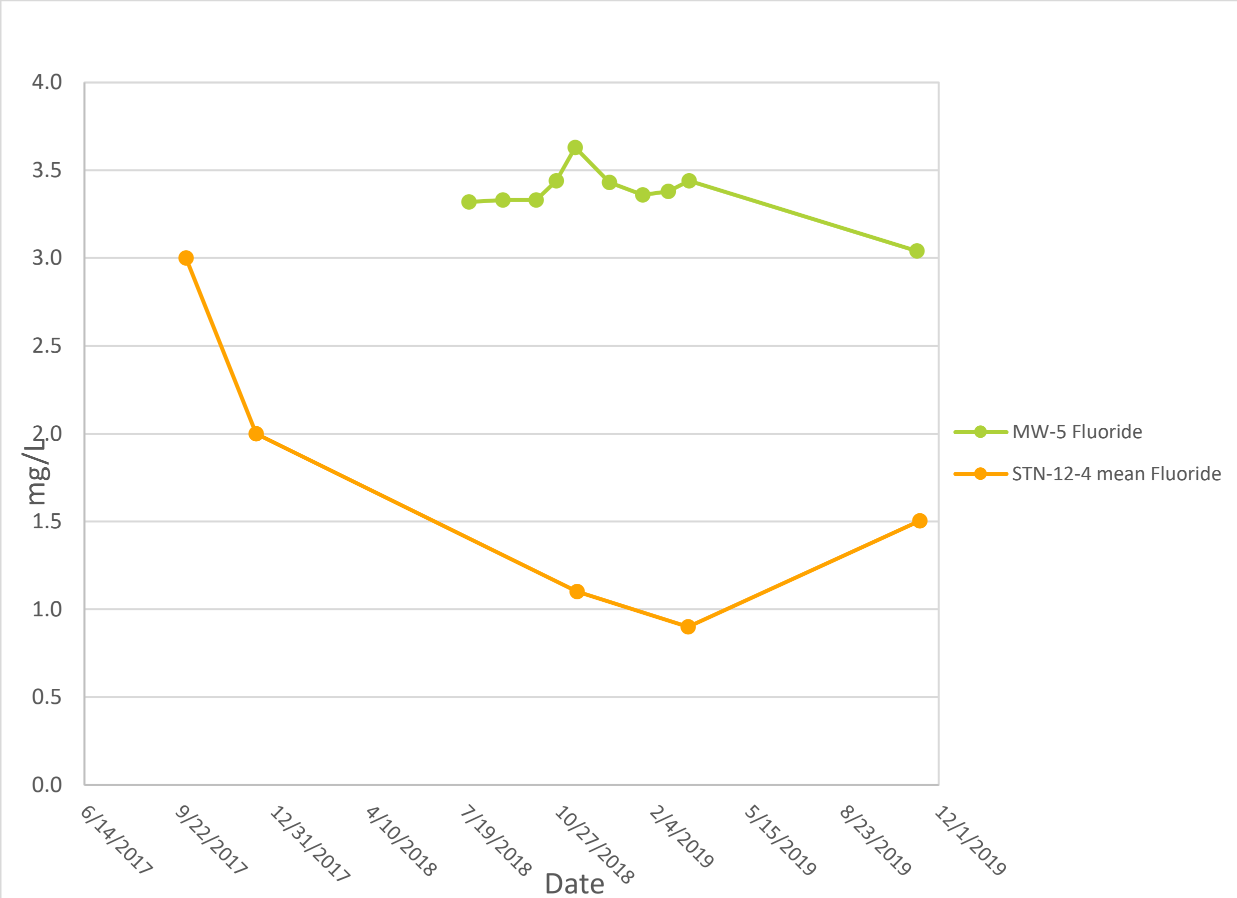

Figure 3-7 MW-5 Fluoride Concentrations

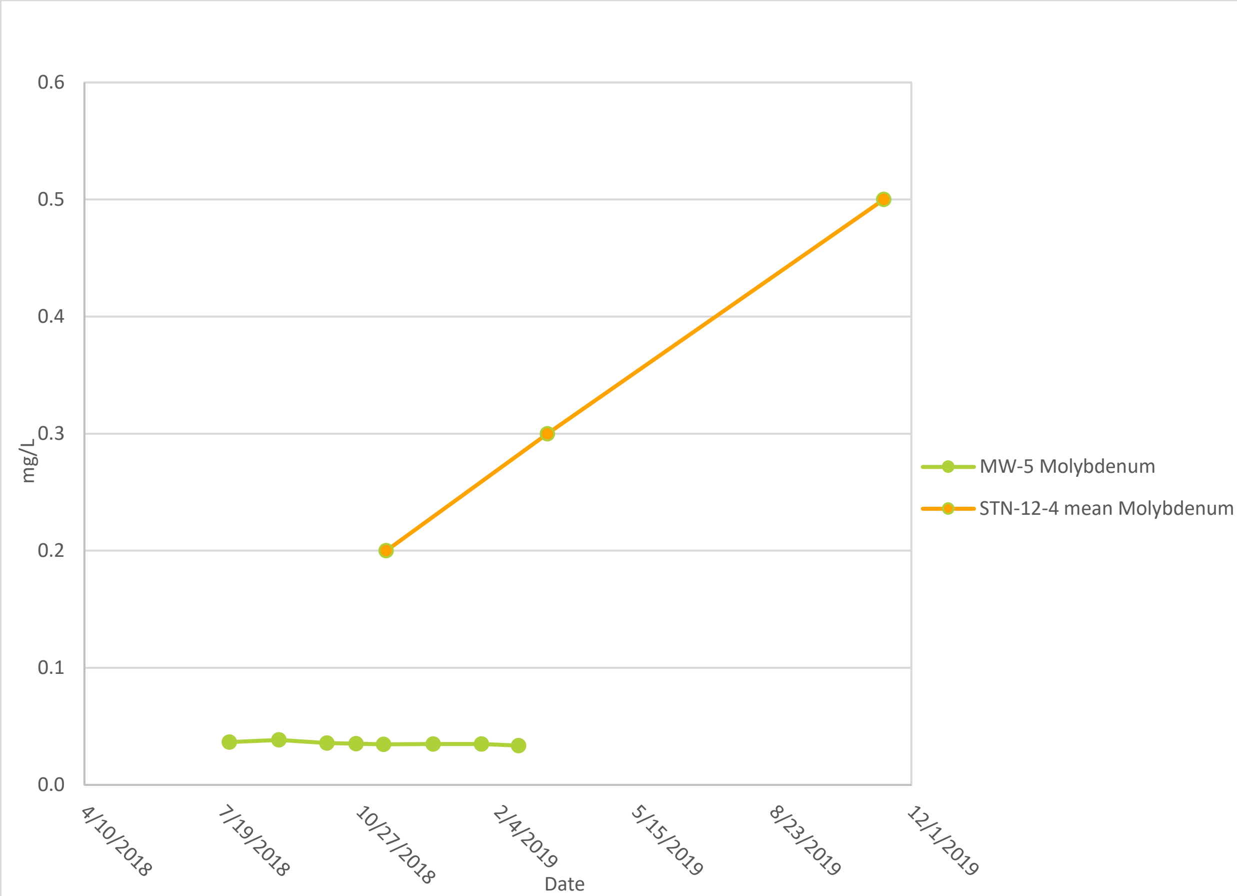

Figure 3-8 MW-5 Molybdenum Concentrations

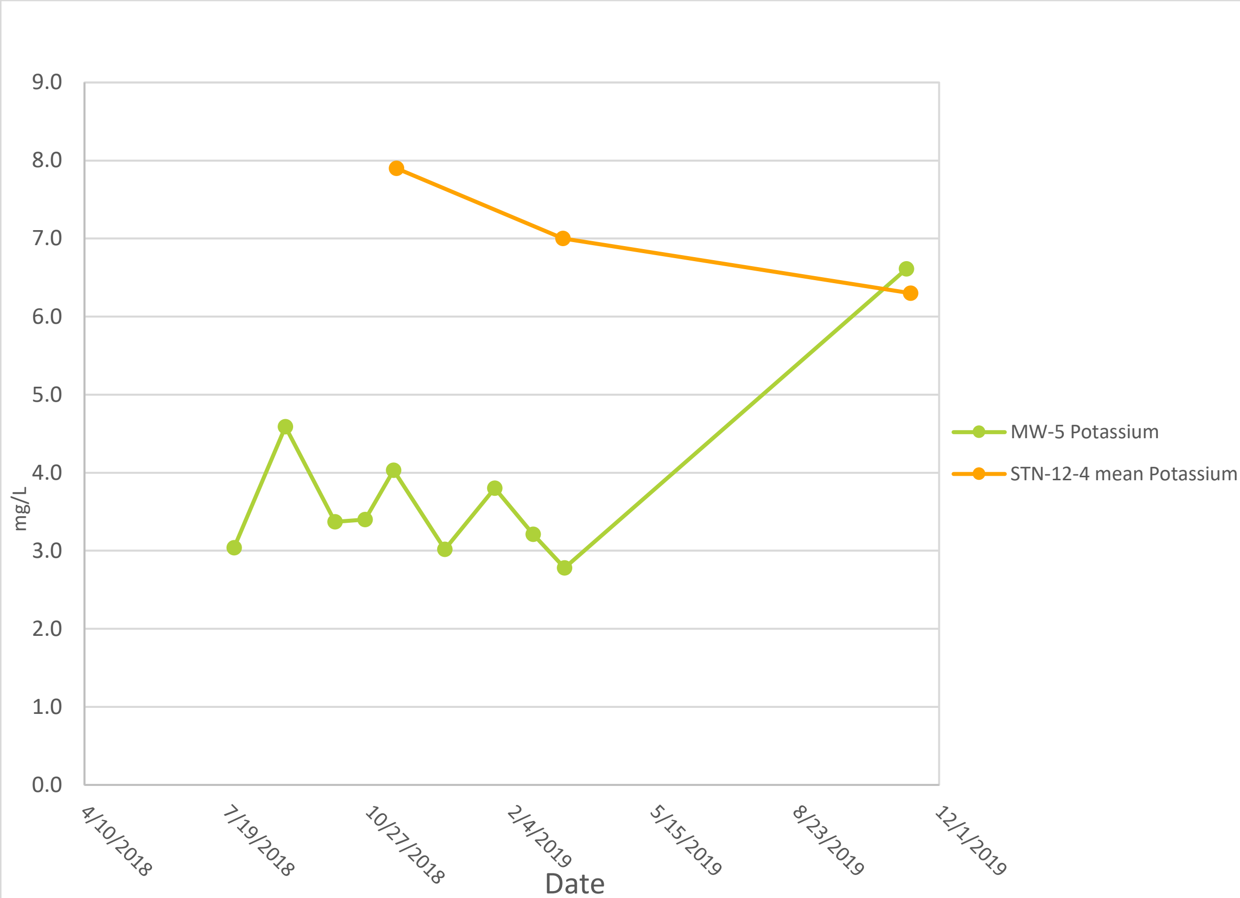

Figure 3-9 MW-5 Potassium Concentrations

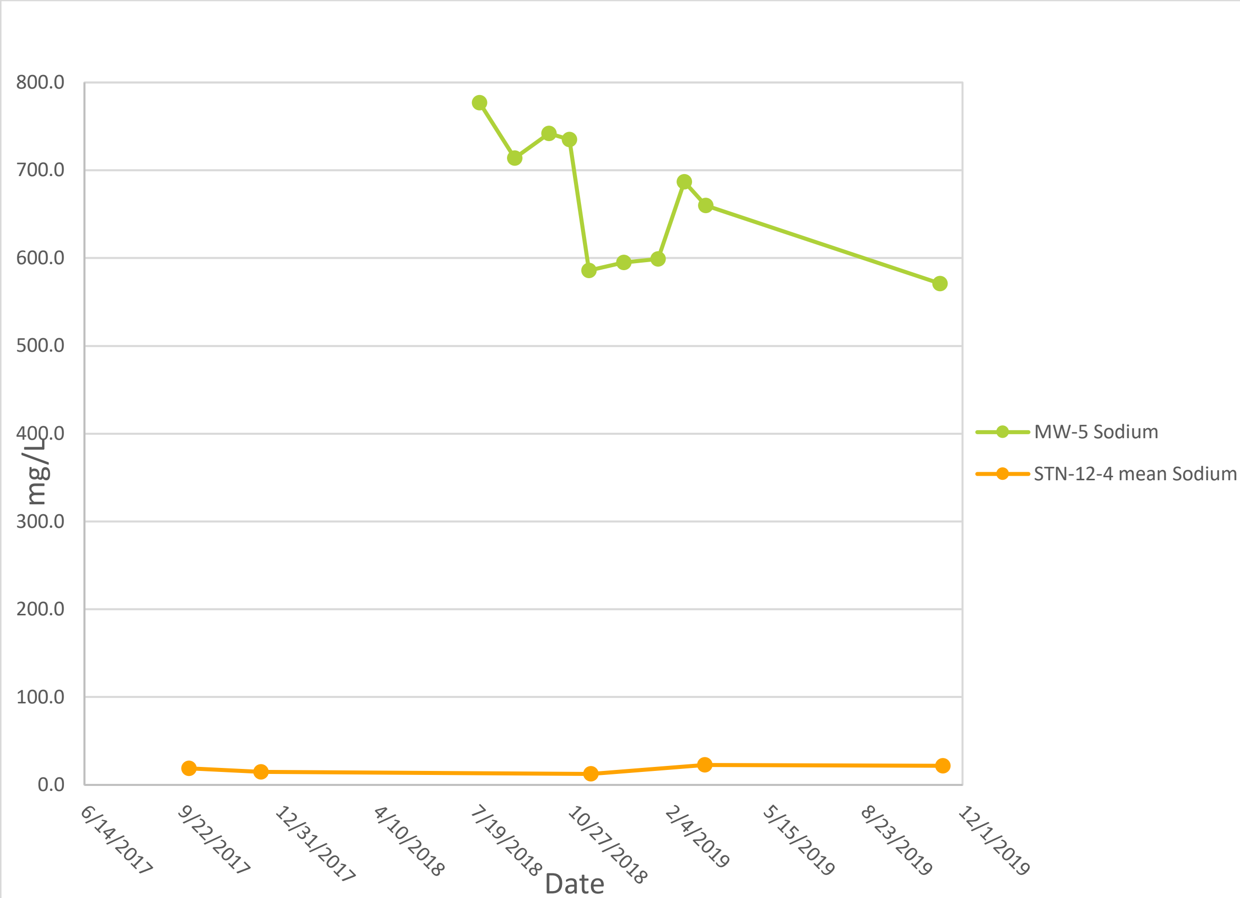

Figure 3-10 MW-5 Sodium Concentrations

3.1.3 MW-1804A Evaluation

Temporal plots for the primary indicators sulfate and chloride in MW-1804A are provided in **Figure 3-11** and **Figure 3-12**, respectively. Sulfate and chloride concentration data for STN-12-4 Intervals 1 and 2, which represent JAFAP porewater at a higher or similar elevation to the MW-1804A sand pack and screen, for each sampling event is presented for comparison.

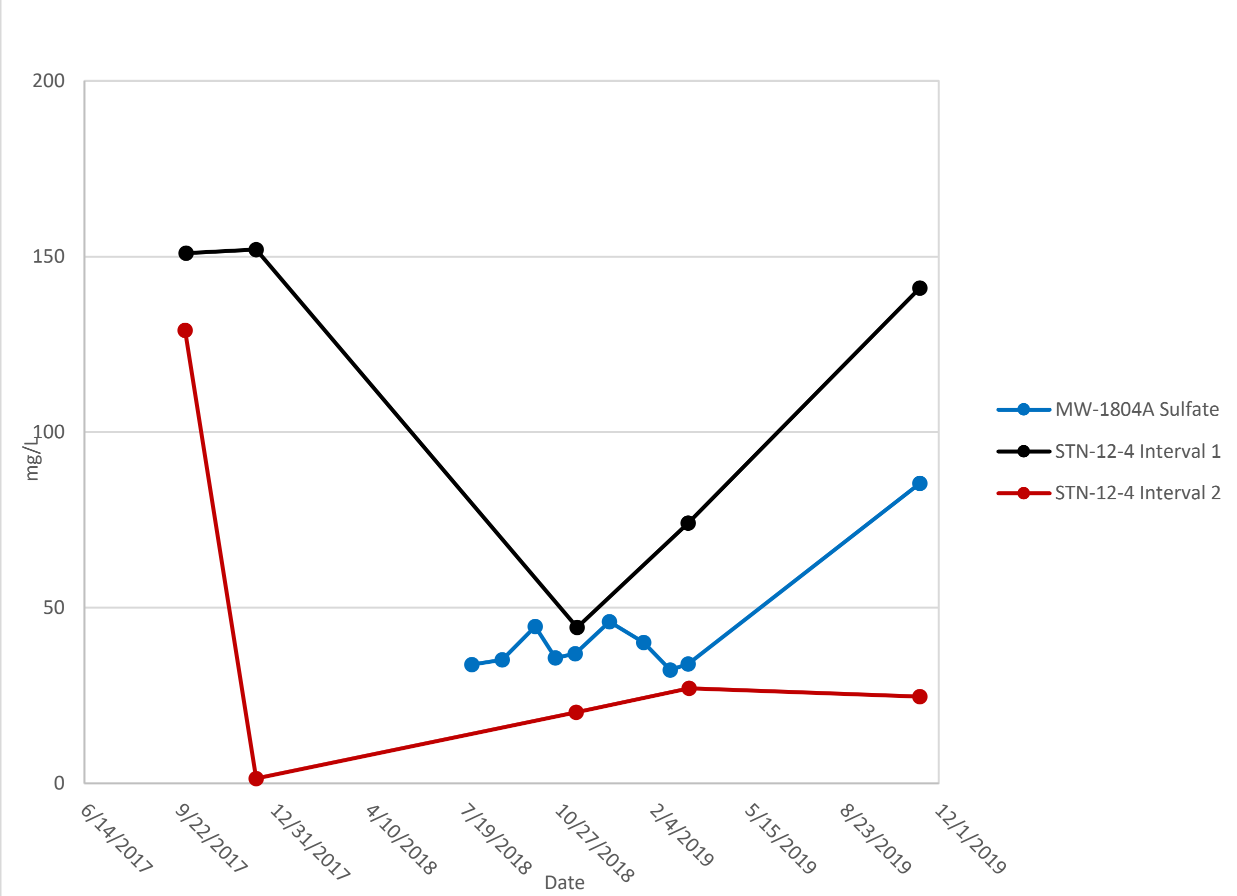

Figure 3-11 MW-1804A Sulfate concentrations

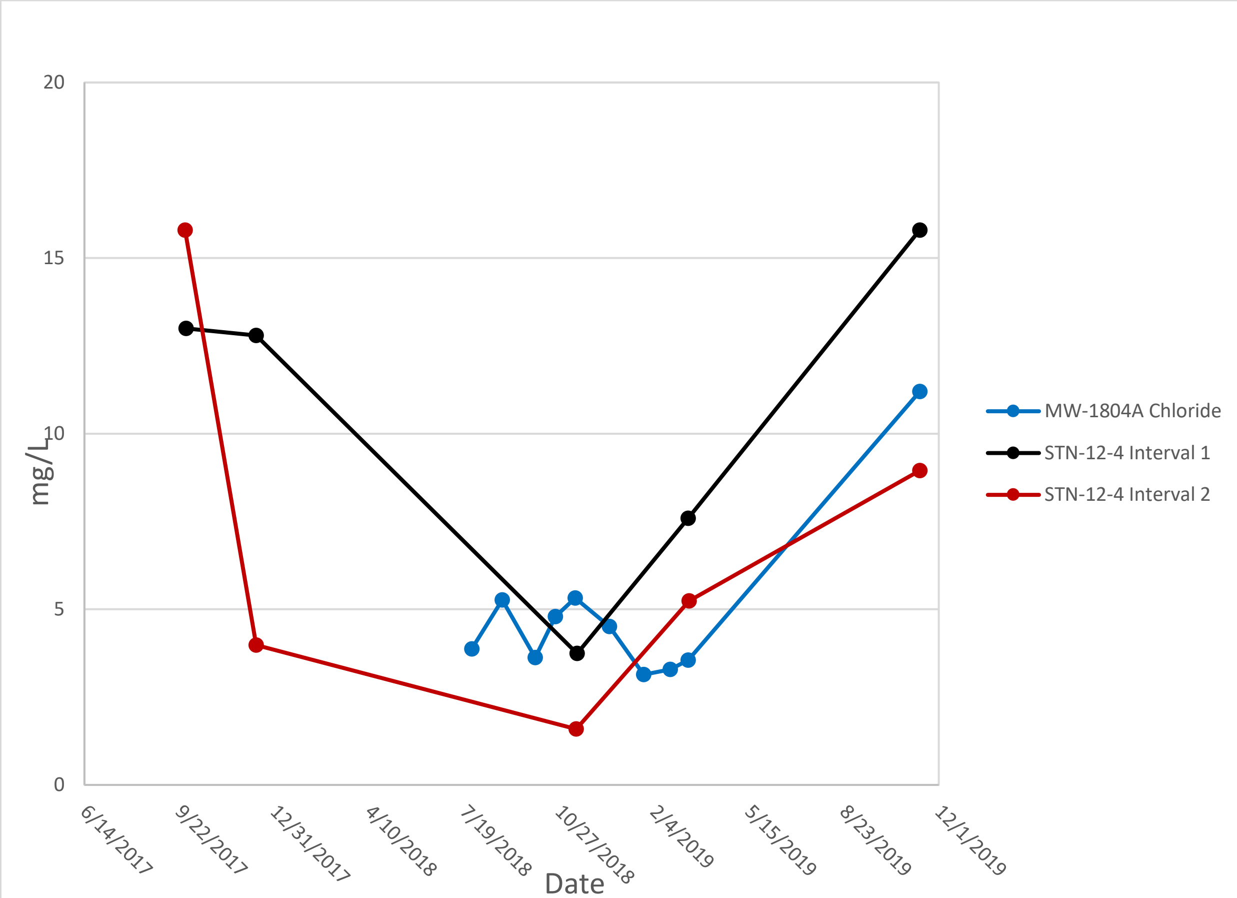

Figure 3-12 MW-1804A Chloride concentrations

Sulfate and chloride concentrations in MW-1804A have remained relatively constant historically, within the range 32.3 mg/L to 46 mg/L (geometric mean = 40.6 mg SO_4/L) and 3.14 mg/L to 5.32 mg/L (geometric mean = 4.5 mg Cl/L), respectively, over the monitoring period from July 2018 through March 2019 (eight background events and initial detection monitoring event). In November 2019, sulfate concentrations were reported as 85.4 mg/L and chloride concentrations as 11.2 mg/L.

Gypsum ($CaSO_4$) dissolution could lead to elevated sulfate concentrations. Calcite and dolomite are often encountered in aquifer rocks. Calcite has been identified in borehole logs for both MW-5 and MW-1804A. If gypsum dissolution occurs (**Equation 1**), increasing calcium ion concentrations ultimately cause calcite to precipitate (**Equation 2**). As calcite precipitates bicarbonate concentrations decrease and initiates the dissolution of dolomite which causes an increase in magnesium concentrations (Equation 3):

$CaSO_4 \rightarrow Ca^{2+} + SO_4^{2-}$ Equation 1

$Ca^{2+} + HCO_3^{2-} \rightarrow CaCO_3 + H^+$ Equation 2

$Ca^{2+} + CaMg(CO_3)_2 \rightarrow CaCO_3 + Mg^{2+}$ Equation 3

$$CaSO_4 + CaMg(CO_3)_2 \rightarrow CaCO_3 + Ca^{2+} + SO_4^{2-} + Mg^{2+} \qquad \text{Equation 4}$$

Overall, calcium, magnesium and sulfate concentrations would be expected to increase and there would be a corresponding decrease in bicarbonate (**Equation 4**). Although acidity is released in **Equation 2**, the buffering provided by calcite likely prevents changes in pH.

While the increase in sulfate could be related to gypsum dissolution, chloride is unlikely sourced from mineral dissolution or water-rock interactions as it is present at only trace concentrations in common rock-forming minerals. Concentration changes in chloride, a conservative ion in groundwater, typically reflects evaporation, dilution, or mixing between distinct water types. Notably, the November 2019 chloride concentration in MW-1804A is almost identical to the concentration in MW-1806A, the only other site well with a sand pack and screen that extend over the same three geologic formations (**Table 1**) providing an indication that this variation in MW-1804A chloride is likely driven by conditions within the formation and not the JAFAP porewater.

Other primary indicators such as boron report a stable concentration over time in MW-1804A, with a historical concentration range from 0.568 to 0.779 mg/L (**Figure 3-13**). The November 2019 event (0.73 mg/L) is within this historical range. Comparing the boron concentrations in MW-1804A groundwater to the upper section of the JAFAP (STN-12-4 Intervals 1 and 2) is complicated by a wide range in this data (with five rounds ranging from 0.145 mg/L to 0.955 and five rounds ranging from 2 mg/L to 10.1 mg/L).

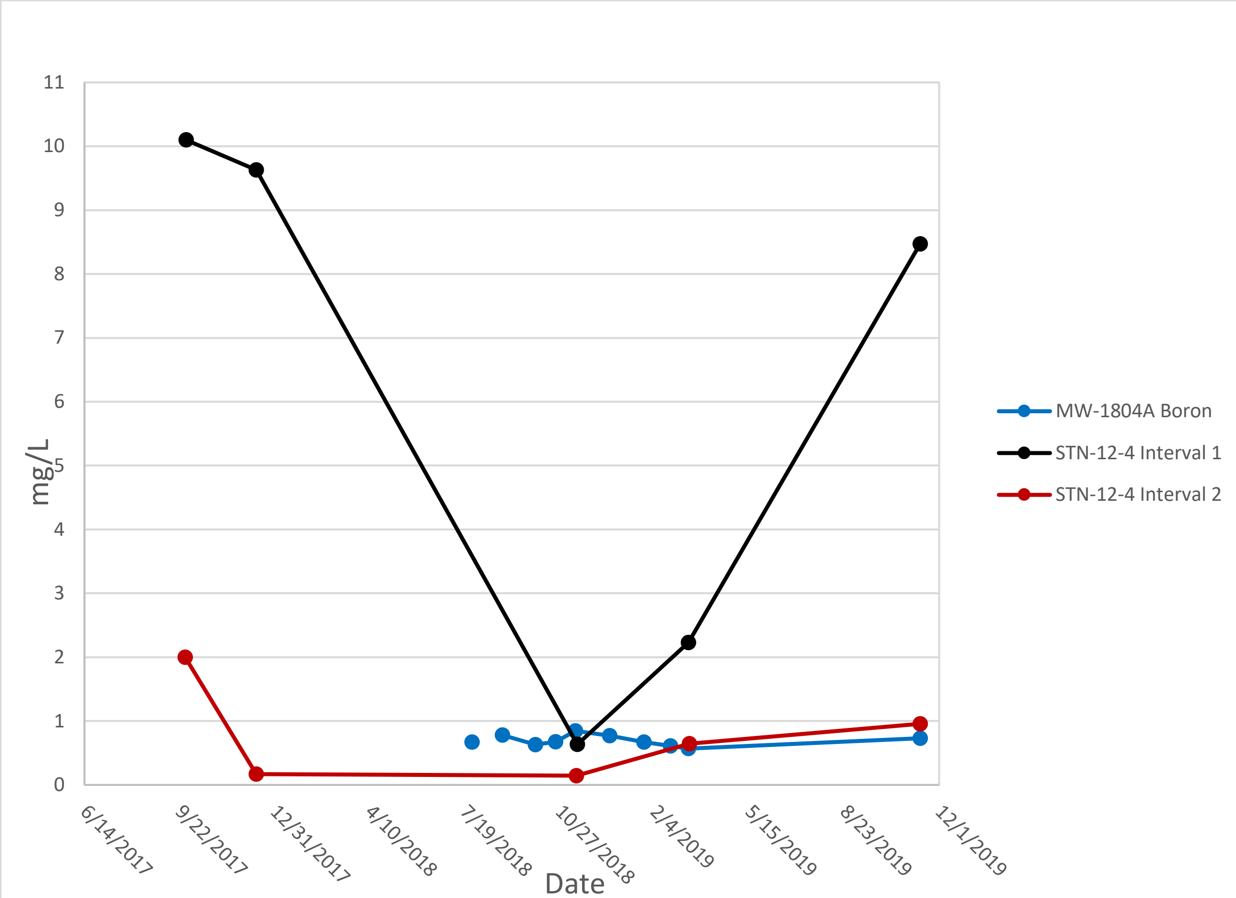

Figure 3-13 MW-1804A Boron Concentrations

Groundwater (**Table 3**) and upper JAFAP porewater data (**Table 4**) were compared for potential indicators bromide, fluoride, molybdenum (not analyzed in March or November 2019 detection monitoring events at MW-1804A), potassium, and sodium. Of these five potential indicators, sodium is the only one where its November 2019 concentration is higher in MW-1804A groundwater than the upper JAFAP porewater (STN-12-4 Intervals 1 and 2), as shown in temporal plot **Figure 3-14** (molybdenum data from the October 2018 background sampling event also had higher concentrations than JAFAP water at that time). These higher concentrations in groundwater indicate this groundwater is being affected by another source within the formation, and likely not being influenced by the JAFAP porewater.

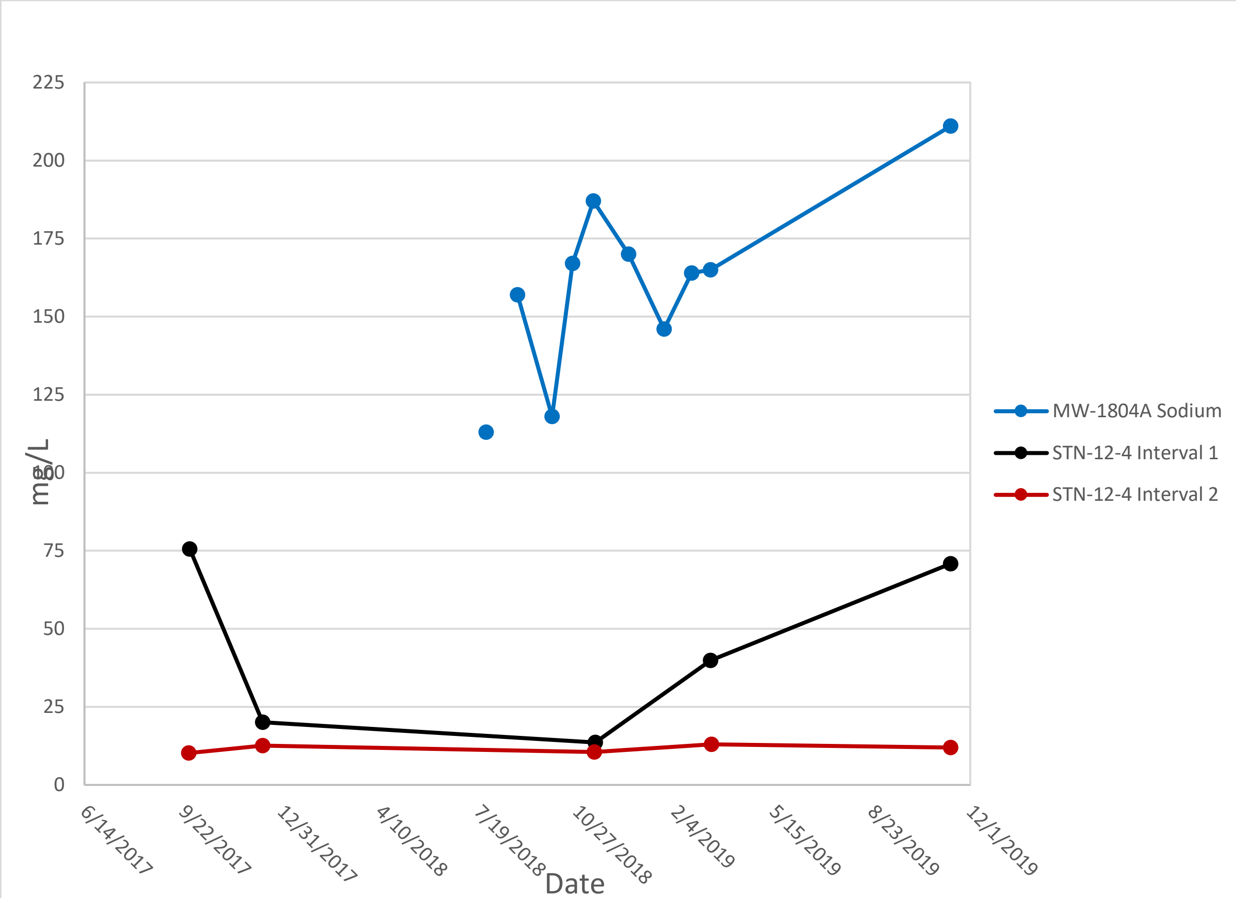

Figure 3-14 MW-1804A Sodium Concentrations

3.2 Statistical Evaluation

Mann Kendall analysis was used to compare the temporal variation in MW-5 sulfate and calcium and MW-1804A sulfate and chloride. Results for two datasets for these analytes were investigated by reviewing the entire 2018/2019 dataset and the dataset omitting the November 2019 groundwater monitoring results (**Table 3-1**).

Table 3-1 Mann Kendall Statistics

Series	Monitoring Well ID	Type	Trend 2018/2019	Trend (excluding Nov 2019)
GW	MW-5	Sulfate	No trend	Decreasing
GW	MW-1804A	Sulfate	No trend	No trend
GW	MW-5	Calcium	No trend	Stable
GW	MW-1804A	Chloride	Stable	Stable

Trends for the entire dataset were either stable or did not have a trend. When the November 2019 set of results were omitted, MW-1804A (sulfate and chloride) still reported a ‘no trend’ and a ‘stable trend’, respectively, while in MW-5 sulfate reported a decreasing trend and calcium a stable trend. Based on the trend analysis, the set of results which triggered the SSI evaluation, do not appear to be contributing towards any significant temporal changes in sulfate, chloride, or calcium concentrations.

3.3 Ion Ratios and Conservative Ion Binary Plots

3.3.1 Ion Ratios

EPRI (2012) recommends the use of ion ratios to identify source waters, or to determine that an additional source water is being added along a flow path. The premise is that the concentration of two constituents in groundwater is maintained unless mixing with a water source that has different ion concentration ratios occurs. Care must be taken to select unreactive constituents (conservative ions) to support this analysis. Conservative ions are generally not volatile, largely do not participate in ion exchange or redox reactions, generally form minerals with high solubilities, and are not typically leached from or incorporated into reactive minerals along groundwater paths in appreciable concentrations. These characteristics result in preservation of conservative ion ratios through binary mixing, dilution, and evaporation processes. Sulfate should be assessed with caution using the conservative ion ratio approach, since sulfate is typically a conservative ion in oxygenated waters, however, oxidation of sulfide or reduction of sulfate on mixing between anoxic and oxygenated waters can shift the sulfate concentration substantially from an expected binary mixing result.

Ion ratios for key constituents in groundwater and JAFAP porewater samples from the November 2019 sampling round are provided in **Table 4**. Notably, the SO_4/Cl and F/Cl ratios for most groundwater samples are indistinguishable from JAFAP porewater; therefore, these SO_4/Cl and F/Cl ratios are not useful for distinguishing JAFAP porewater influence for the majority of locations in the monitoring network. In more detail, SO_4/Cl and F/Cl ratios for JAFAP pore water wells MW-1804A and MW-1806A (**Figure 3-16**) show temporal variability at each sampling point. When coupled with the distinctive B/Cl and Ca/Cl ratios, this supports lack of mixing between JAFAP pore water and MW-1804A/MW-1806A, and external control by an overall common source. The common source may be attributed to local groundwater that ultimately ends up in the well screens and JAFAP pores, and varies with precipitation levels, water levels, and the mineralogy of rocks along the flow paths that ultimately intercept the sampling points. The exception is for wells MW-5, MW-2 and MW-8, which have distinct SO_4/Cl and F/Cl ratios that likely reflect a connate brine component. In contrast, Ca/Cl and B/Cl ion ratios are distinct for most groundwater and JAFAP porewater samples and provide useful indicators of mixing relationships between different water types. To better assess mixing relationships based on ion ratios, ion ratio plots were developed following the method and rationale described below.

Ion ratio plots were developed from historical and current data for MW-5 (**Figure 3-15**) and MW-1804A (**Figure 3-16**). These plots illustrate SSI benchmark exceedances in November 2019 in the context of historical and current JAFAP porewater samples. Ion ratio plots for MW-5 show that the water in both historical and the November 2019 samples show a distinct ion composition compared to shallower co-located wells (MW-1 and MW-6) and JAFAP porewater. This result supports an Appalachian Plateau connate brine origin. Indeed, the composition of MW-5 groundwater on these plots is sufficiently unique that no clear mixing relationship between the November 2019 sampling result and other water sources is clear based on ion ratios. For this reason, absolute conservative ion concentrations (not ratios) are used to better assess mixing between MW-5 and alternative sources, as discussed below (**Section 3.3.2**).

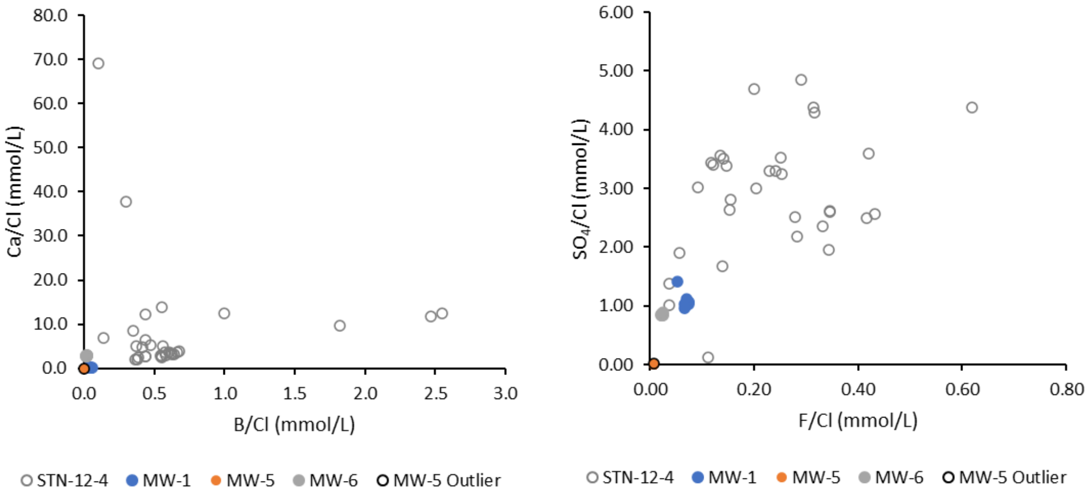

Figure 3-15 Ion Ratio Plots of Historical and Current Data from MW-5, MW-1 and MW-6, and STN-12-4 JAFAP Porewater. Note: the MW-5 outlier plots in the same location as historical MW-5 data.

An ion ratio (Ca/Cl vs. B/Cl) plot for MW-1804A shows that the November 2019 sampling result is intermediate between the composition of historical results from MW-1804A and MW-1806A, which is screened in the same formation over a similar well screen elevation range. The MW-1804A and MW-1806A SO_4/Cl vs. F/Cl ion ratio plot illustrates that these ion ratios are of limited use for distinguishing JAFAP porewater mixing in this formation, as there is substantial overlap between these ion ratios in groundwater and JAFAP porewater. Overall, the plots suggest that the anomalous November 2019 sample from MW-1804A is best attributed to groundwater compositional variations within the Upper Connellsville Sandstone unit rather than mixing with JAFAP porewater.

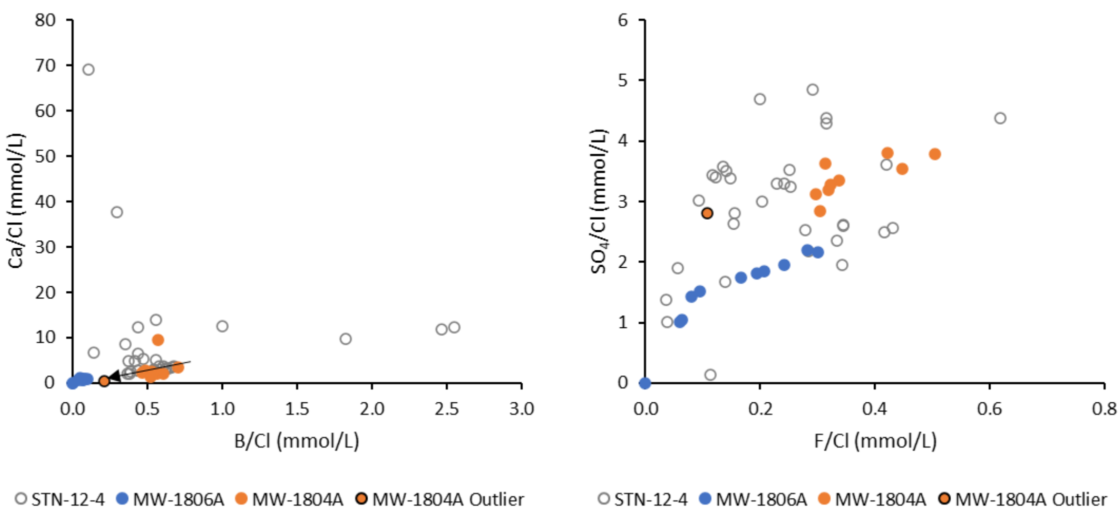

Figure 3-16 Ion Ratio Plots of Historic and Current Data from MW-1804A and well MW-1806A, and STN-12-4 JAFAP Porewater.

3.3.2 Conservative Ion binary plots

Binary plots of the molar concentrations of conservative ions in waters that have undergone binary mixing or dilution trace a straight line between the mixing endmembers, and the intermediate (resulting) water falls on the mixing line. Molal concentrations are preferred in this type of diagram as mineral precipitation effects are more readily apparent. Dissolved elements broadly considered as conservative for this purpose include the halides (e.g. chloride and fluoride) and boron.

Binary conservative ion plots (B-Cl, F-Cl, and B-F) were constructed for MW-5 (**Figure 3-17**) and MW-1804A (**Figure 3-18**). Data for each well from nine sampling events between July 2018 and March 2019 were compared to the data points showing SSI exceedances from November 2019. Data for JAFAP porewater from the seven ports in multilevel well STN-12-4 from September 2017 through November 2019, representing JAFAP porewater, were included on the charts as a possible mixing endmember. For MW-5, co-located and shallower wells MW-1 and MW-6 were included as a possible mixing endmember, whereas well MW-1806A was included with the plots for MW-1804A for comparison, as it is screened in the same formation (Upper Connellsville Sandstone) and at a similar elevation.

For well MW-5, the November 2019 sample falls on a mixing line between historical MW-5 waters and $NaHCO_3$-type waters in the shallower co-located wells MW-1 and MW-6 for all conservative ion plots, and does not indicate mixing with JAFAP porewater (**Figure 3-17**). This relationship indicates that mixing between Appalachian Plateau NaCl-type connate water and overlying more dilute $NaHCO_3$-type water best explains the November 2019 sampling result and mixing with JAFAP porewater is not supported.

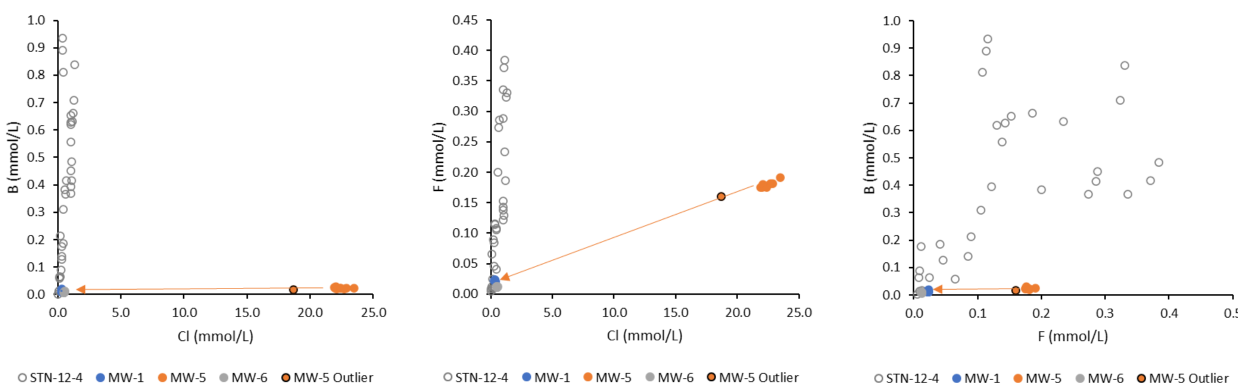

Figure 3-17. Conservative Ion Binary Plots for MW-5.

The B and Cl concentrations in the November 2019 sample from MW-1804A show that Cl increased relative to historical data for the well with no concomitant increase in B, whereas JAFAP porewater results show a distinct linear correlation between Cl and B concentrations (**Figure 3-18**). The Cl and F concentrations in the November 2019 MW-1804A sample also show increasing Cl with no concomitant increase in F compared to historical data from the well along a mixing path defined by historical F and Cl concentrations observed in groundwater samples from MW-1806A and is distinct from the pathway expected for mixing between MW-1804A and JAFAP porewater. The B and F concentrations plotted against each other do not reveal any mixing relationships but do show the broad compositional similarity between groundwater in MW-1804A and MW-1806A.

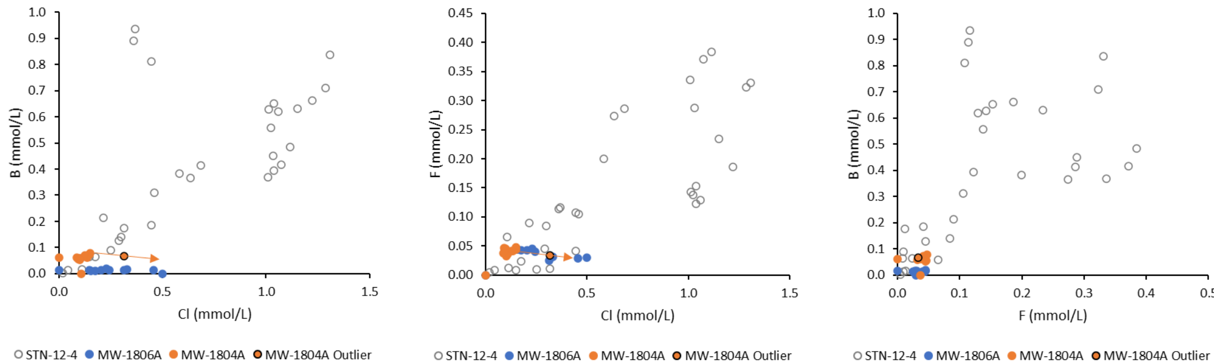

Figure 3-18. Conservative Ion Binary Plots for MW-1804A.

In summary, F and B concentrations plotted against Cl suggest mixing between different groundwater compositions within the Upper Connellsville Sandstone unit best explain the MW-1804A sample result from November 2019 and that mixing with JAFAP porewater is not expected.

3.4 Tier II Evaluation - Geochemical Evaluation

A simple analysis of primary and potential indicator constituents (as performed in **Section 3.1**) may not provide the lines of evidence required for a robust ASD investigation. It is recognized that naturally occurring indicator constituents and upgradient sources may have an additional influence on groundwater quality. Spatially across a site, groundwater quality may be observed to change due to chemical interactions with the aquifer matrix. EPRI (2012) recommended more sophisticated methods that can be used for multiple parameters over multiple locations.

Piper plots are used to classify groundwater types based on the major ion ratios of calcium, magnesium, sodium (and potassium), alkalinity, chloride, and sulfate. They can be used to visually illustrate ion exchange and mixing between different water chemistries.

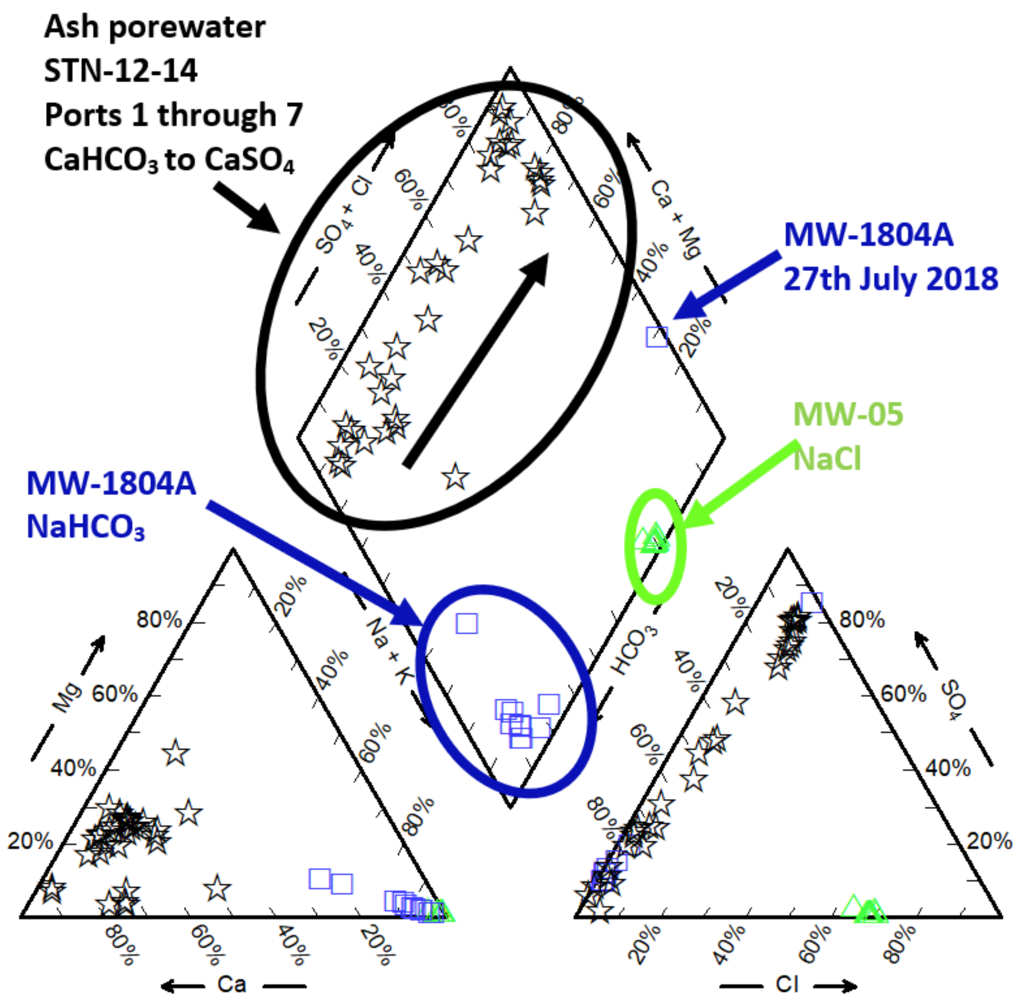

Figure 3-19 **JAFAP and Groundwater Piper Plot (water types)**

Ash porewater and groundwater are represented by different water types. In **Figure 3-19** above, the water types related to the JAFAP porewater are dominated by calcium, bicarbonate, and sulfate. Bicarbonate is associated with both ash porewater and MW-1804A, which is likely related to infiltrating rainwater. MW-1804A reports one event (July 27, 2018) with an alkalinity less than 1 mg/L. Groundwater samples collected in the vicinity of MW-1804A between August 2018 and November 2019 consistently report a sodium bicarbonate water type. The initial groundwater analysis conducted in July 2018 is potentially anomalous (with respect to alkalinity) when compared to the remainder of the historical dataset. During this event, total alkalinity (as $CaCO_3$) was reported as <1 mg/L and a field pH 7.5. Subsequent alkalinity results have ranged from 329 mg/L to 446 mg/L. At this pH, a carbonate alkalinity would be expected to report below 1 mg/L and total alkalinity would be represented by bicarbonate alkalinity only. It is suggested that the laboratory inadvertently reported carbonate alkalinity instead of total (or bicarbonate) alkalinity. The November 2019 sample falls partway along the regional evolution line where less evolved Ca-HCO_3 undergoes Na/Ca ion exchange with clay minerals along the flow path resulting in the Na-HCO_3 water type. The November 2019 sample may be considered a less evolved water that was sampled due to a combination of factors discussed in **Section 3.5** and **Section 3.7.**

The groundwater of MW-5 is distinct from MW-1804A and has a sodium chloride water type. Groundwater samples collected in the vicinity of MW-5 between July 2018 and November 2019 consistently report a sodium chloride water type. This water type is typically indicative of connate brines with a marine component that are relict within the aquifer. This groundwater monitoring location intersects a deeper section of the bedrock aquifer as discussed in **Section 2.3**.

In summary, based on the geochemical evaluation there is insufficient evidence to support the presence of CCR constituents, as derived from the JAFAP, in groundwater sampled in the vicinity of MW-5 and MW-1804A. The Piper plots do not support mixing between groundwater and JAFAP water at any of the groundwater monitoring locations reviewed. The JAFAP water type is calcium bicarbonate (shallow porewater) and calcium sulfate (deeper porewater). Only four other groundwater locations report these two water types – MW-1801A and MW-6 (calcium bicarbonate); and MW-1807A and MW1809A (calcium sulfate). Bicarbonate concentrations are generally more elevated in groundwater in comparison to JAFAP porewater. Sulfate concentrations are mostly higher within groundwater compared to JAFAP, except for MW-6. Additionally, In MW-1804A groundwater, sodium is elevated in concentration compared to JAFAP water and bromide, fluoride and sodium are all present at higher concentrations in MW-5 groundwater compared to the JAFAP water. These concentration imbalances indicate an alternate source of these constituents within the formation. Based on this evidence, it is considered that porewater from JAFAP is unlikely to be influencing the surrounding groundwater chemistry in MW-5 and MW-1804A where the November 2019 SSIs were identified.

3.5 ASD Type I – Natural Variation due to Sampling Causes

EPRI (2012) describes sampling anomalies as a defensible cause for an SSI. Review of field documents indicates a notable change in the sampling technique at MW-5 and MW-1804A during the November sampling and the eight background monitoring events, in that the maximum purge rate was between one half and one quarter the rate used historically (**Figure 3-20** and **Figure 3-21**). Additionally, the total volume purged during November 2019 sampling at MW-5 and MW-1804A was lower than all previous instances (except the October 2018 event in MW-1804A) (**Figure 3-20** and **Figure 3-21**).

Sampling events used to establish benchmark values for evaluating SSIs were formulated through statisitical analysis of the historical samples that were collected at higher purge rates and purge volumes. In the case of MW-5, the excess pumping in the associated low-yield formation during SSI benchmark calibration sampling is expected to result in incursion of reducing, low sulfate, high TDS NaCl-type connate water into the well screen. Subsequent sampling at a lower purge rate and purge volume on November 2019 is expected to have minimized connate water incursion into the well and facilitated sampling of low TDS and sulfate bearing water with elevated Ca from above the connate water mixng interface.

Similar to MW-5, lower purge rates and volumes at MW-1804 during November 2019 sampling is expected to draw groundwater from portions of the formation not typically sampled during the background sampling events. The SSI exceedance can be attributed in part to a substantially lower purge rate and volume than used during background sampling to establish SSI benchmarks. The screen and sand pack extends across the Conemaugh Shale, Upper Connellsville Sandstone, and an unnamed shale/siltstone unit, which conceivably have variable groundwater geochemistry. Notably, MW-1806A is the only other Site well with a sand pack that extends across the same combination of units and a substantial interval of the Conemaugh Shale. Conceivably, differences in the purge rate during sampling affected the relative contributions of different water bearing zones to the well, which resulted in groundwater geochemistry differences.

For MW-1804A, this is supported by the outcome of the Tier II geochemical evaluation (**Section 4.4**) that provides multiple lines of evidence to support the November 2019 MW-1804A groundwater sample has a simlar origin to groundwater sampled from other wells screened over simlar elevation ranges in the Conemaugh Shale/Upper Connellsville Sandstone, and that mixing with JAFAP porewater is not supported.

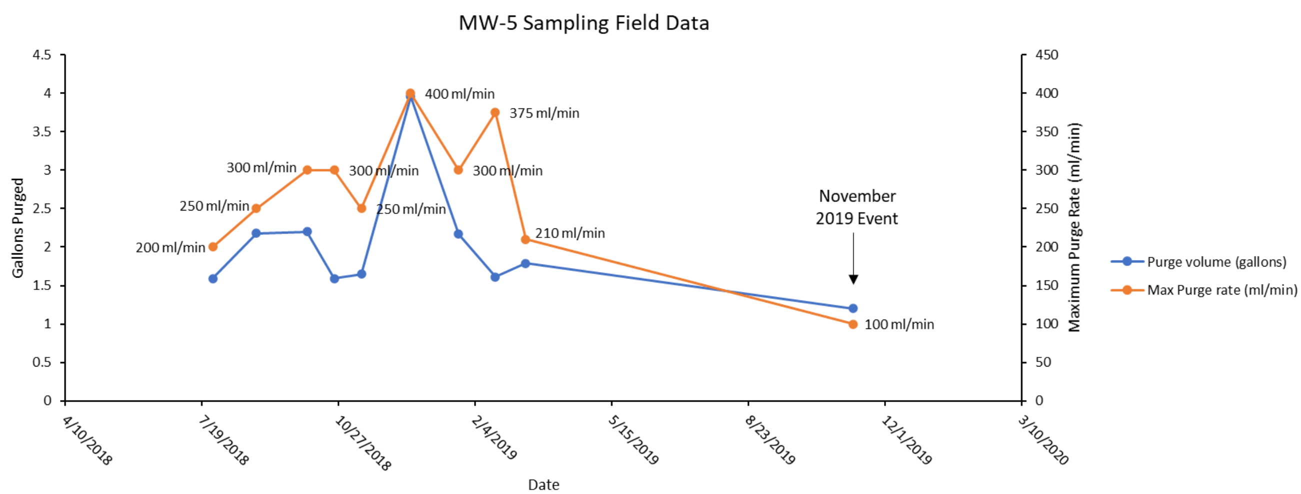

Figure 3-20. Historical Well Purge Rates and Volume Purged for MW-5.

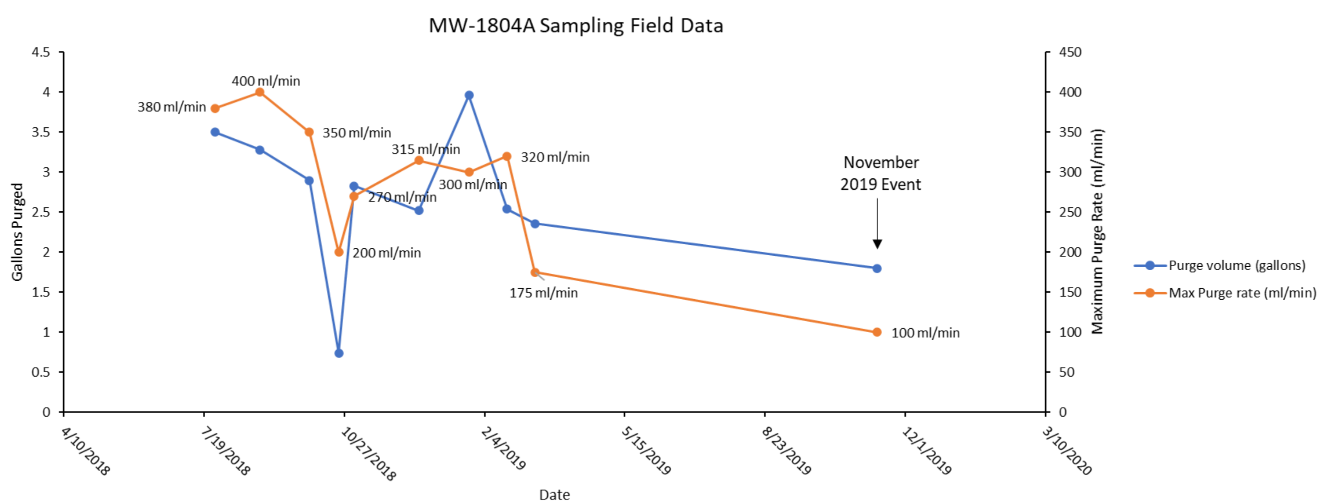

Figure 3-21. Historical Well Purge Rates and Volume Purged for MW-1804A.

3.6 ASD Type III – Statistical Evaluation Causes

Samples to establish SSI benchmarks were obtained over a seven month period between July 25, 2018 to February 18, 2019. For this reason, benchmark statistical calulations are qualified with “Insufficient data to test for seasonality: data were not deseasonalized” (AEP, 2020). Additionally, annual variations owing to high rainfall years (**Section 3.7**) are not accounted for, as detection monitoring began immediately following the establishment of SSI benchmarks. Therefore, periodic SSI exceedences related to seasonal and/or annual weather variations should be expected until a broader dataset is available that incorporates seasonal and annual weather patterns.

3.7 ASD Type IV – Natural Variation

The year highest annual rainfall ever recorded in West Virigina (67.05 inches) occurred in 2018 (NOAA, 2020), which coincides with the time period when 75 percent of the data to support the SSI benchmarks was collected. Historical water level records only extend back to the period where SSI benchmark data was collected for MW-1804A. In addition, the conceptual time-frame for recharge water to infiltrate to the MW-1804A screened zone is on the order of days to weeks (**Figure 2-2**), consistent with the expected response time between precitiation and sampling at MW-1804A during the high rainfall period. The anomalous rainfall is not expected to influence MW-5, as the conceptual time for recharge water to infiltrate the MW-5 screened zone is on the order of years to centuries (**Figure 2-2**).The November 2019 water level elevation (841.72 ft mean sea level) was the lowest measured to date. In comparison, the water level ranged between 842.01 and 846.00 ft during the earlier eight quarters of sampling used to establish SSI benchmarks, an elevation range that spans the overburden/bedrock interface (**Figure 3-22**). The water level measured in November 2019 was nearly 2.5 feet lower than the overburden/bedrock interface and approached the top of a sandstone interbed within the Conemaugh Shale. Variable water level elevations in MW-1804A support potential changes in the relative contributions from different water-bearing zones to the November 2019 sample. Additionally, the lowest historical water level in November 2019 conceivably reflects relaxation of the water table back to typical levels with concomitant changes in groundwater geochemistry, thus, may be more reflective of typical conditions.

It is expected that a combination of a historically low water levels and a notably lower purge rate during the November 2019 sampling event contributed to concentrations outside the range used to establish SSI benchmark exceedances. The variable concentrations in MW-1804A may be attributed to natural variations in the water chemistry at this location.

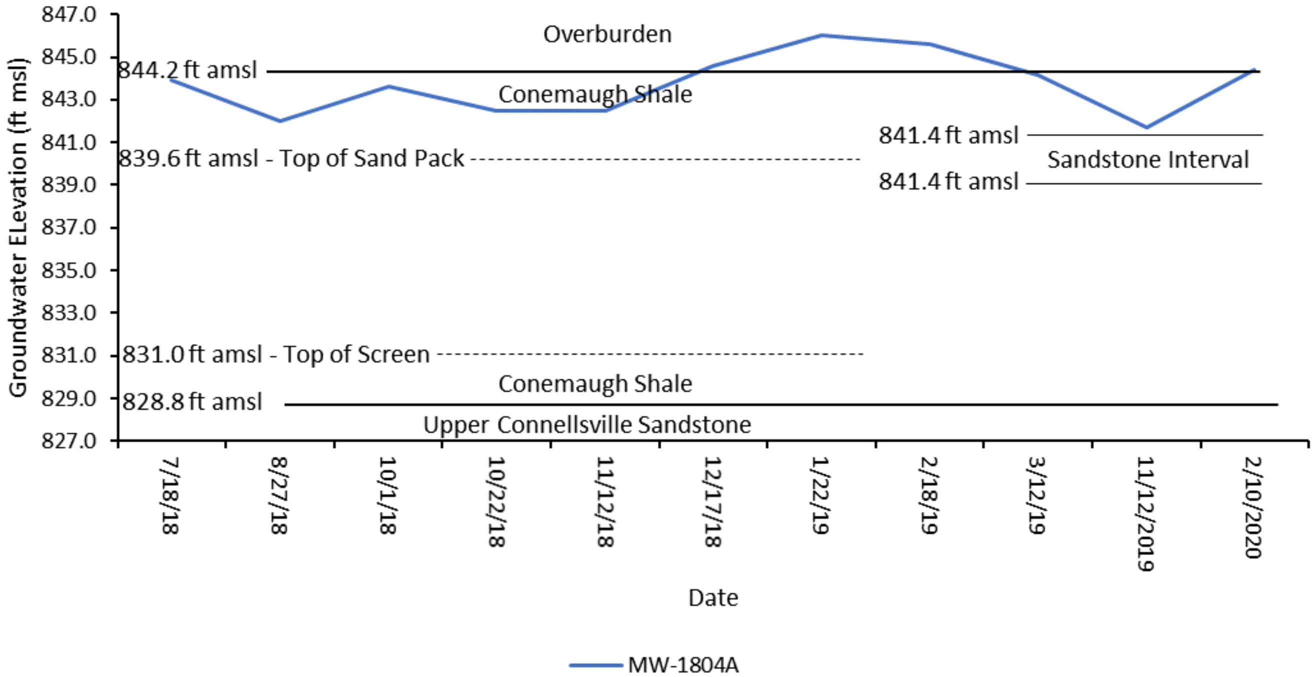

Figure 3-22. Hydrograph for MW-1804A Relative to Geological Observations Over the Screen Interval.

4 Summary and Conclusions

Table 5-1 (Table 6-1 in EPRI, 2017) highlights the potential causes of SSIs at MW-5 and MW-1804A during the November 2019 detection monitoring event that have been identified during this ASD investigation.

Table 5-1 Summary of Potential Causes Identified by ASD Investigation

Table 6-1
Potential Causes for an SSI/SSL

Sampling Causes (ASD Type I)	Laboratory Causes (ASD Type II)	Statistical Evaluation Causes (ASD Type III)	Natural Variation (ASD Type IV)	Alternative Sources (ASD Type V - Natural and Anthropogenic)
• Sample mislabeling • Contamination • Change in technique • Excessive suspended solids or turbidity • Other sampling anomalies	• Analytical method • Calibration • Analytical technique • Contamination • Interference • Recording • Dilution errors • Digestion methods	• Lack of statistical independence • Outliers • Trends • Non-detect Processing • False positives • New background data	• Geology • Precipitation • Seasonality • Water level • Changes in pH and/or ORP • Biological activity • Time of travel	• See Appendix A, Tables A-3 and A-4

Using the EPRI (2017) guidance for completing an ASD, the conclusions that are based on the lines of evidence presented and discussed within **Sections 3** indicate that groundwater in the vicinity of the JAFAP is not being influenced by CCR constituents from the JAFAP. Concentrations of the constituents calcium and sulfate in MW-5 and chloride and sulfate in MW-1804A that lead to SSIs in November 2019 are primarily caused by a change in the sampling procedure (ASD Type I – Sampling Causes), leading to a difference in where sampled water originated in the formation, as detailed in **Table 5-2.** Additionally, ASD Type III – Statistical Evaluation Causes, ASD Type IV Natural Variation Causes at MW-1804A and Type V – Alternatives Source Causes at MW-5 were identified, as discussed below.

Table 5-2 Evidence of ASD for SSIs at the John Amos Fly Ash Pond

MW-5 Evidence	MW-1804A Evidence
MW-5: Calcium SSI	MW-1804A: Chloride SSI
1. High purge rates and purge volumes during background sampling resulted in intrusion of sodium chloride water, setting an unrealistically low calcium SSI value for future comparison. 2. Mixing of shallower calcium-rich groundwater occurred during the November 2019 sampling event due to a substantially lower purge rate and volume, which led to the SSI as evidenced by: a. Calcium was 2.7 times lower in MW-5 than calcium in the shallower, co-located well MW-6. b. Shallow groundwater mixing is supported by Ca/Cl and B/Cl ratios in MW-5 similar to shallow groundwater and notably different than JAFAP porewater. c. Shallow groundwater mixing with brine is supported by conservative element (B, Cl, F) concentrations.	1. The SSI exceedance can be attributed to a substantially lower purge rate and volume than used during background sampling to establish SSI benchmarks. The screen and sand pack extends across the Conemaugh Shale, Upper Connellsville Sandstone, and an unnamed shale/siltstone unit, which conceivably have variable groundwater geochemistry. Variable groundwater chemistry in the different units is supported by the subtle geochemical differences in background data for other Site wells screened over only one or two of these units. Conceivably, differences in the purge rate during sampling affects the relative contributions of different water bearing zones to the well, which results in groundwater geochemistry differences. 2. November 2019 data, obtained with the lower purge rate, is likely due to natural groundwater variation within the screened formations and not the JAFAP, as evidenced by: a. Chloride in MW-1804A (11.2 mg/L) was essentially identical to MW-1806A (11.1 mg/L), which is screened in the same formation and over a similar elevation range. b. Ca/Cl and B/Cl ratios indicate that chloride in MW-1804A cannot be attributed to mixing with JAFAP porewater. c. Mixing between historical MW-1804A groundwater with MW-1806A groundwater is supported by conservative element (B, Cl, F) concentrations. d. The water level in MW-1804A in November 2019 was the lowest previously recorded.

<table>
<tr><th>MW-5 Evidence</th><th>MW-1804A Evidence</th></tr>
<tr><td>MW-5: Sulfate SSI</td><td>MW-1804A: Sulfate SSI</td></tr>
<tr><td>1. High purge rates and purge volumes during background sampling resulted in intrusion of sodium chloride water, with essentially no sulfate, setting an unrealistically low SSI value for future comparison (sulfate SSI benchmark is over 100 times lower than typical groundwater sulfate concentrations due to incursion of reducing, sulfide-bearing and sulfate-free brine)
2. Mixing of shallower sulfate-rich groundwater occurred during the November 2019 sampling event due to a substantially lower purge rate and volume, as evidenced by:
a. Sulfate in MW-5 was lower than in co-located and shallower wells MW-1 and MW-6.
b. SO_4/Cl ratios were substantially lower than JAFAP porewater and closer to those in shallow groundwater wells.
3. The November 2019 sulfate concentration should be considered an anomaly since it is two orders of magnitude higher than historical data.</td><td>1. The SSI exceedance can be attributed to a substantially lower purge rate and volume than used during background sampling to establish SSI benchmarks.
2. November 2019 data, obtained with the lower purge rate, combined with a low groundwater table elevation, is likely due to natural variation within the Upper Connellsville Sandstone formation and not the JAFAP, as evidenced by:
a. Ca/Cl and B/Cl ratios indicate the 11/11/2019 sample from MW-1804A cannot be explained by mixing with JAFAP porewater and is best explained by natural variation within the Upper Connellsville Sandstone/SRF aquifer.
b. Mixing between historical MW-1804A groundwater with groundwater of a composition similar to MW-1806A is supported by conservative element (B, Cl, F) concentrations.
3. The November 2019 sulfate concentration should be considered an anomaly since the anomalous concentration does not correspond to increases in other elements that would suggest mixing with JAFAP porewater.</td></tr>
</table>

An ASD Type III – Statistical evaluation cause could also be the reason for SSIs in the November 2019 detection monitoring event. SSI benchmarks were established over approximately a seven-month period preceding two quarters of detection monitoring. The November 2019 event was the second of two monitoring events following establishment of SSI benchmark values. The eight-month period does not fully capture seasonal and annual weather variations, and future reevaluation of benchmarks may be required to ensure a background data set which accurately reflects the natural variation in groundwater chemistry across the hydrogeologic units surrounding the JAFAP.

In addition to ASD Type I – Sampling Causes and ASD Type III – Statistical Evaluation Causes, the following potential contributing alternative sources were identified:

MW-5

- ASD Type V – Alternative sources (Natural). Historical groundwater geochemistry data for MW-5 show that it is screened close to a mixing zone between low TDS and comparatively young recharge water and high TDS and comparatively ancient connate brine. Regionally, the mixing interface between these two disparate water types is known to be only a few feet thick. The two water types constitute two natural groundwater sources with distinct groundwater geochemistry that may periodically contribute water to the saturated zone within the MW-5 screen/sand pack zone.

MW-1804A

- ASD Type IV – Natural Variation (precipitation and geology). The highest rainfall on record for West Virginia occurred during 2018, which coincides with the period where 75 percent of the values were obtained to establish SSI benchmarks and when water levels were first measured in MW-1804A.
    - Water levels in MW-1804A collected during establishment of SSI benchmarks spanned the overburden-bedrock interface.
    - The lowest water level on record for MW-1804A occurred during November 2019 and was nearly 2.5 feet lower than the overburden/bedrock interface.
    - Water quality variations associated with different water bearing zones exposed to the saturated zone in MW-1804A conceivably contributed to differences in groundwater geochemistry during the November 2019 sampling event compared to the eight background events sampled during a seven month period during the wettest year on record in West Virginia.

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Tables

Table 1
Screened Interval of Monitoring Wells
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos Plant, Winfield, WV
November 2019

Well/ Boring	Hydraulic Location	Hydrolitho-stratigraphic Unit	Surface Elevation (ft amsl)	Screened Interval (ft amsl)	Sand Pack Interval (ft amsl)	Geologic Formation
MW-1807A	Upgradient/ Background	SRF	861.99	766.99 – 746.99	745.99 – 769.99	Unnamed clay shale/ Lower Connellsville SS
MW-1808A	Upgradient/ Background	SRF	857.55	733.73 – 748.35	746.55 – 776.55	Unnamed clay shale/ Lower Connellsville SS
MW-1809A	Upgradient/ Background	SRF	738.09	666.09 – 681.09	664.09 – 683.69	Clarksburg Shale
MW-1810A	Upgradient/ Background	SRF	735.26	655.26 – 675.26	653.26 – 681.26	Clarksburg Shale
MW-1	Downgradient	SRF	647.57	587.57 – 606.47	569.47 – 609.57	Birmingham Shale
MW-2	Downgradient	SRF	645.20	540.20 – 549.10	534.20 – 560.50	Birmingham Shale
MW-5	Downgradient	SRF	648.03	537.03 – 546.43	535.93 – 557.03	Birmingham Shale /Grafton SS
MW-6	Downgradient	SRF	647.50	614.00 – 619.00	613.30 – 620.30	Morgantown SS/ Birmingham Shale
MW-7	Downgradient	U/SRF	953.00	823.00 – 843.00	820.50 – 845.00	Conemaugh Shale/ Upper Connellsville SS
MW-8	Downgradient	U/SRF	963.01	800.01 – 819.01	797.01 – 821.21	Conemaugh Shale/ Upper Connellsville SS
MW-9	Downgradient	U/SRF	944.66	805.56 – 824.56	804.56 – 824.56	Conemaugh Shale/ Upper Connellsville SS
MW-1801A	Downgradient	U/SRF	901.12	826.12 – 846.12	824.12 – 849.12	Conemaugh Shale/ Upper Connellsville SS
MW-1804A	Downgradient	U/SRF	858.53	811.03 – 831.03	809.53 – 838.63	Conemaugh Shale/ Upper Connellsville SS/ Unnamed clay shale
MW-1806A	Downgradient	U/SRF	889.63	809.23 – 829.23	808.63 – 832.63	Conemaugh Shale/ Upper Connellsville SS/ Unnamed clay shale

--- = Boring advanced below the coal interval
~ = Approximate
ft = feet
amsl = above mean sea level
U=Upper Connellsville Sandstone
SRF=Stress Relief Fracture System
SS=Sandstone

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Table 2
Multi-Port Piezometer STN-12-4 Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos Plant, Winfield, WV
November 2019

Multi-Port Interval	Sampling Date	Major Ions					Minor Ions						TDS	pH
		Bicarbonate	Calcium	Chloride	Magnesium	Sulfate	Boron	Bromide	Fluoride	Molybdenum	Potassium	Sodium	TDS	pH
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	SU
1	9/29/2017	630	182	13	41.7	151	10.1	--	2.2	--	--	75.6	810	--
2	9/28/2017	181	84.9	15.8	23.1	129	2	--	0.78	--	--	10.2	394	--
3	9/28/2017	108	69.2	16.3	11.9	146	3.36	--	2	--	--	16.1	344	--
4	9/28/2017	187	103	24.3	25.3	164	4.48	--	5.43	--	--	23.5	458	--
5	9/28/2017	62	122	39.5	22.9	280	5.23	--	7.3	--	--	15.7	582	--
6	9/28/2017	44	134	35.9	3.59	341	6.79	--	2.71	--	--	38.5	612	--
7	9/28/2017	51	168	46.4	29.3	409	9.05	--	6.28	--	--	19.9	740	--
GeoMean	September 2017	118.1	117.1	24.5	18.3	210.3	5.2	--	3.0	--	--	23.1	539.2	--
1	12/12/2017	597	170	12.8	22.6	152	9.63	--	2.16	--	--	20.1	816	--
2	12/12/2017	122	30.7	3.98	19.9	1.4	0.169	--	0.24	--	--	12.6	174	--
3	12/12/2017	102	34.5	6.18	3.06	28.1	0.698	--	0.46	--	--	33.7	224	--
4	12/11/2017	185	91.9	22.5	25.1	156	3.98	--	5.2	--	--	16.2	446	--
5	12/11/2017	67.1	105	38.1	38.5	268	4.5	--	7.05	--	--	66.6	550	--
6	12/11/2017	50.6	122	36.3	6.36	351	6.02	--	2.62	--	--	6.01	608	--
7	12/11/2017	49.6	143	45.6	6.81	435	7.67	--	6.14	--	--	7.42	774	--
GeoMean	December 2017	112.7	84.3	17.2	12.8	87.1	2.7	--	2.0	--	--	17.0	448.9	--
1	11/15/2018	360	58.5	3.74	15.3	44.4	0.634	0.1	1.24	0.0375	8.76	13.6	406	7.57
2	11/14/2018	289	67.9	1.59	17.4	20.2	0.145	0.1	0.17	0.0158	7.36	10.5	320	7.32
3	11/15/2018	181	50	0.64	12.6	8.4	<0.02	0.1	0.1	0.00892	7.6	7.78	217	7.47
4	11/15/2018	229	63.6	10.6	15.1	62.8	1.52	0.2	1.61	0.231	8.26	12.1	330	4.48
5	11/15/2018	80.4	86	35.8	17.9	229	3.98	0.508	6.38	1.62	6.34	10.6	440	7.65
6	11/15/2018	38.7	82.7	36.8	4.82	342	4.27	0.5	2.32	2.52	10.8	22.2	840	8.92
7	11/16/2018	55.8	115	40.8	19.3	332	6.83	0.502	4.45	3.17	7.83	16.1	600	8.01
GeoMean	November 2018	133.3	72.3	8.0	13.6	74.1	1.6	0.2	1.1	0.2	8.0	12.6	413.4	7.2
1	3/12/2019	392	107	7.59	26.8	74.1	2.23	0.1	1.71	0.0924	8.47	39.9	508	7.76
2	3/13/2019	281	73	5.24	19.1	27.1	0.643	<0.1	0.16	0.101	5.43	13	314	7.28
5	3/14/2019	213	75.3	10.3	19	78.2	1.25	<0.1	0.86	0.45	4.67	13.6	346	7.26
6	3/15/2019	47.4	127	37.6	3.98	346	6.67	0.548	2.46	2.5	11.2	37.8	628	9.52
GeoMean	March 2019	182.6	93.0	11.1	14.0	85.9	1.9	0.2	0.9	0.3	7.0	22.7	431.5	7.9
1	11/11/2019	627	173	15.8	36.8	141	8.47	0.311	2.05	0.146	10.4	70.8	816	7.55
2	11/11/2019	314	86.5	8.95	19.5	24.7	0.955	0.224	0.18	0.0714	6.14	12	361	7.25
3	11/11/2019	211	64.6	11.2	13.8	41.8	1.72	0.263	0.22	0.114	4.9	13.4	285	7.46
4	11/11/2019	201	83.4	20.6	20.5	109	3.95	0.423	3.79	0.551	6.01	20.4	391	7.68
5	11/11/2019	75.7	114	36.6	21.6	250	4.88	0.634	5.47	1.69	3.86	12.3	512	7.82
6	11/12/2019	47.7	132	36.8	3.7	337	7.05	0.584	2.91	2.68	10	42	632	9.26
7	11/12/2019	62	136	43.3	19.5	310	6.67	0.657	3.54	2.81	5.58	18.7	625	7.64
GeoMean	November 2019	151.9	107.4	21.2	16.4	122.5	3.9	0.4	1.5	0.5	6.3	21.7	488.5	7.8

Notes:
mg/L : milligrams per Liter
TDS : total dissolved solids
SU : standard units
- - : not analyzed
< : value less than reporting limit

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Table 3
Monitoring Well Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos, Winfield, WV
November 2019

	Collection Date	Monitoring Program	Boron	Bromide	Calcium	Chloride	Fluoride	Molybdenum	Potasium	Sodium	Sulfate	pH	TDS
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
MW-1	7/24/2018	Background	0.182	0.106	2.83	11.7	0.42	1.94	1.75	159	30.6	8.2	473
	8/28/2018	Background	0.135	0.121	2.80	11.3	0.45	1.48	1.63	168	31.6	8.5	435
	10/3/2018	Background	0.138	0.100	2.95	11.1	0.40	1.00	1.40	172	30.8	8.3	457
	10/22/2018	Background	0.180	0.100	2.36	11.4	0.42	1.00	1.49	170	30.7	8.3	434
	11/13/2018	Background	0.209	0.100	3.03	11.5	0.45	1.00	2.27	159	32.2	8.0	444
	12/19/2018	Background	0.117	0.0900	2.71	10.7	0.43	1.00	1.31	162	30.9	8.1	428
	1/23/2019	Background	0.115	0.0400	2.29	14.6	0.41	1.00	1.41	148	55.9	8.2	453
	2/19/2019	Background	0.126	0.0900	2.36	10.9	0.44	1.00	1.22	175	31.3	8.5	457
	MW-1 Intrawell Prediction Limit		**0.261**	- -	**3.58**	**14.6**	**4.85**	- -	- -	- -	**55.9**	**8.8**	**536**
	3/12/2019	Detection	0.110	0.080	2.60	11.0	0.43	- -	1.14	170.0	31.6	8.2	458
	11/8/2019	Detection	0.114	0.100	2.38	11.2	0.42	- -	1.42	165.0	33.7	8.2	461
MW-2	07/27/2018	Background	0.259	2.60	4.24	471	3.08	27.2	1.97	427	2.40	8.4	1260
	08/29/2018	Background	0.249	2.49	3.98	443	2.99	34.5	3.05	426	17.4	8.6	1310
	10/04/2018	Background	0.256	2.55	4.31	435	2.99	30.8	2.33	532	14.8	8.5	1280
	10/23/2018	Background	0.262	2.41	3.95	438	3.08	26.1	2.47	516	7.40	8.5	1250
	11/15/2018	Background	0.328	2.67	4.07	469	3.30	29.2	2.69	482	13.5	8.5	1250
	12/19/2018	Background	0.225	2.34	3.81	430	3.03	25.5	2.03	443	6.40	8.5	1250
	01/23/2019	Background	0.318	2.22	3.67	441	3.00	29.2	2.40	447	6.40	8.2	1310
	02/22/2019	Background	0.237	2.26	3.95	447	3.06	21.9	2.02	461	2.30	8.7	1310
	MW-2 Intrawell Prediction Limit		**0.382**	- -	**4.66**	**495**	**3.39**	- -	- -	- -	**26.7**	**8.9**	**1410**
	3/13/2019	Detection	2.300	2.38	3.98	441	3.02	26.2	1.86	470	1.8	8.7	1300
	11/8/2019	Detection	0.265	2.39	4.77	426	2.73	- -	2.91	481	20.1	8.5	1340
	2/11/2020	Verification	- -	- -	4.31	- -	- -	- -	- -	- -	- -	- -	- -
MW-5	7/24/2018	Background	0.252	4.69	6.75	793	3.32	36.5	3.04	777	0.2	8.1	1890
	8/29/2018	Background	0.240	4.56	6.71	780	3.33	38.4	4.59	714	0.2	8.2	1880
	10/3/2018	Background	0.276	4.67	7.03	776	3.33	35.7	3.37	742	0.1	8.1	1860
	10/24/2018	Background	0.249	4.63	7.09	811	3.44	35.1	3.40	735	<0.06	8.1	1840
	11/13/2018	Background	0.264	4.89	6.79	832	3.63	34.7	4.03	586	0.1	8.0	1880
	12/19/2018	Background	0.221	4.73	6.48	783	3.43	34.8	3.02	595	<0.06	7.9	1890
	1/23/2019	Background	0.323	4.58	5.98	782	3.36	35.0	3.80	599	<0.06	8.1	1910
	2/19/2019	Background	0.239	4.58	6.79	793	3.38	33.6	3.21	687	<0.06	8.2	1920
	MW-5 Intrawell Prediction Limit		**0.355**	- -	**7.79**	**853**	**3.72**	- -	- -	- -	**0.2**	**7.8**	**1980**
	3/13/2019	Detection	0.229	4.690	6.85	804	3.44	- -	2.78	660	0.08	8.0	1930
	11/8/2019	Detection	0.182	4.360	21.00	663	3.04	- -	6.61	571	32	8.0	1840
	2/11/2020	Verification	- -	- -	11.30	713	- -	- -	- -	- -	18.6	7.8	- -

Table 3
Monitoring Well Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos, Winfield, WV
November 2019

	Collection Date	Monitoring Program	Boron	Bromide	Calcium	Chloride	Fluoride	Molybdenum	Potasium	Sodium	Sulfate	pH	TDS
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
MW-6	7/24/2018	Background	0.120	0.168	61.0	19.3	0.22	0.580	2.73	59.0	44.4	6.9	392
MW-6	8/28/2018	Background	0.096	0.203	59.7	19.4	0.24	0.600	2.87	60.8	44.6	6.9	398
MW-6	10/3/2018	Background	0.125	0.200	60.7	18.9	0.21	0.500	2.72	62.5	43.4	6.8	402
MW-6	10/24/2018	Background	0.1	0.200	61.5	18.4	0.23	0.600	2.76	68.3	42.0	6.9	400
MW-6	11/13/2018	Background	0.111	0.200	64.9	19.8	0.24	0.700	3.24	57.4	44.6	6.7	390
MW-6	12/19/2018	Background	0.07	0.100	55.8	17.7	0.23	0.700	2.80	57.4	41.7	6.7	376
MW-6	1/23/2019	Background	0.08	0.100	54.1	17.8	0.22	0.600	2.77	54.8	41.3	6.6	411
MW-6	2/19/2019	Background	0.09	0.100	55.8	17.3	0.24	0.600	2.92	67.4	40.4	7.0	406
MW-6	**MW-6 Intrawell Prediction Limit**		**0.159**	- -	**70.6**	**21.4**	**0.26**	- -	- -	- -	**48.0**	**6.3**	**424**
MW-6	3/12/2019	Detection	0.08	0.1	57.9	17.4	0.23	- -	2.69	65.5	39.8	6.9	390
MW-6	11/8/2019	Detection	0.079	0.201	56.6	17.2	0.24	- -	2.84	66.1	41.7	6.9	368
MW-7	07/26/2018	Background	0.0870	0.0960	1.33	5.41	0.270	1.12	0.590	138	32.0	8.53	368
MW-7	08/29/2018	Background	0.112	0.0900	1.29	5.32	0.270	1.06	1.15	133	31.5	8.75	387
MW-7	10/03/2018	Background	0.156	0.100	1.44	5.23	0.260	<1.00	0.910	147	31.8	8.75	376
MW-7	10/24/2018	Background	0.0900	0.100	1.40	5.37	0.270	<1.00	0.940	154	31.7	8.82	344
MW-7	11/13/2018	Background	0.192	0.100	1.49	5.65	0.290	<1.00	1.45	135	33.2	8.36	379
MW-7	12/17/2018	Background	0.100	0.0900	1.24	5.29	0.270	<1.00	0.730	155	32.0	8.62	387
MW-7	01/23/2019	Background	0.127	0.0800	1.41	5.18	0.250	<1.00	1.04	128	32.0	8.44	389
MW-7	02/18/2019	Background	0.0600	0.0900	1.37	5.39	0.260	<1.00	0.780	154	32.1	8.96	401
MW-7	**MW-7 Intrawell Prediction Limit**		**0.248**	- -	**1.63**	**5.80**	**0.34**	- -	- -	- -	**33.6**	**9.3**	**458**
MW-7	3/13/2019	Detection	0.060	0.090	1,47	5.5	0.270	- -	0.650	162	32.5		385
MW-7	11/8/2019	Detection	0.066	0.100	2.18	5.4	0.250	- -	1.760	139	32.3	8.7	390
MW-7	2/11/2020	Verification	- -	- -	1.39	- -	- -	- -	- -	- -	- -	- -	- -
MW-1804A	7/27/2018	Background	0.672	0.5	28.1	- -	- -	136	2.45	113	- -	- -	- -
MW-1804A	8/1/2018	Background	- -	0.0400	- -	3.87	0.70	- -	- -	- -	35.2	7.4	423
MW-1804A	8/28/2018	Background	0.779	0.0800	15.9	5.27	0.84	136	2.82	157	44.7	8.3	452
MW-1804A	10/2/2018	Background	0.629	0.0400	38.8	3.63	0.61	111	3.18	118	35.7	7.9	458
MW-1804A	10/23/2018	Background	0.675	0.0500	12.9	4.79	0.78	116	1.90	167	36.9	7.6	452
MW-1804A	11/13/2018	Background	0.846	0.0600	8.90	5.32	0.91	129	1.58	187	46	7.8	498
MW-1804A	12/19/2018	Background	0.772	0.0400	10.1	4.51	0.78	130	1.91	170	40.1	7.9	433
MW-1804A	1/24/2019	Background	0.673	0.04	12.1	3.14	0.71	110	1.86	146	32.3	7.4	414
MW-1804A	2/21/2019	Background	0.611	0.04	7.43	3.29	0.89	115	1.29	164	33.8	8.0	461
MW-1804A	**MW-1804A Intrawell Prediction Limit**		**0.965**	- -	**51.20**	**6.93**	**1.10**	- -	- -	- -	**53.9**	**6.8**	**599**
MW-1804A	3/12/2019	Detection	0.568	<0.04	10.2	3.55	0.85	- -	1.37	165.0	34.0	7.9	411
MW-1804A	11/11/2019	Detection	0.730	0.203	6.8	11.20	0.64	- -	0.80	211.0	85.4	8.0	582
MW-1804A	2/12/2020	Verification	- -	- -	- -	9.59	- -	- -	- -	- -	69	7.8	- -

Table 3
Monitoring Well Water Quality Data
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos, Winfield, WV
November 2019

	Collection Date	Monitoring Program	Boron	Bromide	Calcium	Chloride	Fluoride	Molybdenum	Potasium	Sodium	Sulfate	pH	TDS
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	s.u.	mg/L
MW-1806A	7/27/2018	Background	0.164	0.0700	12.9	- -	- -	17	1.63	129	- -	- -	- -
	8/1/2018	Background	- -	0.0600	- -	17.7	0.56	- -	- -	- -	48.4	7.6	426
	8/29/2018	Background	0.162	0.0630	12.0	16.2	0.55	14.2	2.01	139	45.6	8.0	445
	10/2/2018	Background	0.15	0.04	5.81	7.21	0.80	7.73	1.31	160	36.2	8.5	435
	10/23/2018	Background	0.158	0.04	7.43	8.62	0.77	6.66	1.30	158	40.8	8.4	423
	11/13/2018	Background	0.213	0.04	7.51	8.15	0.85	7.44	1.32	159	40.1	8.1	442
	12/19/2018	Background	0.162	0.04	5.14	5.29	0.85	6.02	1.20	161	30.9	8.5	409
	1/24/2019	Background	0.168	0.0500	12.2	11.7	0.59	5.62	2.17	153	48.1	8.1	445
	2/18/2019	Background	0.133	0.04	5.67	6.24	0.81	4.74	1.14	159	33.0	8.6	460
	MW-1806A Intrawell Prediction Limit		**0.235**	- -	**18.80**	**24.60**	**1.14**	- -	- -	- -	**61.4**	**7.2**	**485**
	3/12/2019	Detection	0.130	0.040	4.98	5.51	0.83	- -	0.98	180.0	32.9	8.8	430
	11/12/2019	Detection	0.156	0.100	13.50	11.10	0.48	- -	1.78	149.0	42.8	7.9	423

Notes:

Intrawell Prediction Limits are "Lower" for pH and "Upper" for all other consitutents (AEP, 2020)

- - : not analyzed

TDS : total disolved solids

mg/L : milligrams per Liter

s.u. : standard units

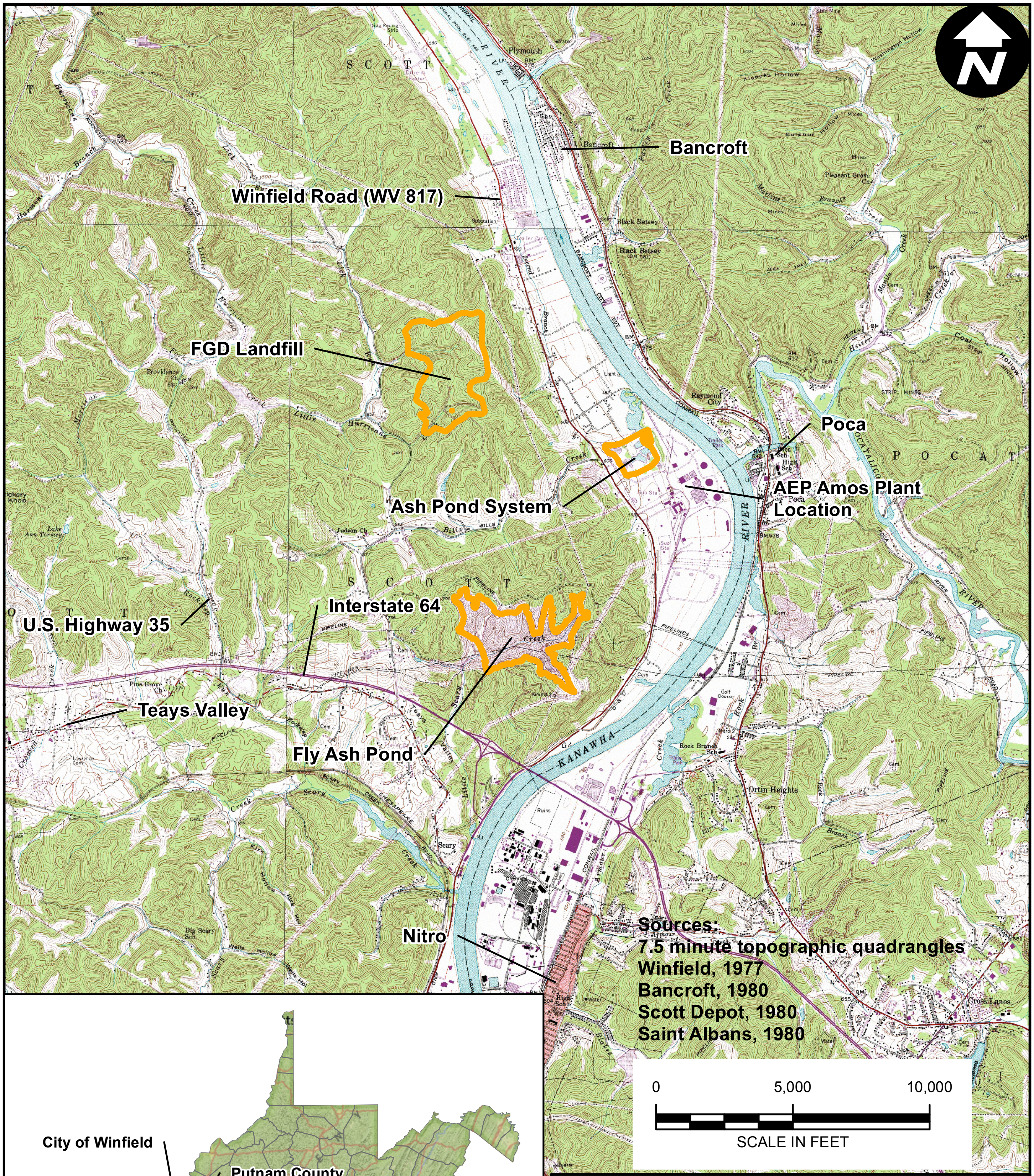
< - Non-detect value, less than the Method Detection Limit

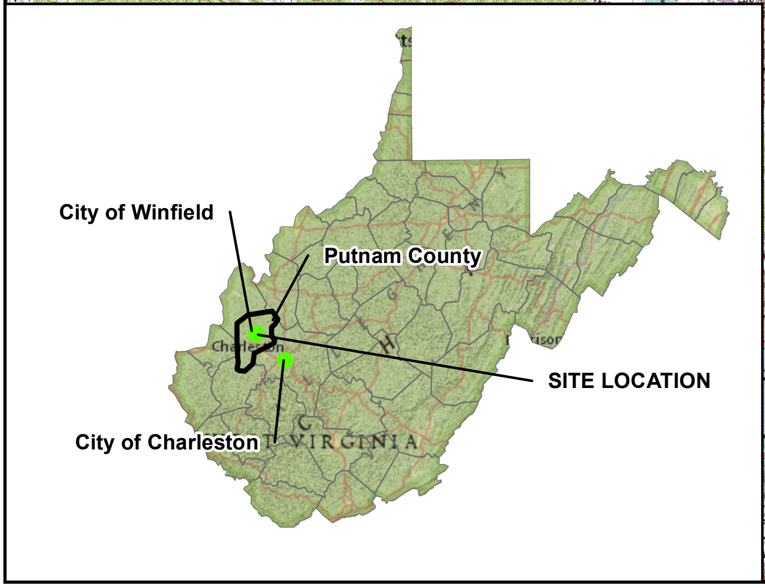
Table 4
Ion Ratios for Key Constituents in Groundwater
Fly Ash Pond Alternative Source Demonstration Investigation
AEP, John E. Amos Plant, Winfield, WV
November 2019

	Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	Sulfate	B/Cl *100	Ca/Cl	F/Cl *1000	SO_4/Cl *1000
			mg/L	mg/L	mg/L	mg/L	mg/L				
JAFAP Pore Water											
STN-12-4 Port 1	11/11/2019	Fly Ash	8.78	173	15.8	2.05	141	556	10.9	0.13	8924
STN-12-4 Port 2	11/11/2019	Fly Ash	0.959	86.5	8.95	0.18	24.7	107	9.7	0.02	2760
STN-12-4 Port 3	11/11/2019	Fly Ash	1.9	64.6	11.2	0.22	41.8	170	5.8	0.02	3732
STN-12-4 Port 4	11/11/2019	Fly Ash	4.15	83.4	20.6	3.79	109	201	4.0	0.18	5291
STN-12-4 Port 5	11/11/2019	Fly Ash	4.88	114	36.6	5.47	250	133	3.1	0.15	6831
STN-12-4 Port 6	11/12/2019	Fly Ash	7.05	132	36.8	2.91	337	192	3.6	0.08	9158
STN-12-4 Port 7	11/12/2019	Fly Ash	7.16	136	43.3	3.54	310	165	3.1	0.08	7159
Benchmark SSI Exceedences											
MW-5	11/8/2019	Detection	0.182	**21.00**	663	3.04	**32**	0.3	0.03	0.005	48
MW-1804A	11/11/2019	Detection	0.730	6.8	**11.20**	0.64	**85.4**	65	0.6	0.06	7625
Downgradient Wells											
MW-1	11/8/2019	Detection	0.114	2.38	11.2	0.42	33.7	10	0.2	0.04	3009
MW-2	11/12/2019	Detection	0.265	4.77	426	2.73	20.1	1	0.01	0.01	47
MW-6	11/8/2019	Detection	0.079	56.6	17.2	0.24	41.7	5	3.3	0.01	2424
MW-7	11/11/2019	Detection	0.066	2.2	5.4	0.25	32	12	0.4	0.05	6026
MW-8	11/8/2019	Detection	0.197	2.0	109	2.97	22.5	2	0.0	0.03	206
MW-9	11/8/2019	Detection	0.133	1.0	7.7	0.83	19.1	17	0.1	0.11	2474
MW-1801A	11/11/2019	Detection	0.229	61.6	9.76	0.12	45.3	23	6.3	0.01	4641
MW-1806A	11/12/2019	Detection	0.156	13.50	11.10	0.48	42.8	14	1.2	0.04	3856

Notes:
mg/L : milligrams per Liter
B/Cl : Boron/Chloride
Ca/Cl : Calcium/Chloride
F/Cl : Fluoride/Chloride
SO_4/Cl : Sulfate/Chloride

Appendix A Site Maps





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

SITE LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE
1

Document Path: Z:\GISProjects_ENV\AEP\Amos\mxd\Impoundment\Report\F1_ site map.mxd

LEGEND:

- Coal Combustion Residual (CCR) Unit
- Rivers and Streams
- Streamflow Direction

NOTES:
1. 2016 AERIAL IMAGERY OBTAINED FROM ESRI IMAGE SERVICE.
2. 2018 SITE SPECIFIC AERIAL IMAGERY OBTAINED FROM AEP.
3. WEST VIRGINIA 1983 STATE PLANAR COORDINATES

0 3,000 6,000 Feet

GRAPHIC SCALE

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

PLANT AND CCR UNIT LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 2

City: CITRIX Div/Group: IM/DV Created By: K.Ives Last Saved By: webb
OH015976.0009.00001 (Mountaineer Ash Pond)
Z:\GISProjects_ENV\AEP\Amos\mxd\ImpoundmentReport\F2_AmosRegionalMap.mxd 1/14/2019 9:27:48 AM

LEGEND:

- CCR Unit Boundary
- 2014 Soil and Rock Boring Location
- Oil & Gas Well
- 2008 Soil Boring and/or Rock Core
- Dewatering Well Converted to Piezometer
- Dewatering Well - Abandoned
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- 2012 Direct Push Boring with Cone Penetration Test (SCPTU)
- 2012 Direct Push Boring
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- 2012 Soil Boring with Standard Penetration Tests and Rock Core
- Rivers and Streams
- Stream Flow Direction
- Access Road

NOTES:
1. 2018 aerial imagery obtained from AEP.
2. FAP monitor well, STN boring, B-1401, and B-1402 coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer and 2008 soil boring coordinate source: AEP-provided boring logs
4. Oil and gas well coordinate source: WVDEP Oil and Gas Well Database
5. West Virginia 1983 State Planar Coordinates

0 600 1,200 Feet
GRAPHIC SCALE

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

FLY ASH POND LAYOUT AND WELL LOCATIONS MAP

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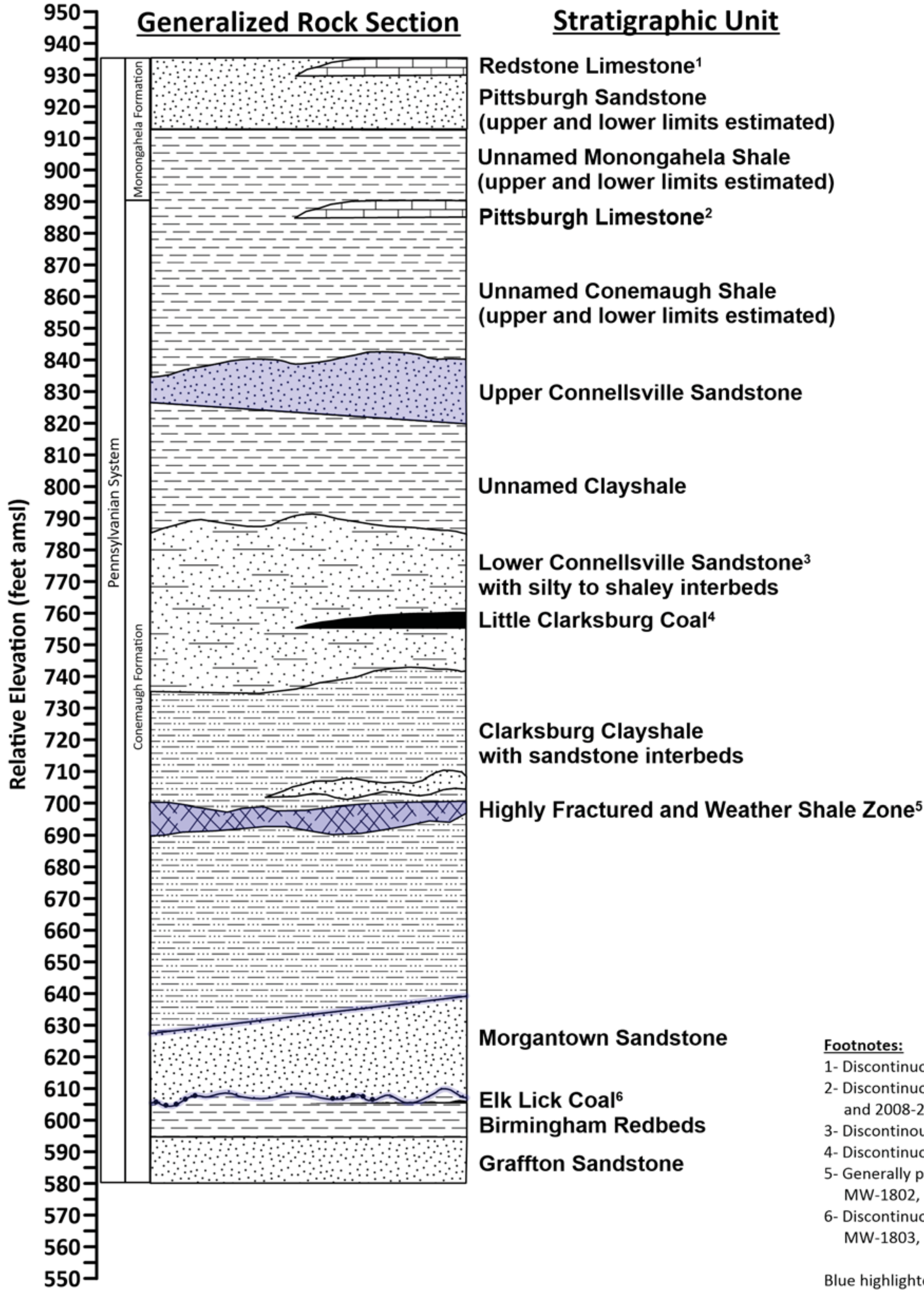
FIGURE 3

City: Div/Group: Created By: Last Saved By: acarlone
Project (Project #)
Z:\GISProjects_ENV\AEP\Amos\mxd\ImpoundmentReport\F3_Layout_WellLocations_v4.mxd 4/11/2019 10:36:50 AM

Appendix B Geologic Cross-Sections



Footnotes:

1- Discontinuous - only present at boring MW-3
2- Discontinuous - only present at borings MW-3 and 2008-26
3- Discontinous - interbeds of sandstone
4- Discontinuous - only present at boring B-0608
5- Generally present at borings MW-1801, MW-1802, MW-1803, and MW-1805
6- Discontinuous and thin - present at MW-1802, MW-1803, MW-1805

Blue highlighted areas designate groundwater-bearing fracture zones

References:

- Site stratigraphic and geophysics from current data collection and historical reports.
- Cross, A.T and M.P. Shemel. 1956. *Geology and Economic Resources of the Ohio River Valley in West Virginia, Part I Geology.* West Virginia Geological Survey Volume XXII.
- Latimer, W.J., et al. 1911. *Jackson, Mason and Putnam Counties, Volume 1, County Reports and Maps*. Wheeling News Litho. Company.
- Orsborn, N.P. 2008. *Deposition and Structural Features of the Basal Morgantown Sandstone of the Casselman Formation (Pennsylvanian) of the Greater Pittsburgh Region*. MS Thesis.
- Reger, D.B., et al. 1918. *Barbour and Upshur Counties and Western Portion of Randolph, Volume 1, County Reports and Maps.* Wheeling News Litho. Company.

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

GENERALIZED STRATIGRAPHIC COLUMN

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FIGURE
4

LEGEND:

- CCR Unit Boundary
- Stormwater Pond
- 2014 Soil and Rock Boring Location
- Oil & Gas Well
- 2008 Soil Boring and/or Rock Core
- Dewatering Well Converted to Piezometer
- Dewatering Well - Abandoned
- Downgradient Monitoring Well
- Upgradient or Background Monitoring Well
- Monitoring wells for the Ash Pond CCR Unit
- 2012 Direct Push Boring with Cone Penetration Test (SCPTU)
- 2012 Direct Push Boring
- Piezometer
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests
- 2012 Direct Push Soil Boring with Undisturbed (Shelby) Tube Samples and/or Standard Penetration Tests and Piezometer
- 2012 Soil Boring with Standard Penetration Tests and Rock Core
- Rivers and Streams
- Stream Flow Direction
- Access Road
- Cross Section Location

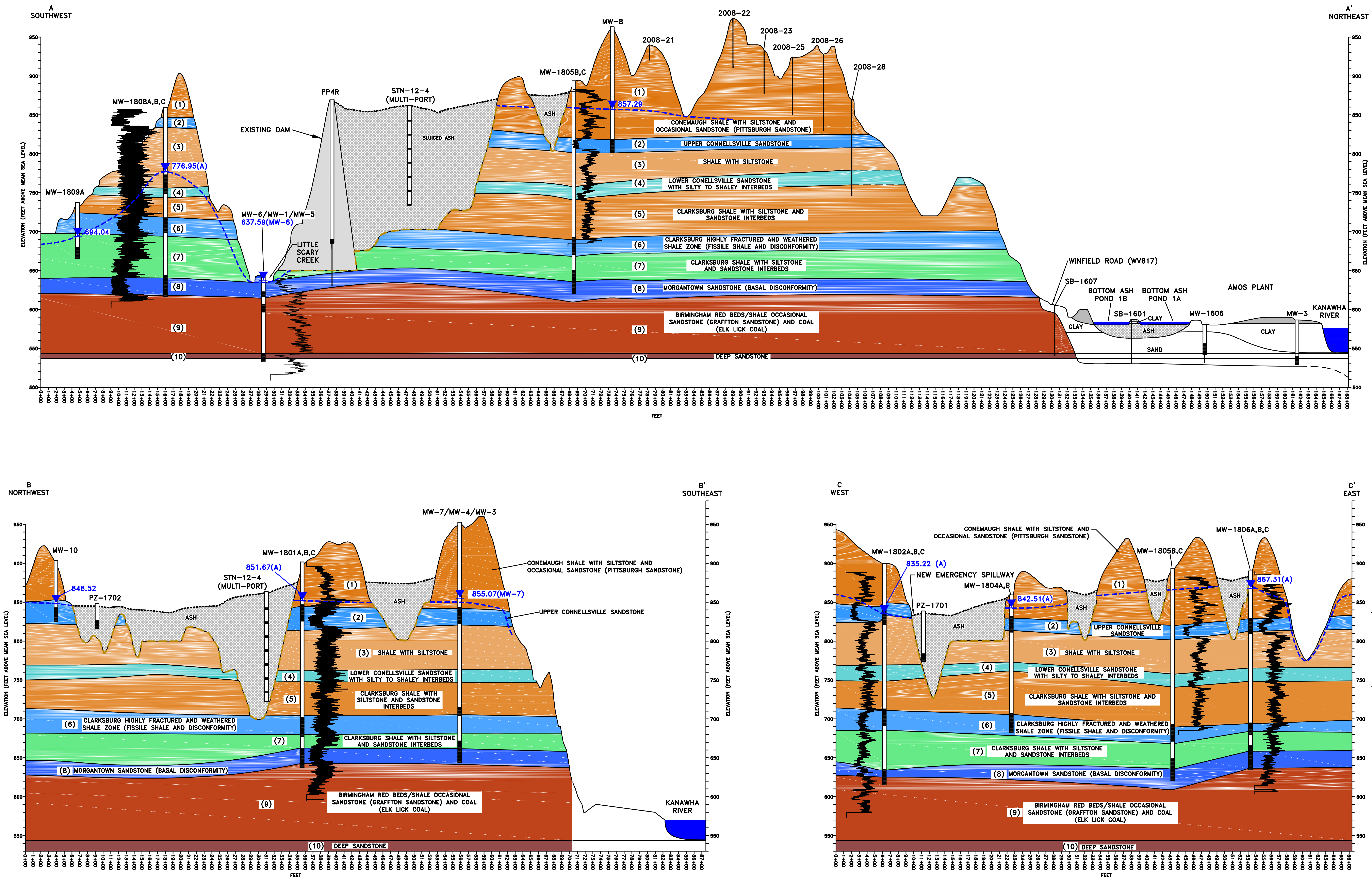
NOTES:
1. Topography from AEP dwg no. 13-30705-0 and 3dAMtopo_FAP11_aerial05.dgn. Contour Interval: 10 feet (2 feet within CCR unit boundary)
2. FAP monitor well, STN boring, B-1401, and B-1402 coordinate source: AEP Drawing No. 13-30702-1
3. FAP piezometer and 2008 soil boring coordinate source: AEP-provided boring logs
4. Oil and gas well coordinate source: WVDEP Oil and Gas Well Database
5. Amos Generating Plant monitor well, piezometer, and soil boring coordinate source: June 2016 AEP survey and EPRI, April 1999, Groundwater Quality at the John E. Amos Power Plant, Putnam County, West Virginia
6. West Virginia 1983 State Planar Coordinates
7. CSM = Conceptual Site Model

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

CROSS SECTION LOCATION MAP

ARCADIS Design & Consultancy for natural and built assets

FIGURE 5



LEGEND

MW-9 — WELL OR BORING IDENTIFICATION

- WELL
- WELL SCREEN
- BORING

CAP CONSTRUCTION (BOTTOM TO TOP):
- SUBGRADE PREPARATION (IN-PLACE FLY ASH AND ONSITE BORROW MATERIAL DEWATERING, EXCAVATING, GRADING)
- 40-MIL LINEAR LOW-DENSITY POLYETHYLENE (LLDPE) FLEXIBLE MEMBRANE LINER
- 8oz. GEOTEXTILE CUSHION LAYER
- 18 INCHES OF PROTECTIVE SOIL COVER LAYER
- 6 INCHES OF VEGETATIVE COVER LAYER
- DRAINAGE STRUCTURES
- SEEDING AND MULCHING

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) MONITORING WELL WATER LEVEL OCTOBER 22, 2018

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) POTENTIOMETRIC SURFACE

UPPERMOST AQUIFER (UPPER CONNELLSVILLE SANDSTONE AND SRF) TOP BELOW SATURATED ASH

NATURAL GAMMA LOG

0 100 200 300 COUNTS PER SECOND

(1) CONEMAUGH SHALE WITH SILTSTONE AND OCCASIONAL SANDSTONE (PITTSBURGH SANDSTONE)
(2) UPPER CONNELLSVILLE SANDSTONE
(3) SHALE WITH SILTSTONE
(4) LOWER CONNELLSVILLE SANDSTONE WITH SILTY TO SHALEY INTERBEDS
(5) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS
(6) CLARKSBURG HIGHLY FRACTURED AND WEATHERED SHALE ZONE (FISSILE SHALE AND DISCONFORMITY)
(7) CLARKSBURG SHALE WITH SILTSTONE AND SANDSTONE INTERBEDS
(8) MORGANTOWN SANDSTONE (BASAL DISCONFORMITY)
(9) BIRMINGHAM RED BEDS/SHALE OCCASIONAL SANDSTONE (GRAFFTON SANDSTONE) AND COAL (ELK LICK COAL)
(10) DEEP SANDSTONE

VERTICAL SCALE: 1" = 100'
HORIZONTAL SCALE: 1" = 1000'

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

CROSS SECTIONS A-A', B-B' AND C-C'

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FIGURE 6

CITY:(COLUMBUS, OHIO) DIV/GROUP:(ENV) DB:(R. SMITH) LD:(Opt) PIC:(Opt) PM:(T. FORTNER) TM:(Opt) LYR:(Opt)ON=*;OFF=*REF*
C:\BIM\OneDrive - ARCADIS\BIM 360 Docs\AMERICAN ELECTRIC POWER\AEP AMOS FAP\2019\WV015976.0005\01-DWG\0001E\WV015976-0005-0001E-FAP-CS01.dwg LAYOUT: CS ALL SAVED: 2/1/2019 8:34 AM ACADVER: 21.0S (LMS TECH) PAGESETUP: ---- PLOTSTYLETABLE: ACAD.CTB
PLOTTED: 2/1/2019 12:57 PM BY: SMITH, BOB
XREFS:

Appendix C MW-5, MW-1804A and STN-12-4 Boring Logs

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

COORDINATES **N 531,282.0 E 1,724,360.0**

GROUND ELEVATION **648.0** SYSTEM **STATE PLANE**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **1** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

PIEZOMETER TYPE WELL TYPE **OW**

HGT. RISER ABOVE GROUND **1.9** DIA **2.0**

DEPTH TO TOP OF WELL SCREEN **101.6** BOTTOM **111.0**

WELL DEVELOPMENT **YES** BACKFILL **QUICK GROUT**

FIELD PARTY **MCR-RLY=TJH-REB** RIG **BK-81 CME-75**

Water Level, ft	▽	▼	▼
TIME			
DATE			

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										AUGERED TO 2'		
1	SS	2.0	3.5	??-28-19	15"				GM	**GRAY ROCK FRAGMENTS, GRAVEL, SILT,** DRY, (FILL).		
									ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 3\4), Moist. AUGERED TO 7.0'		
							5					
2	SS	7.0	22.0	10-9-9	7.5"				ML	**CLAYEY SILT AND GRAVEL**, MODERATE BROWN (5YR 4\8) LIGHT BROWN (5YR 5\6 AND MODERATE BROWN (5YR 3\4), TRACE FELDSPAR, MOIST. AUGERED TO 12.0'		
							10					
3	SS	12.0	13.5	13-8-5	17"				ML	**SAME AS ABOVE**		
									CL	**SILTY CLAY**, PALE YELLOWISH BROWN (12YR 6\2) AND LIGHT OLIVE GRAY (5YR 5\2), LOW TO MEDIUM PLASTICITY, MOIST. AUGERED TO 17.0'		
							15					
4	SS	17.0	18.5	3-3-3	18"				SC	**CLAYEY-SILTY FINE SAND**, DUSKY YELLOWISH BROWN (10 YR 2\2),MOIST TO WET. AUGERED TO 22.0'		

TYPE OF CASING USED

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

Continued Next Page

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

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

RECORDER **D.BENNETT**

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER ______

COMPANY ______

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **2** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	USCS	SOIL / ROCK IDENTIFICATION	DRILLER'S NOTES
5	SS	22.0	23.2	7-7-50/3"	13"			SC	**SAME AS SAMPLE No. 4**	
								SW	**MEDIUM TO COARSE SAND**, LIGHT BLUISH GRAY (5B 7\1), MOIST.	
1	NQ	24.0	29.8		5.0	60			AUGERED TO 23.9' - AUGERED THROUGH OBSTRUCTION (ROCK?)	
							25		**MORGANTOWN SANDSTONE?**, GRAY. 24.0 - 25.0' Solid, light gray, (N-7) 25.0 - 26.0' Fractured, brown clay lined fractures, light gray (N-7). 26.0 - 27.0' Minimal fractures 27.0 - 27.7' Fractured, weathered, very fine dark gray (N-3) bedding. 27.7 - 29.8' Light gray (N-7) sandstone	25.0 Fracture = 8 26.0 Fracture = 3 26.5 Lost water 27.0 Fracture = 5
2	NQ	29.8	39.8		10.0	93	30		29.8 - 33.8' Light gray (N-7) sandstone	
									CLAY SHALE, MEDIUM GRAY (N4) MOIST, VERY SOFT.	
							35		**CLAY SHALE**, GRAYISH BROWN (5YR 3\2), MOIST, VERY SOFT.	35.2 Fracture = 3
									CLAY SHALE, LIGHT OLIVE GRAY (5Y 5\2) MEDIUM LIGHT GRAY (N6), SOFT, MODERATE WEATHERING.	36.3 Fracture = 3
									SHALE, MEDIUM BLUISH GRAY (5B 5\1), TRACE IRREGULAR BEDDING PLANES, SOFT.	37.3 Fracture = 2
3	NQ	39.8	49.8		9.8	67	40		**SAME AS ABOVE**	39.8 Fracture = 6
									SAME, WITH MODERATE BROWN (5YR 3\4) BEDDING PLANES, MEDIUM TO HIGHLY FRACTURED, MODERATE WEATHERING.	42.5 Fracture = 8
									SHALE, MEDIUM BLUISH GRAY 5Y 5\2), SLIGHT TO MODERATE WEATHERED	
							45		**CLAY SHALE**, PALE BROWN (5YR 5/2), TO DARK YELLOWISH BROWN (10YR 4/2) AND	44.6 numerous fractures.

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **3** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										LIGHT OLIVE GRAY (5YR 4/2), SOFT, SOME IRREGULAR BEDDING PLANES		
4	NQ	49.8	56.5		4.7	54	50					
												51.0 Regained drill water
							55					
5	NQ	56.5	59.8		2.55	50				**SAME EXCEPT VERY SOFT**		56.5 Fracture = 7
6	NQ	59.8	67.3		7.5	96	60			**CLAYEY SILT**, DARK YELLOWISH BROWN (10yr 4\2), MOIST - WET		
										SAME, VERY WEATHERED, SOFT		
										CLAY SHALE, PALE BROWN (5YR 5\2), SLIGHTLY WEATHERED		
							65					
										SAME, SOME MODERATELY WEATHERED, SOFT		
7	NQ	67.3	69.8		2.5	40				**SAME**, VERY WEATHERED, VERY SOFT		
										SAME, MODERATELY WEATHERED, SOFT		68.0 Fracture = 5
										SHALE, MEDIUM GRAY (N5), SOFT.		
8	NQ	69.8	78.8		6.8	64	70			**SAME**		
										CLAY SHALE, PALE BROWN (YR 5\2) AND		71.6 Fracture = 12

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JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **4** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
										MEDIUM GRAY (N5), MODERATELY WEATHERED, SOFT.		
							75					
9	NQ	78.8	79.8		1.0	40				**SHALE**, PALE BROWN (5YR 5\2) AND LIGHT OLIVE GRAY (5Y 5\2), IRREGULAR BEDDING, WEATHERED, SOFT.		78.8 numerous fracture.
10	NQ	79.8	87.8		6.3	48	80			**SAME**, SOME SEDIMENT FILLED FRACTURES		
							85					86.0 Top of seal.
11	NQ	87.8	89.8		2.0	75				**SHALE**, GRAYISH OLIVE (10 YR 4\2) AND MODERATE BROWN (5YR 3\4), INTERBEDDED LAYERS, SOFT, SLIGHTLY WEATHERED.		
12	NQ	89.8	90.8		.75	0	90			**SAME**, EXCEPT WEATHERED		
13	NQ	90.8	99.8		9.0	100				**SHALE**, MEDIUM BLUISH GRAY (5B 5\1), WITH SOME INTERBEDDED BROWNISH GRAY (5YR 4\1) COLOR, SLIGHTLY WEATHERED, SOFT		91.0 Top sand.
							95					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER

COMPANY

PROJECT **EPRI GROUND WATER STUDY - AMOS**

BORING NO. **D=MW-05** DATE **8/27/07** SHEET **5** OF **5**

BORING START **7/11/95** BORING FINISH **7/26/95**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
14	NQ	99.8	100.3		.25	0	100			**SAME**, EXCEPT WEATHERED		Lost water return on run #14.
15	NQ	100.3	109.8		9.5	95				**SHALE**, MEDIUM BLUISH GRAY 5B 5\1), SLIGHTLY WEATHERED, SOFT		101.6 Top of screen.
										SANDSTONE, MEDIUM BLUISH GRAY (5B 5\1), SLIGHTLY WEATHERED AT 104', SOFT.		
							105					
16	NQ	109.8	114.8		4.4	40	110			**SAME**, SOFT		
										SHALE, MEDIUM BLUISH GRAY (5B 5\1), SOFT.		111.0 Bottom of screen.
										SHALE, MEDIUM DARK GRAY, SOFT, WEATHERED, VERY FRACTURED.		112.0 Fracture = 7 112.1 Bottom of sand.
										CLAY SHALE, GRAYISH BROWN (5YB 3\2), WEATHERED, SOFT TO VERY SOFT, FRACTURED.		
										114.8 BOTTOM OF HOLE		114.7 Bottom of seal.

AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

COORDINATES **N 533,349.8 E 1,725,662.5**

GROUND ELEVATION **858.5** SYSTEM **NAD83/NAVD88**

BORING NO. **MW-1804A** DATE **1/11/19** SHEET **1** OF **3**

BORING START **5/21/18** BORING FINISH **5/23/18**

PIEZOMETER TYPE **NA** WELL TYPE **OW**

HGT. RISER ABOVE GROUND **3.32** DIA **2"**

DEPTH TO TOP OF WELL SCREEN **27.5** BOTTOM **47.5**

WELL DEVELOPMENT **Surge/Purge** BACKFILL **Bentonite Grout**

FIELD PARTY **Zachary Racer (AEP)** RIG **Direct Circulation - Wireline Core**

Water Level, ft	▽ 17.9	▼	▼
TIME			
DATE	7/18/2018		

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
0	NR	0.0	14.3		0				CL ML	0-14.3': No recovery - Silty CLAY overburden.		0-27.50': Riser
							5					
												7-18.90': Bentonite Seal
							10					
1	RC	14.3	24.3		120	14	15			14.3-17.1': SHALE; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; highly decomposed; moderately disintegrated, mottling; intensely fractured.		
										17.1-19.2': SANDSTONE; moderate to strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; slightly decomposed; slightly fractured.	▽	
										19.2-26.5': SHALE; weak field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly		18.90-19.90': Secondary Sand

Continued Next Page

TYPE OF CASING USED

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

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

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

RECORDER **A. Gillespie**

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power** BORING NO. **MW-1804A** DATE **1/11/19** SHEET **2** OF **3**

PROJECT **Amos Fly Ash Pond** BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	USCS	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
1	RC	14.3	24.3		120	14				bedded; moderately decomposed; moderately disintegrated, iron staining in bedded intervals and vertical fractures; moderately fractured with iron-stained vertical fractures.		Pack (Global #6) 19.90-49': Primary Sand Pack (Global #5)
2	RC	24.3	34.3		120	7	25					
										26.5-29.7': Interbedded SHALE and SANDSTONE; moderate field strength; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; slightly decomposed in some bedded intervals in the top 3' of the interval; slightly disintegrated; slightly to moderately fractured.		27.50-47.50': Slotted PVC (20-slot) Screen
							30			29.7-34.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
3	RC	34.3	44.3			NR	35			34.3-45.3': SANDSTONE; strong field strength; GLEY 6/N (Gray); fine-grained texture; thinly bedded; fresh; competent; unfractured.		
							40					
4	RC	44.4	54.4			NR	45					

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AMERICAN ELECTRIC POWER SERVICE CORPORATION

AEP CIVIL ENGINEERING LABORATORY

LOG OF BORING

JOB NUMBER **WV015976.0005**

COMPANY **American Electric Power**

PROJECT **Amos Fly Ash Pond**

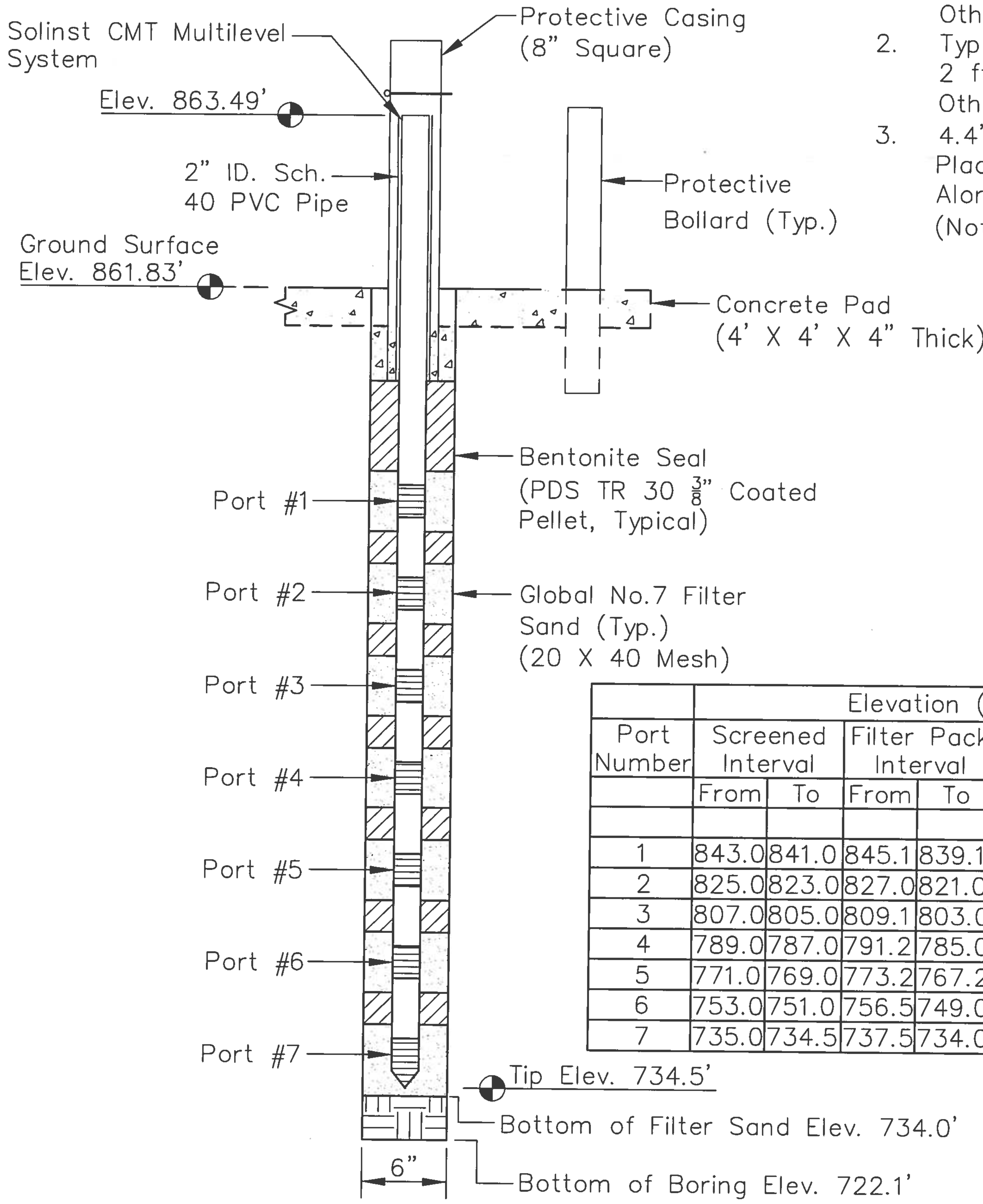
BORING NO. **MW-1804A** DATE **1/11/19** SHEET **3** OF **3**

BORING START **5/21/18** BORING FINISH **5/23/18**

SAMPLE NUMBER	SAMPLE	SAMPLE DEPTH IN FEET FROM	TO	STANDARD PENETRATION RESISTANCE BLOWS / 6"	TOTAL LENGTH RECOVERY	RQD %	DEPTH IN FEET	GRAPHIC LOG	U S C S	SOIL / ROCK IDENTIFICATION	WELL	DRILLER'S NOTES
4	RC	44.4	54.4			NR				45.3-49': SHALE; GLEY 4/N (Dark Gray); fine-grained texture; thinly bedded; moderately decomposed; slightly to moderately disintegrated, calcite layer from 46.8-46.9' bgs; moderately fractured.		
							50					
							55					
							60					
							65					
							70					

NOTES:

1. All Units Are in Feet Unless Noted Otherwise.
2. Typical Port Length is 2 ft. Unless Noted Otherwise.
3. 4.4" Dia. Centralizers Placed at 10ft. Spacing Along Well Tubing (Not Shown).



Port Number	Elevation (ft.) Screened Interval From	To	Filter Pack Interval From	To	Bentonite Seal Interval From	To
					861.5	845.1
1	843.0	841.0	845.1	839.1	839.1	827.0
2	825.0	823.0	827.0	821.0	821.0	809.1
3	807.0	805.0	809.1	803.0	803.0	791.2
4	789.0	787.0	791.2	785.0	785.0	773.2
5	771.0	769.0	773.2	767.2	767.2	756.5
6	753.0	751.0	756.5	749.0	749.4	737.5
7	735.0	734.5	737.5	734.0		

PLOT DATE: 04/27/2012 USER: JENNINGS, MATTHEW
U:\1756\175661014\ENVIRONMENTAL\DRAWING\SHEET_FILES\MONITORING WELLS\STN-12-4-WELL-LOG.DWG

LOCATION:

Northing: 531,882.29
Easting: 1,726,127.18
Ground Elevation: 861.83'
Installation Date: 3/8/12
Horizontal Datum: NAD 83
WV. South
Vertical Datum: NAVD 88

PIEZOMETER DETAIL
AEP AMOS POWER PLANT, FLY ASH DAM COMPLEX
STN-12-4, WEST VIRGINIA WELL ID WV00054-0003-12

Stantec

Stantec Consulting Services Inc.
11687 Lebanon Rd.
Cincinnati, Ohio
45241-2012
513-842-8200
www.stantec.com

DRAWN BY	MSJ	DATE	4/25/12	REVISED		SHEET
CHECKED BY	JMM	PROJ. NO.	175661014	1.	3.	1 OF 1
CHECKED BY	JSD	SCALE	NTS	2.	4.	

APPENDIX 4

Not applicable.

APPENDIX 5

Not applicable.

EPA ADDITIONAL INFORMATION REQUEST

ATTACHMENT C

AMOS PLANT LANDFILL

2020 ANNUAL GROUNDWATER MONITORING REPORT

Annual Groundwater Monitoring Report

Appalachian Power Company

John E. Amos Plant

Landfill CCR Management Unit

Winfield, West Virginia

January 2021

Prepared by:
American Electric Power Service Corporation
1 Riverside Plaza
Columbus, Ohio 43215

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I. <u>Overview</u>

This *Annual Groundwater Monitoring and Corrective Action Report* (Report) has been prepared to report the status of activities for the preceding year for an existing 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.
- Groundwater data summary tables, groundwater velocity, and flow direction maps are included in **Appendix 1**.
- The Amos Landfill (AMLF) continued in detection monitoring throughout all of 2020.
- Statistically significant increase (SSI) was confirmed at MW-5 for calcium from the November 2019 detection monitoring event which included re-sampling in February 2020 in accordance with the statistical analysis plan. Statistical analysis for this event was completed in April 2020. An alternative source demonstration (ASD) was successfully completed in June 2020. The AMLF continued in detection monitoring.
- SSI was confirmed at MW-2 for calcium for the May 2020 detection monitoring event which included re-sampling in July 2020. Statistical analysis for this event was completed in August 2020. An ASD was successfully completed in October 2020. The AMLF continued in detection monitoring.
- A detection monitoring event was conducted at the AMLF in November 2020. From the initial sampling, potential SSI's have been noted. Those are:
    - MW-4: chloride and fluoride
    - MW-1801: chloride
    - MW-1802: chloride

  A re-sampling occurred in January 2021 for the above mentioned parameters and well locations in accordance with the statistical analysis plan. Statistical analysis is ongoing. If any of the above potential SSI's are confirmed following statistical analysis, an ASD will be completed to determine if the unit can remain in detection monitoring or if it must transition to assessment monitoring in accordance with the CCR rule.
- The two additional downgradient groundwater monitoring wells that were installed at the CCR Unit in 2018 completed background sampling of eight events at the end of 2019. The additional wells were officially added to the AMLF CCR Groundwater Monitoring

Network (GWMN) in May 2020 replacing two of the previously used downgradient monitoring wells, MW-1 and MW-5. MW-1 and MW-5 remain intact for the state groundwater monitoring program. MW-1 and MW-5 were removed from the CCR GWMN due to the shallow monitoring depth not monitoring the uppermost aquifer but the shallow perched groundwater table. The CCR GWMN Report was revised and uploaded to the facility electronic operating record and the publically available website for CCR Rule compliance data and information in May 2020. Boring logs and well construction forms for MW-1801 and MW-1802 are included in that report and were included in the annual report that was completed January 31, 2020.

- Statistical analysis reports completed in 2020 for the above mentioned events (November 2019 and May 2020) are included in **Appendix 2**. The November 2020 event statistical analysis is still on-going.
- Also included in **Appendix 2** is the statistical background update for the original monitoring well network and the statistical background development for the two new wells, MW-1801 and MW-1802.
- Alternative source demonstrations completed in 2020 are included in **Appendix 3**.

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.
- 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 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). This is not applicable to this report
- 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). This is not applicable to this report.

- 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 groundwater monitoring well network was updated in 2020. MW-1801 and MW-1802 replaced MW-1 and MW-5. Additional information regarding this change to the monitoring well network can be found at https://aep.com/Assets/docs/requiredpostings/ccr/2020/AM-JEALF-GWMonitoringSystemDesignConstructionCert-052820.pdf

The monitoring well distribution adequately covers downgradient and upgradient areas as detailed in the revised *Groundwater Monitoring Network Evaluation Report*, referenced above, that was placed on the American Electric Power CCR public internet site on June 5, 2020.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-1801, MW-1802, MW-2, and MW-4.

Legend

Upgradient Sampling Location
Downgradient Sampling Location
FGD Landfill

Notes
- Monitoring well coordinates provided by AEP.

700 350 0 700 Feet

Site Layout
FGD Landfill

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2021/01/28

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_Site_Layout.mxd. ARevezzo. 1/28/2021. CHA8423/04/08.

III. Monitoring Wells Installed or Decommissioned

No monitoring wells were installed or decommissioned in 2020.

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 2020 as part of the detection monitoring program. Static water elevation data from each monitoring event in 2020 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 2019 detection monitoring samples was completed in April 2020. An SSI in the Appendix III parameter of calcium at MW-5 was documented in the April 3, 2020 *Evaluation of Detection Monitoring Data at Amos Plant's Landfill* memorandum (**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 May 2020 detection monitoring samples was completed in August 2020. An SSI in the Appendix III parameter of calcium at MW-2 was documented in the July 29, 2020 *Evaluation of Detection Monitoring Data at Amos Plant's Landfill* memorandum (**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.

The November 2020 detection monitoring samples received indicate potential SSI's at MW-4 and MW-1802 for chloride. The re-sampling event in accordance with the statistical analysis plan was conducted in early January 2021 and statistical analysis will be completed in early 2021. If any SSI's are confirmed, an ASD will be attempted. If successful, the AMLF will remain in detection monitoring. However, if unsuccessful, the AMLF will transition into assessment monitoring.

VI. Alternative Source Demonstration

An alternative source demonstration (ASD) relative to the Appendix III SSI (MW-5: Calcium) resulting from the November 2019 detection monitoring event was completed in June 2020. 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**.

An alternative source demonstration (ASD) relative to the Appendix III SSI (MW-2: Calcium) resulting from the May 2020 detection monitoring event completed in October 2020. 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 2021 pending the results of the aforementioned statistical analysis regarding the November 2020 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 2020 and Actions Taken

No significant problems were encountered. The low flow sampling effort went smoothly and the schedule was met to support the 2020 annual groundwater report preparation covering the year 2020 groundwater monitoring activities.

X. A Projection of Key Activities for the Upcoming Year

Key activities for 2021 include:

- Complete the statistical evaluation of the November 2020 detection monitoring results and subsequent verification sampling, looking for any confirmed statistically significant increases.
- Perform an ASD, if necessary, for the November 2020 detection monitoring event if any SSI's are confirmed. If the ASD if necessary and is unsuccessful, the CCR unit will transition into assessment monitoring. If it is successful or no SSI's are confirmed, the CCR unit will continue detection monitoring on a semi-annual basis.
- Respond to any new data received in light of what the CCR rule requires.
- Preparation of the 2021 annual groundwater report.

APPENDIX 1

Tables follow, showing the groundwater monitoring data collected and received in 2020 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	Sulfate	Total Dissolved Solids
		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	30.6	182
10/18/2016	Background	0.060	29.0	3.31	0.09	6.5	30.8	232
11/9/2016	Background	0.076	29.9	3.42	0.10	6.5	31.3	194
12/13/2016	Background	0.065	29.3	3.08	0.07 J	6.1	27.7	250
2/9/2017	Background	0.050	26.8	3.16	0.09	6.3	27.9	234
3/16/2017	Background	0.046	28.4	3.32	0.09	7.5	29.4	216
5/23/2017	Background	0.123	30.2	3.19	0.09	6.6	28.5	215
6/21/2017	Background	0.037	28.1	4.94	0.08	6.4	31.9	204
11/1/2017	Detection	0.047	28.7	3.08	0.10	6.4	30.2	224
5/2/2018	Detection	0.134	27.2	3.22	0.10	6.5	29.9	194
11/29/2018	Detection	0.143	26.4	3.07	0.11	6.7	27.8	191
12/18/2018	Detection	0.07 J	--	--	--	6.5	--	--
6/11/2019	Detection	0.04 J	28.1	2.86	0.11	7.0	29.9	184
11/6/2019	Detection	0.04 J	30.1	3.20	0.10	6.2	29.4	193

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

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

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
8/23/2016	Background	0.04 J	0.27	207	0.024	0.02 J	0.3	0.097	0.0848	0.09 J	0.186	0.017	< 0.002 U	0.04 J	0.9	0.01 J
10/18/2016	Background	0.04 J	0.62	206	0.050	0.03	0.627	0.306	1.24	0.09	0.567	0.017	0.002 J	0.08 J	1.4	0.05 J
11/9/2016	Background	0.04 J	0.44	210	0.036	0.03	0.564	0.200	1.001	0.10	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	0.73	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
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	12.0	362
10/17/2016	Background	0.198	1.53	4.21	1.26	9.1	11.8	354
11/8/2016	Background	0.216	1.46	4.13	1.30	8.2	11.3	378
12/13/2016	Background	0.217	1.65	2.99	1.19	8.5	7.6	350
2/8/2017	Background	0.190	1.56	2.66	1.33	8.7	7.4	374
3/14/2017	Background	0.184	1.81	3.91	1.20	8.4	7.7	354
5/23/2017	Background	0.187	1.42	4.23	1.17	8.7	8.1	354
6/21/2017	Background	0.189	1.56	3.47	1.19	8.5	7.4	356
11/1/2017	Detection	0.202	1.88	2.34	1.46	8.8	8.6	394
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	9.4	344
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	8.5	355
12/17/2018	Detection	--	--	--	--	8.6	--	--
1/24/2019	Detection	0.218	--	--	--	--	--	--
6/11/2019	Detection	0.215	1.80	3.26	1.63	8.7	9.4	379
7/22/2019	Detection	--	--	--	1.41	8.7	--	--
11/6/2019	Detection	0.203	1.73	3.44	1.66	8.6	9.5	379
2/11/2020	Detection	--	--	--	1.37	8.5	--	--
5/5/2020	Detection	0.174	2.76	5.08	1.37	8.6	7.8	368
7/7/2020	Detection	--	2.74	--	--	8.5	--	--
11/3/2020	Detection	0.179	1.69	4.31	1.45	8.8	9.0	378

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

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

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
8/23/2016	Background	0.03 J	6.57	51.8	0.129	0.14	1.3	1.02	0.904	1.34	1.24	0.009	< 0.002 U	6.04	0.2 J	0.03 J
10/17/2016	Background	0.01 J	3.94	25.7	0.040	0.005 J	0.592	0.290	0.208	1.26	0.258	0.010	< 0.002 U	3.70	0.09 J	0.067
11/8/2016	Background	0.01 J	3.54	23.7	0.02 J	< 0.004 U	0.295	0.107	0.8825	1.30	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
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	10.7	368
10/18/2016	Background	0.165	0.807	13.9	1.33	9.8	11.7	386
11/7/2016	Background	0.203	0.842	14.6	1.44	9.5	11.1	376
12/13/2016	Background	0.180	0.836	15.7	1.34	9.0	8.0	372
2/8/2017	Background	0.170	0.807	14.9	1.40	9.3	8.0	412
3/14/2017	Background	0.173	0.855	14.5	1.46	8.8	7.4	381
5/23/2017	Background	0.190	0.750	15.3	1.38	9.2	7.9	390
6/20/2017	Background	0.161	0.814	15.1	1.36	9.1	7.6	392
11/1/2017	Detection	0.194	0.766	14.2	1.36	9.4	9.3	404
1/8/2018	Detection	0.145	--	--	1.37	3.3	--	--
5/1/2018	Detection	0.199	0.783	14.9	1.47	9.2	9.0	380
11/28/2018	Detection	0.188	0.807	14.1	1.42	8.8	8.8	383
6/12/2019	Detection	0.167	0.788	14.4	1.46	8.6	9.0	415
11/6/2019	Detection	0.173	0.761	14.9	1.49	9.2	9.4	382
5/5/2020	Detection	0.150	0.790	15.2	1.37	9.2	8.4	397
11/3/2020	Detection	0.157	0.783	17.1	1.53	9.4	9.7	397

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

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

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
8/23/2016	Background	0.01 J	9.61	24.1	0.020	0.11	0.9	0.158	0.444	1.49	0.371	0.008	< 0.002 U	8.82	0.09 J	< 0.01 U
10/18/2016	Background	< 0.01 U	8.81	20.2	< 0.005 U	0.006 J	0.064	0.014	0.152	1.33	0.021	0.002	< 0.002 U	8.01	< 0.03 U	0.03 J
11/7/2016	Background	< 0.01 U	9.07	21.5	< 0.005 U	< 0.004 U	1.68	0.029	1.56	1.44	0.007 J	0.003	< 0.002 U	8.14	< 0.03 U	< 0.01 U
12/13/2016	Background	< 0.01 U	9.44	22.4	< 0.005 U	< 0.004 U	0.169	0.011	0.16	1.34	0.009 J	0.007	< 0.002 U	8.94	< 0.03 U	0.02 J
2/8/2017	Background	< 0.01 U	8.78	19.2	0.006 J	< 0.004 U	0.122	0.043	0.567	1.40	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	9.70	< 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
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	29.3	124
10/18/2016	Background	0.034	15.6	3.61	0.12	6.4	29.3	148
11/8/2016	Background	0.034	14.3	3.52	0.11	6.3	25.5	92
12/13/2016	Background	0.015	14.6	3.61	0.07	8.2	24.3	100
2/8/2017	Background	0.030	14.1	3.54	0.09	6.4	24.0	126
3/16/2017	Background	0.026	15.9	3.72	0.09	7.0	24.9	158
5/23/2017	Background	0.032	13.7	3.70	0.09	6.3	24.2	108
6/20/2017	Background	0.017	14.5	3.66	0.08	6.0	27.8	102
11/1/2017	Detection	0.046	15.6	4.09	0.09	6.1	28.4	136
1/8/2018	Detection	--	--	4.22	--	6.7	--	--
5/2/2018	Detection	0.123	14.3	4.39	0.09	6.2	26.3	122
6/20/2018	Detection	0.126	--	4.61	--	6.1	--	--
11/29/2018	Detection	0.122	14.1	4.86	0.13	7.4	24.5	113
12/17/2018	Detection	--	--	4.77	--	6.2	--	--
6/12/2019	Detection	0.02 J	16.2	4.60	0.11	6.1	26.4	132
7/22/2019	Detection	--	--	4.61	--	6.0	--	--
11/6/2019	Detection	0.03 J	18.3	5.21	0.10	6.0	28.3	131
2/11/2020	Detection	--	18.5	--	--	5.8	--	--

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

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

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
8/23/2016	Background	0.04 J	0.47	93.3	0.02 J	0.07	0.3	0.188	1.025	0.14	0.263	0.006	< 0.002 U	0.17	0.1	0.01 J
10/18/2016	Background	0.04 J	0.34	82.5	0.02 J	0.02	0.546	0.198	0.353	0.12	0.250	0.005	< 0.002 U	0.16	0.2	0.03 J
11/8/2016	Background	0.04 J	0.49	80.1	0.050	0.05	0.945	0.446	1.847	0.11	0.698	< 0.0002 U	< 0.002 U	0.14	0.1	0.01 J
12/13/2016	Background	0.04 J	0.51	80.9	0.033	0.03	0.622	0.339	1.18	0.07	0.442	0.010	< 0.002 U	0.18	0.2	0.070
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
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	41.3	408
10/19/2016	Background	0.093	39.8	7.67	0.23	7.9	51.1	438
11/7/2016	Background	0.147	42.7	7.76	0.25	7.7	51.6	426
12/12/2016	Background	0.109	44.4	8.17	0.20	7.5	54.0	414
2/7/2017	Background	0.122	36.7	7.20	0.23	7.5	31.1	380
3/16/2017	Background	0.098	37.1	7.09	0.24	7.9	29.1	388
5/22/2017	Background	0.171	33.7	6.89	0.23	7.7	24.7	359
6/19/2017	Background	0.154	37.2	7.01	0.21	7.4	33.1	386
11/2/2017	Detection	0.159	41.3	7.77	0.22	7.5	51.8	440
5/1/2018	Detection	0.163	33.4	6.94	0.26	7.4	24.7	358
11/28/2018	Detection	0.156	35.8	6.85	0.24	7.6	22.9	333
6/12/2019	Detection	0.08 J	32.8	6.85	0.28	7.7	21.9	363
11/6/2019	Detection	0.100	39.8	8.00	0.24	7.4	33.2	390
5/7/2020	Detection	0.092	37.0	6.61	0.21	7.6	14.9	349
11/4/2020	Detection	0.088	38.4	7.63	0.28	7.7	32.5	375

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

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

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.04 J	6.03	245	0.036	0.03	0.5	0.183	2.318	0.26	0.461	0.015	< 0.002 U	0.77	0.09 J	0.138
10/19/2016	Background	0.02 J	6.42	235	0.033	0.005 J	0.413	0.148	0.697	0.23	0.381	0.015	< 0.002 U	0.36	0.09 J	0.02 J
11/7/2016	Background	0.01 J	6.64	250	0.009 J	< 0.004 U	0.160	0.023	2.7	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	2.4	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
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	228	678
10/18/2016	Background	0.083	30.9	3.86	0.32	8.0	229	706
11/8/2016	Background	0.102	33.5	3.78	0.31	7.0	209	618
12/14/2016	Background	0.084	32.2	3.94	0.26	7.6	217	606
2/9/2017	Background	0.071	37.7	3.45	0.22	7.6	186	542
3/14/2017	Background	0.078	33.6	3.79	0.30	7.7	215	640
5/24/2017	Background	0.072	30.4	3.80	0.29	7.6	226	663
6/21/2017	Background	0.092	32.5	3.60	0.26	7.6	246	680
11/2/2017	Detection	0.109	31.7	3.59	0.28	7.6	211	636
5/1/2018	Detection	0.145	30.3	4.09	0.36	7.7	239	688
11/28/2018	Detection	0.118	44.4	3.65	0.26	7.4	201	627
6/12/2019	Detection	0.1 J	36.8	3.75	0.35	7.4	226	700
11/6/2019	Detection	0.099	26.6	4.15	0.34	7.5	217	655
5/6/2020	Detection	0.079	41.7	3.68	0.28	7.5	208	629
11/3/2020	Detection	0.077	37.9	3.93	0.35	7.6	247	731

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

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

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

Notes:
μg/L: micrograms per liter
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	73.6	578
10/19/2016	Background	0.037	135	12.6	0.15	7.2	66.5	538
11/9/2016	Background	0.029	137	5.12	0.07	6.9	26.1	532
12/14/2016	Background	0.017	136	14.2	0.13	6.8	59.7	504
2/8/2017	Background	0.092	132	12.9	0.15	6.9	67.5	540
3/15/2017	Background	0.074	151	13.5	0.16	7.2	74.5	623
5/24/2017	Background	0.031	137	13.9	0.14	6.8	73.2	596
6/20/2017	Background	0.034	139	12.6	0.13	6.9	77.2	574
11/2/2017	Detection	0.031	125	12.1	0.15	6.8	63.1	526
5/1/2018	Detection	0.065	136	13.1	0.17	6.9	78.8	592
11/29/2018	Detection	0.05 J	126	13.2	0.17	6.8	58.8	558
6/12/2019	Detection	0.03 J	125	8.58	0.20	7.6	54.5	540
11/6/2019	Detection	< 0.02 U	134	21.2	0.16	6.8	78.6	613
5/7/2020	Detection	< 0.02 U	115	15.3	0.15	7.0	98.4	590
11/4/2020	Detection	< 0.02 U	112	9.87	0.20	6.8	87.3	549

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

Geosyntec Consultants, Inc.

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
8/24/2016	Background	0.04 J	0.41	221	0.021	0.04	0.4	0.270	0.776	0.16	0.393	0.013	< 0.002 U	0.40	0.2	0.03 J
10/19/2016	Background	0.03 J	0.35	195	0.01 J	0.04	0.158	0.140	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
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
8/24/2016	Background	0.064	80.1	6.30	0.24	7.3	37.3	414
10/19/2016	Background	0.042	103	6.09	0.18	7.5	36.4	444
11/9/2016	Background	0.076	90.6	6.11	0.22	7.2	34.5	420
12/13/2016	Background	0.057	94.4	6.59	0.18	7.1	35.1	390
2/8/2017	Background	0.052	99.0	6.22	0.16	7.1	34.9	382
3/15/2017	Background	0.093	99.1	6.26	0.22	7.4	35.8	402
5/23/2017	Background	0.084	86.4	6.21	0.18	7.1	34.8	438
6/20/2017	Background	0.079	93.8	6.17	0.15	7.0	38.4	424
11/2/2017	Detection	0.075	79.1	5.97	0.20	7.1	33.1	404
5/1/2018	Detection	0.200	73.1	6.14	0.26	7.2	30.9	402
11/29/2018	Detection	0.09 J	78.8	6.08	0.21	7.1	31.6	412
6/11/2019	Detection	0.04 J	97.6	6.03	0.20	7.3	37.9	436
11/7/2019	Detection	0.04 J	85.8	6.11	0.19	7.3	38.2	442
5/6/2020	Detection	0.03 J	80.3	2.53	0.22	7.2	22.4	333
11/4/2020	Detection	0.056	61.5	2.73	0.30	7.1	28.4	362

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

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

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

Notes:
μg/L: micrograms per liter
mg/L: milligrams per liter
<: 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	Sulfate	Total Dissolved Solids
		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	19.1	512
10/19/2016	Background	0.081	1.09	4.49	0.72	9.6	18.0	504
11/9/2016	Background	0.118	2.31	5.46	0.92	8.9	16.9	546
12/13/2016	Background	0.076	1.24	4.15	0.38	8.7	14.1	482
2/8/2017	Background	0.113	1.37	4.24	0.57	9.1	14.4	504
3/14/2017	Background	0.125	1.18	4.60	0.50	8.7	13.3	499
5/24/2017	Background	0.081	1.16	4.19	0.43	8.9	14.3	467
6/20/2017	Background	0.078	1.04	4.11	0.44	8.6	14.9	492
11/2/2017	Detection	0.095	1.12	5.08	0.55	9.2	17.0	508
5/2/2018	Detection	0.157	1.74	5.67	0.69	9.2	16.7	522
11/29/2018	Detection	0.174	1.03	5.27	0.59	8.7	15.3	506
6/11/2019	Detection	0.08 J	1.03	5.12	0.72	9.0	16.0	524
11/6/2019	Detection	0.076	1.43	5.62	0.52	8.7	16.8	490
5/6/2020	Detection	0.074	1.25	4.90	0.60	8.6	13.0	526
11/4/2020	Detection	0.071	1.18	5.77	0.73	8.9	16.5	523

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

Table 1 - Groundwater Data Summary: MW-10
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
8/24/2016	Background	0.36	24.5	105	0.058	0.26	0.5	0.367	0.769	0.89	1.11	0.010	0.003 J	3.08	0.5	0.01 J
10/19/2016	Background	0.26	19.4	62.4	0.02 J	0.01 J	0.373	0.102	0.0283	0.72	0.357	0.008	< 0.002 U	2.58	0.4	0.082
11/9/2016	Background	0.38	21.5	144	0.264	0.05	3.96	1.66	0.168	0.92	3.41	0.007	0.004 J	2.53	1.1	0.057
12/13/2016	Background	0.63	17.1	69.8	0.029	0.20	1.63	0.212	0.0992	0.38	0.895	0.019	< 0.002 U	2.79	0.7	< 0.01 U
2/8/2017	Background	0.38	22.8	92.9	0.124	0.04	2.28	0.850	0.14643	0.57	1.89	0.008	0.003 J	2.76	1.9	0.071
3/14/2017	Background	0.32	21.2	69.0	0.039	0.01 J	0.965	0.280	2.089	0.50	0.635	0.010	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
mg/L: milligrams per liter
<: 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-1801
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
12/18/2018	Background	0.273	1.76	10.4	5.01	8.9	8.1	498
1/24/2019	Background	0.247	1.59	10.8	5.19	8.9	7.2	490
2/21/2019	Background	0.219	1.38	11.0	5.26	9.0	6.8	550
3/13/2019	Background	0.251	1.55	11.1	5.32	9.0	6.6	509
4/23/2019	Background	0.246	1.50	11.3	5.35	9.1	8.2	507
6/11/2019	Background	0.260	1.45	10.4	5.03	9.4	6.5	506
7/23/2019	Background	0.246	1.41	10.8	5.47	8.8	7.2	502
11/5/2019	Background	0.255	1.46	11.7	5.36	8.7	7.0	501
5/7/2020	Detection	0.252	1.65	11.6	4.98	8.9	6.8	541
11/4/2020	Detection	0.215	1.52	12.5	5.34	9.0	7.5	535

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-1801
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L	µg/L
12/18/2018	Background	0.30	13.5	39.3	0.113	0.07	3.30	0.876	0.816	5.01	0.966	< 0.009 U	< 0.002 U	58.4	0.3	< 0.1 U
1/24/2019	Background	0.14	11.8	34.6	0.08 J	< 0.01 U	2.56	0.436	0.983	5.19	0.544	0.032	< 0.002 U	64.5	0.2 J	< 0.1 U
2/21/2019	Background	0.14	10.4	28.7	0.02 J	< 0.01 U	0.585	0.162	0.175	5.26	0.272	< 0.009 U	< 0.002 U	66.3	0.1 J	< 0.1 U
3/13/2019	Background	0.1 J	9.02	26.6	< 0.02 U	< 0.01 U	0.463	0.143	0.58	5.32	0.116	< 0.009 U	< 0.002 U	60.8	0.05 J	< 0.1 U
4/23/2019	Background	0.14	9.95	30.9	0.02 J	< 0.01 U	0.722	0.180	0.751	5.35	0.240	< 0.009 U	< 0.002 U	69.4	0.06 J	< 0.1 U
6/11/2019	Background	0.1 J	7.80	25.4	< 0.02 U	< 0.01 U	0.336	0.120	0.208	5.03	0.09 J	< 0.009 U	< 0.002 U	61.6	0.05 J	< 0.1 U
7/23/2019	Background	0.06 J	7.95	26.2	< 0.02 U	< 0.01 U	0.229	0.092	0.569	5.47	0.07 J	< 0.02 U	< 0.002 U	62.7	< 0.03 U	< 0.1 U
11/5/2019	Background	0.04 J	7.74	25.9	< 0.02 U	< 0.01 U	0.483	0.073	0.29	5.36	0.07 J	0.00829	< 0.002 U	62.8	< 0.03 U	< 0.1 U

Notes:
µg/L: micrograms per liter
mg/L: milligrams per liter
<: 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-1802
Amos - LF
Appendix III Constituents

Collection Date	Monitoring Program	Boron	Calcium	Chloride	Fluoride	pH	Sulfate	Total Dissolved Solids
		mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L
12/17/2018	Background	0.267	0.821	8.33	4.79	9.1	20.6	482
1/25/2019	Background	0.249	0.924	8.87	4.82	9.1	20.3	451
2/21/2019	Background	0.233	0.840	8.94	4.87	9.3	20.1	532
3/13/2019	Background	0.234	0.860	9.21	4.75	9.3	18.8	477
4/24/2019	Background	0.242	0.910	9.13	5.04	9.2	21.2	478
6/12/2019	Background	0.253	0.876	9.01	4.54	9.0	19.1	476
7/23/2019	Background	0.236	0.865	8.80	5.16	9.0	20.7	476
11/5/2019	Background	0.254	0.892	9.90	4.84	8.9	19.7	460
5/7/2020	Detection	0.258	0.963	9.12	4.91	8.8	15.2	490
11/5/2020	Detection	0.223	0.974	10.7	4.89	9.2	19.0	494

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-1802
Amos - LF
Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	μg/L	pCi/L	mg/L	μg/L	mg/L	μg/L	μg/L	μg/L	μg/L
12/17/2018	Background	0.03 J	6.08	15.5	< 0.02 U	< 0.01 U	0.296	0.081	0.445	4.79	0.1 J	< 0.009 U	< 0.002 U	22.7	0.04 J	< 0.1 U
1/25/2019	Background	0.05 J	6.00	17.1	0.03 J	< 0.01 U	0.497	0.219	0.522	4.82	0.214	0.03 J	< 0.002 U	23.1	0.05 J	< 0.1 U
2/21/2019	Background	0.03 J	6.42	16.1	< 0.02 U	< 0.01 U	0.232	0.083	0.1739	4.87	0.08 J	< 0.009 U	< 0.002 U	24.9	< 0.03 U	< 0.1 U
3/13/2019	Background	0.04 J	6.28	15.2	< 0.02 U	< 0.01 U	0.269	0.074	0.0735	4.75	0.1 J	< 0.009 U	< 0.002 U	23.9	< 0.03 U	< 0.1 U
4/24/2019	Background	0.08 J	6.24	17.0	< 0.02 U	< 0.01 U	0.300	0.099	0.281	5.04	0.142	< 0.009 U	< 0.002 U	28.0	0.06 J	< 0.1 U
6/12/2019	Background	0.02 J	5.66	13.6	< 0.02 U	< 0.01 U	0.08 J	0.03 J	0.418	4.54	0.04 J	< 0.009 U	< 0.002 U	23.3	< 0.03 U	< 0.1 U
7/23/2019	Background	0.04 J	6.43	15.5	< 0.02 U	< 0.01 U	0.281	0.071	0.0519	5.16	0.1 J	< 0.02 U	< 0.002 U	26.9	0.05 J	< 0.1 U
11/5/2019	Background	0.04 J	6.37	14.6	< 0.02 U	< 0.01 U	0.273	0.04 J	0.2057	4.84	0.06 J	0.00714	< 0.002 U	26.8	0.05 J	< 0.1 U

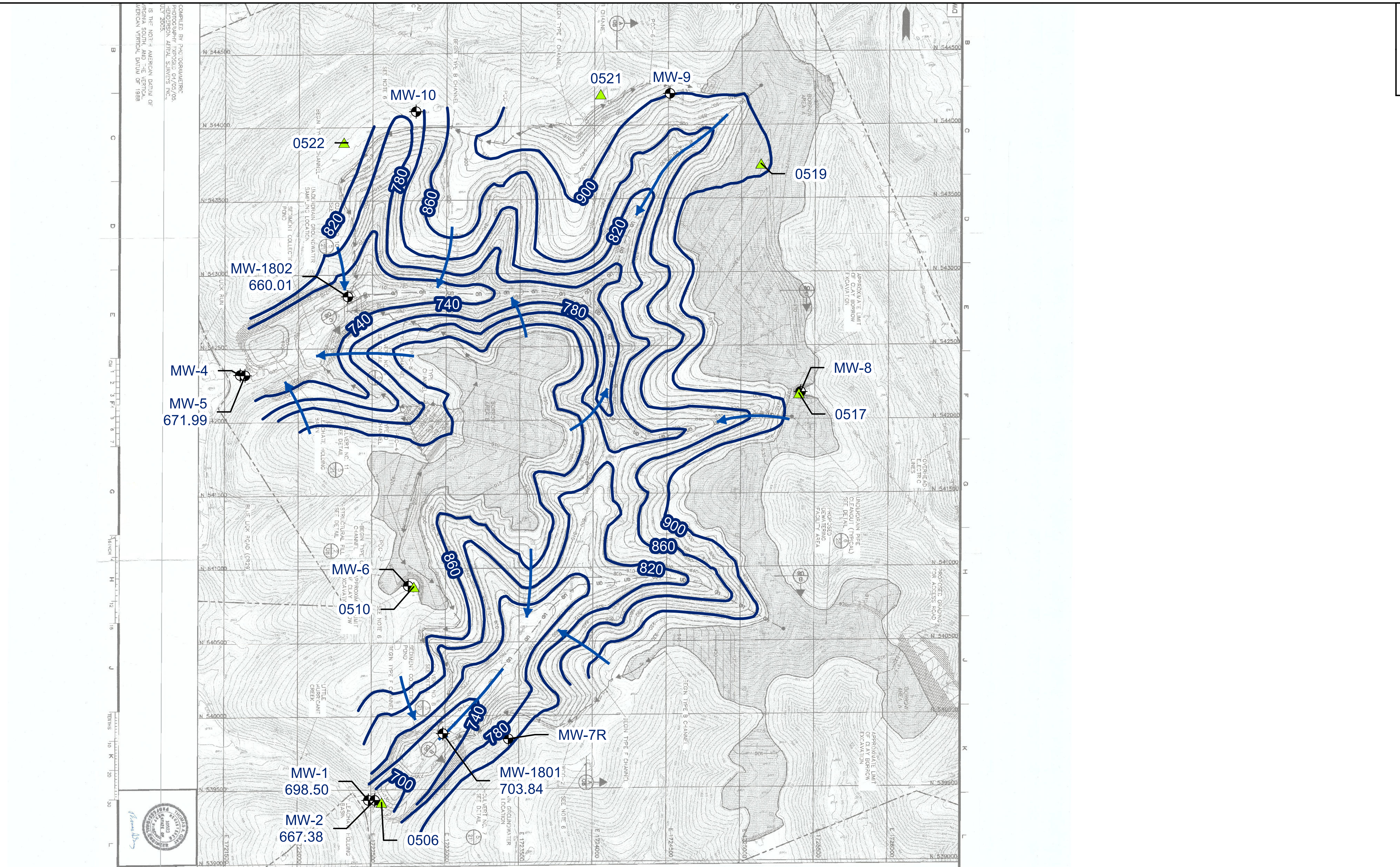
Notes:
μg/L: micrograms per liter
mg/L: milligrams per liter
<: Non-detect value. Parameters which were not detected are shown as less than the method detection limit (MDL) followed by a 'U' flag.
J: Estimated value. Parameter was detected at concentration below the reporting limit
- -: Not analyzed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

Table 2: Residence Time Calculation Summary
Amos Landfill

			2018-12		2019-01		2019-02		2019-03		2019-04	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW-1 [2]	2.0	3.1	19.4	3.1	19.4	NC	NC	NC	NC	NC	NC
	MW-2 [2]	2.0	0.6	94.6	1.2	49.5	0.6	95.2	NC	NC	NC	NC
	MW-4 [2]	2.0	NC	NC	1.7	35.3	NC	NC	NC	NC	NC	NC
	MW-5 [2]	2.0	1.9	32.7	2.0	30.1	NC	NC	NC	NC	NC	NC
	MW-6 [1]	2.0	NC	NC	1.6	37.7	NC	NC	NC	NC	NC	NC
	MW-7R [1]	2.0	NC	NC	0.9	70.5	NC	NC	NC	NC	NC	NC
	MW-8 [1]	2.0	NC	NC	2.5	24.6	NC	NC	NC	NC	NC	NC
	MW-9 [1]	2.0	NC	NC	5.7	10.7	NC	NC	NC	NC	NC	NC
	MW-10 [1]	2.0	NC	NC	0.7	81.2	NC	NC	NC	NC	NC	NC
	MW-1801 [2]	2.0	2.3	27.0	2.3	27.0	2.3	26.8	2.3	26.4	2.3	26.4
	MW-1802 [2]	2.0	2.5	23.9	2.5	24.0	2.6	23.8	2.6	23.2	2.6	23.6

			2019-06		2019-07		2019-11		2020-05		2020-11	
CCR Management Unit	Monitoring Well	Well Diameter (inches)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)	Groundwater Velocity (ft/year)	Groundwater Residence Time (days)
Landfill	MW-1 [2]	2.0	3.5	17.6	3.2	18.9	3.5	17.3	3.4	17.6	3.5	17.3
	MW-2 [2]	2.0	0.6	106	0.6	94.5	0.6	104	0.6	107	0.6	104
	MW-4 [2]	2.0	1.8	33.5	1.8	33.3	1.8	34.4	1.7	36.4	1.8	34.5
	MW-5 [2]	2.0	1.8	33.5	1.8	33.2	1.8	33.2	1.9	31.2	1.8	33.3
	MW-6 [1]	2.0	1.9	31.3	2.1	29.6	2.1	28.4	1.6	38.6	2.2	27.4
	MW-7R [1]	2.0	0.8	72.3	0.8	73.1	0.7	83.6	0.9	67.5	0.7	89.4
	MW-8 [1]	2.0	2.3	26.2	2.1	28.3	2.4	25.8	3.1	19.7	2.3	26.9
	MW-9 [1]	2.0	3.4	18.2	2.1	28.4	0.0	1,441	3.4	18.0	2.1	29.3
	MW-10 [1]	2.0	1.1	56.7	0.9	71.1	0.6	95.7	4.6	13.3	0.6	95.0
	MW-1801 [2]	2.0	2.3	26.3	2.3	26.3	2.3	26.6	2.3	26.3	2.3	26.6
	MW-1802 [2]	2.0	2.6	23.5	2.6	23.5	2.6	23.6	2.6	23.6	2.6	23.5

Notes:
[1] - Background Well
[2] - Downgradient Well
NC - Not Calculated



Legend

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

Notes

- Monitoring well coordinates and water level data (collected on December 17, 2018) 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.
- Locations without groundwater elevation data were not gauged during this event.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
December 2018

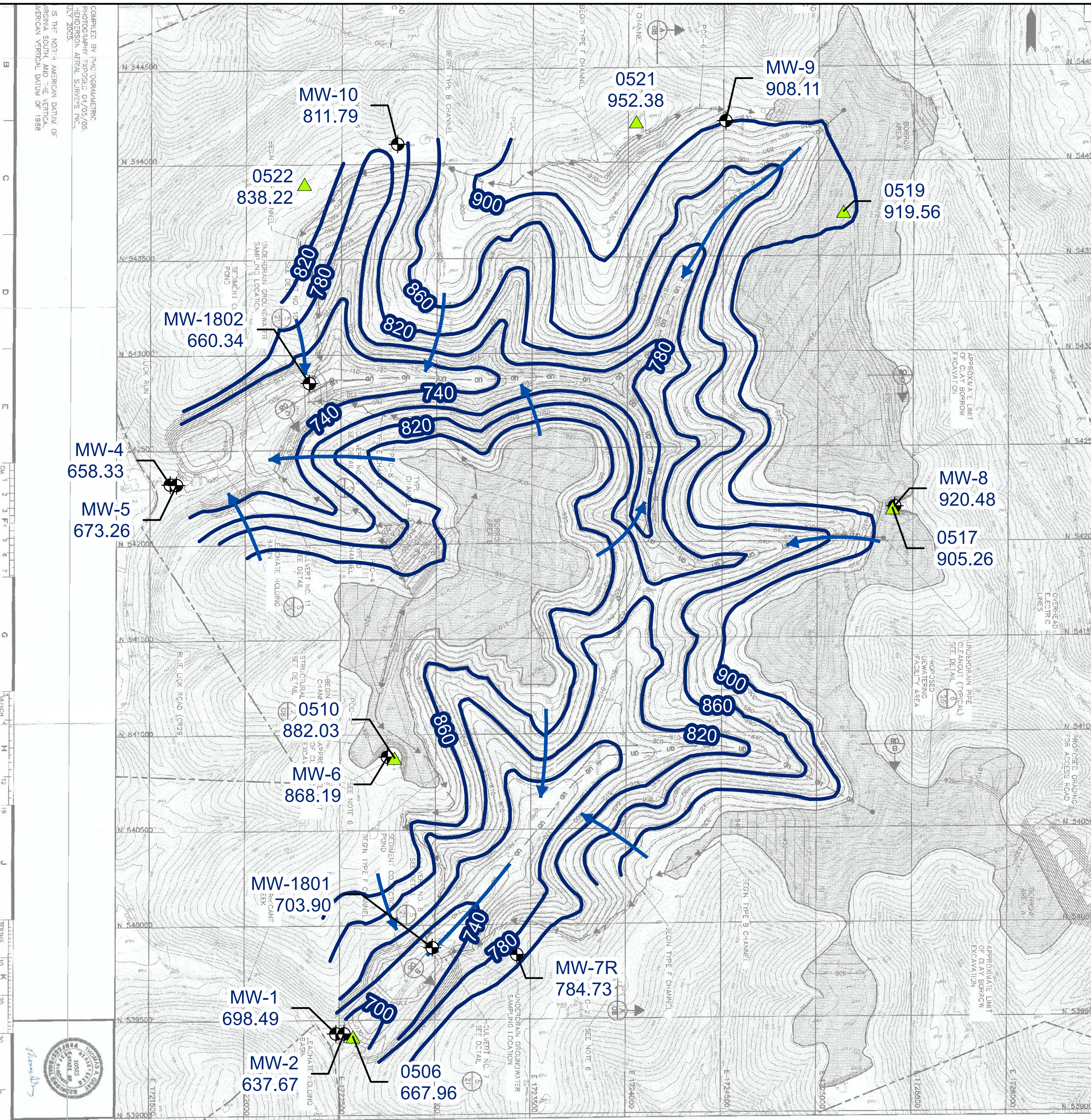
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure **2**

Columbus, Ohio | 2021/01/28

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\MW-1801 MW-1802 Background\AEP-Amos_Landfill_GW_2018-12.mxd. ARevezzo. 1/28/2021. CHA8423/04/08.



Legend

Groundwater Monitoring Well

Piezometer

Groundwater Flow Direction

Groundwater Elevation Contour

Notes

- Monitoring well coordinates and water level data (collected on January 24, 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.
- Locations without groundwater elevation data were not gauged during this event.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
January 2019

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure 3

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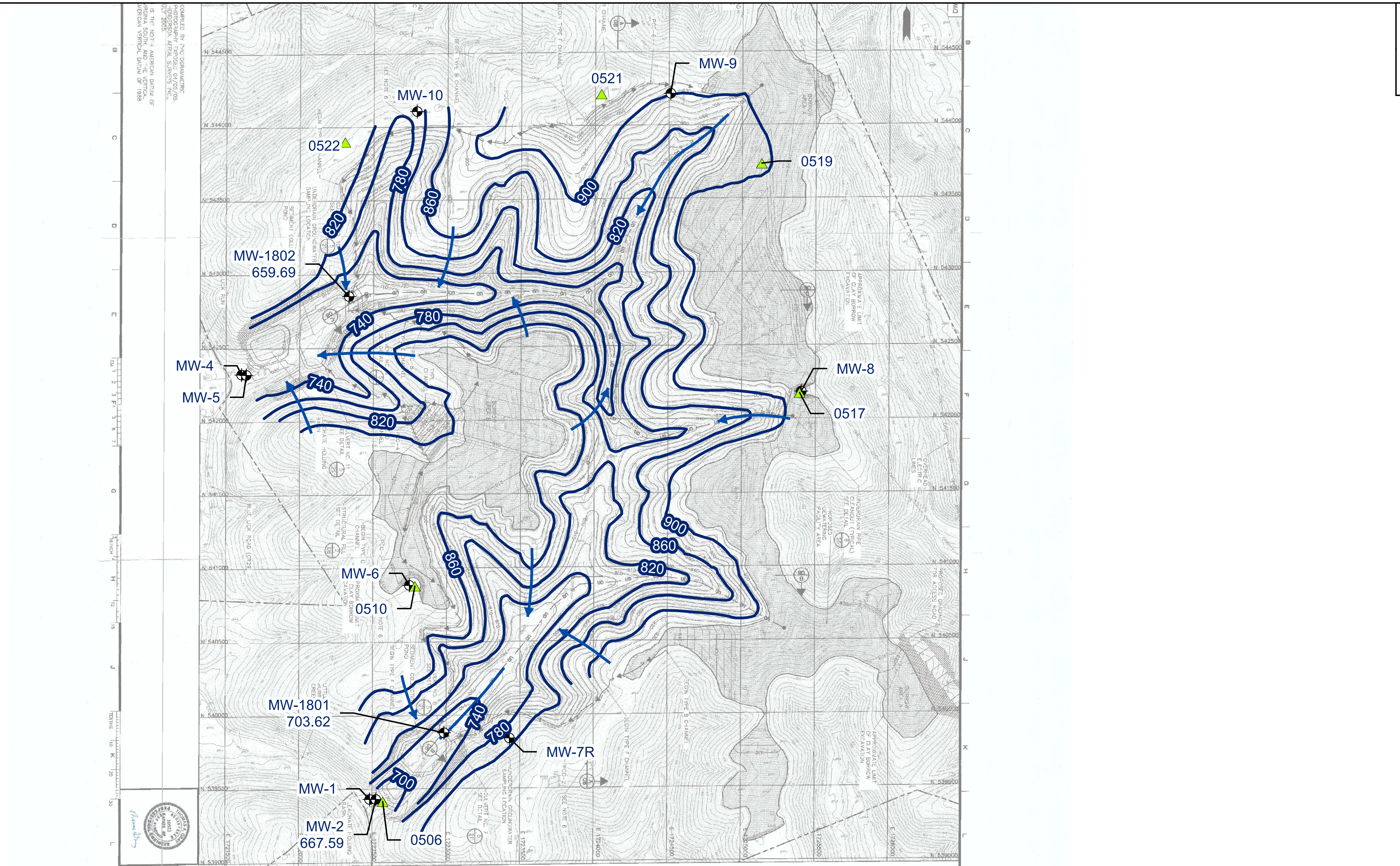
P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\MW-1801 MW-1802 Background\AEP-Amos_Landfill_GW_2019-01.mxd. ARevezzo. 1/28/2021. CHA8423/04/08.



Legend

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

Notes

- Monitoring well coordinates and water level data (collected on February 21, 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.
- Locations without groundwater elevation data were not gauged during this event.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
February 2019

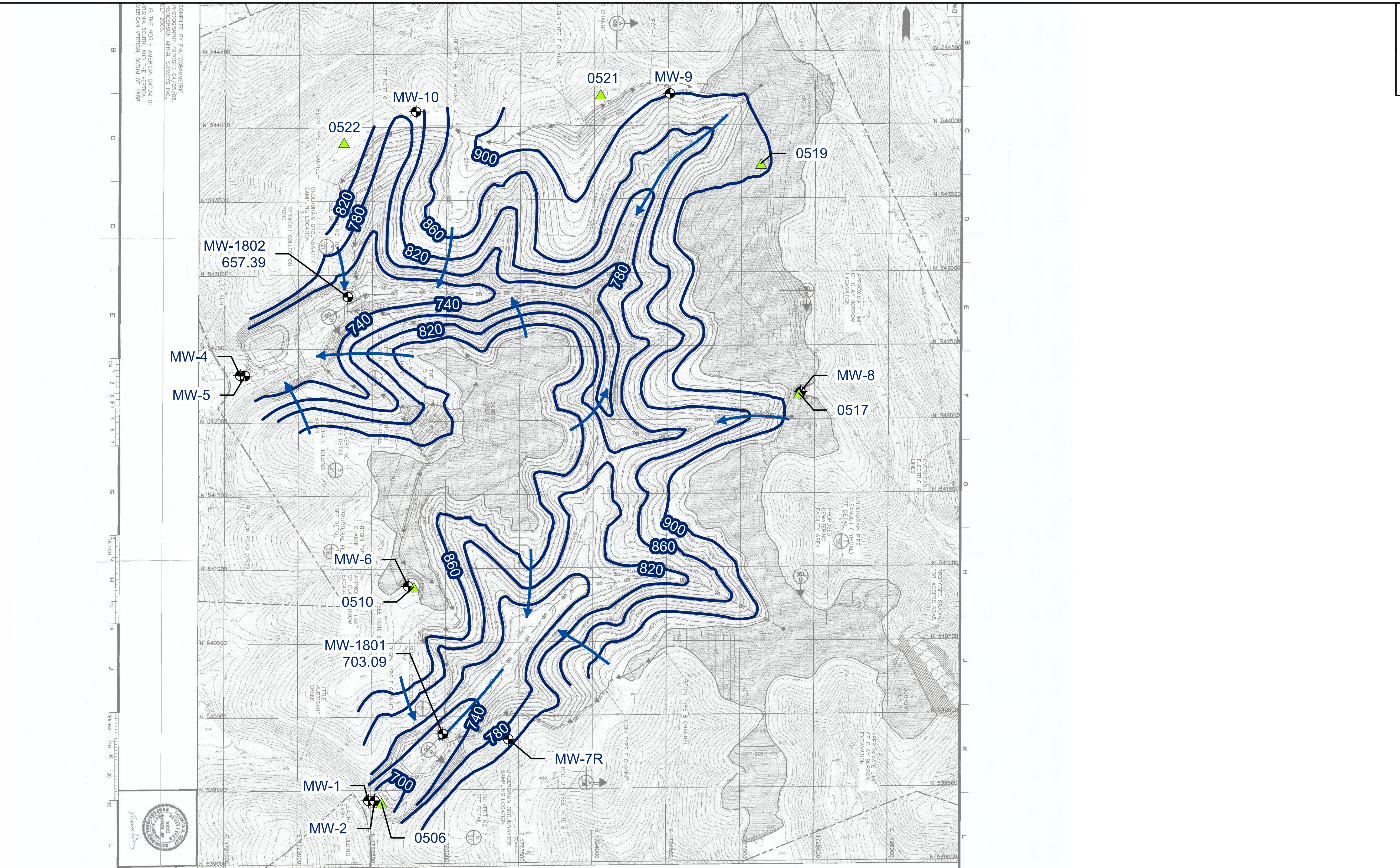
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure 4

Columbus, Ohio | 2021/01/28

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\MW-1801 MW-1802 Background\AEP-Amos_Landfill_GW_2019-02.mxd. ARevezzo. 1/28/2021. CHA8423/04/08.



Legend

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

Notes

- Monitoring well coordinates and water level data (collected on March 31, 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.
- Locations without groundwater elevation data were not gauged during this event.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer March 2019

AEP Amos Generating Plant
Winfield, West Virginia

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Figure 5

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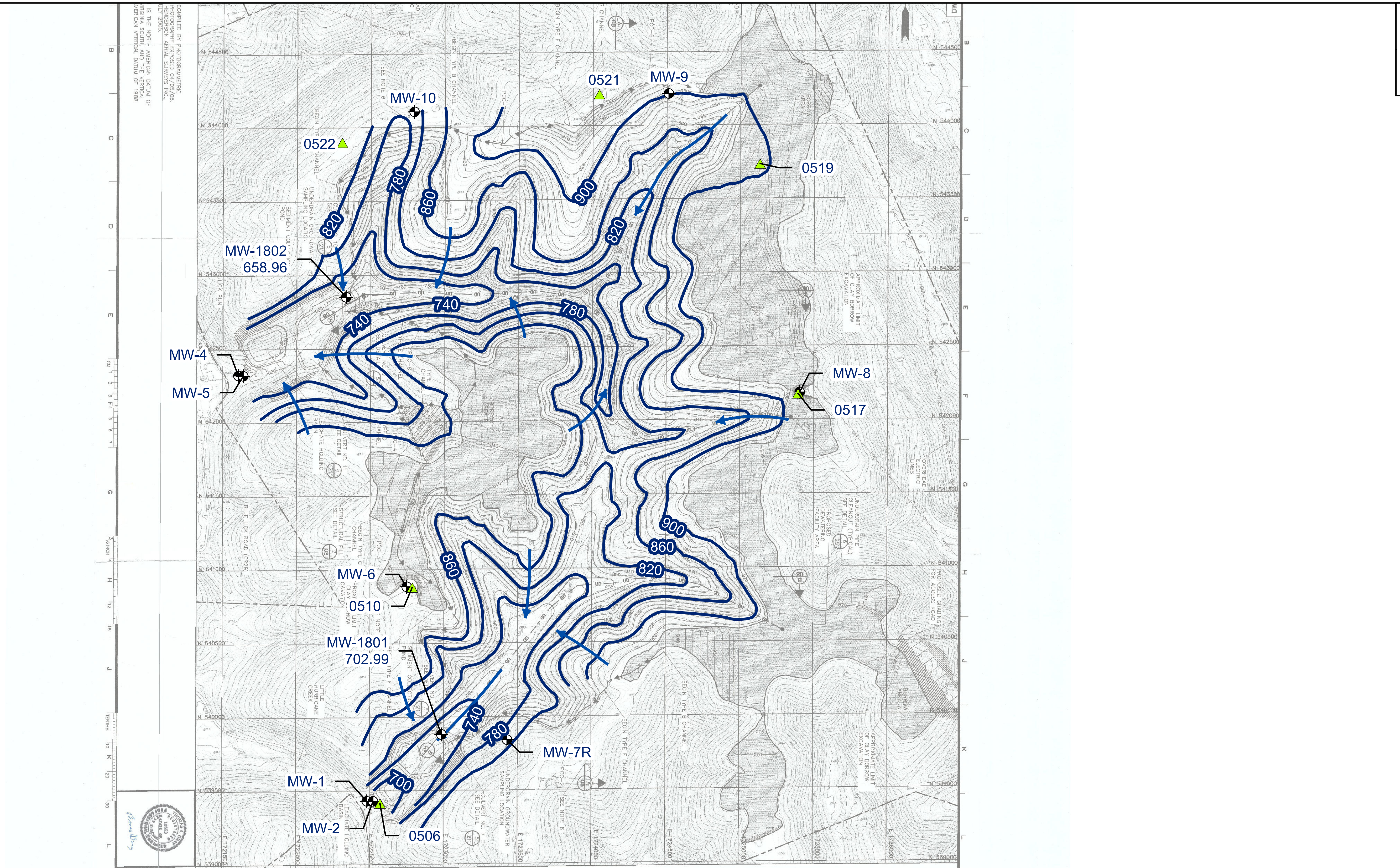


Legend

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

Notes

- Monitoring well coordinates and water level data (collected on April 23, 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.
- Locations without groundwater elevation data were not gauged during this event.

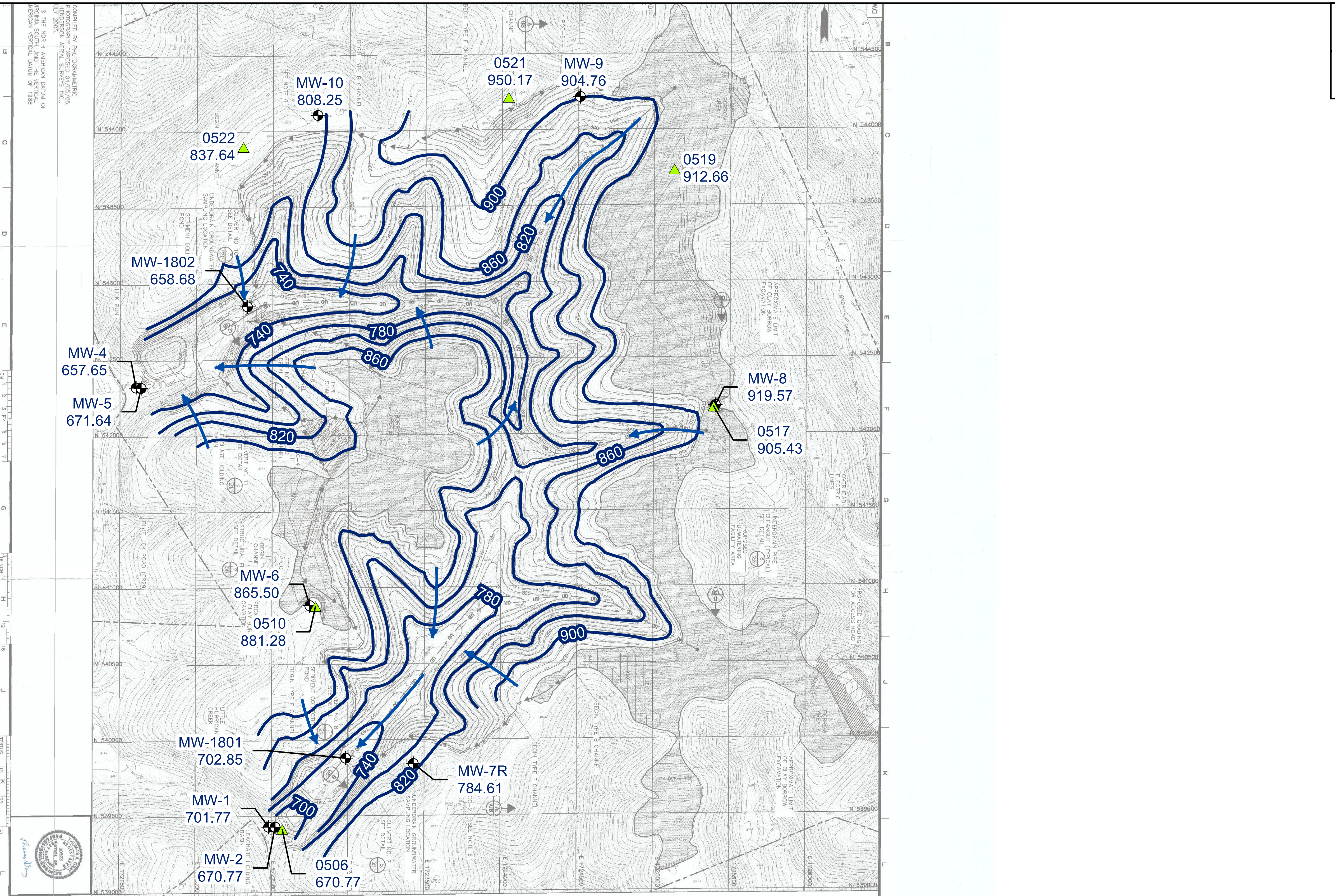
Potentiometric Surface Map - Uppermost Aquifer April 2019

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure 6

Columbus, Ohio | 2021/01/28



Legend

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

Notes

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

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer June 2019

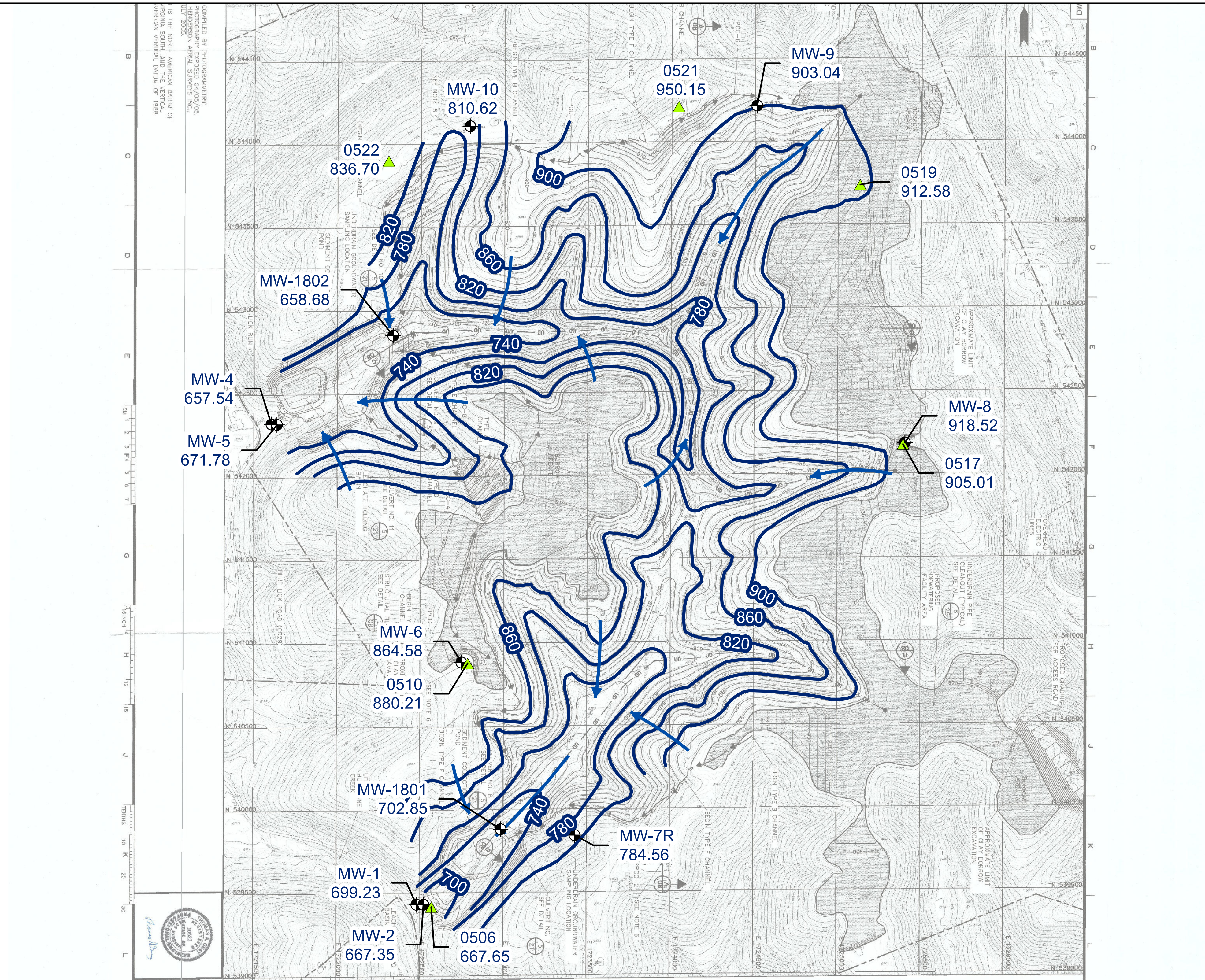
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure 7

Columbus, Ohio | 2021/02/01

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_Landfill_GW_2019-06.mxd. NWilliams. 2/1/2021. CHA8423/04/08.



Legend

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

Notes

- Monitoring well coordinates and water level data (collected on July 22, 2019) provided by AEP.
- Potentiometric surface contour interval is 40 feet.
- Topography and drainage system basemap from AEP Drawing No. 13-30500-05-A (topographic contour interval: 10 feet).
- Groundwater elevation units are feet above mean sea level.

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer July 2019

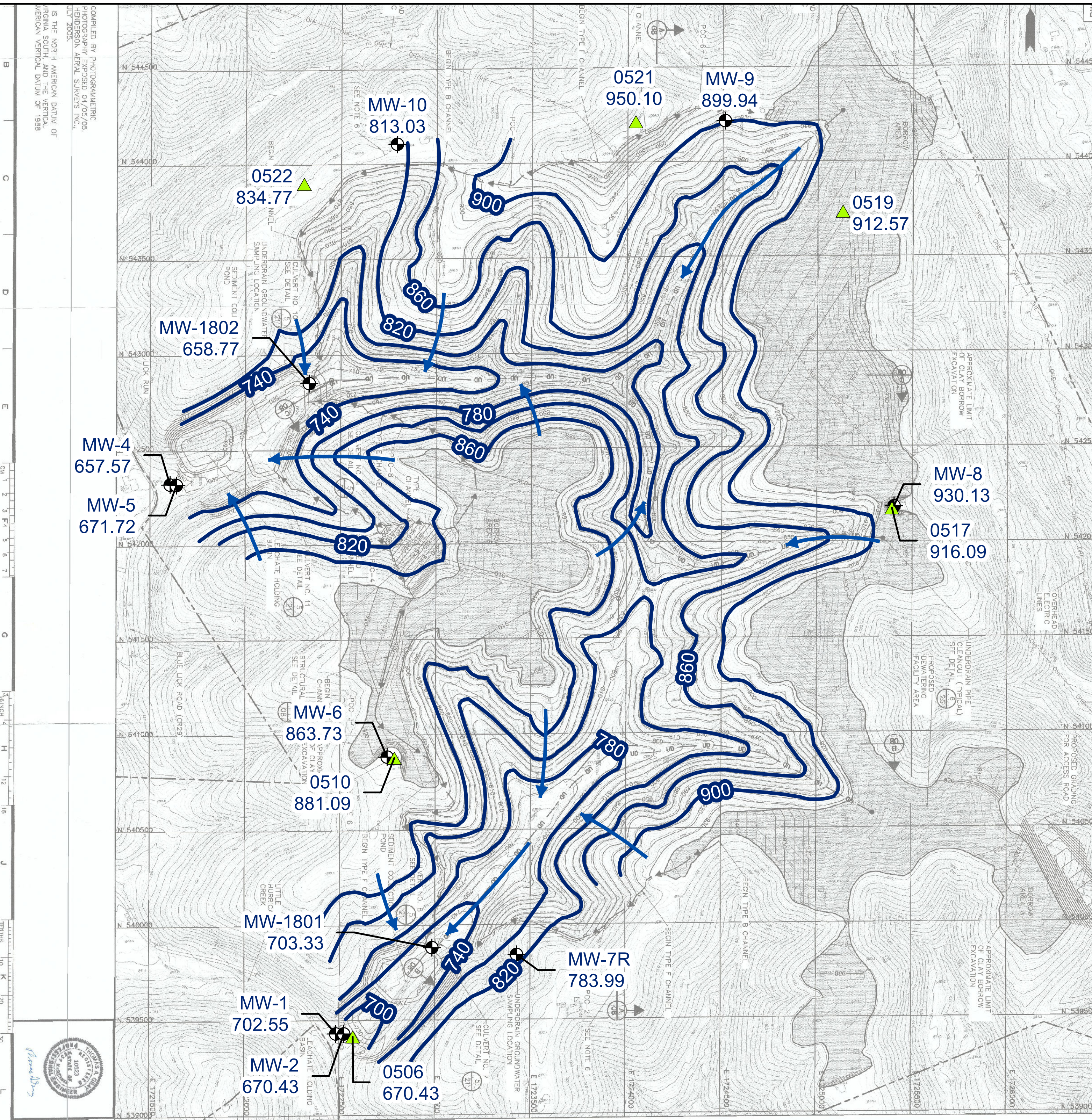
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2021/01/28

Figure **8**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\MW-1801 MW-1802 Background\AEP-Amos_Landfill_GW_2019-07.mxd. ARevezzo. 1/28/2021. CHA8423/04/08.



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

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

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer November 2019

AEP Amos Generating Plant
Winfield, West Virginia

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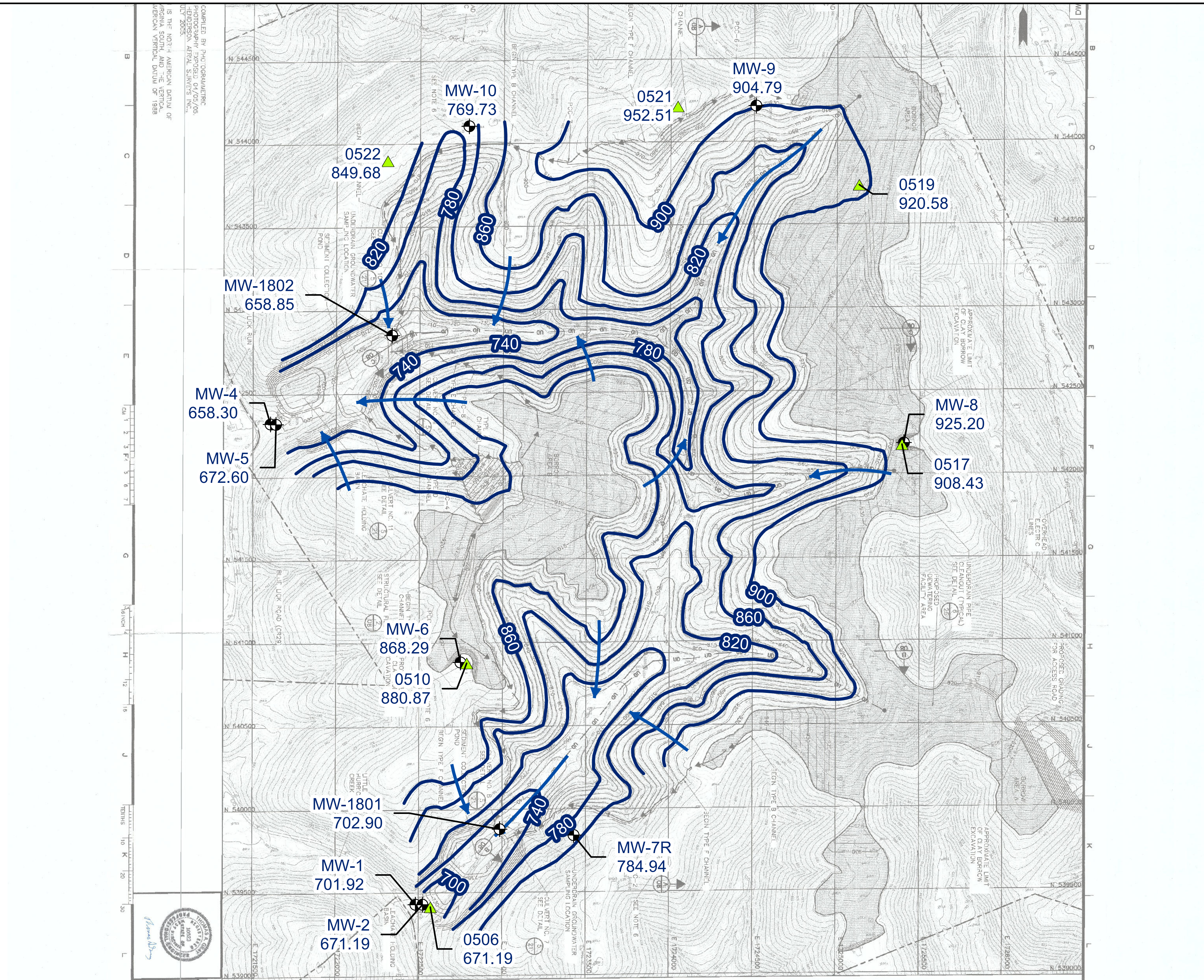
Columbus, Ohio | 2021/02/01

Figure 9

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2019\AEP-Amos_Landfill_GW_2019-11.mxd. NWilliams. 2/1/2021. CHA8423/04/08.



700 350 0 700 Feet

Legend

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

Notes

- Monitoring well coordinates and water level data (collected on May 4, 2020) 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 May 2020

AEP Amos Generating Plant
Winfield, West Virginia

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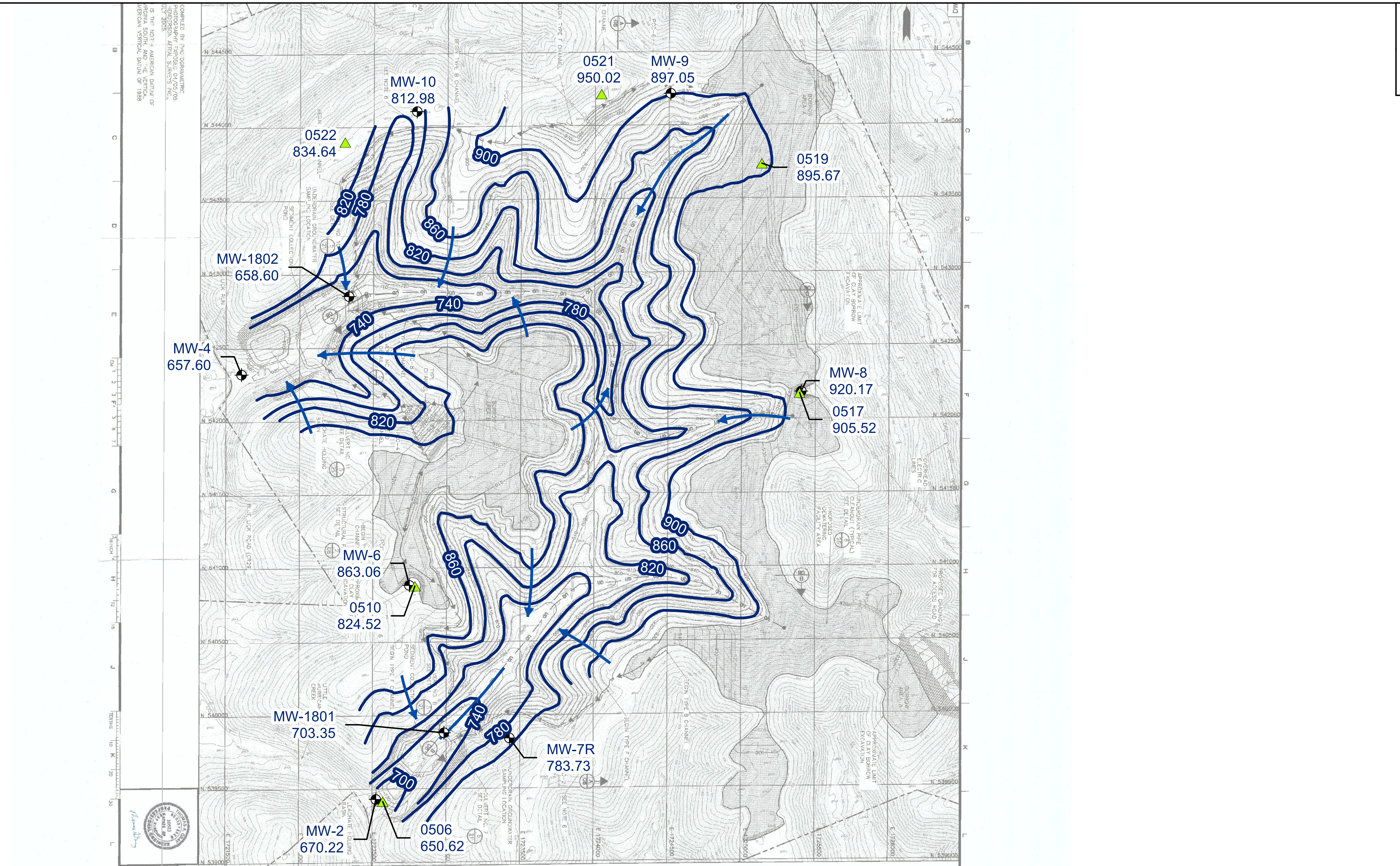
Figure 10

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2020\AEP-Amos_Landfill_GW_2020-05.mxd. NWilliams. 2/1/2021. CHA8423/04/08.



Legend

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

Notes

- Monitoring well coordinates and water level data (collected on November 2, 2020) 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 November 2020

AEP Amos Generating Plant
Winfield, West Virginia

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Columbus, Ohio | 2021/02/01

Figure **11**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2020\AEP-Amos_Landfill_GW_2020-11.mxd. NWilliams. 2/1/2021. CHA8423/04/08.

APPENDIX 2

The statistical analysis reports, background update, and background development for the monitoring wells added to the groundwater monitoring network follow.

STATISTICAL ANALYSIS SUMMARY-
Background Update Calculations
Landfill – John E. Amos Plant
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

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Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
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Columbus, Ohio 43221

February 27, 2020

CHA8473

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LIST OF ATTACHMENTS

LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LF	Landfill
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257.90-257.98, "CCR rule"), groundwater monitoring has been conducted at the landfill (LF), an existing CCR unit at the John E. Amos Power Plant located in Winfield, West Virginia.

Eight monitoring events were completed prior to June 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Four semiannual detection monitoring events were conducted between November 2017 and July 2019. Data from these four events, including both initial and verification results, were evaluated for inclusion in the background dataset. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The detection monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The compliance data were reviewed for outliers, with select values removed prior to updating upper prediction limits (UPLs) for each Appendix III parameter to represent background values. Oversight on the use of statistical calculations was provided by Dr. Kirk Cameron of MacStat Consulting, Ltd. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Previous Background Calculations

Eight background monitoring events were completed between August 2016 and June 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. The data were reviewed for outliers and trends prior to calculating upper prediction limits (UPLs) for each Appendix III parameter. Lower prediction limits (LPLs) were also established for pH. Intrawell prediction limits were selected for all parameters with a one-of-two resampling procedure. The statistical analyses to establish background levels were previously documented in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2017).

A review of groundwater geochemistry at the site identified two types of groundwater, which are referred to as Group 1 and Group 2. Group 1 groundwater is predominantly composed of sodium and bicarbonate, whereas Group 2 has notable concentrations of calcium and magnesium in addition to sodium and bicarbonate. Group 1 consists of upgradient well MW-10 and downgradient wells MW-2 and MW-4. Group 2 consists of upgradient wells MW-6, MW-7R, MW-8 and MW-9 and downgradient wells MW-1 and MW-5. As the two groups of groundwater have distinct geochemistries, the statistics for boron and fluoride were revised to an intrawell approach (Geosyntec, 2018a).

2.2 Data Validation & QA/QC

Since November 2017, four semiannual detection monitoring events have been conducted at the LF. If a possible exceedance was identified for the initial detection monitoring event, verification sampling was completed on an individual well/parameter basis to confirm or refute the exceedance. Thus, a minimum of four samples were collected from each compliance well. A summary of data collected during these detection monitoring events may be found in Table 1. Select boron values at MW-2 were excluded from the dataset, as they were likely biased high due to field sampling procedures (Geosyntec, 2018b; Geosyntec, 2019).

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) procedures including laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs) were performed by the analytical laboratory.

The analytical data were imported into a Microsoft Access database, where checks were performed to assess the accuracy of sample identification and analyte results. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.23 statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.3 Statistical Analysis

The detection monitoring data used to conduct the statistical analyses described below are summarized in Table 1. Statistical analyses for the LF were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. The complete statistical analysis results are included in Attachment B.

Time series plots of Appendix III parameters are included in Attachment B and were used to evaluate concentrations over time and to provide an initial screening of suspected outliers and trends for each Group of monitoring wells. Box plots were also compiled to provide visual representation of variations between wells and within individual wells for each grouping of monitoring wells (Attachment B).

2.3.1 Outlier Evaluation

Potential outliers were evaluated using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Data that were evaluated as potential outliers are summarized in Attachment B. Tukey's outlier test and visual inspection indicated two potential outliers in the data collected for the four most recent detection monitoring events. Next, the data were reviewed to identify possible sources of errors or discrepancies, including data recording errors, unusual sampling conditions, laboratory quality, or inconsistent sample turbidity. After further review the two values were deselected from the database prior to construction of prediction limits to allow more conservative limits. These outliers included the reported calcium value of 3.5 mg/L for the May 2018 event at well MW-2 and the reported boron value of 0.338 mg/L for the June 2018 event at well MW-2. While the reported pH value of 3.3 SU during the January 2018 sampling event at MW-4 was not identified as an outlier using Tukey's test, it was deselected from the database as it was considerably lower than other measurements within MW-4.

2.3.2 Establishment of Updated Background Levels

Analysis of variance (ANOVA) was conducted during the initial background screening to assist in identifying if intrawell tests are the most appropriate statistical approach for assessing Appendix III parameters. Intrawell tests compare compliance data from a single well to background data within the same well and are most appropriate when 1) upgradient wells exhibit spatial variation; 2) when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; or 3) when downgradient water quality is not impacted compared to upgradient water quality for the same parameter. Periodic updating of background statistical limits is necessary as natural systems continuously change due to physical changes to the environment. For intrawell analyses, data for all wells and constituents are re-evaluated when a minimum of four new data points are available. These four (or more) new data points are used to determine if earlier concentrations are representative of present-day groundwater quality.

Mann-Whitney (Wilcoxon rank-sum) tests were used to compare the medians of historical data (August 2016 - June 2017) to the new compliance samples (November 2017 – July 2019). Results were evaluated to determine if the medians of the two groups were similar at the 99% confidence level. Where no significant difference was found, the new compliance data were added to the background dataset. Where a statistically significant difference was found between the medians of the two groups, the data were reviewed to evaluate the cause of the difference and to determine if adding newer data to the background dataset, replacing the background dataset with the newer data, or continuing to use the existing background dataset was most appropriate. If the differences appeared to have been caused by a release, then the previous background dataset would have continued to be used.

The complete Mann-Whitney test results and a summary of the significant findings can be found in Attachment B. Statistical differences were noted between historic and recent chloride results at monitoring well MW-5 and fluoride results at monitoring well MW-1, both of which are in the Group 2 groundwater type. Typically, when the test concludes that the medians of the two groups are significantly different the background is not updated to include the newer data; however, the more recent concentrations noted in these wells for these constituents were similar to or lower than concentrations noted in upgradient wells. Therefore, the most recent eight samples, which are the more stable and more reflective of present-day conditions, were used to update intrawell prediction limits for chloride at MW-5 and fluoride at MW-1.

2.3.3 Updated Prediction Limits

After the revised background set was established, a parametric or non-parametric analysis was selected based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., “J-flagged” data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

Intrawell UPLs were updated using all the historical data through July 2019 to represent background values. Intrawell LPLs were also generated for pH. The only exceptions were for chloride and fluoride at MW-5 and MW-1, respectively, as described in Section 2.3.2. The updated prediction limits are summarized in Table 2.

The intrawell UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result did not exceed the UPL, a second sample was not collected. The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.4 Conclusions

Four detection monitoring events were completed in accordance with the CCR Rule. The laboratory and field data from these events were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. Mann-Whitney tests were completed to evaluate whether data from the detection monitoring events could be added to the existing background dataset. Where appropriate, the background datasets were updated, and UPLs and LPLs were recalculated. Intrawell tests using a one-of-two retesting procedure were utilized for Appendix III parameters.

SECTION 3

REFERENCES

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Geosyntec Consultants, 2017. Statistical Analysis Summary. Landfill – John E. Amos Plant. January.

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

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United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March.

TABLES

Table 1: Groundwater Data Summary
Amos - Landfill

Component	Unit	MW-1					MW-2									
		11/1/2017	5/2/2018	11/29/2018	12/17/2018	6/11/2019	11/1/2017	1/8/2018	5/1/2018	6/19/2018	9/24/2018	11/28/2018	12/17/2018	1/24/2019	6/11/2019	7/22/2019
		D-1	2018-D1	2018-D2	2018-D2-R1	2019-D1	D-1	D-R1	2018-D1	2018-D1-R1	2018-D1-R2	2018-D2	2018-D2-R1	2018-D2-R1	2019-D1	2019-D1-R1
Boron	mg/L	0.0470	0.134	0.143	0.0700 J	0.0400 J	0.202	0.251	--	0.338	0.215	--	--	0.218	0.215	--
Calcium	mg/L	28.7	27.2	26.4	--	28.1	1.88	--	3.50	1.79	--	1.84	--	--	1.80	--
Chloride	mg/L	3.08	3.22	3.07	--	2.86	2.34	--	3.90	--	--	5.09	--	--	3.26	--
Fluoride	mg/L	0.100	0.100	0.110	--	0.110	1.46	1.07	1.45	1.28	--	1.15	--	--	1.63	1.41
Total Dissolved Solids	mg/L	224	194	191	--	184	394	353	344	--	--	355	--	--	379	--
Sulfate	mg/L	30.2	29.9	27.8	--	29.9	8.6	--	9.40	--	--	8.50	--	--	9.40	--
pH	SU	6.4	6.5	6.7	6.5	7.0	8.8	8.4	8.5	8.5	--	8.5	8.6	--	8.7	8.7

Component	Unit	MW-4					MW-5							
		11/1/2017	1/8/2018	5/1/2018	11/28/2018	6/12/2019	11/1/2017	1/8/2018	5/2/2018	6/20/2018	11/29/2018	12/17/2018	6/12/2019	7/22/2019
		D-1	D-R1	2018-D1	2018-D2	2019-D1	D-1	D-R1	2018-D1	2018-D1-R1	2018-D2	2018-D2-R1	2019-D1	2019-D1-R1
Boron	mg/L	0.194	0.145	0.199	0.188	0.167	0.0460	--	0.123	0.126	0.100 U	--	0.0200 J	--
Calcium	mg/L	0.766	--	0.783	0.807	0.788	15.6	--	14.3	--	14.1	--	16.2	--
Chloride	mg/L	14.2	--	14.9	14.1	14.4	4.09	4.22	4.39	4.61	4.86	4.77	4.60	4.61
Fluoride	mg/L	1.36	1.37	1.47	1.42	1.46	0.0900	--	0.0900	--	0.130	--	0.110	--
Total Dissolved Solids	mg/L	404	--	380	383	415	136	--	122	--	113	--	132	--
Sulfate	mg/L	9.30	--	9.00	8.80	9.00	28.4	--	26.3	--	24.5	--	26.4	--
pH	SU	9.4	3.3	9.2	8.8	8.6	6.1	6.7	6.2	6.1	7.4	6.2	6.1	6.0

Component	Unit	MW-6				MW-7R				MW-8			
		11/2/2017	5/1/2018	11/28/2018	6/12/2019	11/2/2017	5/1/2018	11/28/2018	6/12/2019	11/2/2017	5/1/2018	11/29/2018	6/12/2019
		D-1	2018-D1	2018-D2	2019-D1	D-1	2018-D1	2018-D2	2019-D1	D-1	2018-D1	2018-D2	2019-D1
Boron	mg/L	0.159	0.163	0.156	0.0800 J	0.109	0.145	0.118	0.100 J	0.0310	0.0650	0.0500 J	0.0300 J
Calcium	mg/L	41.3	33.4	35.8	32.8	31.7	30.3	44.4	36.8	125	136	126	125
Chloride	mg/L	7.77	6.94	6.85	6.85	3.59	4.09	3.65	3.75	12.1	13.1	13.2	8.58
Fluoride	mg/L	0.220	0.260	0.240	0.280	0.280	0.360	0.260	0.350	0.150	0.170	0.170	0.200
Total Dissolved Solids	mg/L	440	358	333	363	636	688	627	700	526	592	558	540
Sulfate	mg/L	51.8	24.7	22.9	21.9	211	239	201	226	63.1	78.8	58.8	54.5
pH	SU	7.5	7.4	7.6	7.7	7.6	7.7	7.4	7.4	6.8	6.9	6.8	7.6

Component	Unit	MW-9				MW-10			
		11/2/2017	5/1/2018	11/29/2018	6/11/2019	11/2/2017	5/2/2018	11/29/2018	6/11/2019
		D-1	2018-D1	2018-D2	2019-D1	2018-D1	2018-D2	2018-D2	2019-D1
Boron	mg/L	0.0750	0.200	0.0900 J	0.0400 J	0.0950	0.157	0.174	0.0800 J
Calcium	mg/L	79.1	73.1	78.8	97.6	1.12	1.74	1.03	1.03
Chloride	mg/L	5.97	6.14	6.08	6.03	5.08	5.67	5.27	5.12
Fluoride	mg/L	0.200	0.260	0.210	0.200	0.550	0.690	0.590	0.720
Total Dissolved Solids	mg/L	404	402	412	436	508	522	506	524
Sulfate	mg/L	33.1	30.9	31.6	37.9	17.0	16.7	15.3	16.0
pH	SU	7.1	7.2	7.1	7.3	9.2	9.2	8.7	9.0

Notes:
mg/L: milligrams per liter
SU: standard unit
U: Parameter was not present in concentrations above the method detection limit and is reported as the reporting limit
J: Estimated value. Parameter was detected in concentrations below the reporting limit
--: Not Measured
D1: First semi-annual detection monitoring event of the year
D2: Second semi-annual detection monitoring event of the year
R1: First verification event associated with detection monitoring round

Table 2: Background Level Summary
Amos - Landfill

Parameter	Unit	Description	MW-1	MW-2	MW-4	MW-5
Boron	mg/L	Intrawell Background Value (UPL)	0.162	0.247	0.214	0.135
Calcium	mg/L	Intrawell Background Value (UPL)	31.7	2.10	0.912	18.1
Chloride	mg/L	Intrawell Background Value (UPL)	3.60	5.40	15.9	5.37
Fluoride	mg/L	Intrawell Background Value (UPL)	0.124	1.61	1.52	0.148
pH	SU	Intrawell Background Value (UPL)	7.3	9.0	10.1	8.2
		Intrawell Background Value (LPL)	5.8	8.2	8.3	6.0
Sulfate	mg/L	Intrawell Background Value (UPL)	32.8	12.9	12.2	30.7
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	259	394	422	166

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

ATTACHMENT A

Certification by a Qualified Professional Engineer

Certification by a Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the John E. Amos Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER

Printed Name of Licensed Professional Engineer

David Anthony Miller

Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663

License Number

WEST VIRGINIA

Licensing State

02.27.2020

Date

ATTACHMENT B

Statistical Analysis Output

November 5, 2019

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

RE: Amos Landfill Background Update

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the background update and statistical analysis of the groundwater data for 2019 at American Electric Power's Amos Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at Amos Landfill for the CCR program in 2016, and at least 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, is divided into two zones based on groundwater properties and geochemistry, which are referred to as Group 1 and Group 2.

Group 1 consists of the following wells:

- **Upgradient well:** LF-MW-10
- **Downgradient wells:** LF-MW-2 and LF-MW-4

Group 2 consists of the following wells:

- **Upgradient wells:** MF-MW-6, LF-MW-7R, LF-MW-8 and LF-MW-9
- **Downgradient wells:** LF-MW-1 and LF-MW-5

Data were provided electronically to Groundwater Stats Consulting (GSC), and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting and primary author of the USEPA Unified Guidance. The statistical analysis was performed according to the groundwater data screening that was performed in April 2018 by GSC and approved by Dr. Cameron.

The following constituents were evaluated:

- **Appendix III parameters** – boron, calcium, chloride, fluoride, pH, sulfate, and TDS;

Time series plots for Appendix III parameters at all wells for each Group are provided for the purpose of updating data at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

Data at all wells were originally evaluated during the background screening conducted in March 2018 (summarized below) for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided with the previous screening to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Methods:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, fluoride, pH, sulfate and TDS.

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Historical Summary - April 2018 Background Screening

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at all wells for Appendix III parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

A couple outliers were noted for Group 1 which included arsenic and barium in well LF-MW-2. While outliers were noted for cadmium in wells LF-MW-2 and LF-MW-4, no values were flagged due to similar patterns noted in upgradient well LF-MW-10.

Tukey's outlier test did not identify any outliers for the upgradient wells in Group 2 except for thallium which were trace values and, therefore, not flagged. Outliers were noted for barium and molybdenum in downgradient well LF-MW-5 which were flagged in the database. The outlier noted by Tukey's test for chloride in well LF-MW-1 was not flagged as an outlier because the concentration is similar to those in neighboring wells. Additionally, it was the most recent value at the time and more information would be needed as more data are collected to determine if that concentration is unlike the others. A summary of these results were included in the previous screening.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed Appendix III concentrations were stable over time with no statistically significant increasing or decreasing trends for Groups 1 and 2. A summary table of the trend test results accompanied the trend tests. Therefore, none of the data sets required any adjustments at that time.

Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells at Group 2, which assists in identifying the most appropriate statistical approach. The ANOVA requires a minimum of two upgradient wells; therefore, Group 1 could not be tested as there is only one upgradient well.

Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when average concentrations are similar across upgradient wells. Intrawell tests, which compare compliance data from a single well to screened historical data within the same well, are appropriate when upgradient wells exhibit spatial variation; when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective; and when downgradient water quality is unimpacted compared to upgradient water quality for the same parameter.

The ANOVA identified variation for all Appendix III parameters in Group 2. Therefore, all parameters in Groups 1 and 2 were further evaluated as described for the appropriateness of intrawell testing to accommodate the groundwater quality. A summary table of the ANOVA results for Group 2 was included with the previous screening.

Appendix III – Intrawell Method Eligibility Screening

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps were required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits were used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits were initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility. When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards were eligible for intrawell prediction limits.

Confidence intervals for the above parameters in Group 1 were found to be within their respective background limits for calcium, fluoride, pH, sulfate, and TDS; while confidence intervals were above their respective background limits in at least one well for boron and chloride. Therefore, intrawell methods would typically be recommended for calcium, fluoride, pH, sulfate and TDS, and interwell methods recommended for boron and chloride; however, evidence provided by Geosyntec supports the use of intrawell analyses for all parameters in Group 1 based on additional studies conducted.

Confidence intervals for the above parameters in Group 2 were all found to be within their respective background limits for all Appendix III parameters. Therefore, these parameters are eligible for intrawell methods.

All available data through October 2017 at each well were used to establish intrawell background limits for Groups 1 and 2 for each of the Appendix III parameters based on a 1-of-2 resample plan that will be used for future comparisons. Future compliance observations at each well will be compared to these background limits during each subsequent semi-annual sampling event.

Background Update Summary – October 2019

Prior to updating background data, samples were re-evaluated for both Groups using Tukey's outlier test and visual screening with the June/July 2019 samples (Figure C). A few outliers were noted in both groups and those values were flagged. While Tukey's test did not identify the following values as outliers, these values were flagged and deselected in the database as they are considerably lower than the majority of measurements within each well: pH in Group 1 well MW-4; and chloride and sulfate in Group 2 well MW-8.

As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. An updated summary of Tukey's test results and flagged outliers follows this letter.

For constituents requiring intrawell prediction limits, the Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through October 2017 to the new compliance samples at each well through June/July 2019 to evaluate whether the groups are statistically similar at the 99% confidence level, in which case background data may be updated with compliance data (Figure D). While no statistically significant differences were found between the two groups for the well/constituent pairs in Group 1, differences were noted for chloride in well MW-5 and fluoride in MW-1 for Group 2.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. The concentrations noted in these wells for these constituents, however, are similar to or lower than concentrations noted in upgradient wells. Therefore, at a minimum, the most 8 recent samples through June/July 2019, which are more stable and reflective of present-day conditions, will be used for construction of intrawell prediction limits. A summary of these results follows this letter and the test results are included with the Mann Whitney test section at the end of this report. Additionally, a summary of well/constituent pairs using a truncated portion of their records follows this letter.

Intrawell prediction limits using all historical data through June/July 2019 (except for the two cases noted above), combined with a 1-of-2 resample plan, were constructed and a summary of the updated limits follows this letter (Figure E). Future compliance observations at each well will be compared to these background limits during each subsequent semi-annual sampling event.

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

For Groundwater Stats Consulting,

Andrew T. Collins
Groundwater Analyst

Kristina L. Rayner
Groundwater Statistician

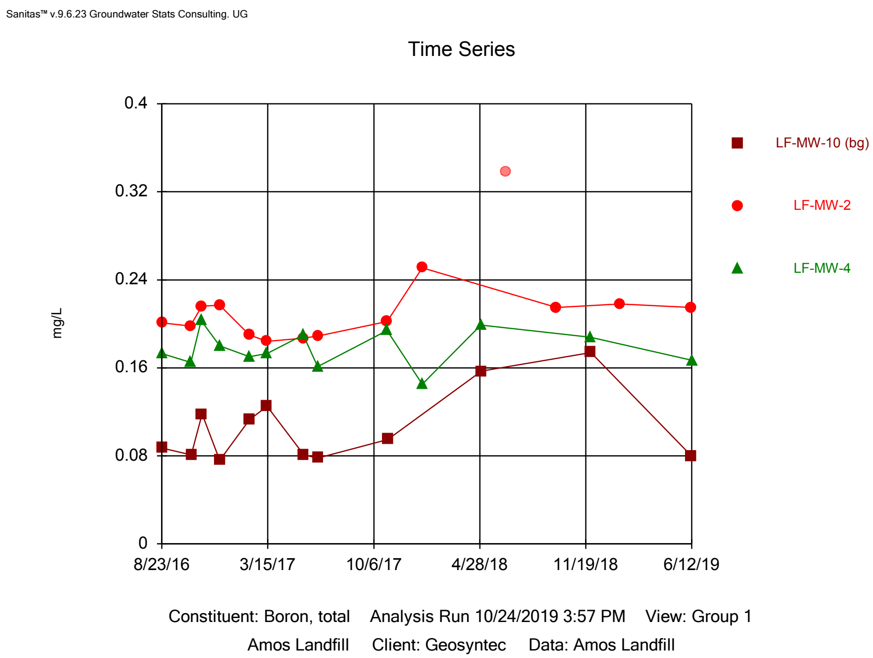
Date Ranges

Date: 10/25/2019 9:09 AM

Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Chloride, total (mg/L)
    LF-MW-5 background:6/20/2017-7/22/2019
Fluoride, total (mg/L)
    LF-MW-1 background:2/7/2017-7/22/2019

FIGURE A: TIME SERIES


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Time Series
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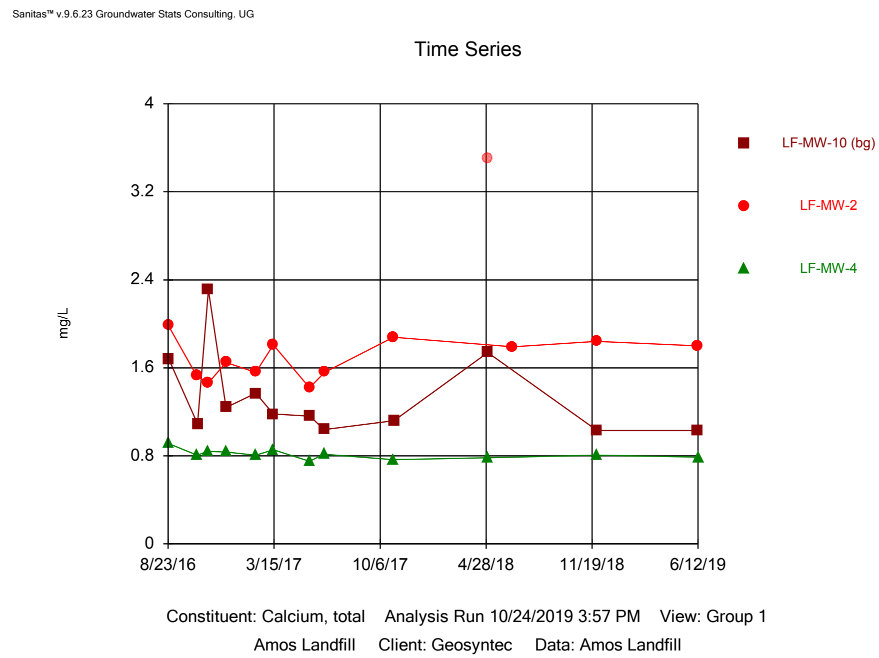
0.32
0.24
0.16
0.08
0
mg/L
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
Constituent: Boron, total Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Time Series
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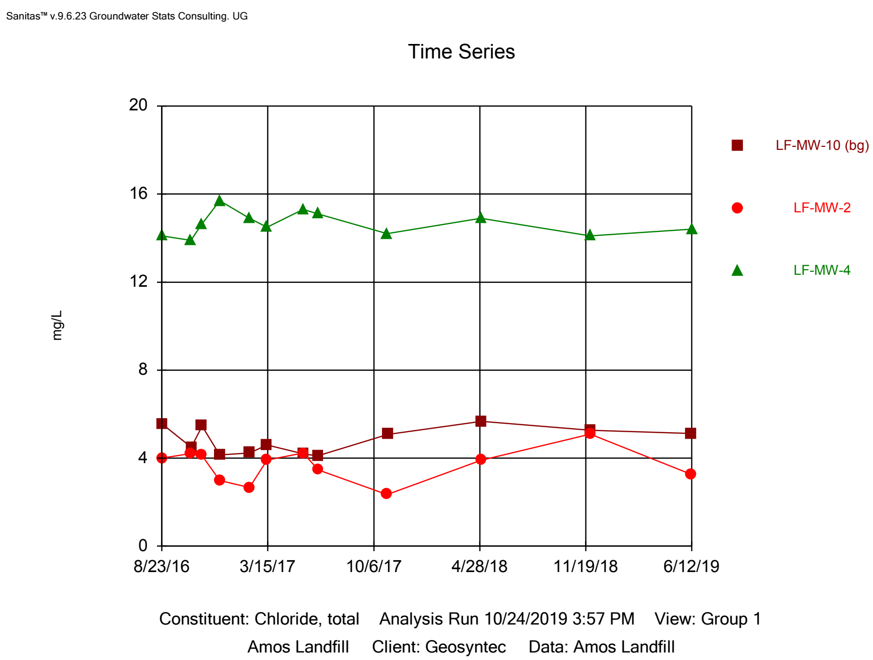
mg/L
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
Constituent: Calcium, total Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Time Series
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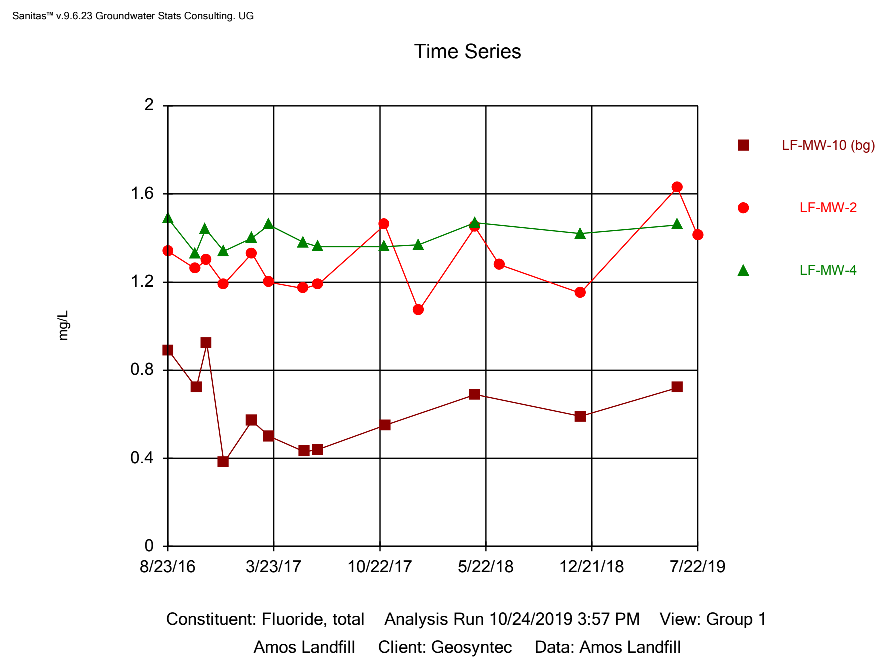
16
12
8
4
0
mg/L
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
Constituent: Chloride, total Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Time Series
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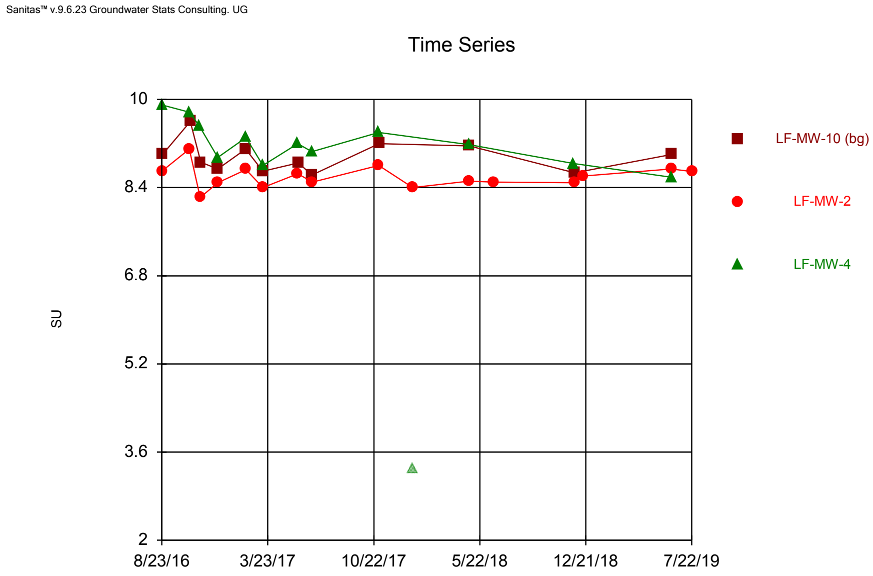
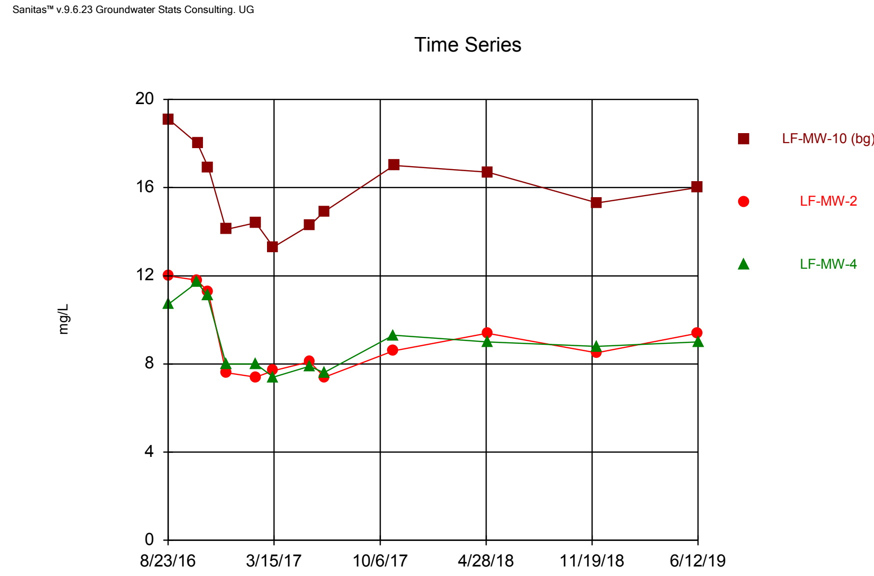
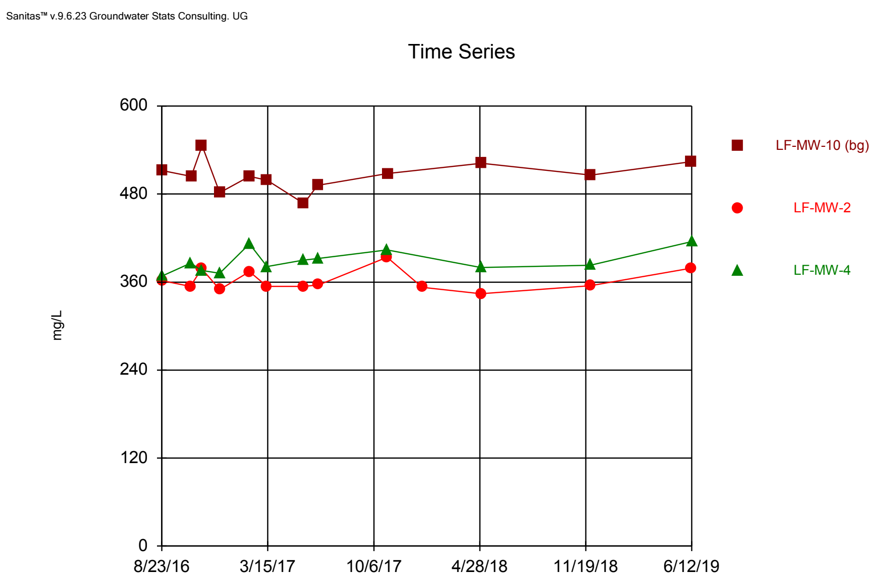
1.6
1.2
0.8
0.4
0
mg/L
8/23/16
3/23/17
10/22/17
5/22/18
12/21/18
7/22/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
Constituent: Fluoride, total Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



Constituent: pH, field Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

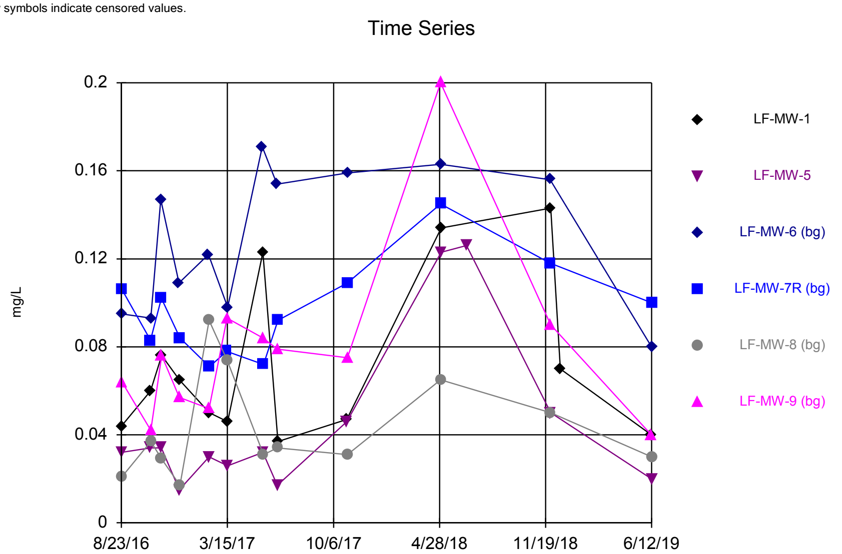


Constituent: Sulfate, total Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



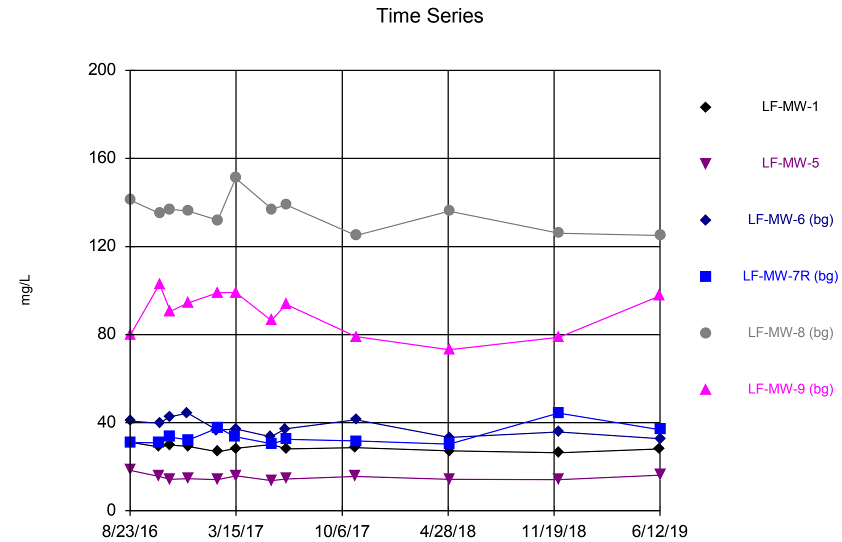
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 3:57 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



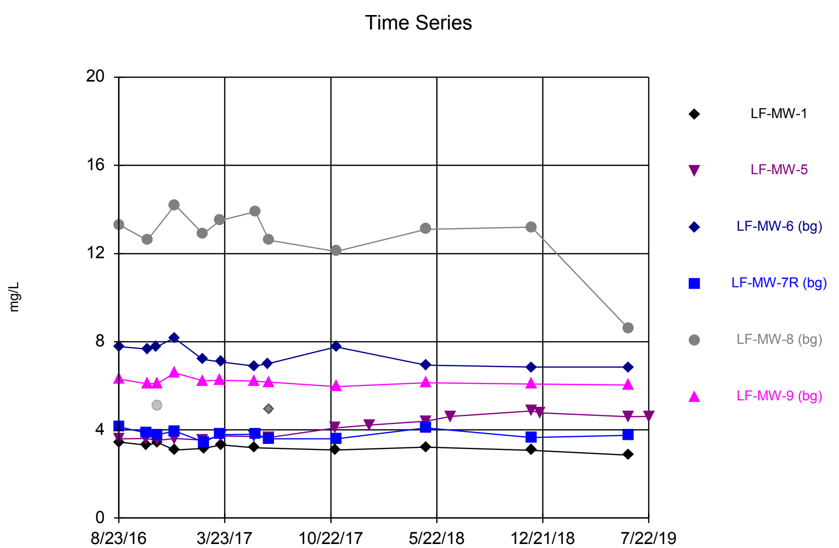
Constituent: Boron, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



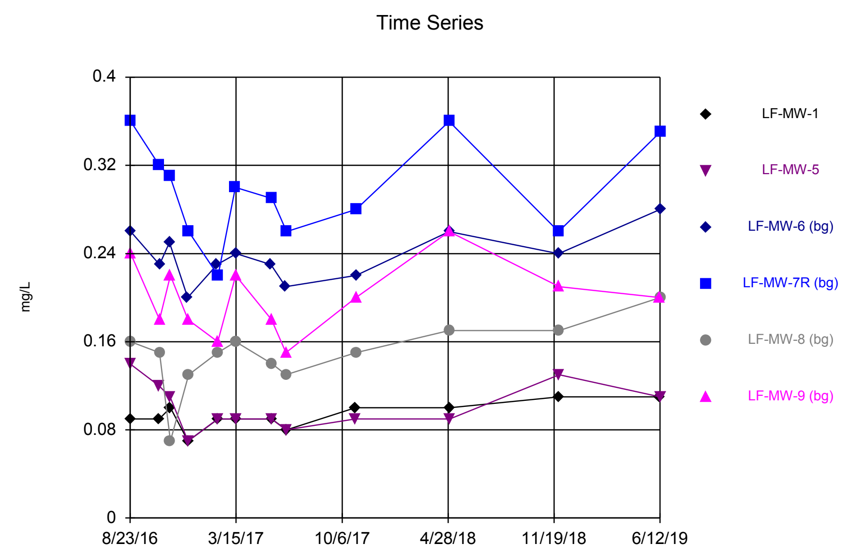
Constituent: Calcium, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

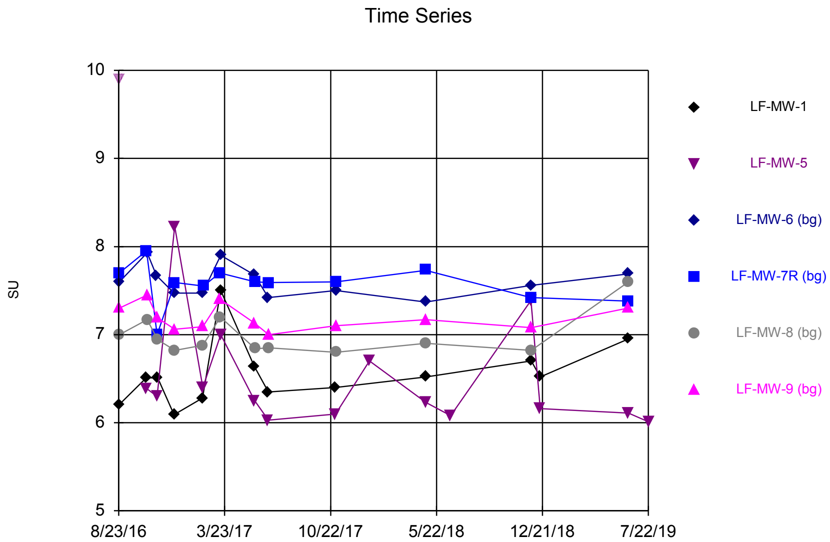


Constituent: Chloride, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

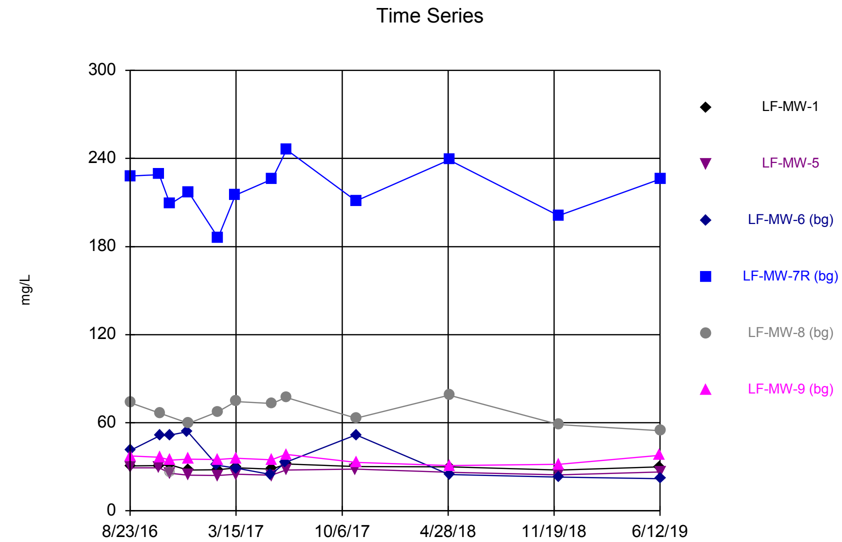
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



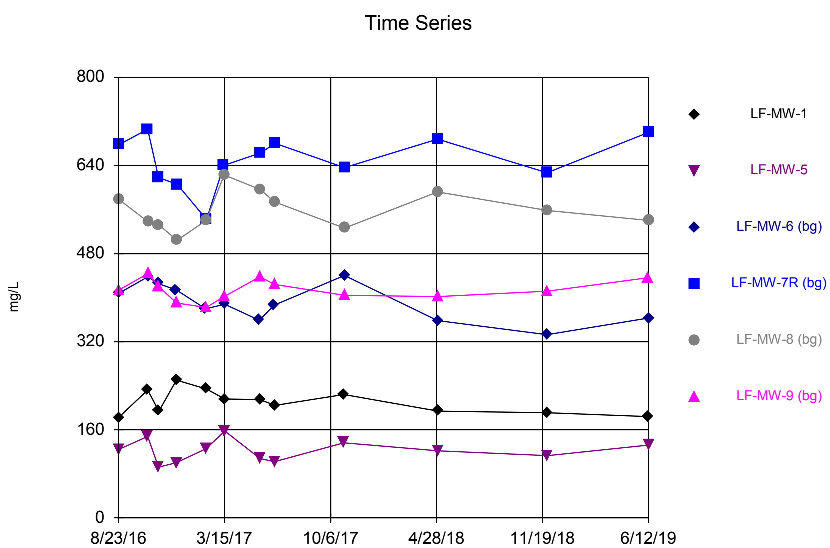
Constituent: Fluoride, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill



Constituent: pH, field Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

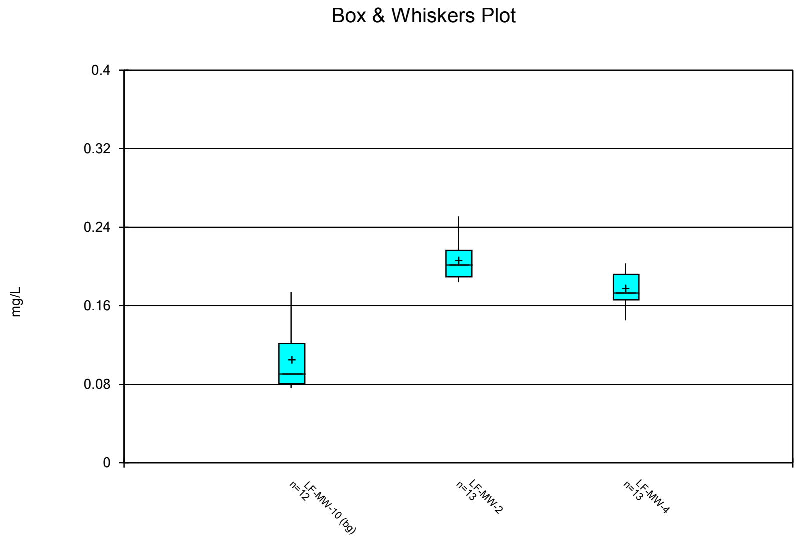


Constituent: Sulfate, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill



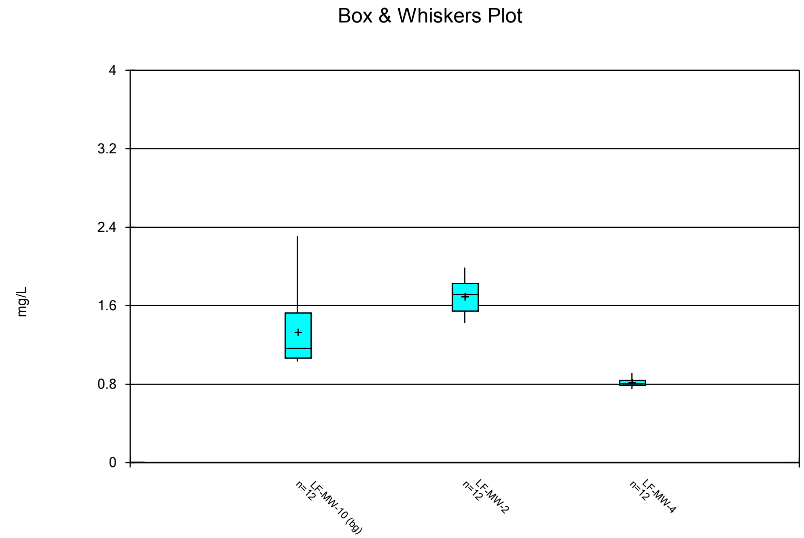
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

FIGURE B: BOX PLOTS



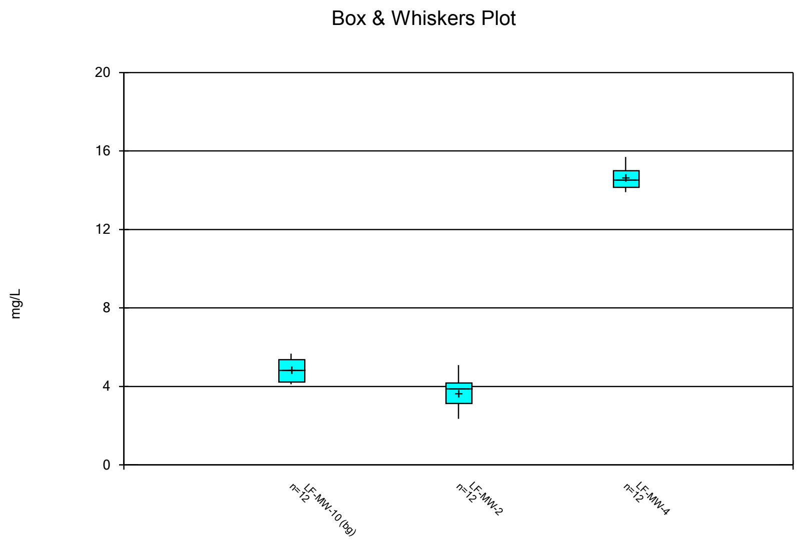
Constituent: Boron, total Analysis Run 10/24/2019 4:27 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



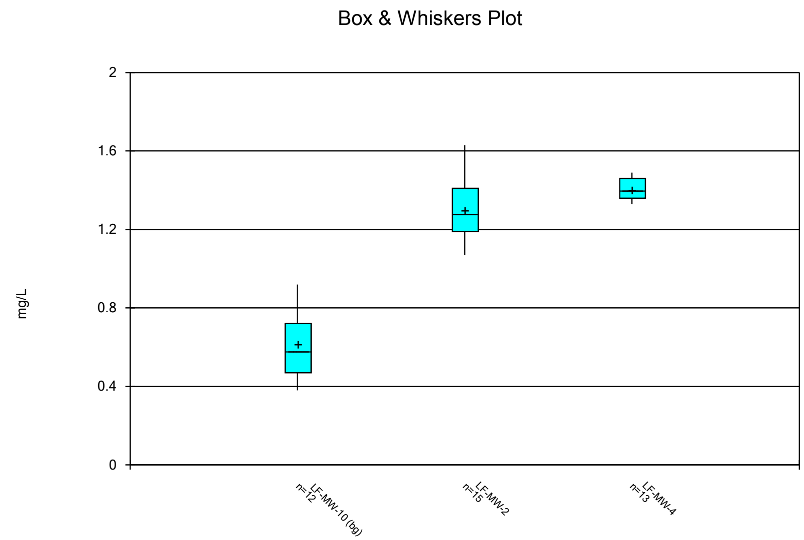
Constituent: Calcium, total Analysis Run 10/24/2019 4:27 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

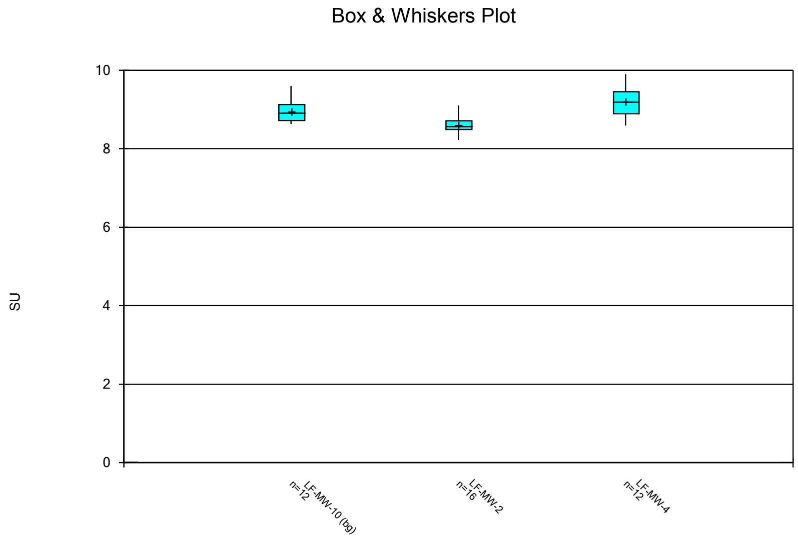


Constituent: Chloride, total Analysis Run 10/24/2019 4:27 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

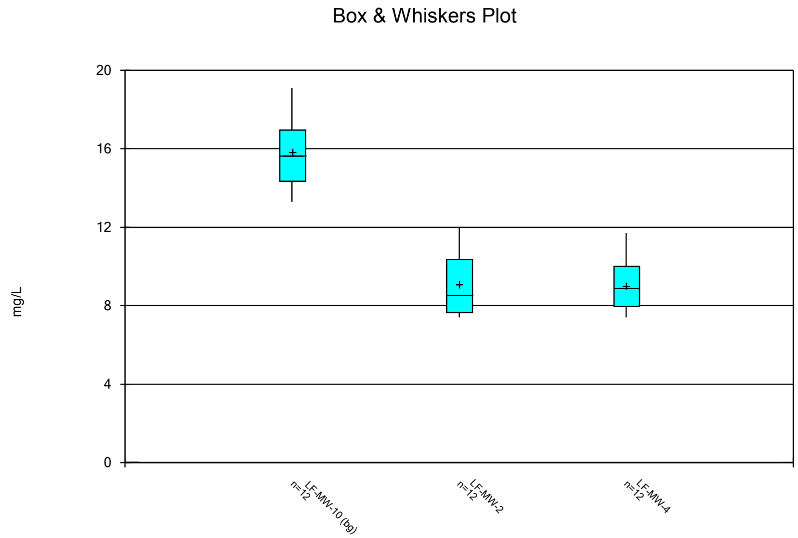


Constituent: Fluoride, total Analysis Run 10/24/2019 4:27 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



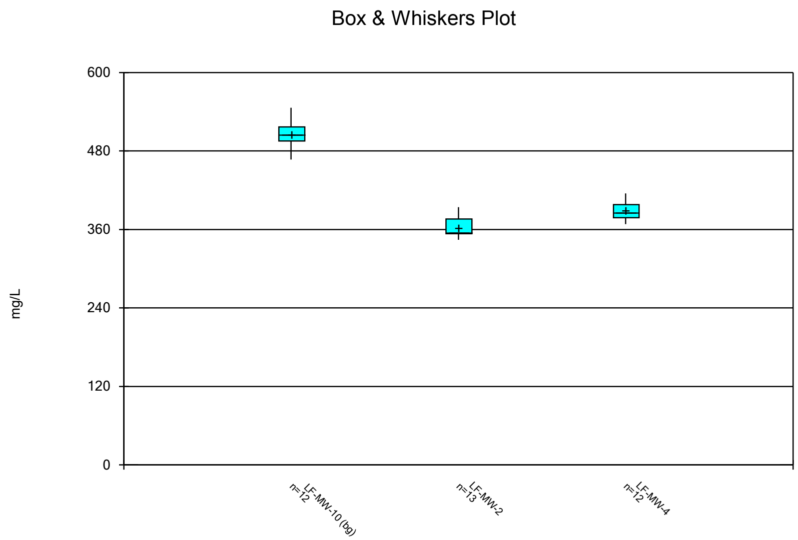
Constituent: pH, field   Analysis Run 10/24/2019 4:27 PM   View: Group 1
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate, total   Analysis Run 10/24/2019 4:27 PM   View: Group 1
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

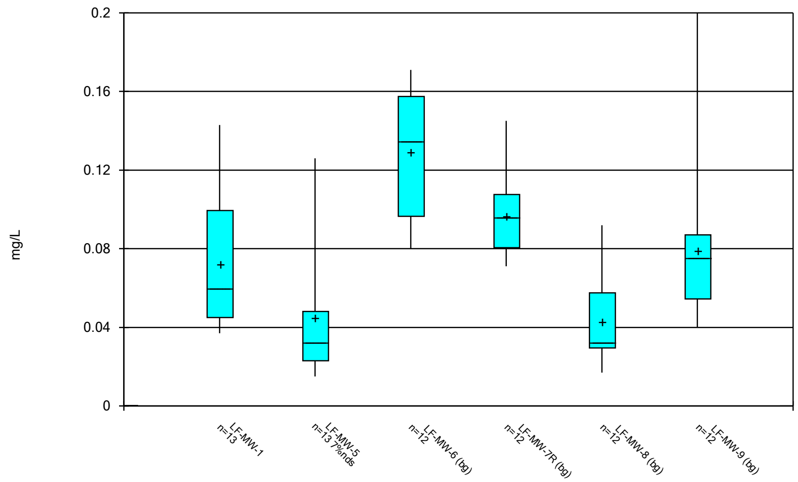
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS]   Analysis Run 10/24/2019 4:27 PM   View: Group 1
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

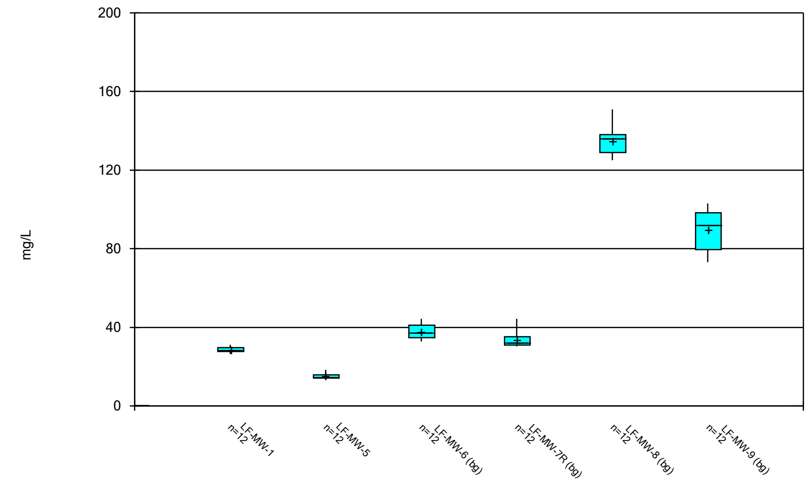
Box & Whiskers Plot



Constituent: Boron, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

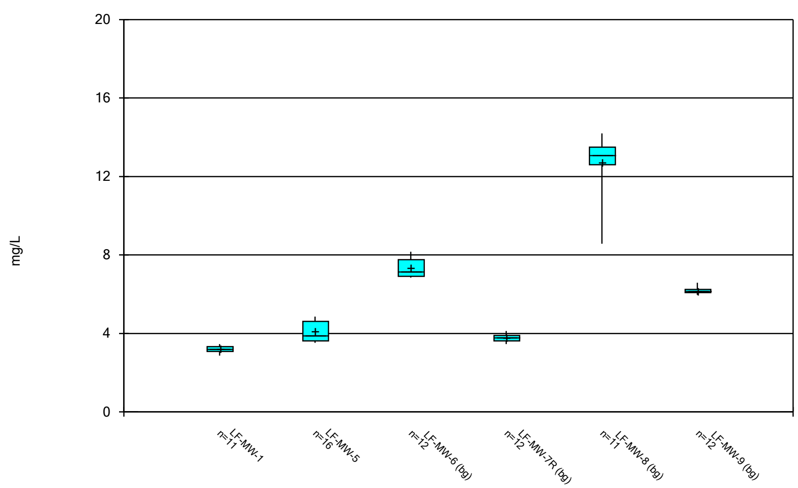
Box & Whiskers Plot



Constituent: Calcium, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

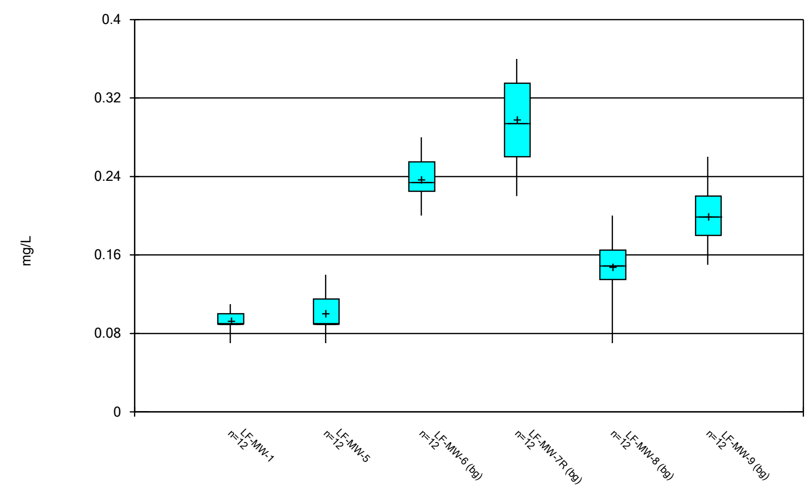
Box & Whiskers Plot



Constituent: Chloride, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

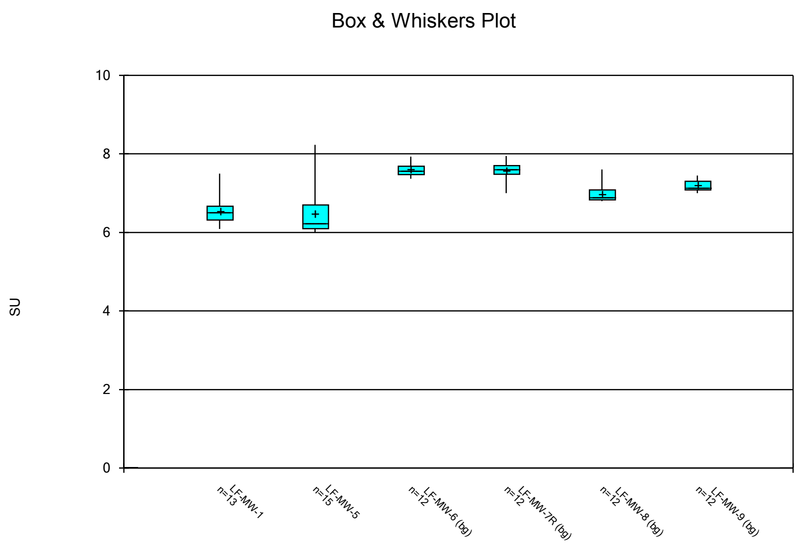
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Box & Whiskers Plot



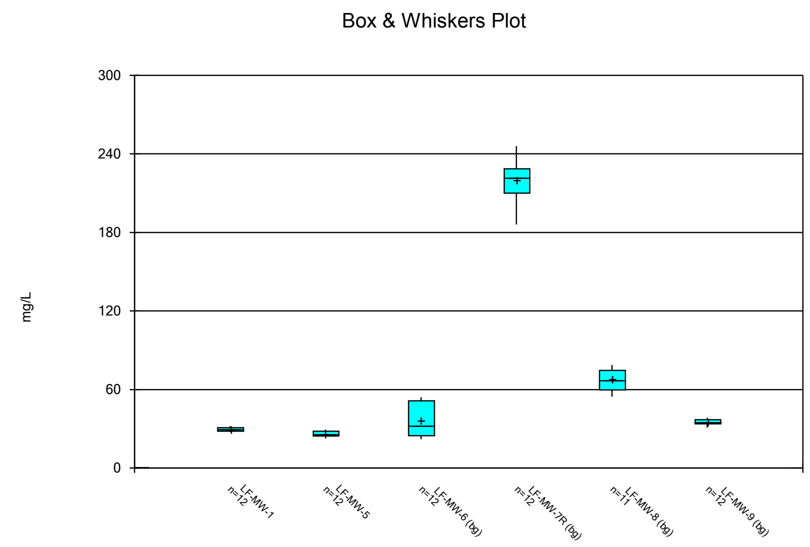
Constituent: Fluoride, total Analysis Run 10/24/2019 4:32 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



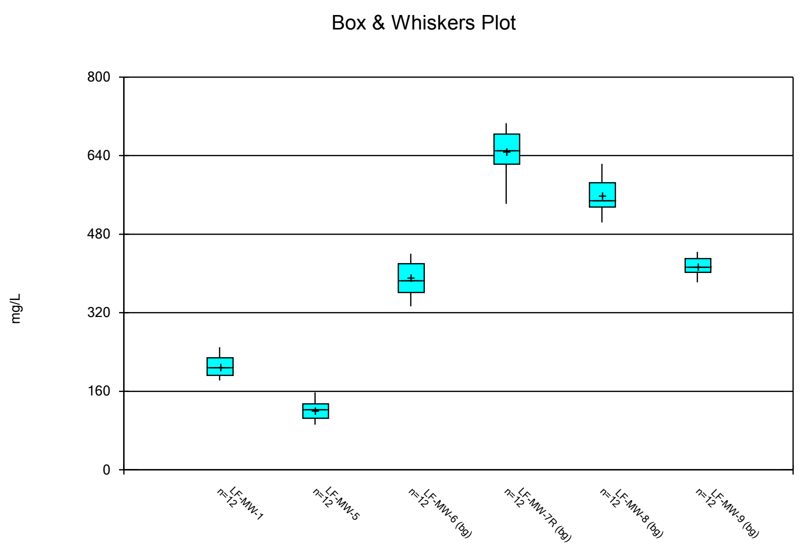
Constituent: pH, field   Analysis Run 10/24/2019 4:32 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Sulfate, total   Analysis Run 10/24/2019 4:32 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS]   Analysis Run 10/24/2019 4:32 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

FIGURE C: OUTLIER SUMMARY

Outlier Summary - Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill Printed 10/24/2019, 3:58 PM

	LF-MW-2 Boron, total (mg/L)	LF-MW-2 Calcium, total (mg/L)	LF-MW-4 pH, field (SU)
1/8/2018			3.3 (o)
5/1/2018		3.5 (o)	
6/19/2018	0.338 (o)		

Outlier Analysis - Significant Results - Group 1

Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 10/24/2019, 3:53 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	**LF-MW-2**	**Yes**	**0.338**	**6/19/2018**	**NP**	**NaN**	**14**	**0.2158**	**0.03935**	**ln(x)**	**ShapiroWilk**
Calcium, total (mg/L)	**LF-MW-2**	**Yes**	**3.5**	**5/1/2018**	**NP**	**NaN**	**13**	**1.83**	**0.5318**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results - Group 1

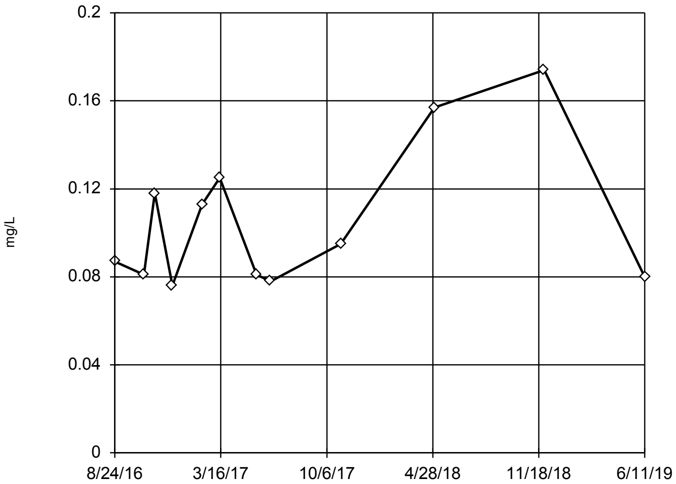
Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 10/24/2019, 3:53 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	0.1054	0.03285	ln(x)	ShapiroWilk
Boron, total (mg/L)	**LF-MW-2**	**Yes**	**0.338**	**6/19/2018**	**NP**	**NaN**	**14**	**0.2158**	**0.03935**	**ln(x)**	**ShapiroWilk**
Boron, total (mg/L)	LF-MW-4	No	n/a	n/a	NP	NaN	13	0.1775	0.01671	x^2	ShapiroWilk
Calcium, total (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	1.333	0.3906	ln(x)	ShapiroWilk
Calcium, total (mg/L)	**LF-MW-2**	**Yes**	**3.5**	**5/1/2018**	**NP**	**NaN**	**13**	**1.83**	**0.5318**	**ln(x)**	**ShapiroWilk**
Calcium, total (mg/L)	LF-MW-4	No	n/a	n/a	NP	NaN	12	0.8141	0.04383	ln(x)	ShapiroWilk
Chloride, total (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	4.827	0.5919	x^2	ShapiroWilk
Chloride, total (mg/L)	LF-MW-2	No	n/a	n/a	NP	NaN	12	3.683	0.7693	normal	ShapiroWilk
Chloride, total (mg/L)	LF-MW-4	No	n/a	n/a	NP	NaN	12	14.64	0.5485	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	0.6167	0.1749	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-2	No	n/a	n/a	NP	NaN	15	1.295	0.1463	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-4	No	n/a	n/a	NP	NaN	13	1.406	0.05378	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	8.959	0.2798	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-2	No	n/a	n/a	NP	NaN	16	8.596	0.2036	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-4	No	n/a	n/a	NP	NaN	13	8.754	1.682	x^6	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	15.83	1.748	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-2	No	n/a	n/a	NP	NaN	12	9.1	1.714	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-4	No	n/a	n/a	NP	NaN	12	9.042	1.428	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	NaN	12	505.5	20.38	sqrt(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-2	No	n/a	n/a	NP	NaN	13	362.1	14.55	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-4	No	n/a	n/a	NP	NaN	12	388.3	15.14	ln(x)	ShapiroWilk

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-10 (bg)



n = 12

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

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

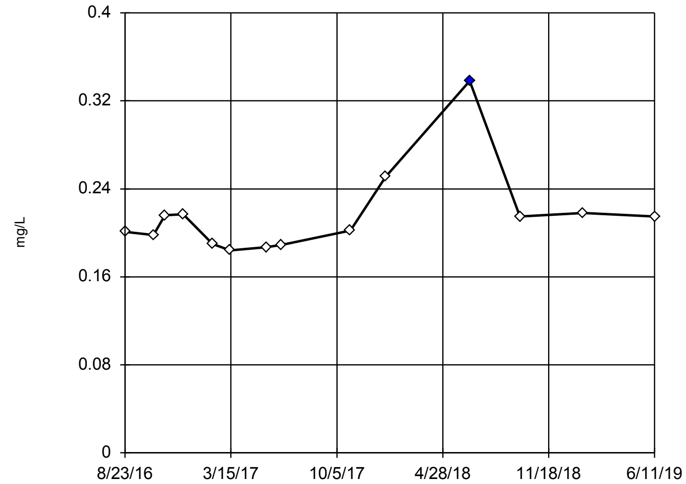
High cutoff = 0.4171, low cutoff = 0.02344, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-2



n = 14

Outlier is drawn as solid. Tukey's method selected by user.

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

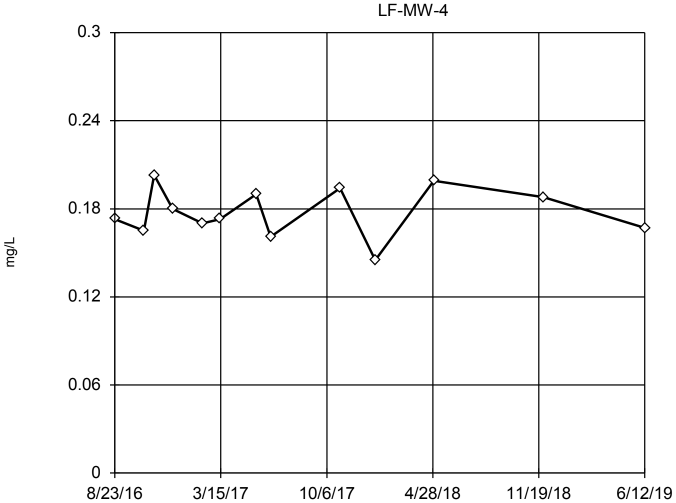
High cutoff = 0.3289, low cutoff = 0.1253, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-4



n = 13

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

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

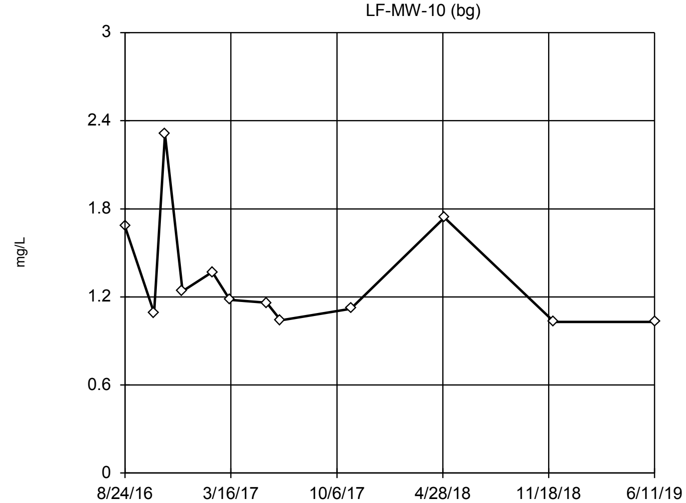
High cutoff = 0.2546, low cutoff = -0.01939, based on IQR multiplier of 3.

Constituent: Boron, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-10 (bg)



n = 12

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

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

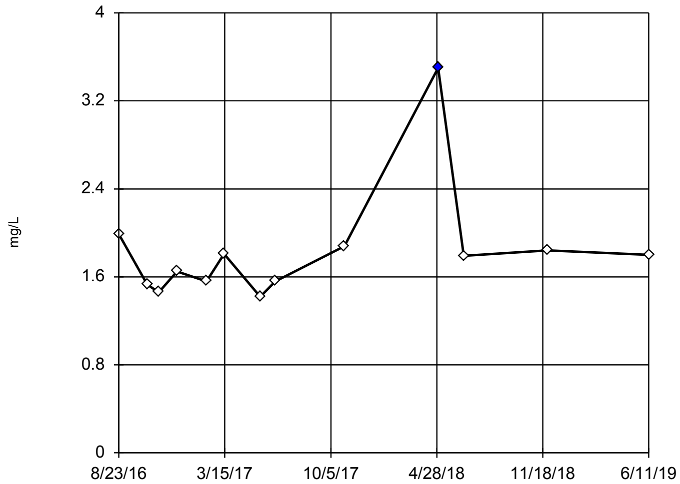
High cutoff = 4.389, low cutoff = 0.368, based on IQR multiplier of 3.

Constituent: Calcium, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-2



n = 13

Outlier is drawn as solid. Tukey's method selected by user.

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

High cutoff = 3.245, low cutoff = 0.8855, based on IQR multiplier of 3.

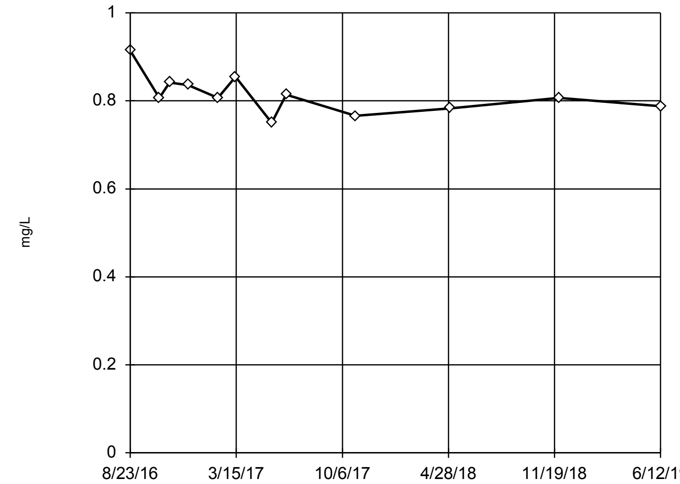
Constituent: Calcium, total Analysis Run 10/24/2019 3:51 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-4



n = 12

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

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

High cutoff = 1.022, low cutoff = 0.6446, based on IQR multiplier of 3.

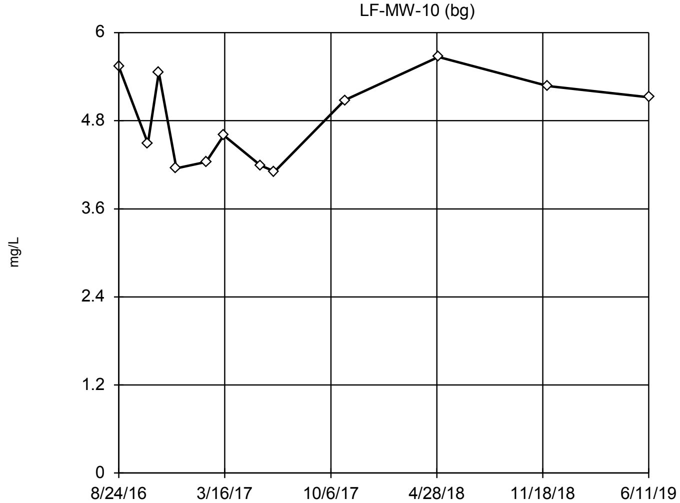
Constituent: Calcium, total Analysis Run 10/24/2019 3:51 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-10 (bg)



n = 12

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

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

High cutoff = 7.866, low cutoff = -3.913, based on IQR multiplier of 3.

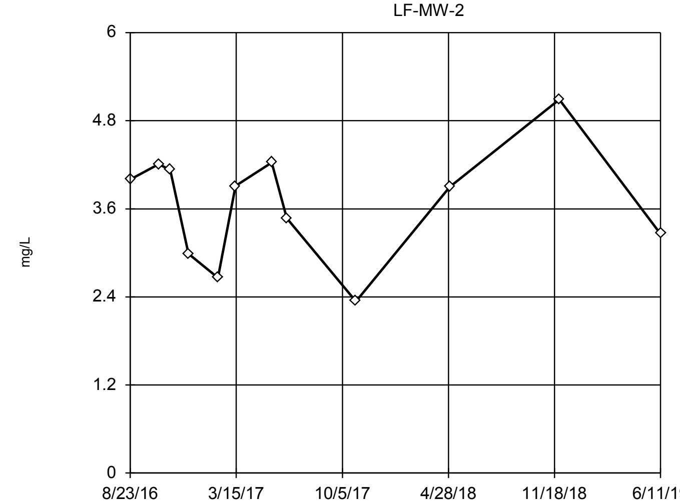
Constituent: Chloride, total Analysis Run 10/24/2019 3:51 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-2



n = 12

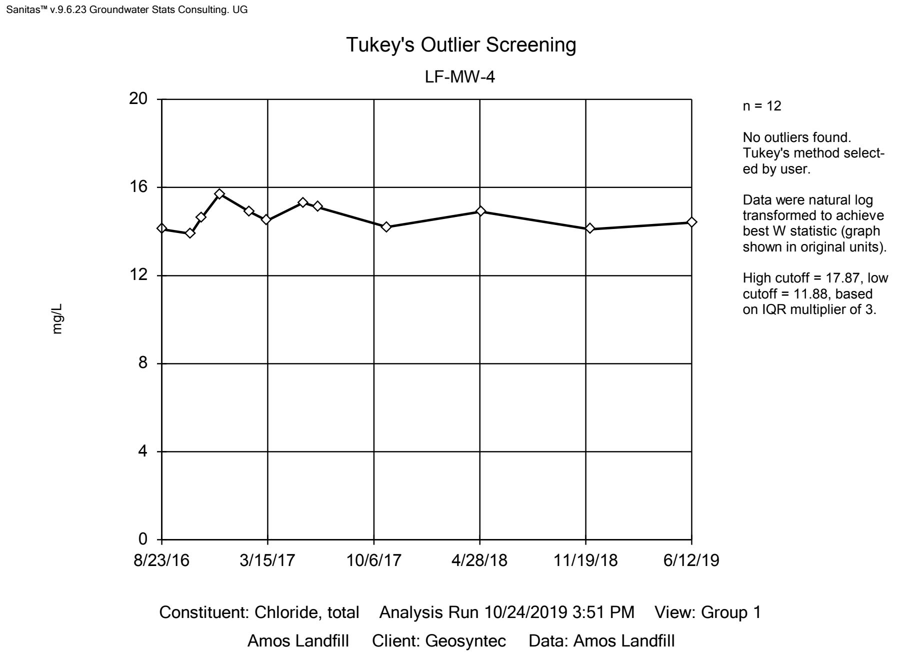
No outliers found. Tukey's method selected by user.

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

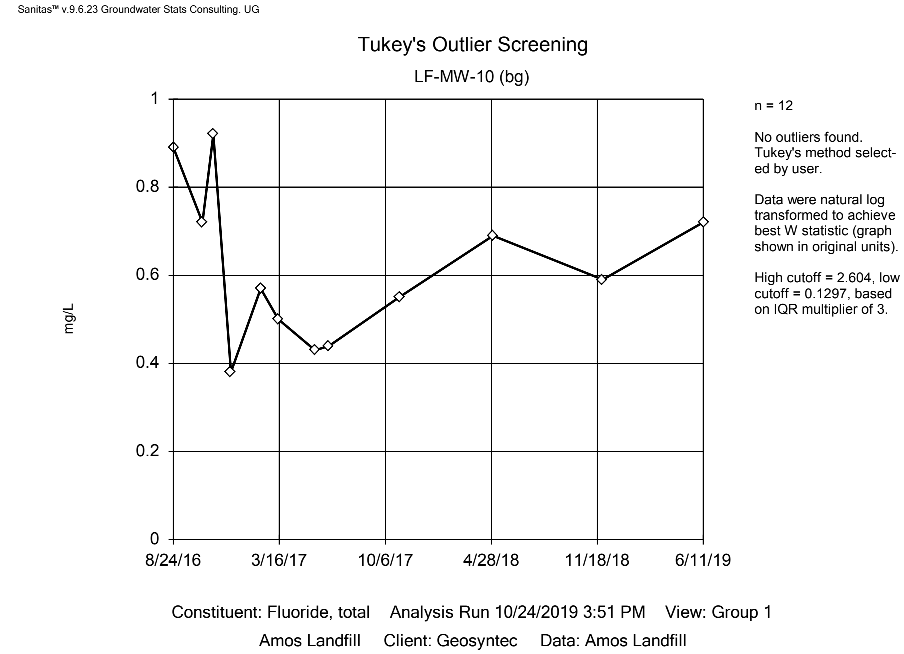
High cutoff = 7.305, low cutoff = -0.01, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/24/2019 3:51 PM View: Group 1

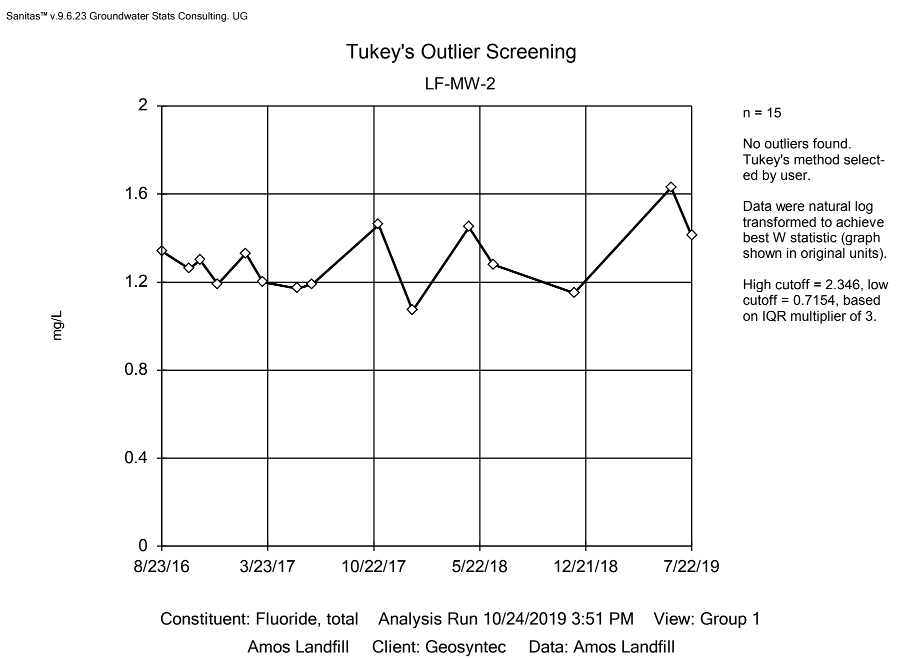
Amos Landfill Client: Geosyntec Data: Amos Landfill



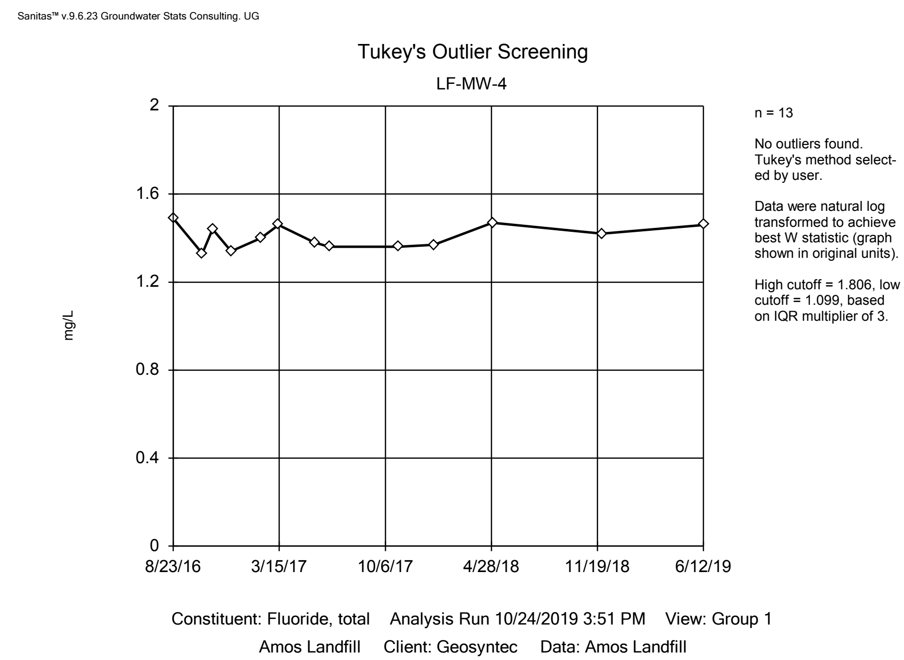
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-4
20
16
12
8
4
0
mg/L
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 17.87, low cutoff = 11.88, based on IQR multiplier of 3.
Constituent: Chloride, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-10 (bg)
1
0.8
0.6
0.4
0.2
0
mg/L
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 2.604, low cutoff = 0.1297, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

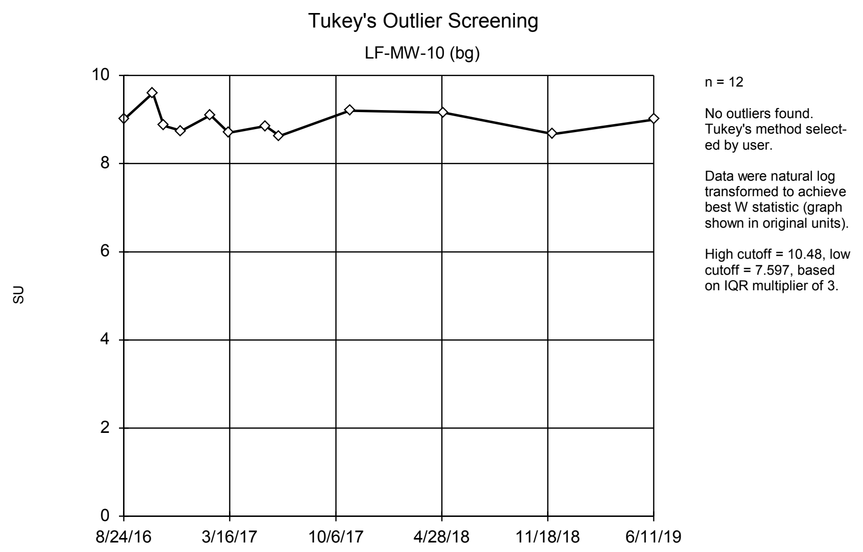


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-2
2
1.6
1.2
0.8
0.4
0
mg/L
8/23/16
3/23/17
10/22/17
5/22/18
12/21/18
7/22/19
n = 15
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 2.346, low cutoff = 0.7154, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



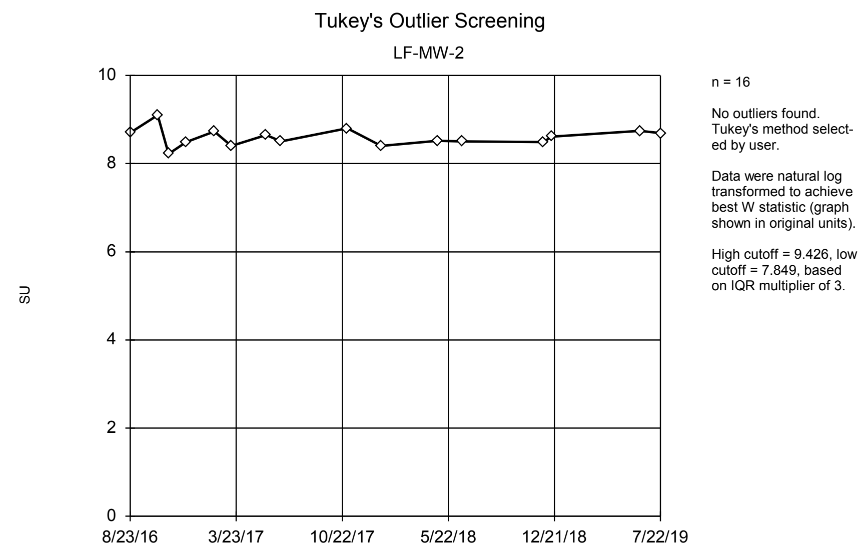
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-4
2
1.6
1.2
0.8
0.4
0
mg/L
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 1.806, low cutoff = 1.099, based on IQR multiplier of 3.
Constituent: Fluoride, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



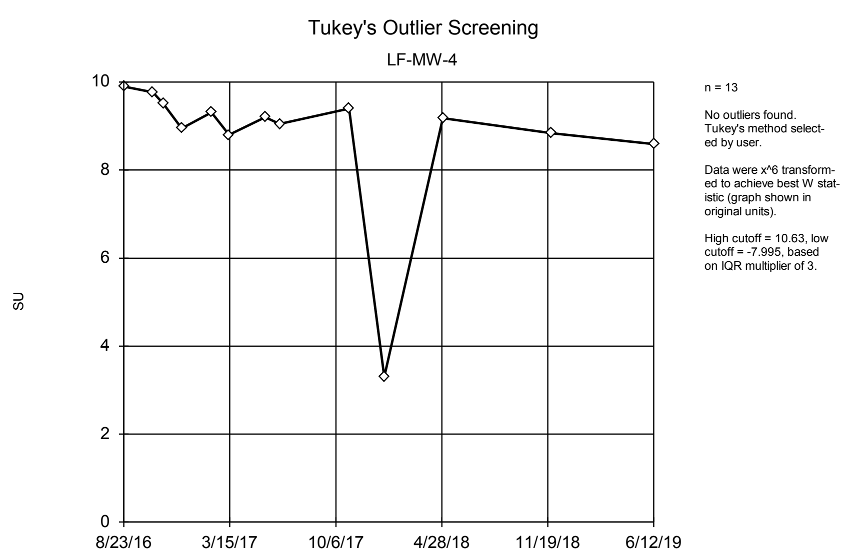
Constituent: pH, field Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



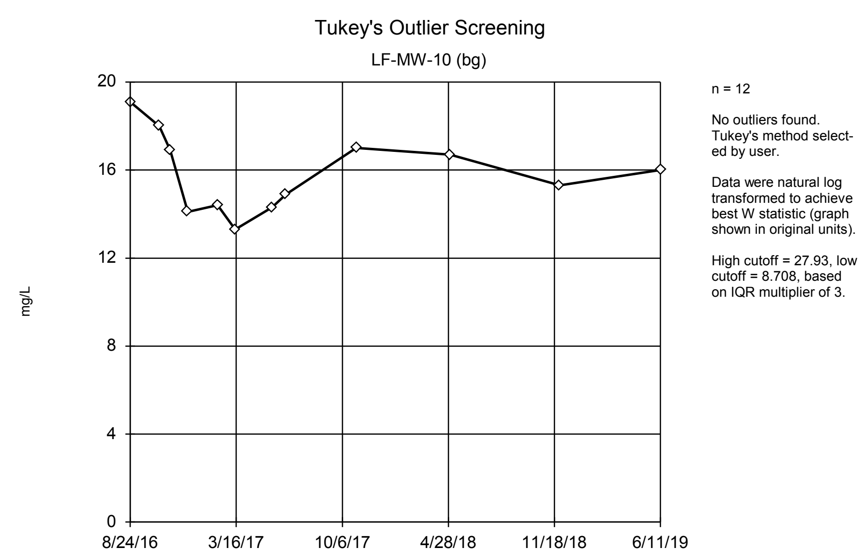
Constituent: pH, field Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

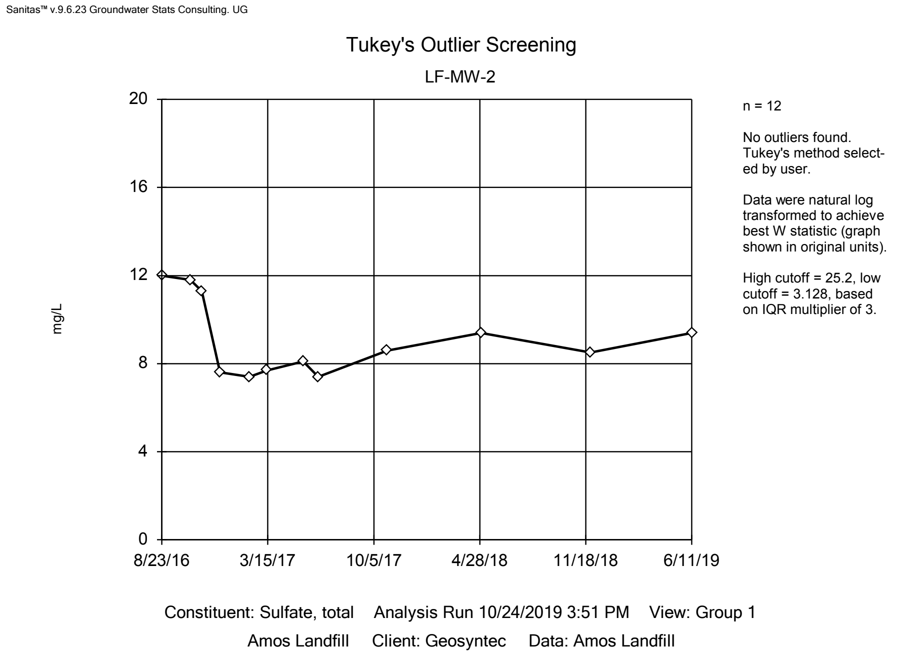


Constituent: pH, field Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

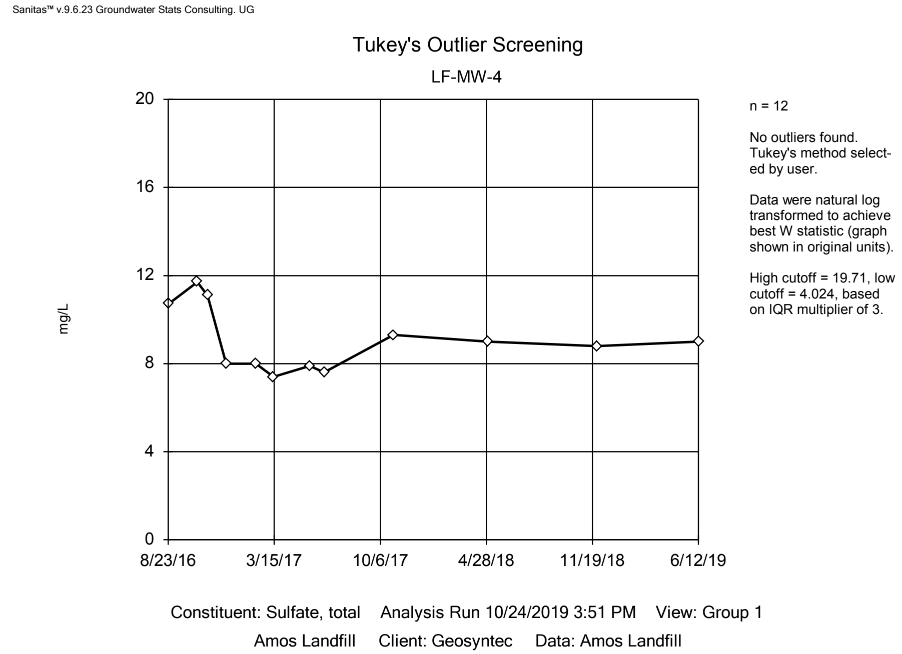
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



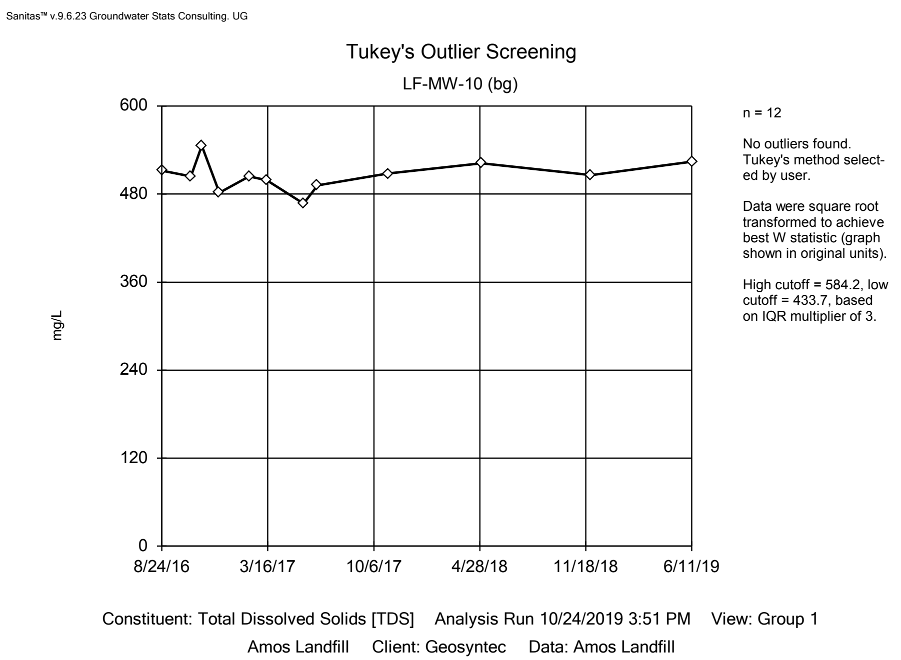
Constituent: Sulfate, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



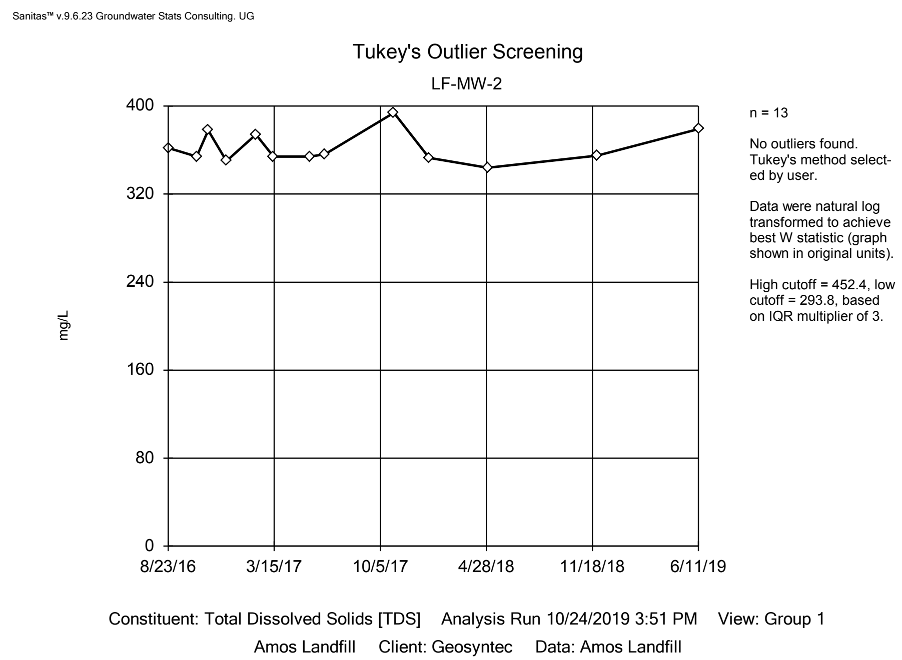
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-2
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 25.2, low cutoff = 3.128, based on IQR multiplier of 3.
mg/L
Constituent: Sulfate, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



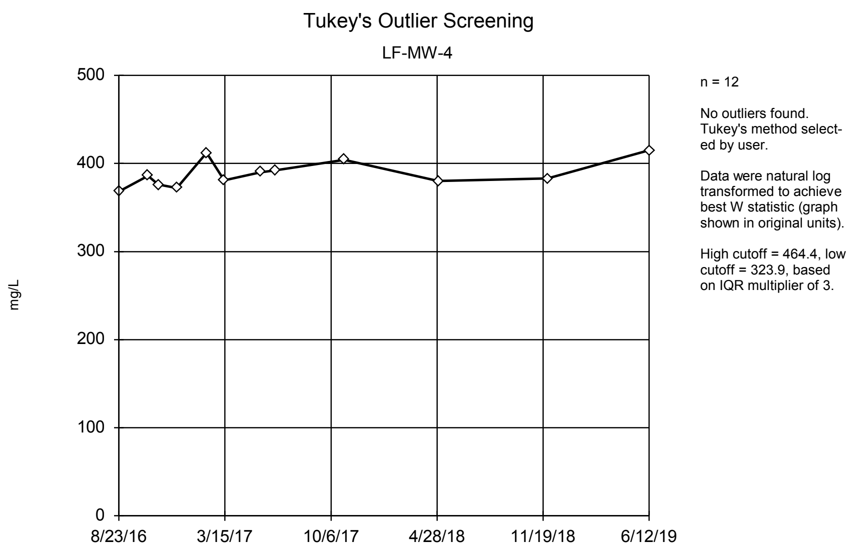
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-4
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 19.71, low cutoff = 4.024, based on IQR multiplier of 3.
mg/L
Constituent: Sulfate, total Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-10 (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were square root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 584.2, low cutoff = 433.7, based on IQR multiplier of 3.
mg/L
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-2
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 452.4, low cutoff = 293.8, based on IQR multiplier of 3.
mg/L
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 3:51 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 3:51 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Outlier Summary - Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 10/24/2019, 4:29 PM

	LF-MW-1 Chloride, total (mg/L)	LF-MW-8 Chloride, total (mg/L)	LF-MW-5 pH, field (SU)	LF-MW-8 Sulfate, total (mg/L)
8/23/2016			9.9 (o)	
11/9/2016		5.12 (o)		26.1 (o)
6/21/2017	4.94 (o)			

Outlier Analysis - Significant Results - Group 2

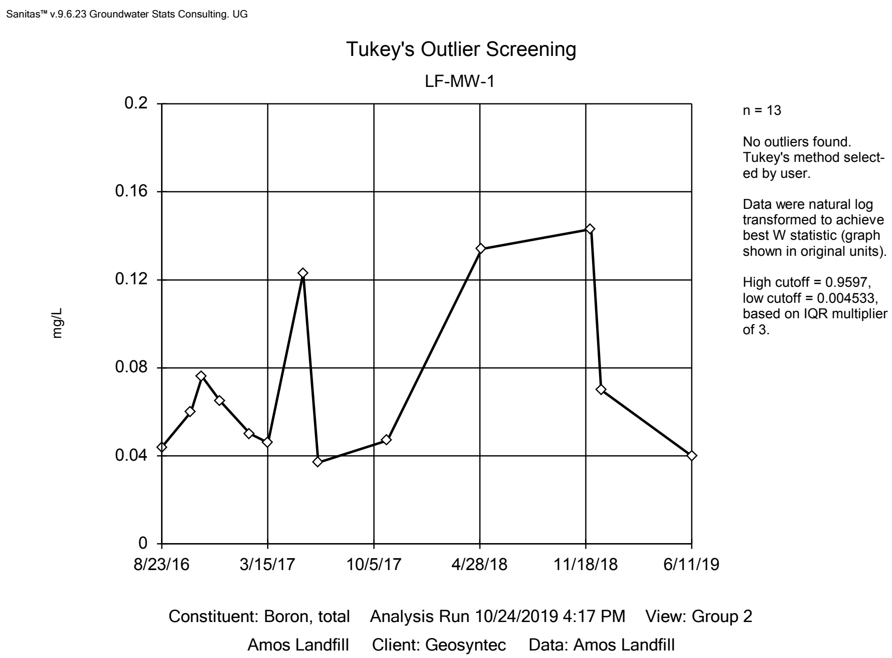
Amos Landfill Client: Geosyntec Data: Amos Landfill Printed 10/24/2019, 4:20 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Chloride, total (mg/L)	**LF-MW-1**	**Yes**	**4.94**	**6/21/2017**	**NP**	**NaN**	**12**	**3.342**	**0.5298**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	**LF-MW-5**	**Yes**	**9.9**	**8/23/2016**	**NP**	**NaN**	**16**	**6.705**	**1.04**	**ln(x)**	**ShapiroWilk**

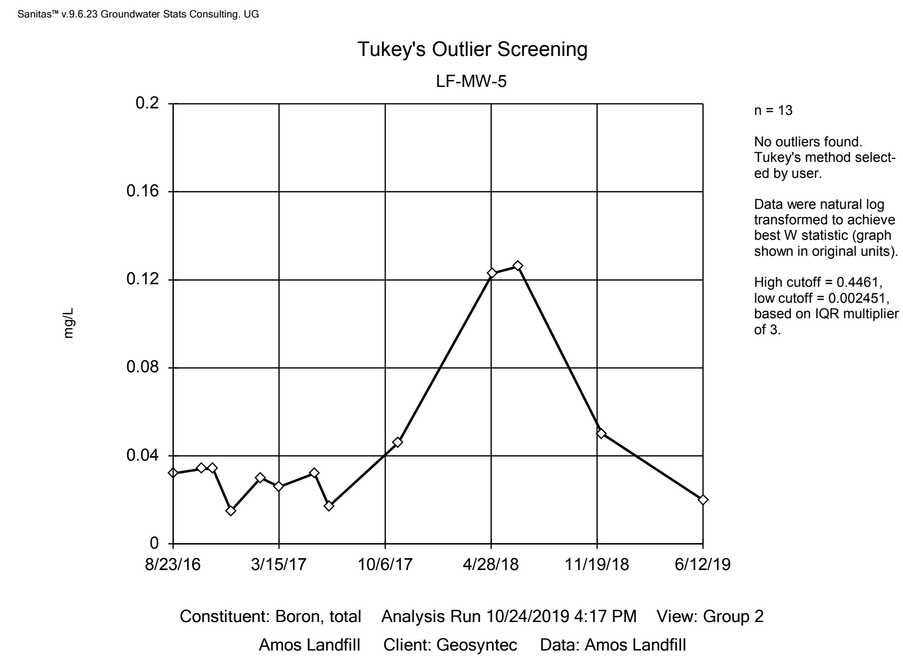
Outlier Analysis - All Results - Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill Printed 10/24/2019, 4:20 PM

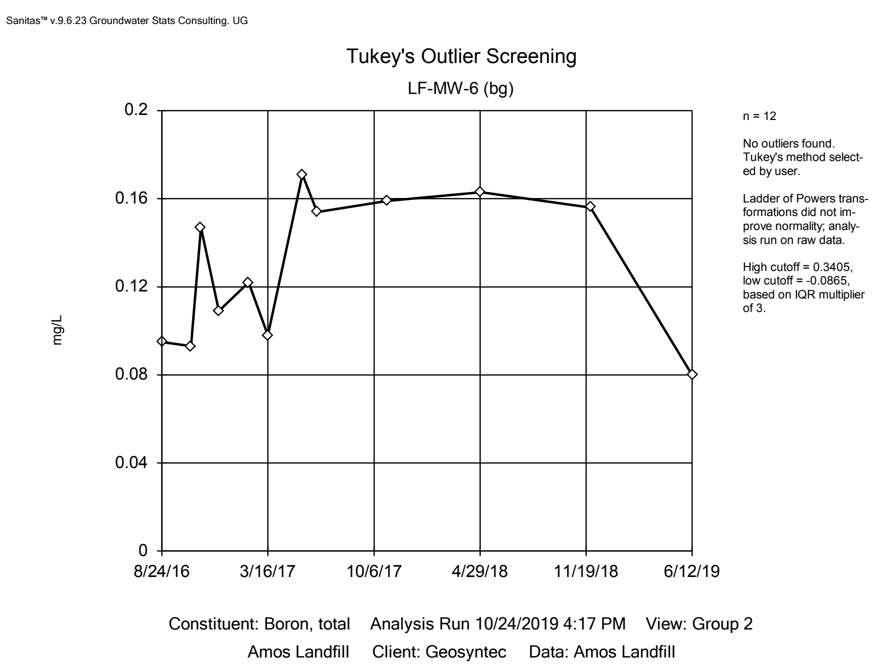
Constituent	Well	Outlier	Value(s)	Date(s)	Method	Alpha	N	Mean	Std. Dev.	Distribution	Normality Test
Boron, total (mg/L)	LF-MW-1	No	n/a	n/a	NP	NaN	13	0.07192	0.0371	ln(x)	ShapiroWilk
Boron, total (mg/L)	LF-MW-5	No	n/a	n/a	NP	NaN	13	0.045	0.03668	ln(x)	ShapiroWilk
Boron, total (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	0.1289	0.0327	normal	ShapiroWilk
Boron, total (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	0.09667	0.02144	ln(x)	ShapiroWilk
Boron, total (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	0.04258	0.02301	ln(x)	ShapiroWilk
Boron, total (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	0.07933	0.04192	ln(x)	ShapiroWilk
Calcium, total (mg/L)	LF-MW-1	No	n/a	n/a	NP	NaN	12	28.6	1.406	x^(1/3)	ShapiroWilk
Calcium, total (mg/L)	LF-MW-5	No	n/a	n/a	NP	NaN	12	15.11	1.317	ln(x)	ShapiroWilk
Calcium, total (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	37.97	3.803	ln(x)	ShapiroWilk
Calcium, total (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	33.75	4.105	ln(x)	ShapiroWilk
Calcium, total (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	135	7.435	ln(x)	ShapiroWilk
Calcium, total (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	89.58	9.833	x^4	ShapiroWilk
Chloride, total (mg/L)	**LF-MW-1**	**Yes**	**4.94**	**6/21/2017**	**NP**	**NaN**	**12**	**3.342**	**0.5298**	**ln(x)**	**ShapiroWilk**
Chloride, total (mg/L)	LF-MW-5	No	n/a	n/a	NP	NaN	16	4.069	0.5012	ln(x)	ShapiroWilk
Chloride, total (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	7.332	0.4657	ln(x)	ShapiroWilk
Chloride, total (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	3.786	0.2013	ln(x)	ShapiroWilk
Chloride, total (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	12.09	2.62	x^6	ShapiroWilk
Chloride, total (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	6.181	0.1603	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-1	No	n/a	n/a	NP	NaN	12	0.09333	0.01155	x^2	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-5	No	n/a	n/a	NP	NaN	12	0.1008	0.02109	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	0.2375	0.02261	ln(x)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	0.2975	0.04454	x^(1/3)	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	0.1483	0.03129	x^2	ShapiroWilk
Fluoride, total (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	0.2	0.03219	x^(1/3)	ShapiroWilk
pH, field (SU)	LF-MW-1	No	n/a	n/a	NP	NaN	13	6.552	0.3614	ln(x)	ShapiroWilk
pH, field (SU)	**LF-MW-5**	**Yes**	**9.9**	**8/23/2016**	**NP**	**NaN**	**16**	**6.705**	**1.04**	**ln(x)**	**ShapiroWilk**
pH, field (SU)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	7.605	0.178	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	7.568	0.2316	x^6	ShapiroWilk
pH, field (SU)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	6.985	0.2349	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	7.189	0.1424	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-1	No	n/a	n/a	NP	NaN	12	29.66	1.418	x^6	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-5	No	n/a	n/a	NP	NaN	12	26.24	2.004	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	36.44	12.71	ln(x)	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	219.4	16.52	x^3	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	64.46	14.36	x^4	ShapiroWilk
Sulfate, total (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	35.06	2.338	x^4	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-1	No	n/a	n/a	NP	NaN	12	210	21.92	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-5	No	n/a	n/a	NP	NaN	12	121.8	19.88	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	NaN	12	391.1	34.47	x^(1/3)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	NaN	12	648.7	47.06	x^6	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	NaN	12	558.4	34.57	ln(x)	ShapiroWilk
Total Dissolved Solids [TDS] (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	NaN	12	414	19.28	ln(x)	ShapiroWilk



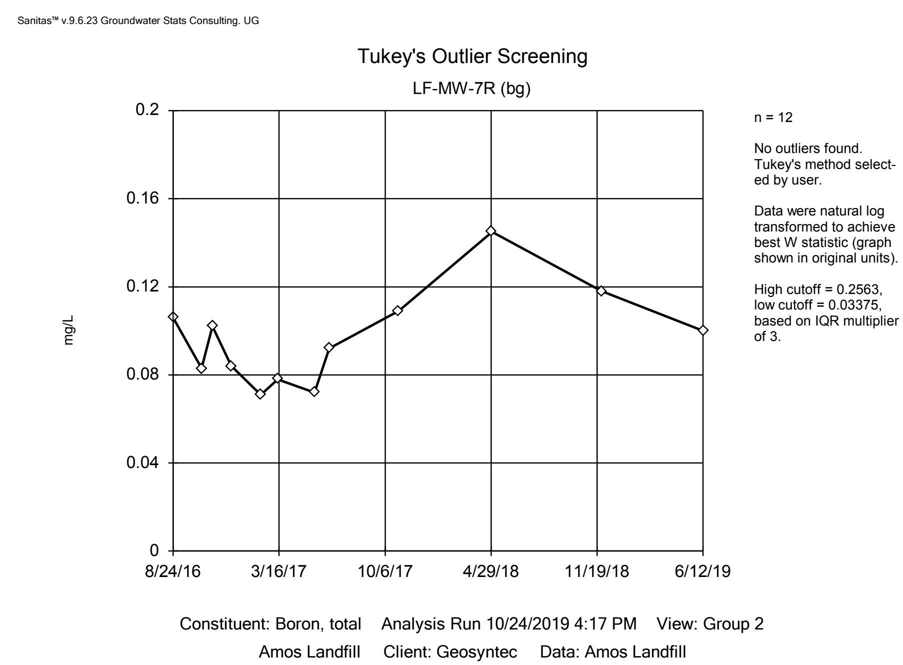
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-1
mg/L
0.2
0.16
0.12
0.08
0.04
0
8/23/16
3/15/17
10/5/17
4/28/18
11/18/18
6/11/19
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.9597, low cutoff = 0.004533, based on IQR multiplier of 3.
Constituent: Boron, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-5
mg/L
0.2
0.16
0.12
0.08
0.04
0
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
n = 13
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.4461, low cutoff = 0.002451, based on IQR multiplier of 3.
Constituent: Boron, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill



Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-6 (bg)
mg/L
0.2
0.16
0.12
0.08
0.04
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Ladder of Powers transformations did not improve normality; analysis run on raw data.
High cutoff = 0.3405, low cutoff = -0.0865, based on IQR multiplier of 3.
Constituent: Boron, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

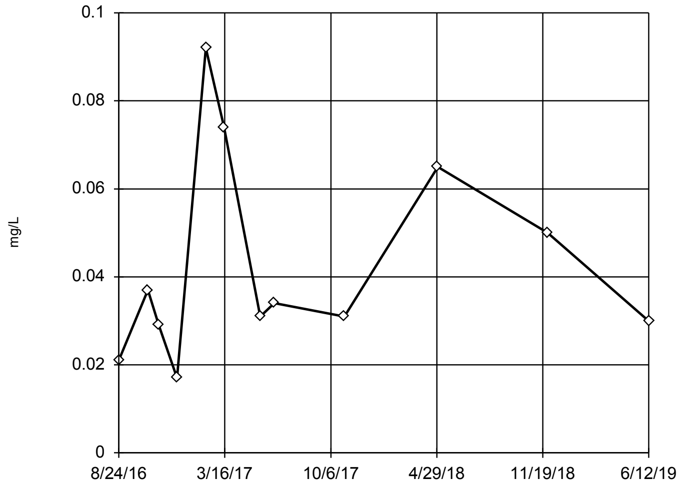


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-7R (bg)
mg/L
0.2
0.16
0.12
0.08
0.04
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.2563, low cutoff = 0.03375, based on IQR multiplier of 3.
Constituent: Boron, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-8 (bg)



n = 12

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

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

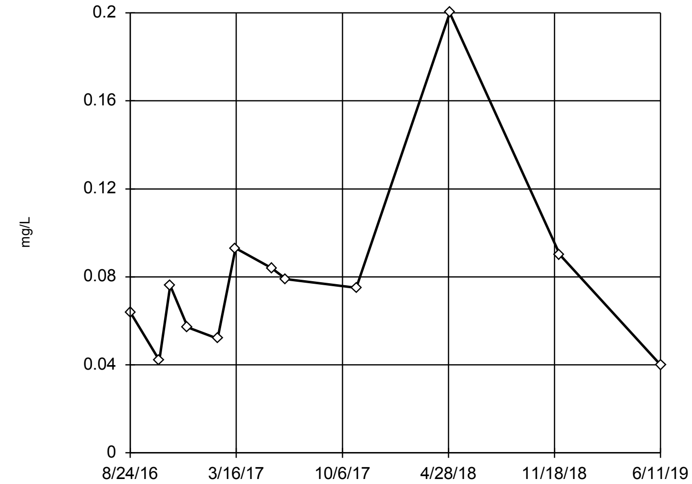
High cutoff = 0.4116, low cutoff = 0.004085, based on IQR multiplier of 3.

Constituent: Boron, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-9 (bg)



n = 12

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

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

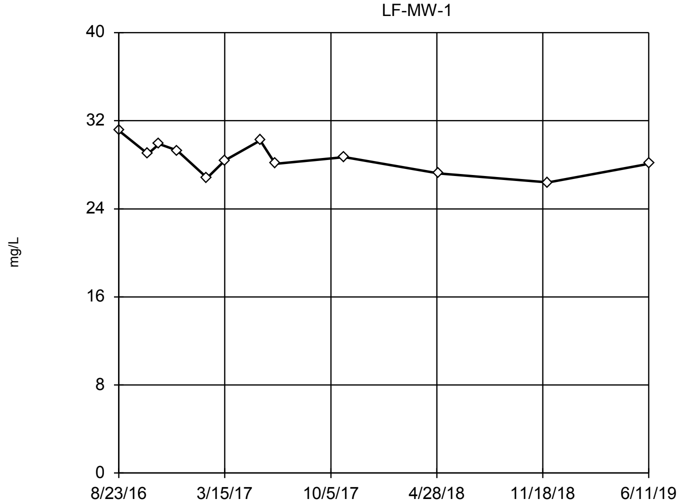
High cutoff = 0.3542, low cutoff = 0.01337, based on IQR multiplier of 3.

Constituent: Boron, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-1



n = 12

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

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

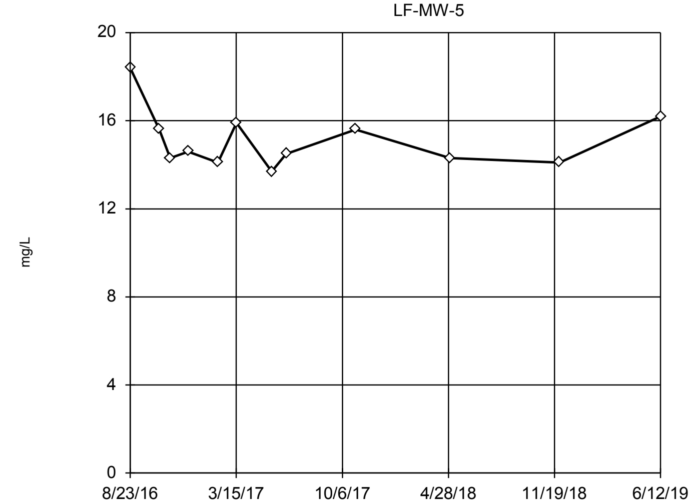
High cutoff = 36, low cutoff = 22.31, based on IQR multiplier of 3.

Constituent: Calcium, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-5



n = 12

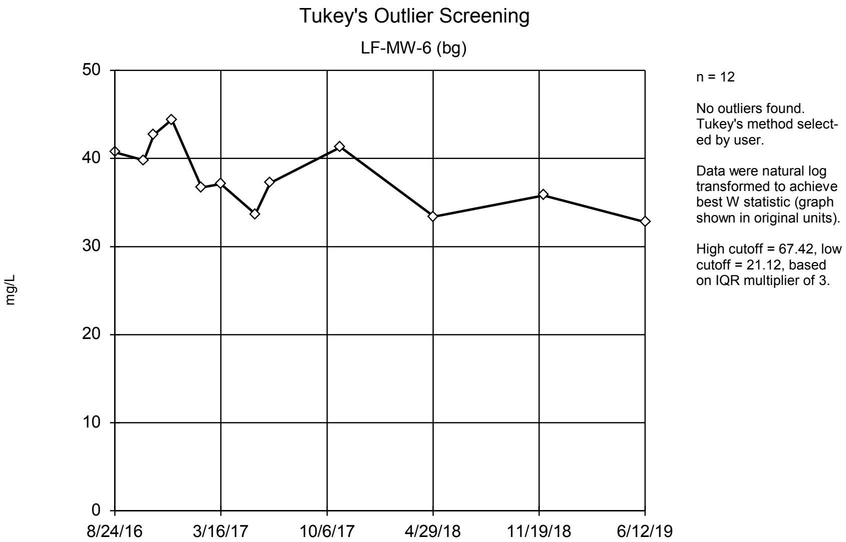
No outliers found. Tukey's method selected by user.

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

High cutoff = 21.49, low cutoff = 10.41, based on IQR multiplier of 3.

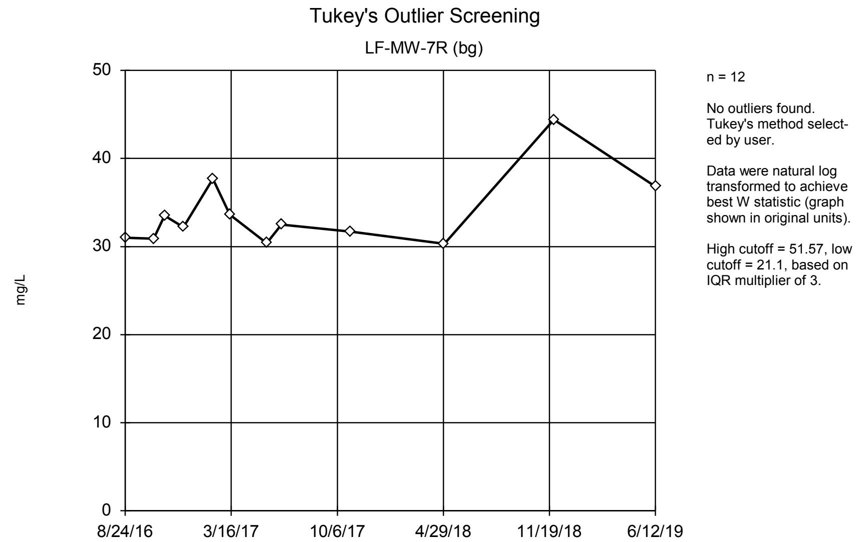
Constituent: Calcium, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



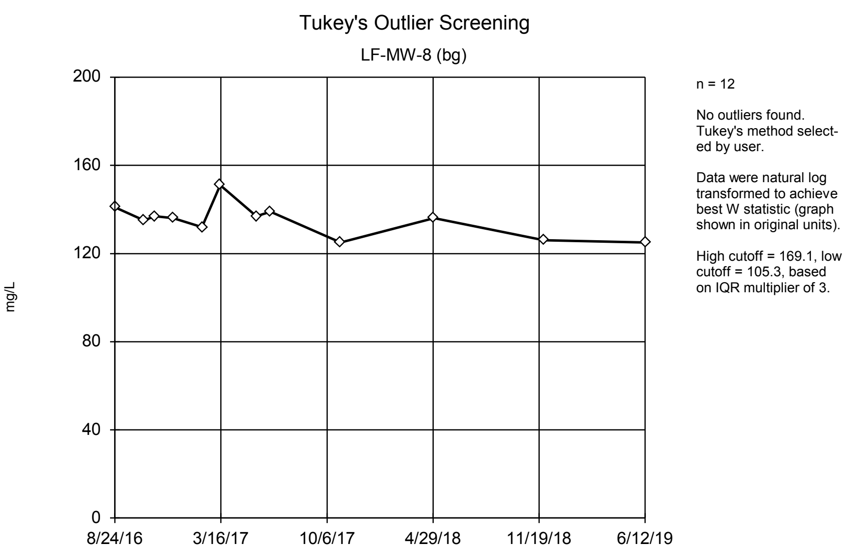
Constituent: Calcium, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



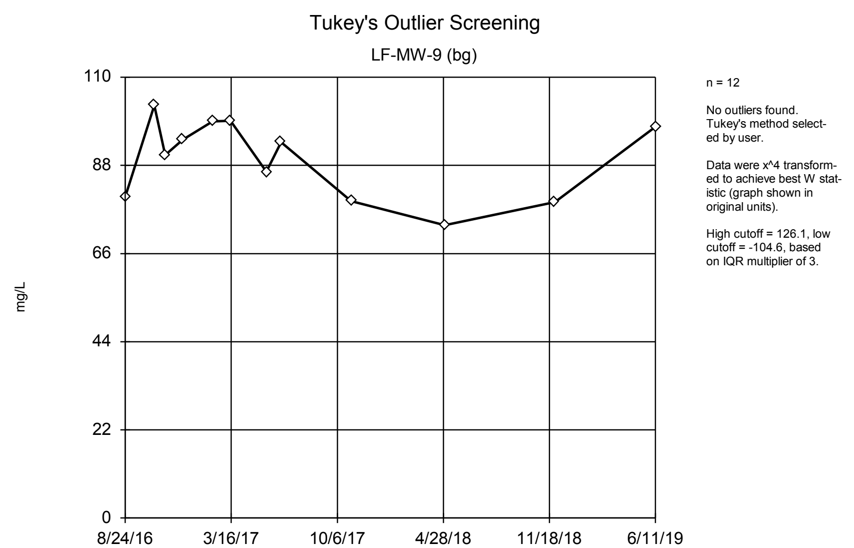
Constituent: Calcium, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Calcium, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

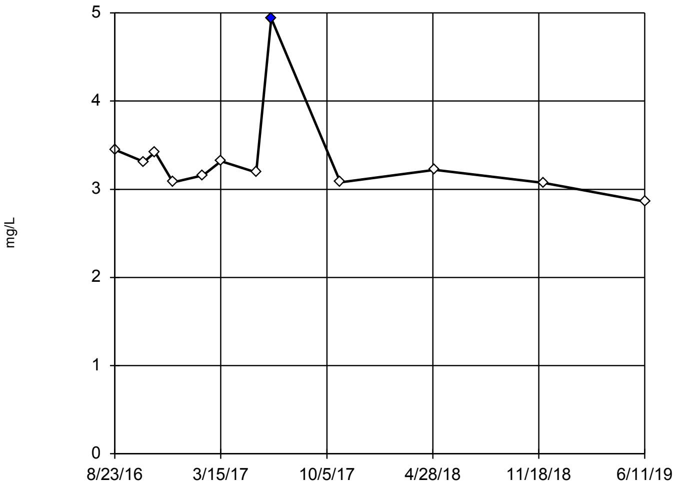


Constituent: Calcium, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-1



n = 12

Outlier is drawn as solid. Tukey's method selected by user.

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

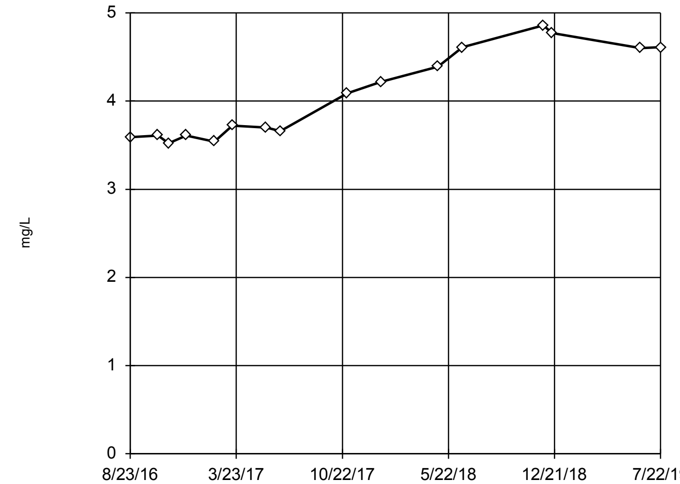
High cutoff = 4.412, low cutoff = 2.352, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-5



n = 16

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

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

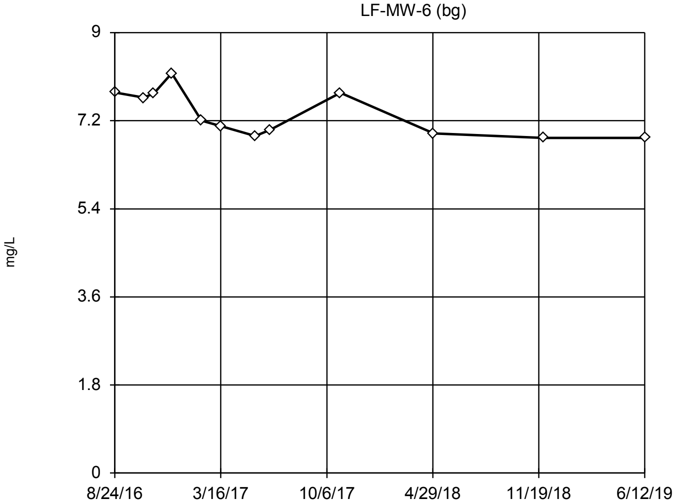
High cutoff = 9.559, low cutoff = 1.739, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-6 (bg)



n = 12

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

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

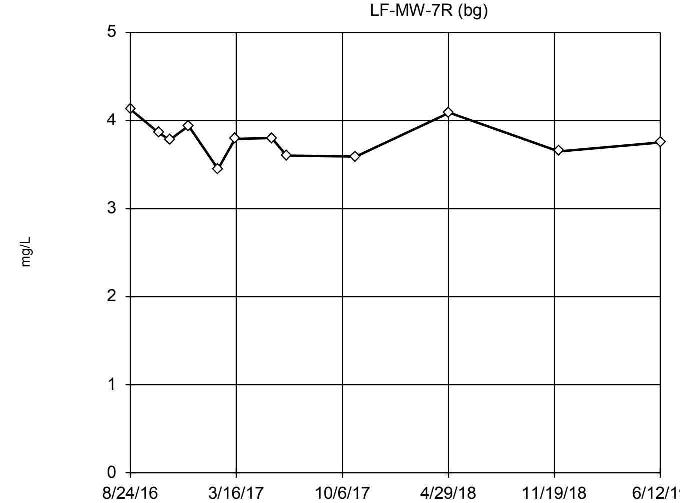
High cutoff = 11, low cutoff = 4.884, based on IQR multiplier of 3.

Constituent: Chloride, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-7R (bg)



n = 12

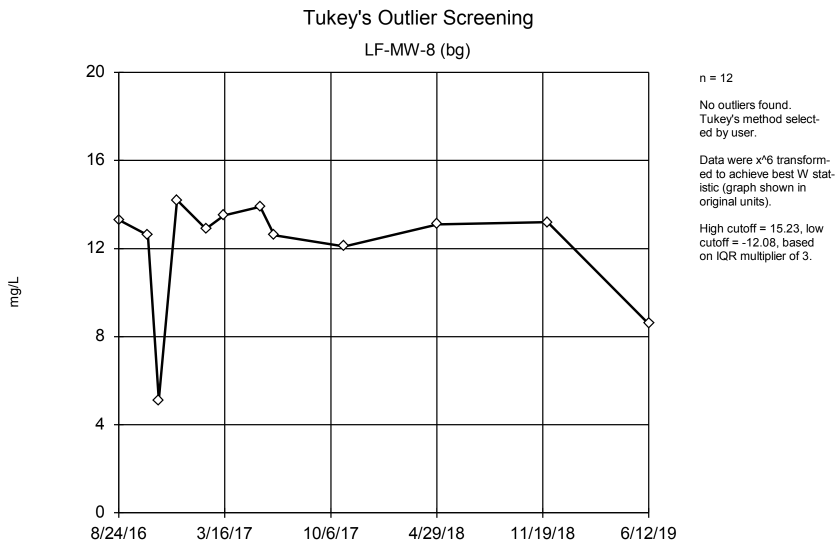
No outliers found. Tukey's method selected by user.

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

High cutoff = 4.856, low cutoff = 2.911, based on IQR multiplier of 3.

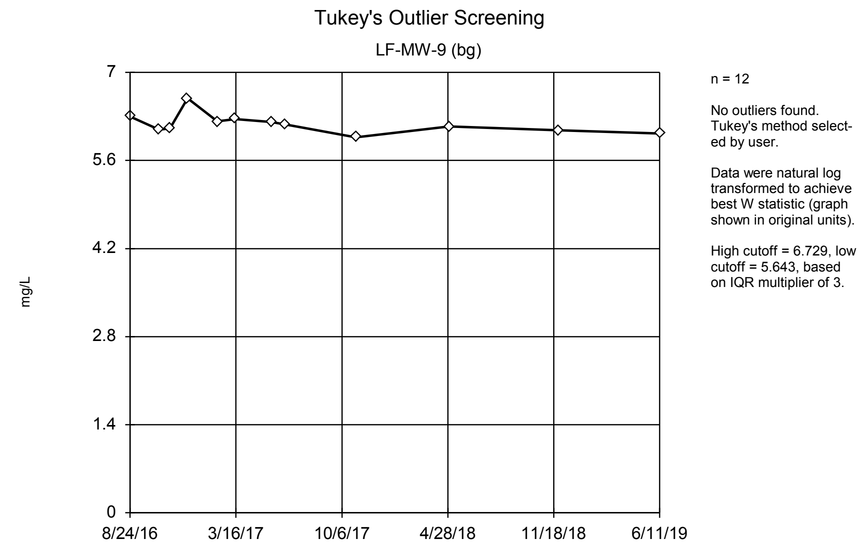
Constituent: Chloride, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



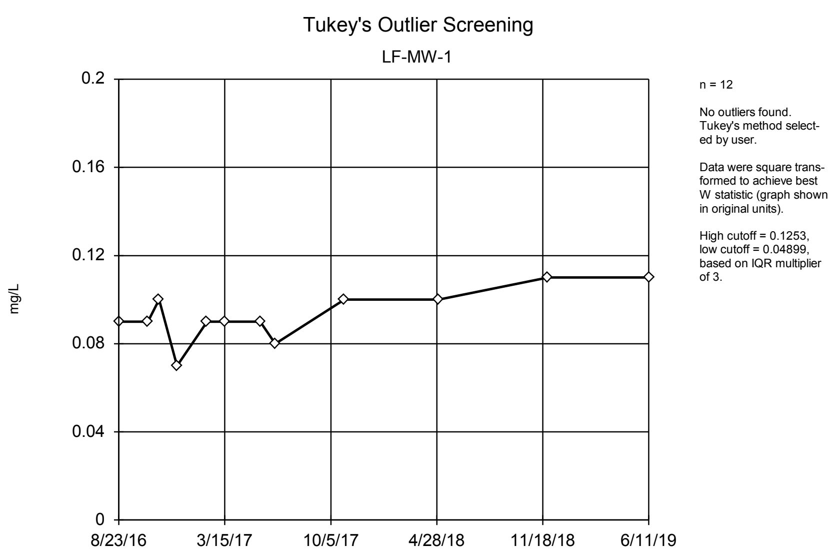
Constituent: Chloride, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



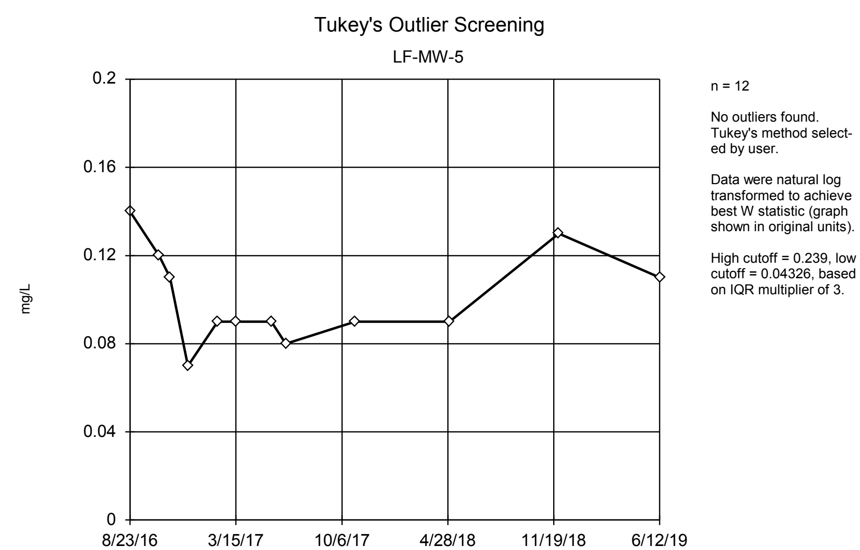
Constituent: Chloride, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Constituent: Fluoride, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

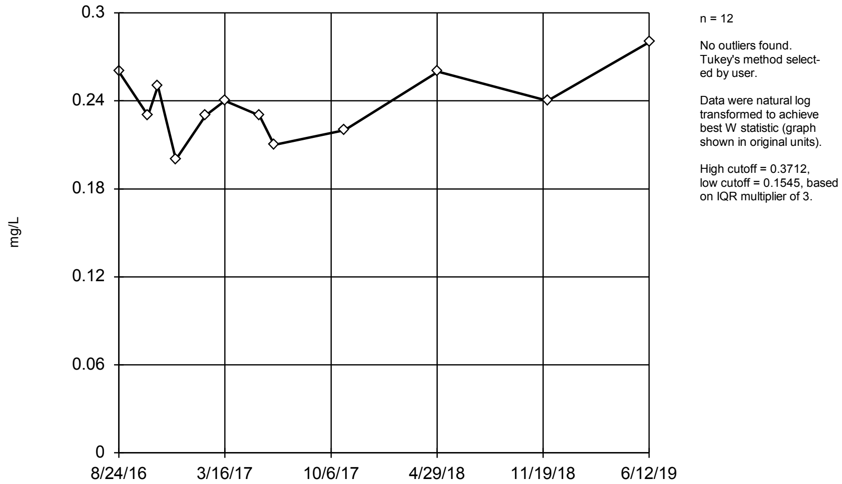


Constituent: Fluoride, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-6 (bg)



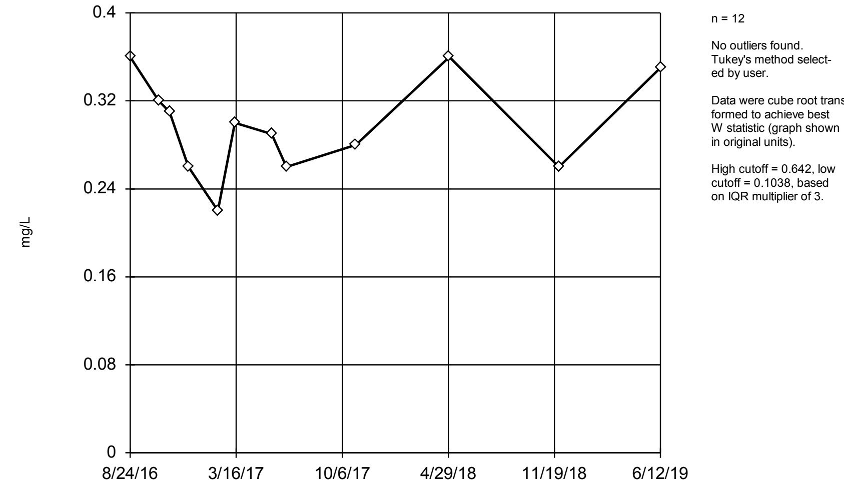
Constituent: Fluoride, total Analysis Run 10/24/2019 4:17 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-7R (bg)



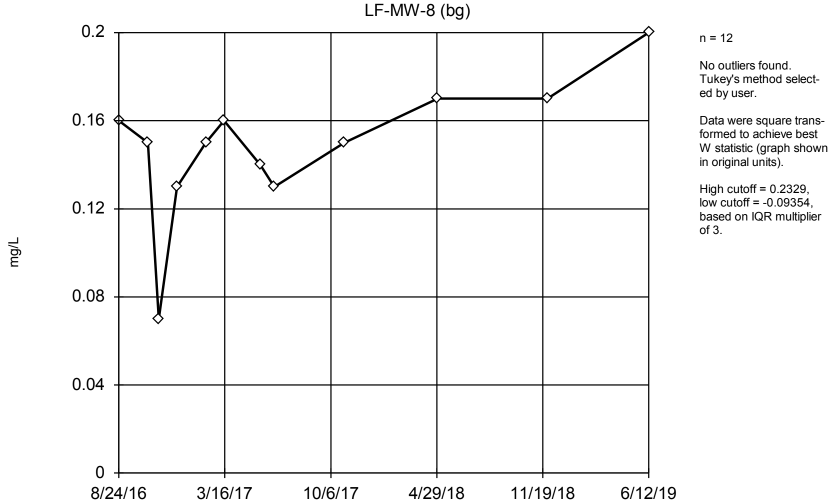
Constituent: Fluoride, total Analysis Run 10/24/2019 4:17 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-8 (bg)



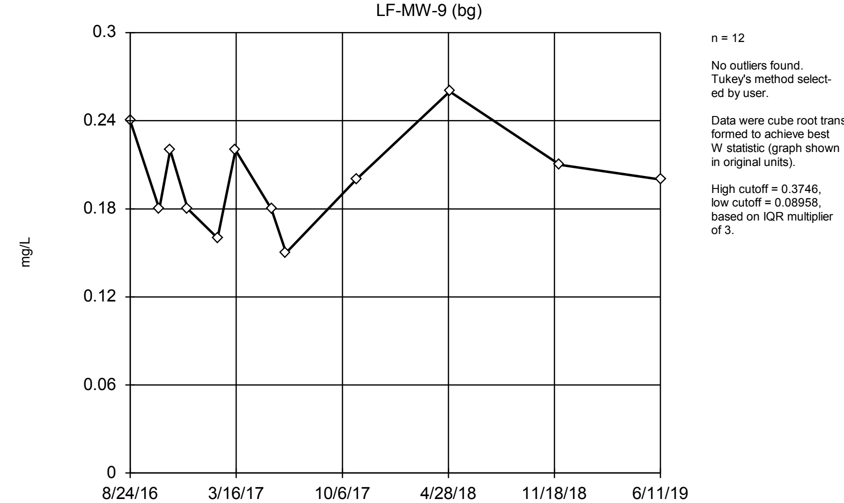
Constituent: Fluoride, total Analysis Run 10/24/2019 4:17 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-9 (bg)



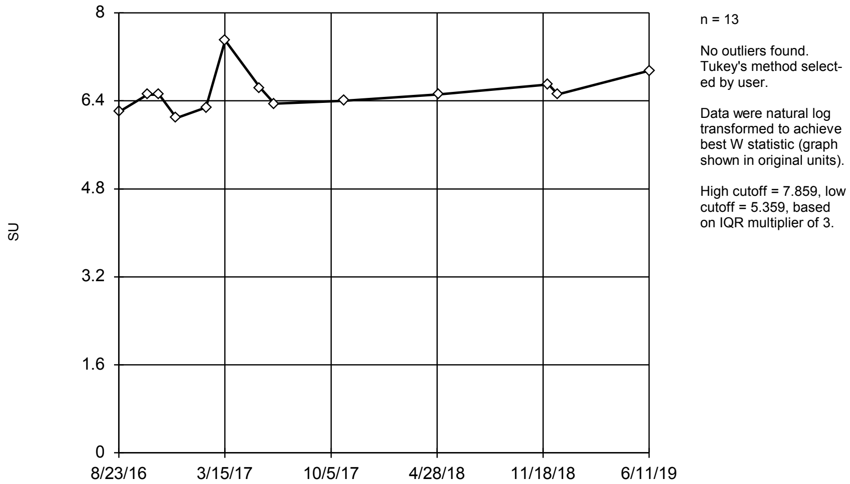
Constituent: Fluoride, total Analysis Run 10/24/2019 4:17 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-1



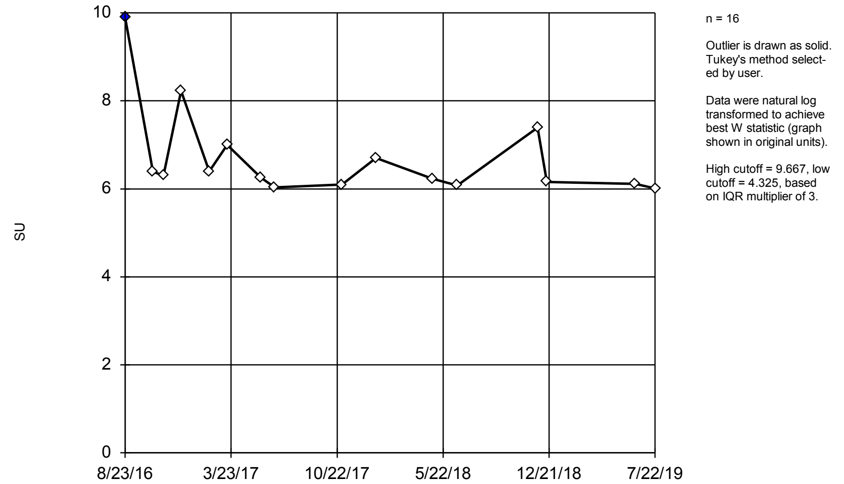
Constituent: pH, field   Analysis Run 10/24/2019 4:17 PM   View: Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-5



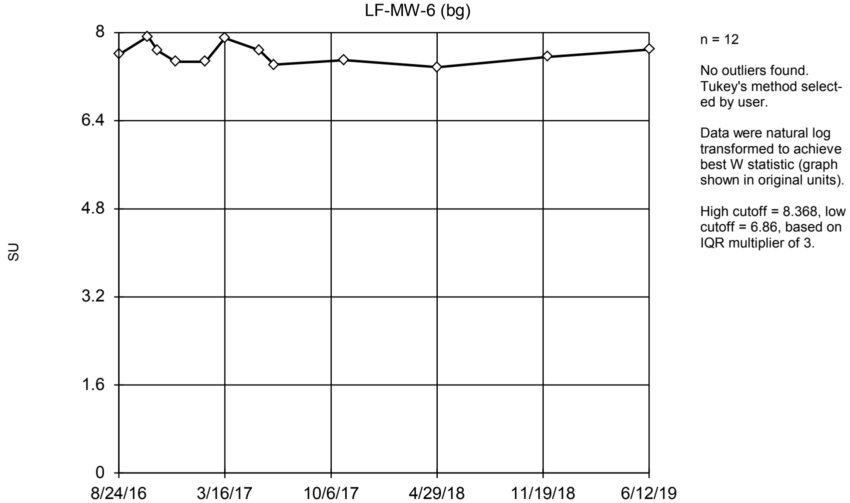
Constituent: pH, field   Analysis Run 10/24/2019 4:17 PM   View: Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-6 (bg)



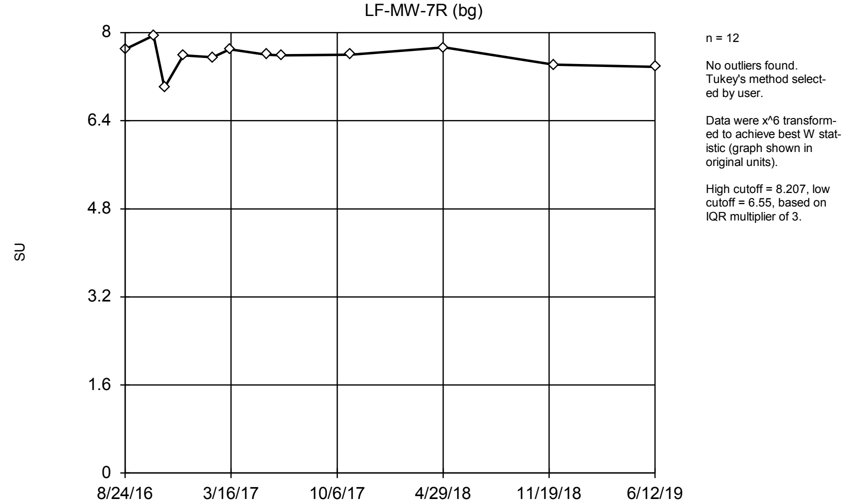
Constituent: pH, field   Analysis Run 10/24/2019 4:17 PM   View: Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

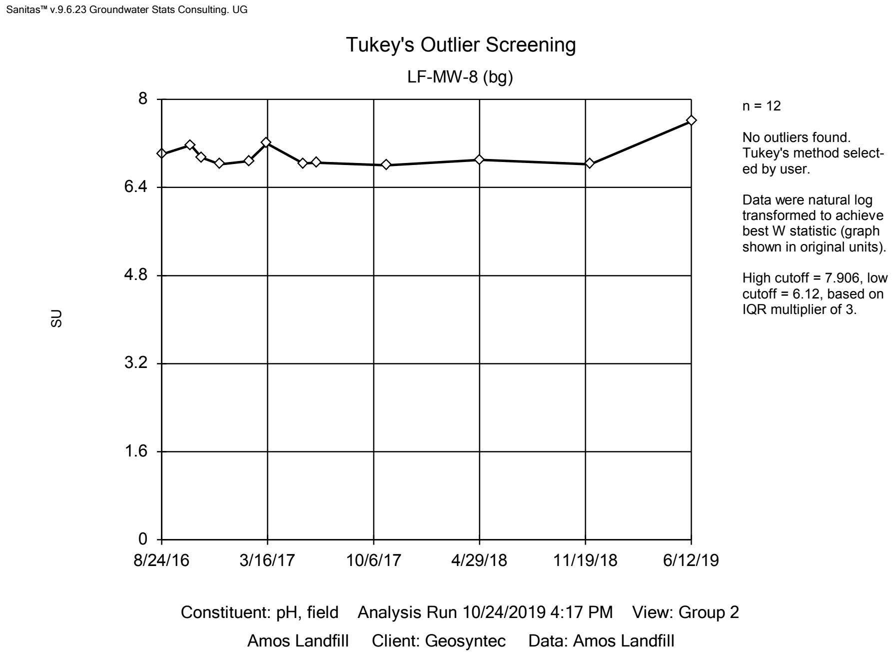
Tukey's Outlier Screening

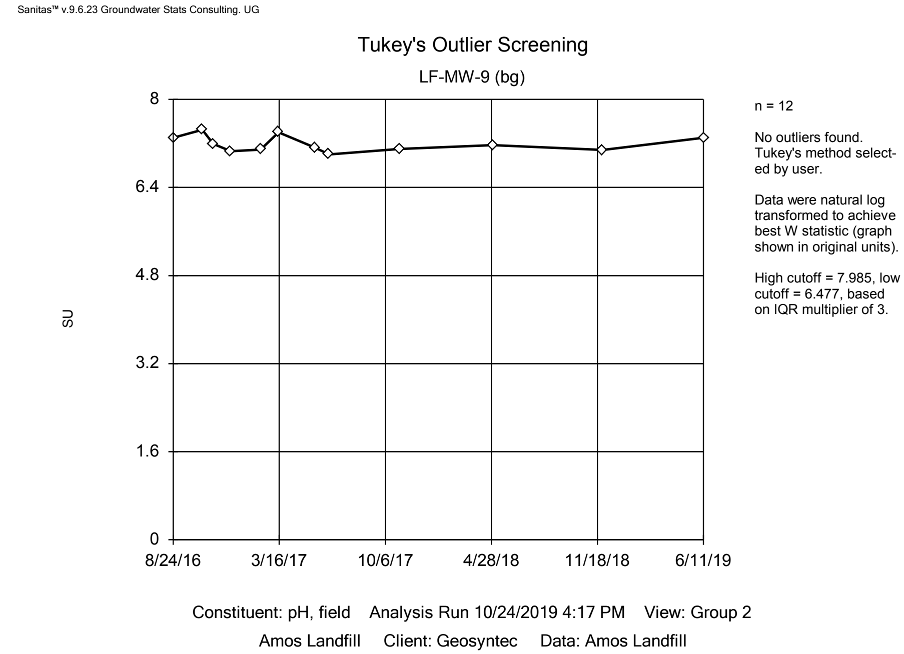
LF-MW-7R (bg)

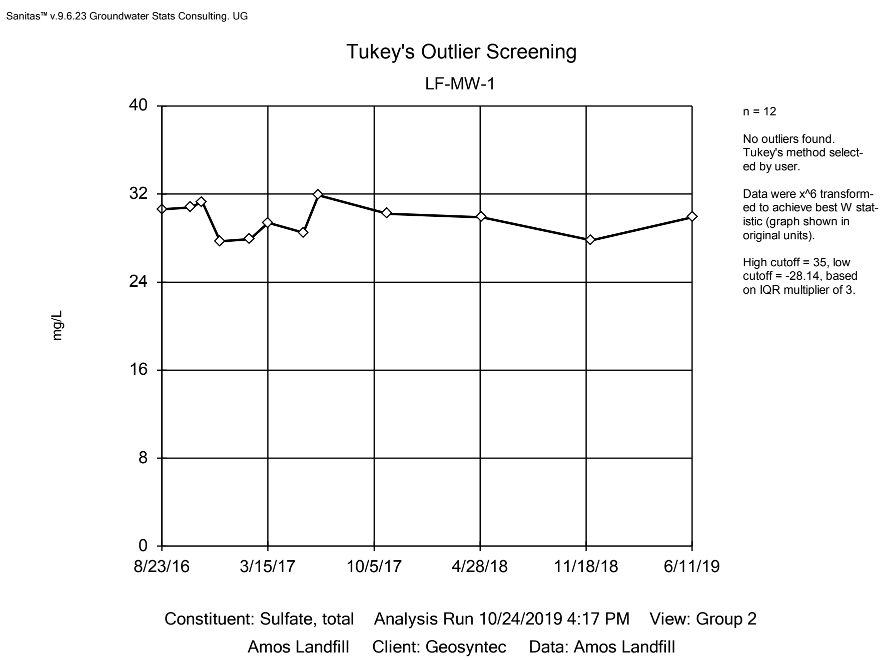


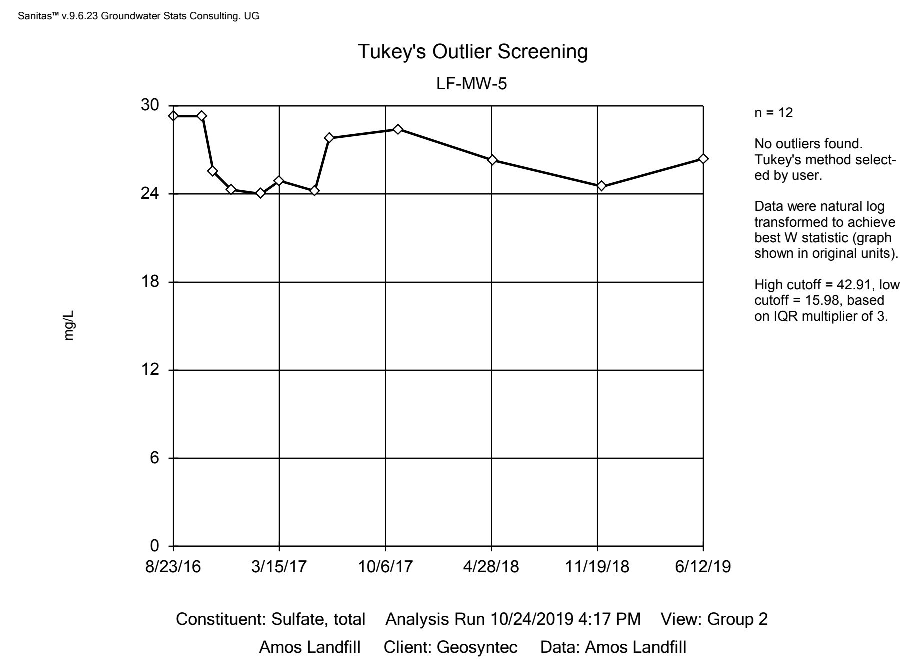
Constituent: pH, field   Analysis Run 10/24/2019 4:17 PM   View: Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill

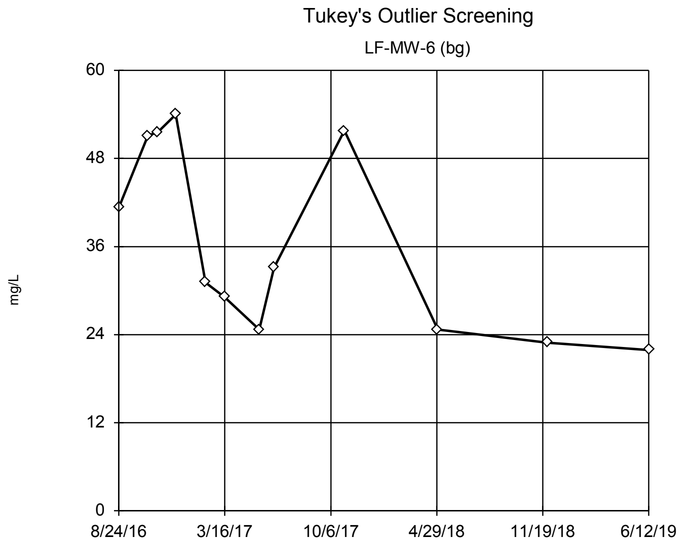

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-8 (bg)
SU
8
6.4
4.8
3.2
1.6
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 7.906, low cutoff = 6.12, based on IQR multiplier of 3.
Constituent: pH, field Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-9 (bg)
SU
8
6.4
4.8
3.2
1.6
0
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 7.985, low cutoff = 6.477, based on IQR multiplier of 3.
Constituent: pH, field Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-1
mg/L
40
32
24
16
8
0
8/23/16
3/15/17
10/5/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 35, low cutoff = -28.14, based on IQR multiplier of 3.
Constituent: Sulfate, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill


Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-5
mg/L
30
24
18
12
6
0
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 42.91, low cutoff = 15.98, based on IQR multiplier of 3.
Constituent: Sulfate, total Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

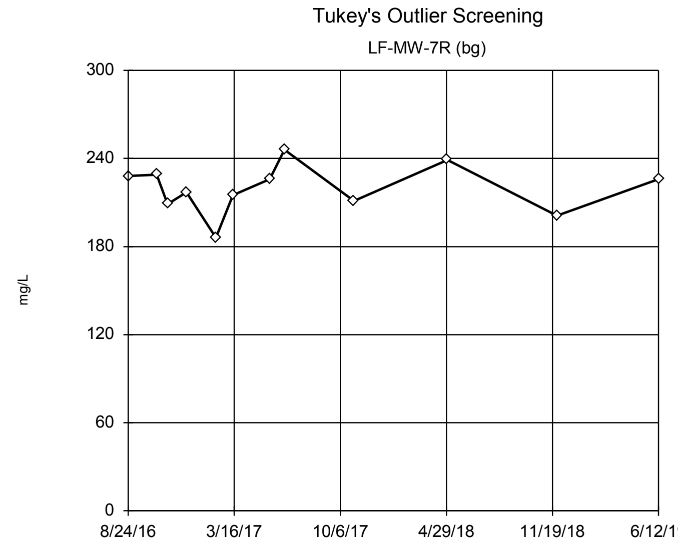
No outliers found. Tukey's method selected by user.

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

High cutoff = 461.4, low cutoff = 2.749, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

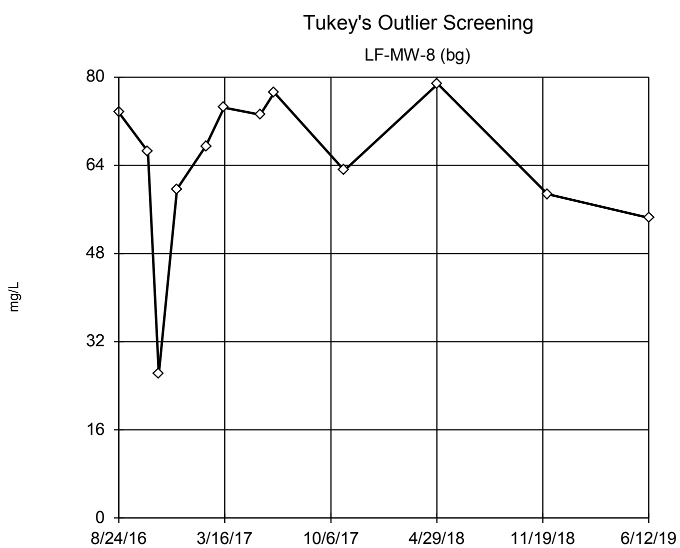
No outliers found. Tukey's method selected by user.

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

High cutoff = 271.2, low cutoff = 107.9, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

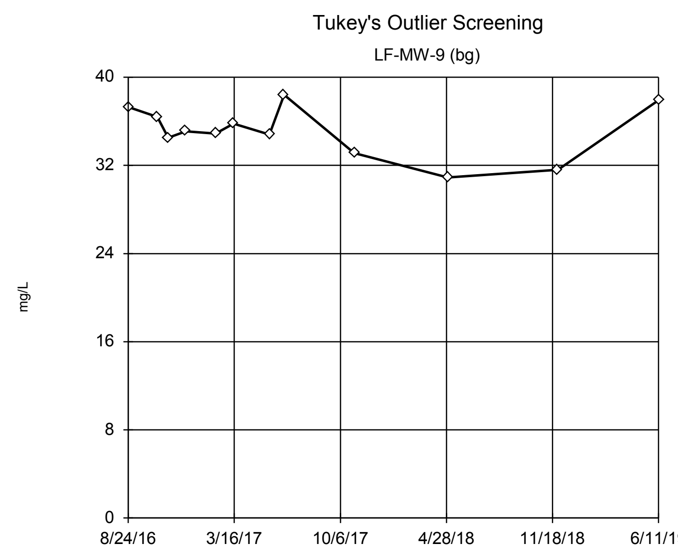
No outliers found. Tukey's method selected by user.

Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 95.54, low cutoff = -79.98, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



n = 12

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

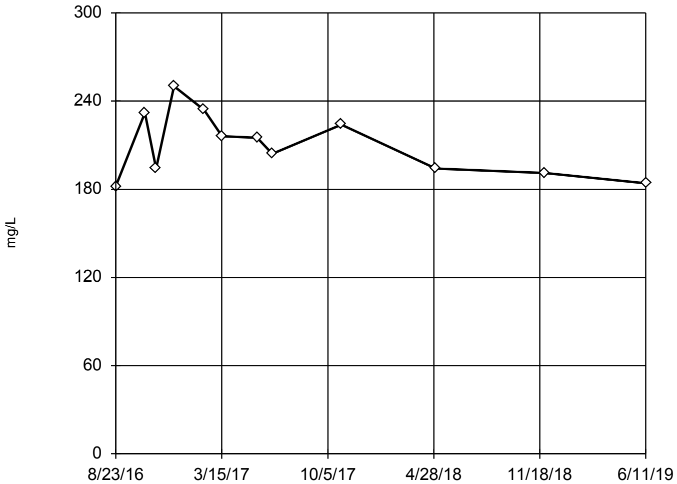
Data were x^4 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 43.12, low cutoff = -23.46, based on IQR multiplier of 3.

Constituent: Sulfate, total   Analysis Run 10/24/2019 4:17 PM   View: Group 2
Amos Landfill   Client: Geosyntec   Data: Amos Landfill

Tukey's Outlier Screening

LF-MW-1



n = 12

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

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

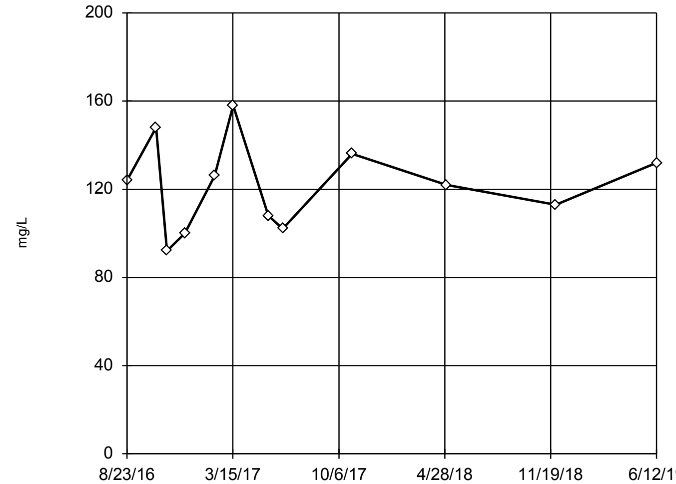
High cutoff = 378.6, low cutoff = 115.9, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-5



n = 12

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

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

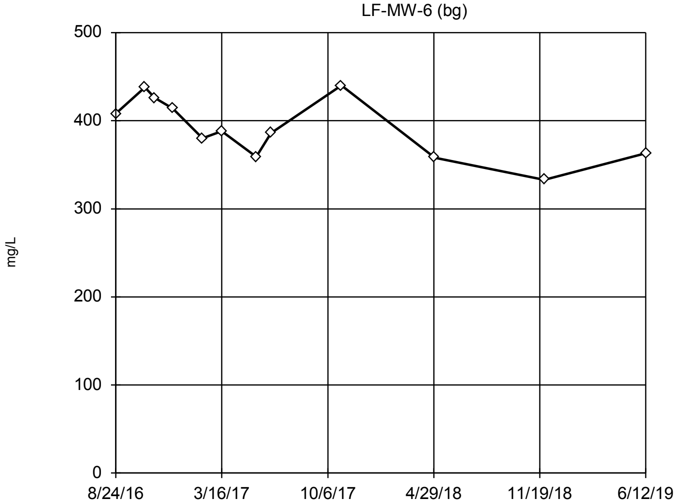
High cutoff = 278.7, low cutoff = 50.45, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-6 (bg)



n = 12

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

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

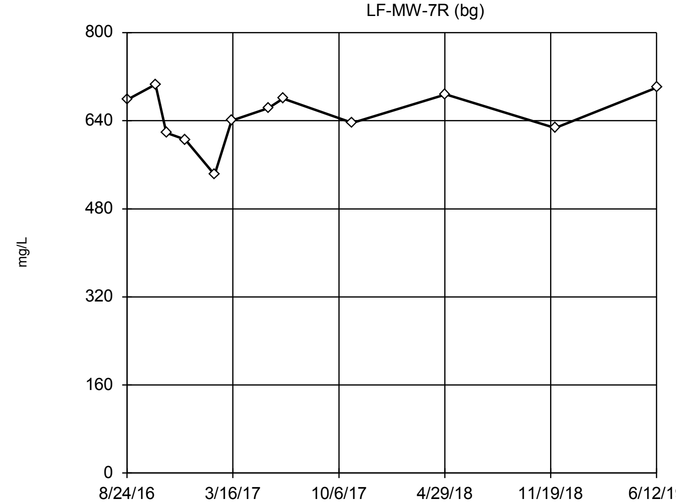
High cutoff = 634.7, low cutoff = 217.7, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-7R (bg)



n = 12

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

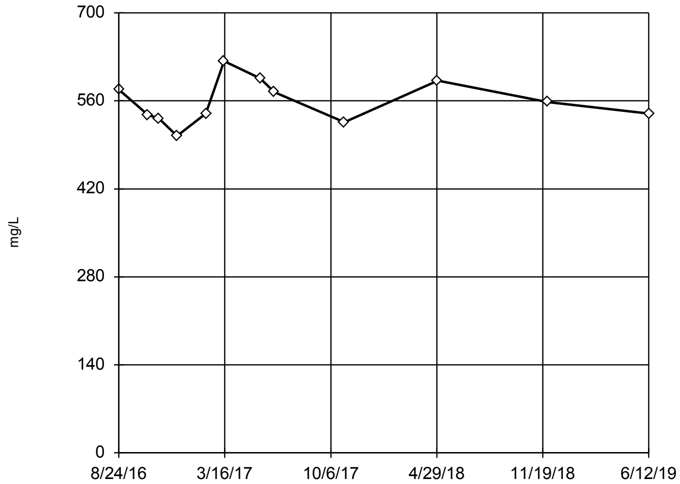
Data were x^6 transformed to achieve best W statistic (graph shown in original units).

High cutoff = 785.6, low cutoff = -648.6, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:17 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Tukey's Outlier Screening

LF-MW-8 (bg)



n = 12

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

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

High cutoff = 764.6, low cutoff = 409.3, based on IQR multiplier of 3.

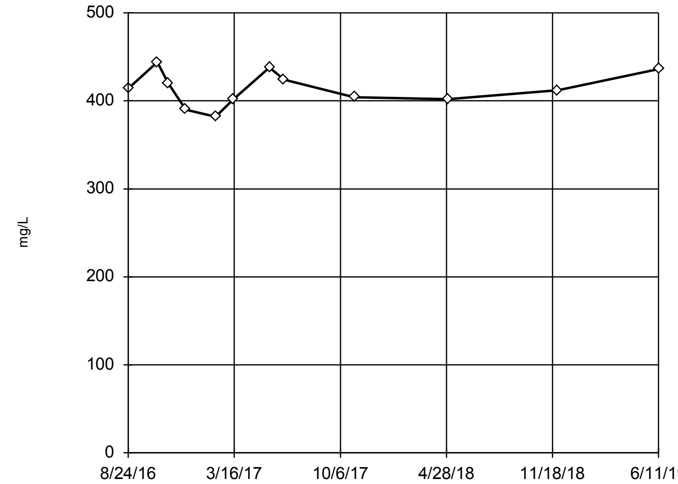
Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:17 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-9 (bg)



n = 12

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

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

High cutoff = 526, low cutoff = 328.6, based on IQR multiplier of 3.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:17 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

FIGURE D: MANN-WHITNEY ANALYSIS

Welch's t-test/Mann-Whitney - All Results - Group 1

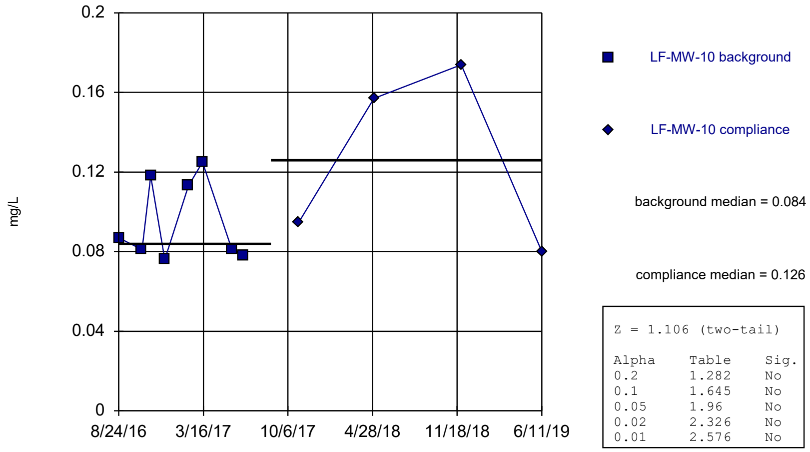
Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 1/9/2020, 2:07 PM

Constituent	Well	Calc.	0.01	Method
Boron, total (mg/L)	LF-MW-10 (bg)	1.106	No	Mann-W
Boron, total (mg/L)	LF-MW-2	1.979	No	Mann-W
Boron, total (mg/L)	LF-MW-4	0.2199	No	Mann-W
Calcium, total (mg/L)	LF-MW-10 (bg)	-1.276	No	Mann-W
Calcium, total (mg/L)	LF-MW-2	1.616	No	Mann-W
Calcium, total (mg/L)	LF-MW-4	-1.967	No	Mann-W
Chloride, total (mg/L)	LF-MW-10 (bg)	1.613	No	Mann-W
Chloride, total (mg/L)	LF-MW-2	-0.5944	No	Mann-W
Chloride, total (mg/L)	LF-MW-4	-1.108	No	Mann-W
Fluoride, total (mg/L)	LF-MW-10 (bg)	0.5104	No	Mann-W
Fluoride, total (mg/L)	LF-MW-2	0.9846	No	Mann-W
Fluoride, total (mg/L)	LF-MW-4	0.5138	No	Mann-W
pH, field (SU)	LF-MW-10 (bg)	0.6806	No	Mann-W
pH, field (SU)	LF-MW-2	0.2105	No	Mann-W
pH, field (SU)	LF-MW-4	-1.274	No	Mann-W
Sulfate, total (mg/L)	LF-MW-10 (bg)	0.7643	No	Mann-W
Sulfate, total (mg/L)	LF-MW-2	0.5965	No	Mann-W
Sulfate, total (mg/L)	LF-MW-4	0.5965	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-10 (bg)	1.616	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-2	0.0736	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-4	0.9341	No	Mann-W

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-10 (bg)



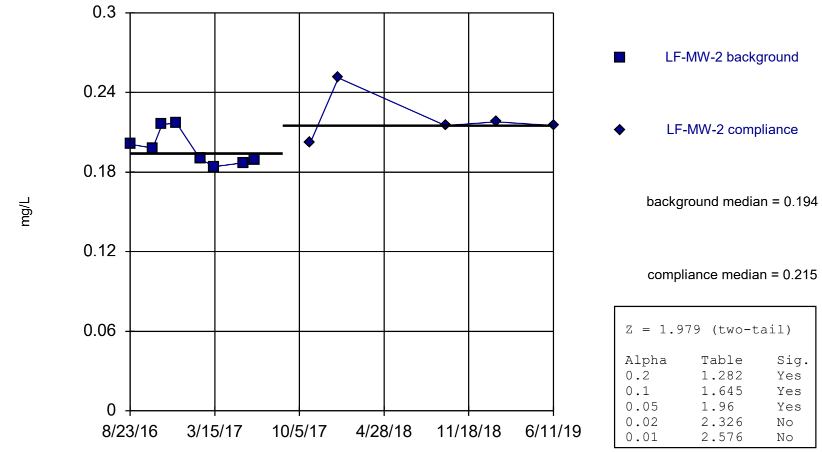
Constituent: Boron, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-2



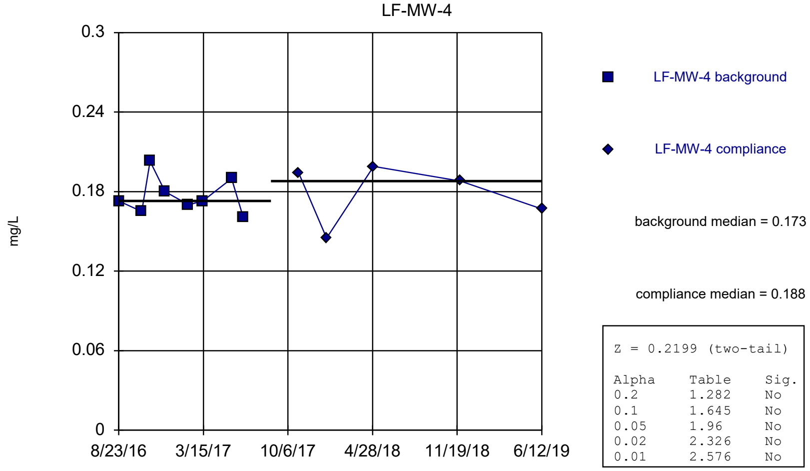
Constituent: Boron, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-4



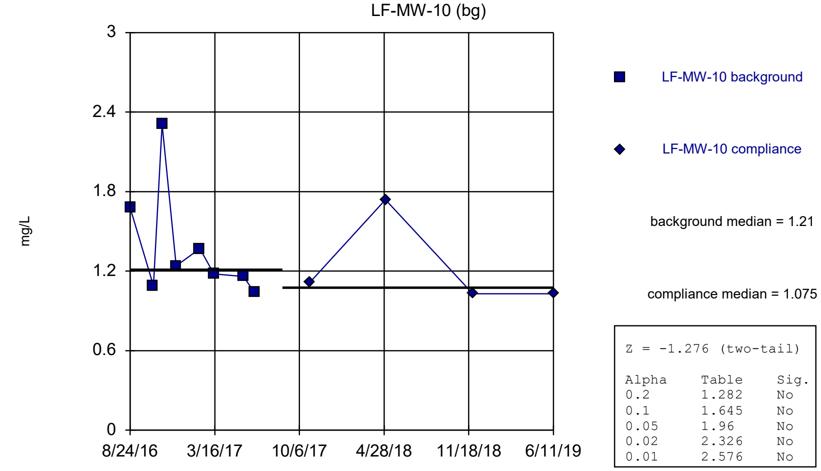
Constituent: Boron, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-10 (bg)



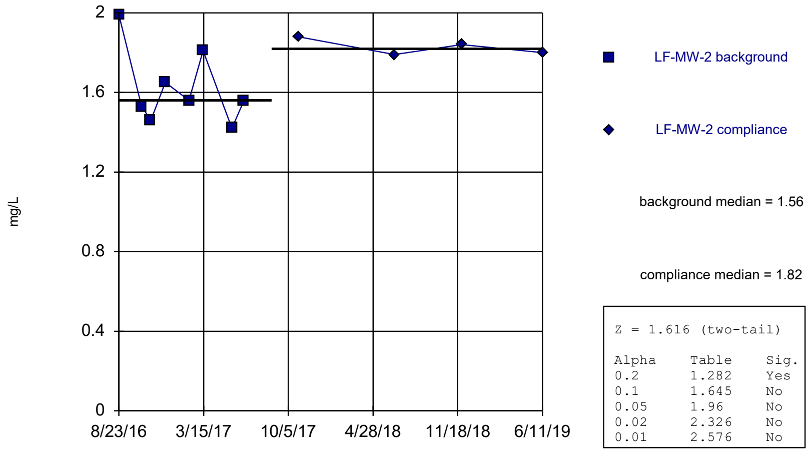
Constituent: Calcium, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-2



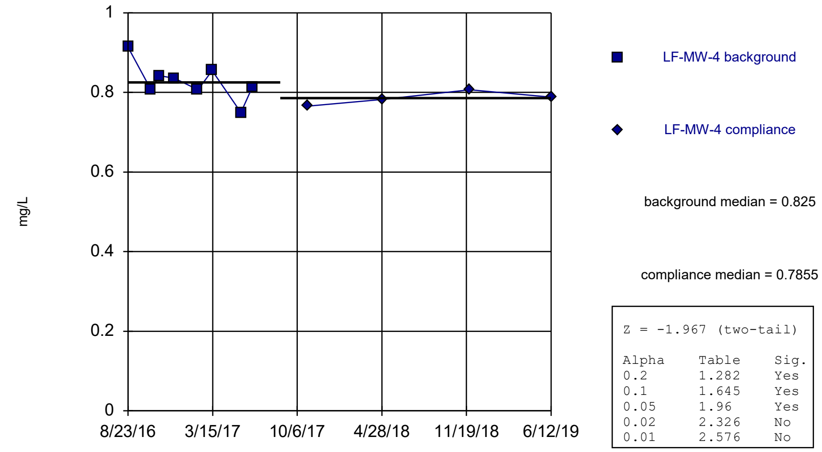
Constituent: Calcium, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-4



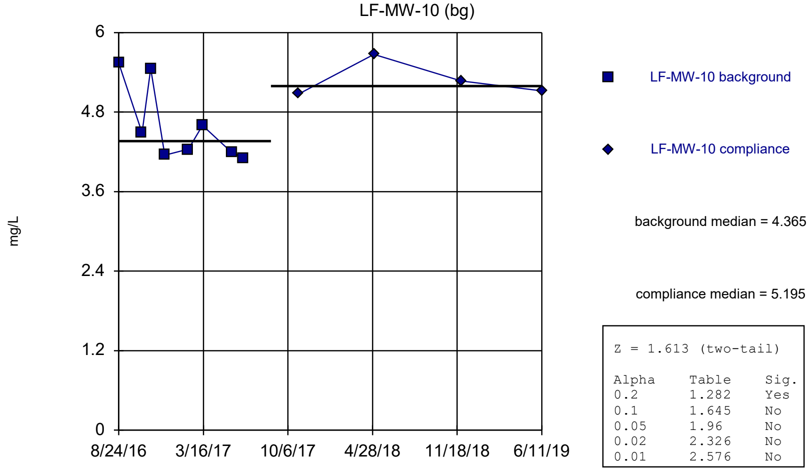
Constituent: Calcium, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-10 (bg)



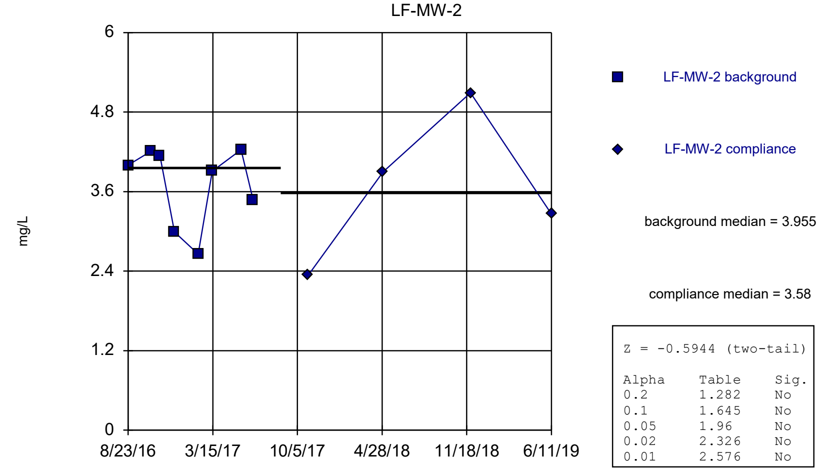
Constituent: Chloride, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-2

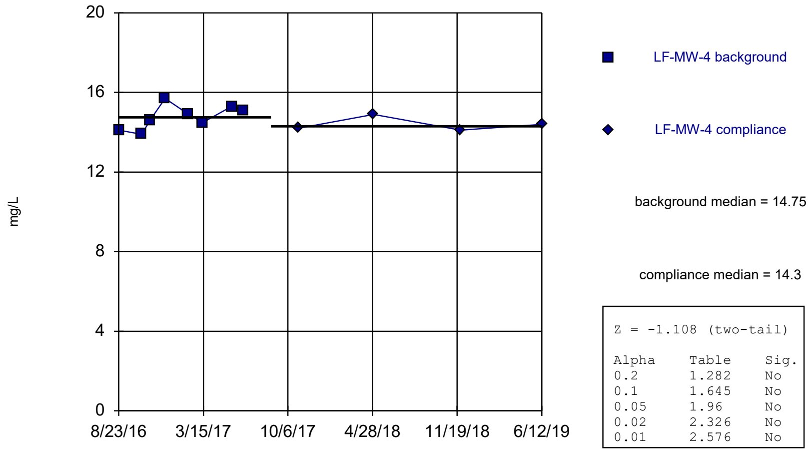


Constituent: Chloride, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-4



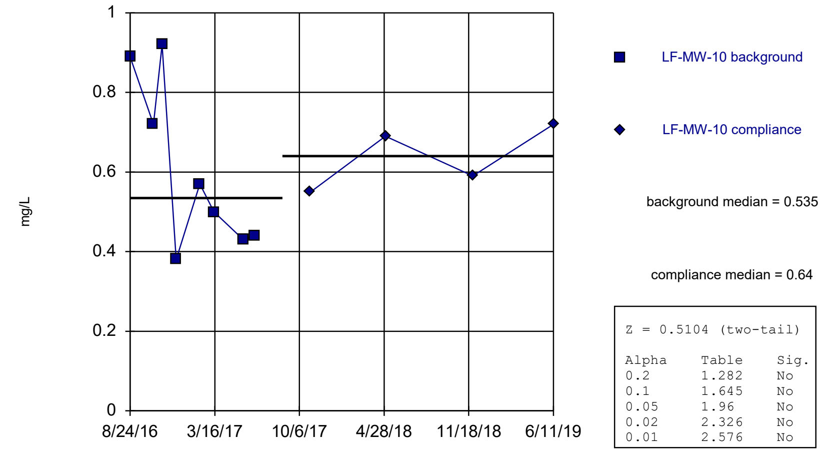
Constituent: Chloride, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-10 (bg)



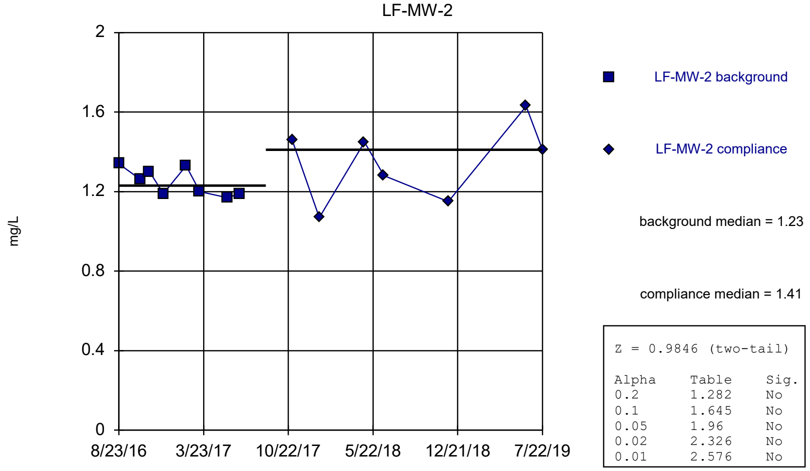
Constituent: Fluoride, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-2



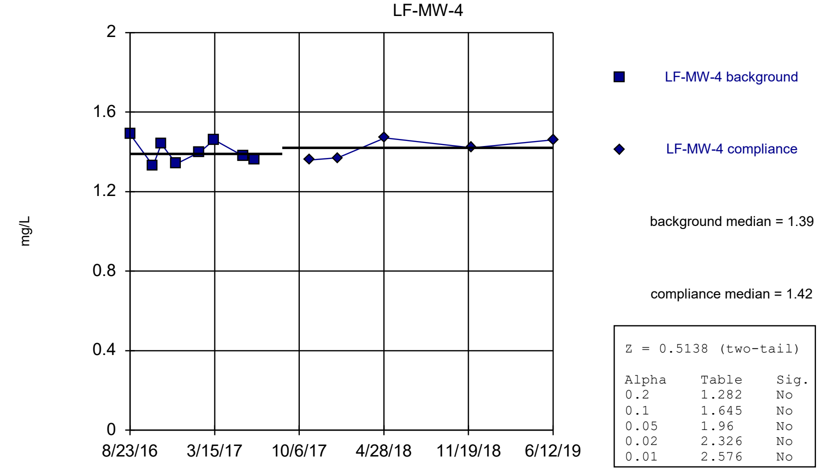
Constituent: Fluoride, total Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

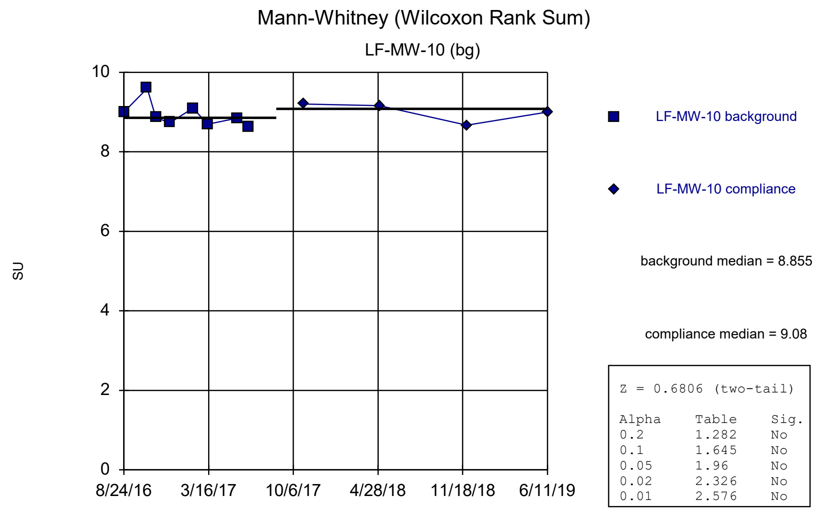
LF-MW-4



Constituent: Fluoride, total Analysis Run 1/9/2020 2:06 PM View: Group 1

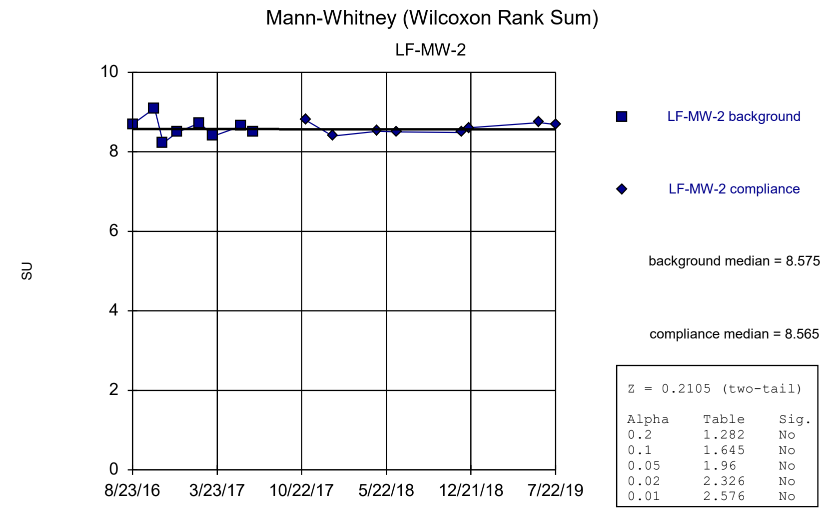
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



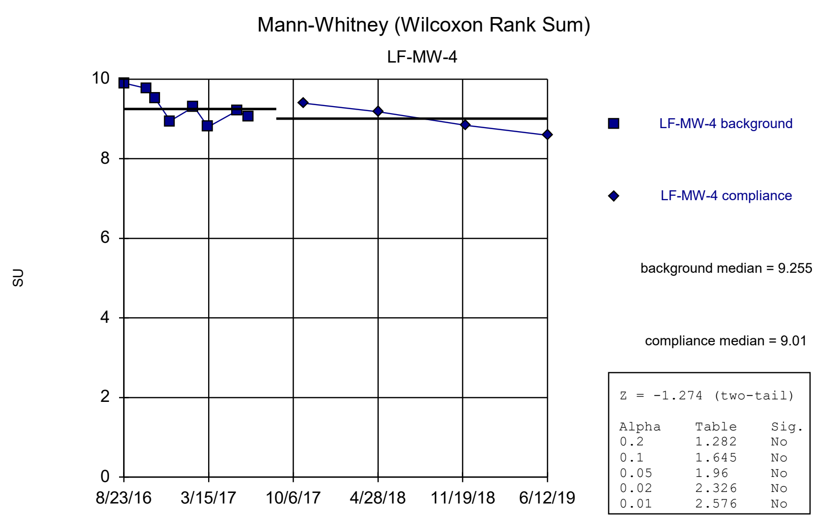
Constituent: pH, field Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



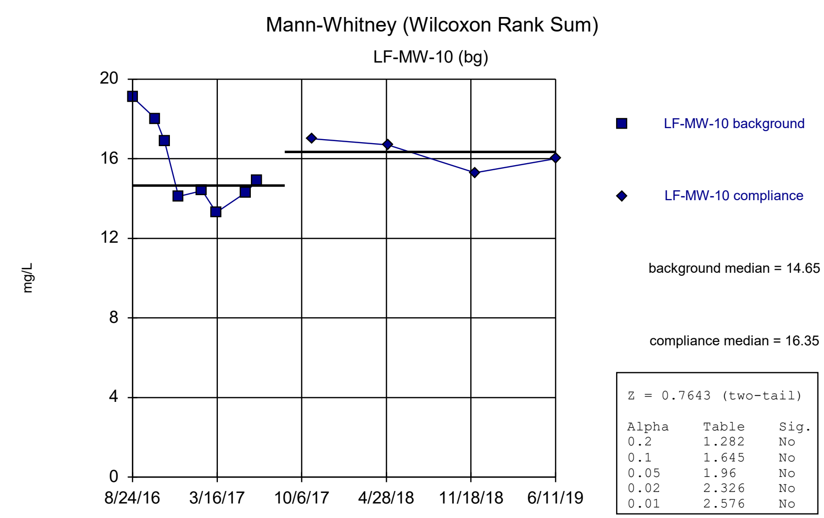
Constituent: pH, field Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: pH, field Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

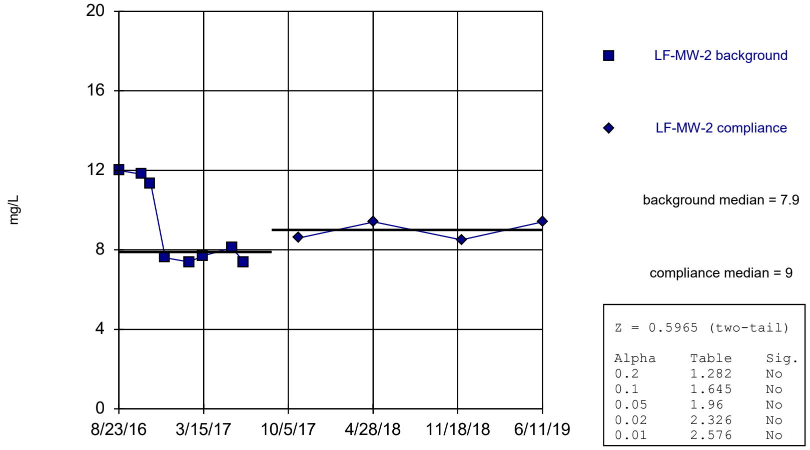


Constituent: Sulfate, total Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-2

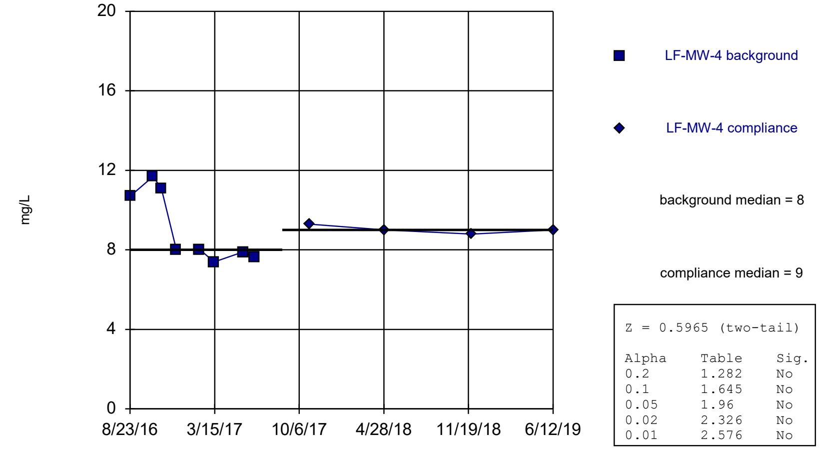


Constituent: Sulfate, total Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-4

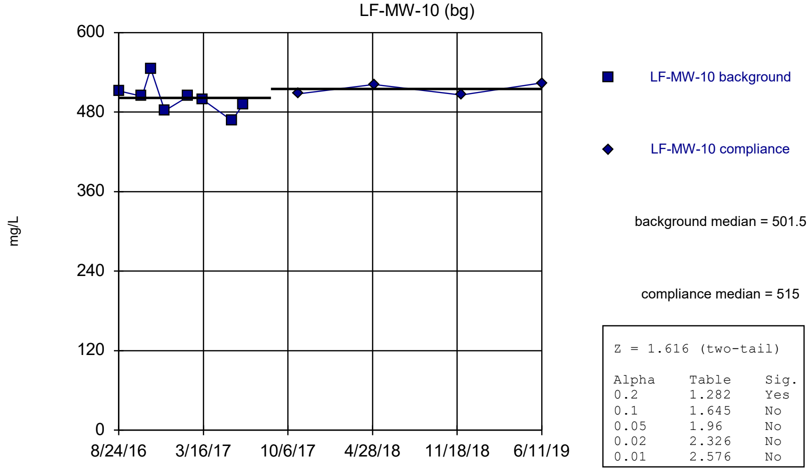


Constituent: Sulfate, total Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-10 (bg)

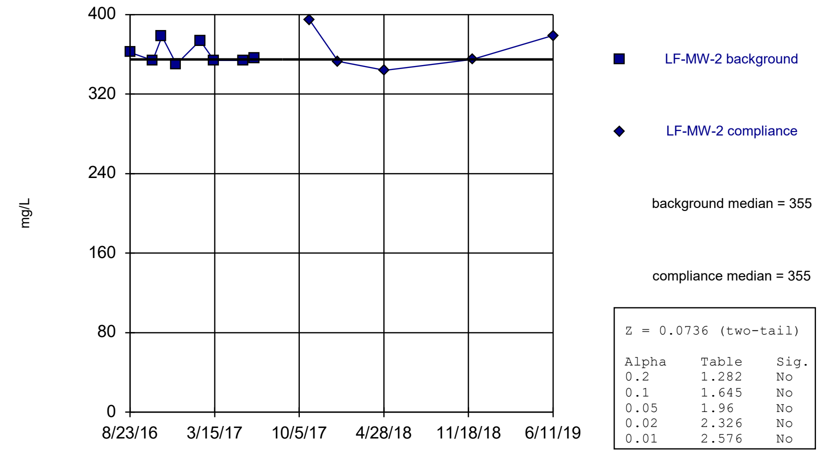


Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

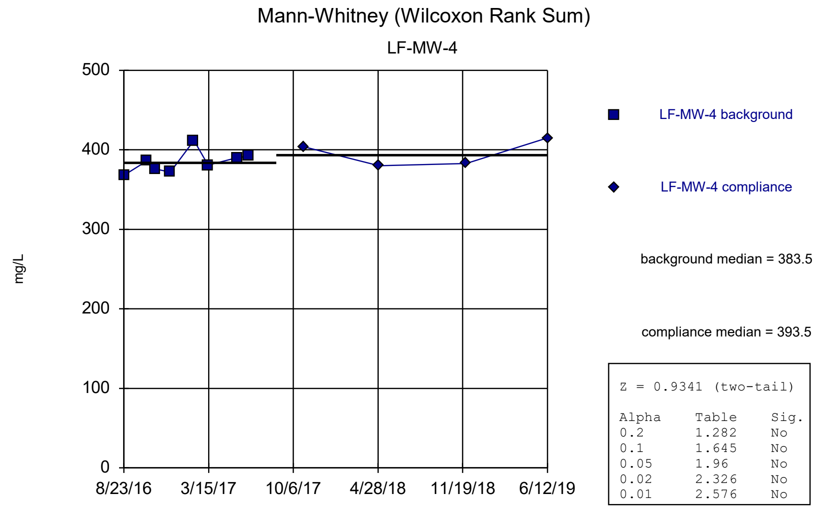
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-2



Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 2:06 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill



Z = 0.9341 (two-tail)

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

Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 2:06 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Welch's t-test/Mann-Whitney - Significant Results - Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill Printed 1/9/2020, 2:01 PM

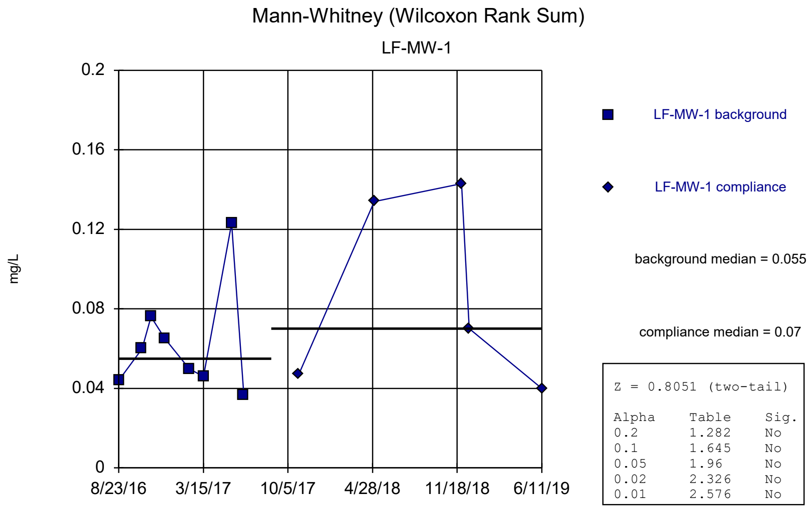
Constituent	Well	Calc.	0.01	Method
Chloride, total (mg/L)	**LF-MW-5**	**3.313**	**Yes**	**Mann-W**
Fluoride, total (mg/L)	**LF-MW-1**	**2.578**	**Yes**	**Mann-W**

Welch's t-test/Mann-Whitney - All Results - Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 1/9/2020, 2:01 PM

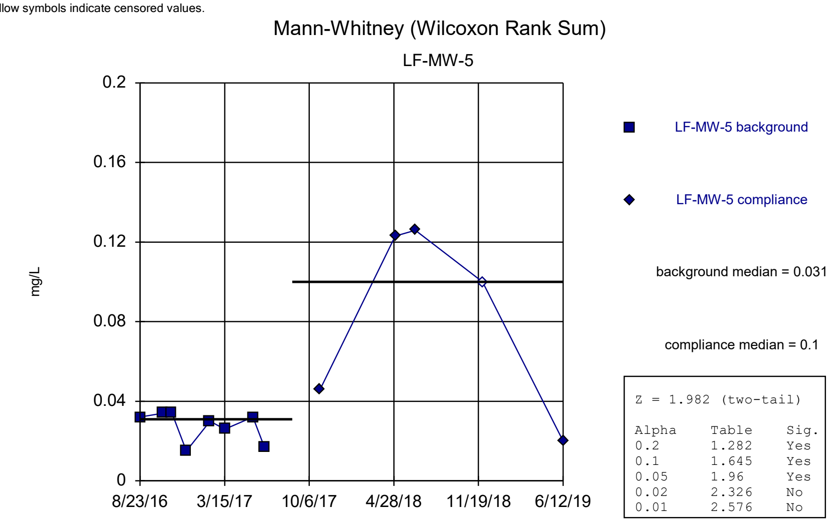
Constituent	Well	Calc.	0.01	Method
Boron, total (mg/L)	LF-MW-1	0.8051	No	Mann-W
Boron, total (mg/L)	LF-MW-5	1.982	No	Mann-W
Boron, total (mg/L)	LF-MW-6 (bg)	0.7643	No	Mann-W
Boron, total (mg/L)	LF-MW-7R (bg)	2.293	No	Mann-W
Boron, total (mg/L)	LF-MW-8 (bg)	0.3403	No	Mann-W
Boron, total (mg/L)	LF-MW-9 (bg)	0.4246	No	Mann-W
Calcium, total (mg/L)	LF-MW-1	-1.872	No	Mann-W
Calcium, total (mg/L)	LF-MW-5	0	No	Mann-W
Calcium, total (mg/L)	LF-MW-6 (bg)	-1.613	No	Mann-W
Calcium, total (mg/L)	LF-MW-7R (bg)	0.2548	No	Mann-W
Calcium, total (mg/L)	LF-MW-8 (bg)	-2.39	No	Mann-W
Calcium, total (mg/L)	LF-MW-9 (bg)	-1.953	No	Mann-W
Chloride, total (mg/L)	LF-MW-1	-2.212	No	Mann-W
Chloride, total (mg/L)	**LF-MW-5**	**3.313**	**Yes**	**Mann-W**
Chloride, total (mg/L)	LF-MW-6 (bg)	-1.616	No	Mann-W
Chloride, total (mg/L)	LF-MW-7R (bg)	-0.7643	No	Mann-W
Chloride, total (mg/L)	LF-MW-8 (bg)	-1.106	No	Mann-W
Chloride, total (mg/L)	LF-MW-9 (bg)	-2.463	No	Mann-W
Fluoride, total (mg/L)	**LF-MW-1**	**2.578**	**Yes**	**Mann-W**
Fluoride, total (mg/L)	LF-MW-5	0.5293	No	Mann-W
Fluoride, total (mg/L)	LF-MW-6 (bg)	1.116	No	Mann-W
Fluoride, total (mg/L)	LF-MW-7R (bg)	0.514	No	Mann-W
Fluoride, total (mg/L)	LF-MW-8 (bg)	2.149	No	Mann-W
Fluoride, total (mg/L)	LF-MW-9 (bg)	1.116	No	Mann-W
pH, field (SU)	LF-MW-1	1.394	No	Mann-W
pH, field (SU)	LF-MW-5	-1.733	No	Mann-W
pH, field (SU)	LF-MW-6 (bg)	-0.7656	No	Mann-W
pH, field (SU)	LF-MW-7R (bg)	-0.5122	No	Mann-W
pH, field (SU)	LF-MW-8 (bg)	-0.6806	No	Mann-W
pH, field (SU)	LF-MW-9 (bg)	-0.3403	No	Mann-W
Sulfate, total (mg/L)	LF-MW-1	-0.5955	No	Mann-W
Sulfate, total (mg/L)	LF-MW-5	0.4253	No	Mann-W
Sulfate, total (mg/L)	LF-MW-6 (bg)	-1.531	No	Mann-W
Sulfate, total (mg/L)	LF-MW-7R (bg)	-0.3403	No	Mann-W
Sulfate, total (mg/L)	LF-MW-8 (bg)	-0.7643	No	Mann-W
Sulfate, total (mg/L)	LF-MW-9 (bg)	-1.613	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-1	-1.361	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-5	0.5944	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-6 (bg)	-1.274	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-7R (bg)	0.5944	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-8 (bg)	-0.3403	No	Mann-W
Total Dissolved Solids [TDS] (mg/L)	LF-MW-9 (bg)	-0.3403	No	Mann-W

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



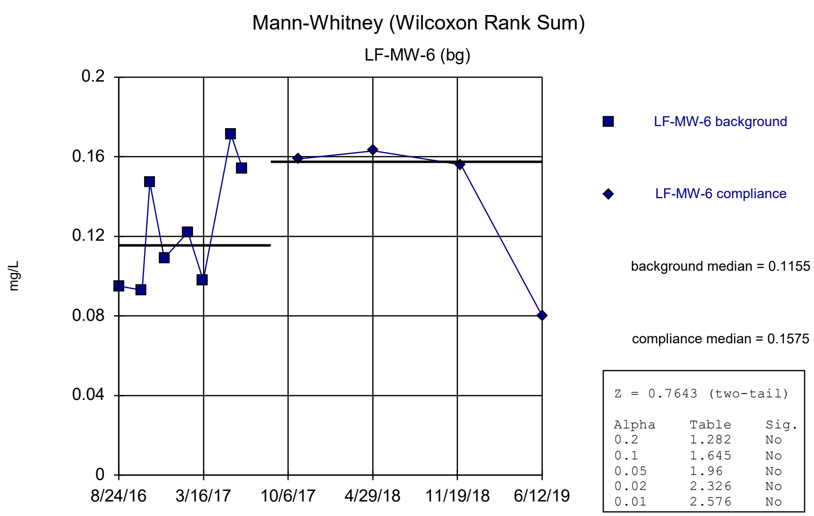
Constituent: Boron, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG
Hollow symbols indicate censored values.



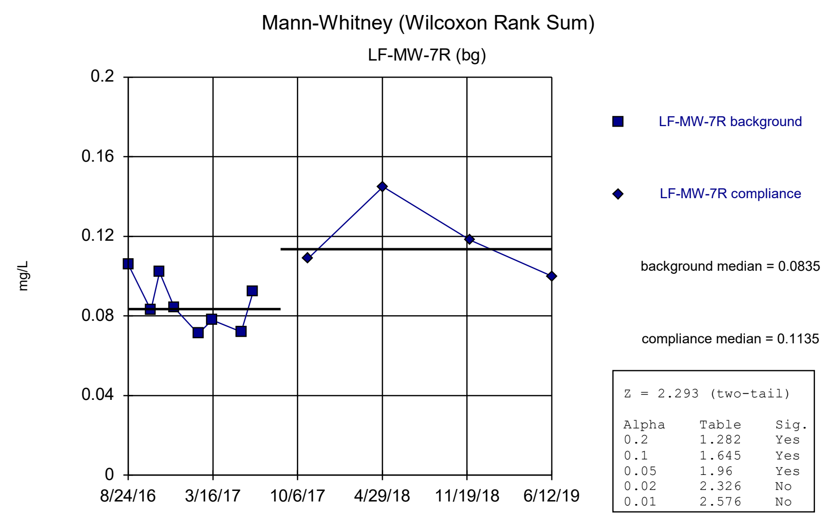
Constituent: Boron, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



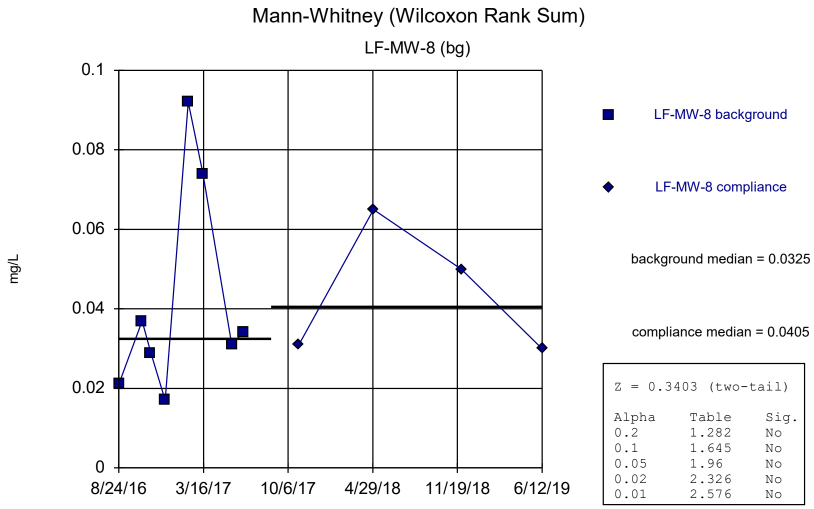
Constituent: Boron, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



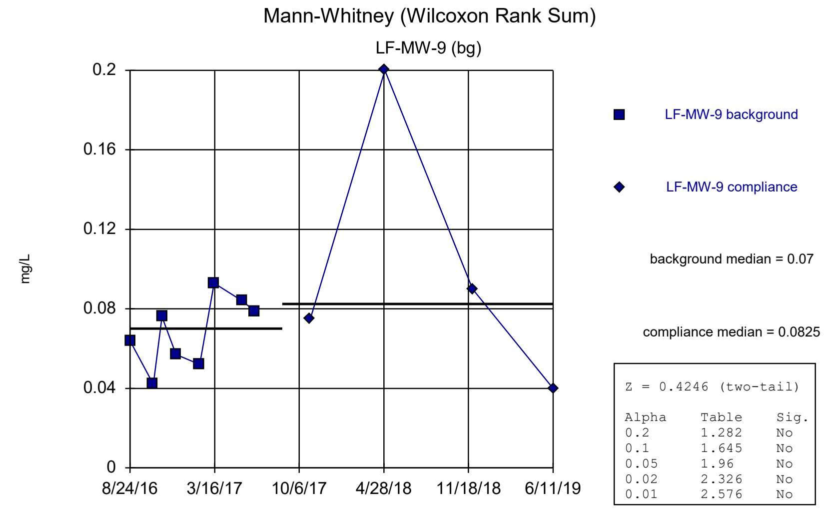
Constituent: Boron, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



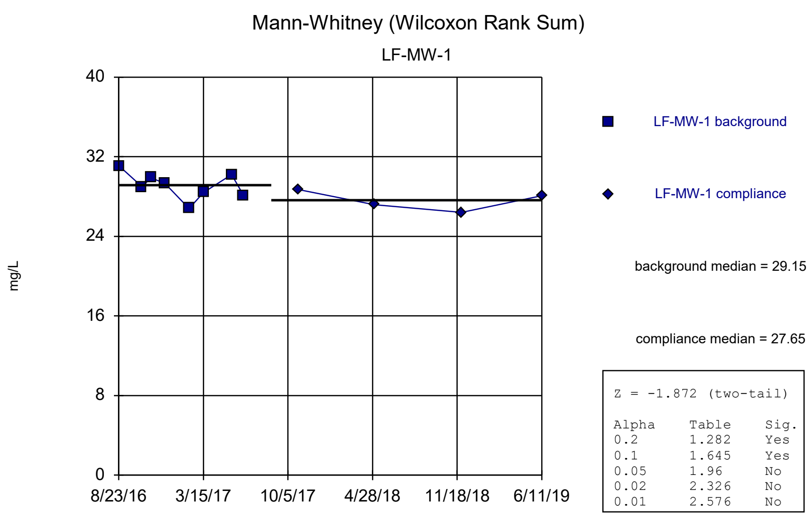
Constituent: Boron, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



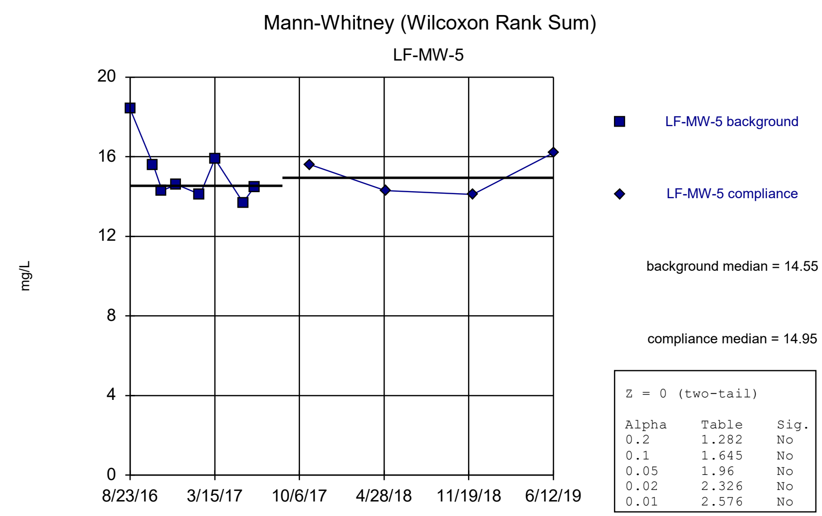
Constituent: Boron, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



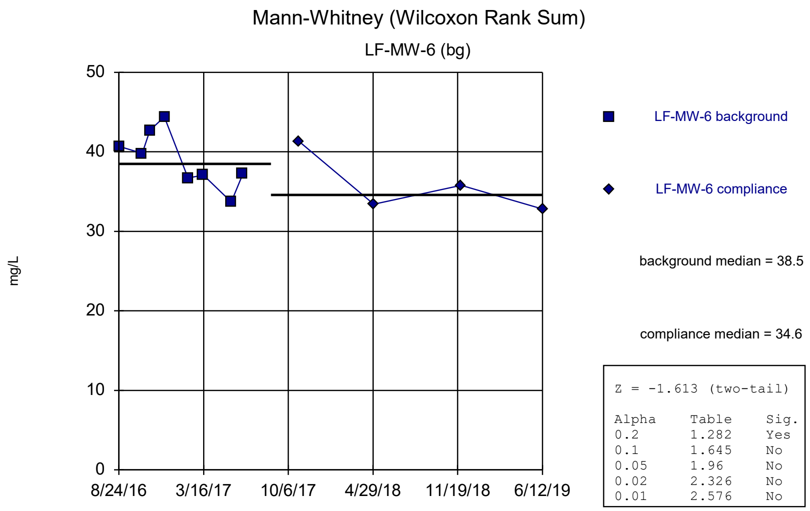
Constituent: Calcium, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



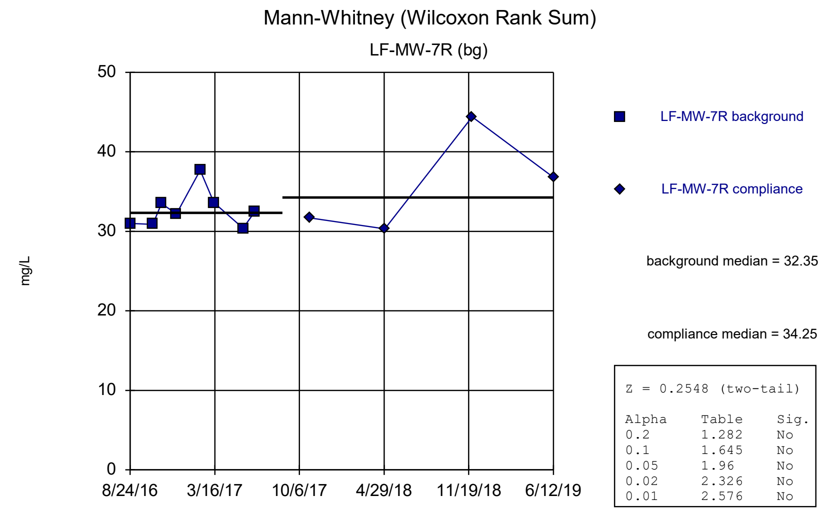
Constituent: Calcium, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



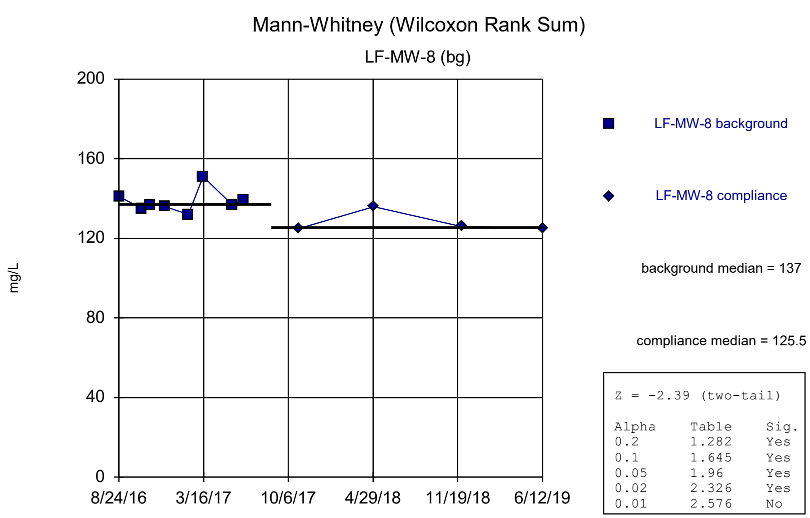
Constituent: Calcium, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



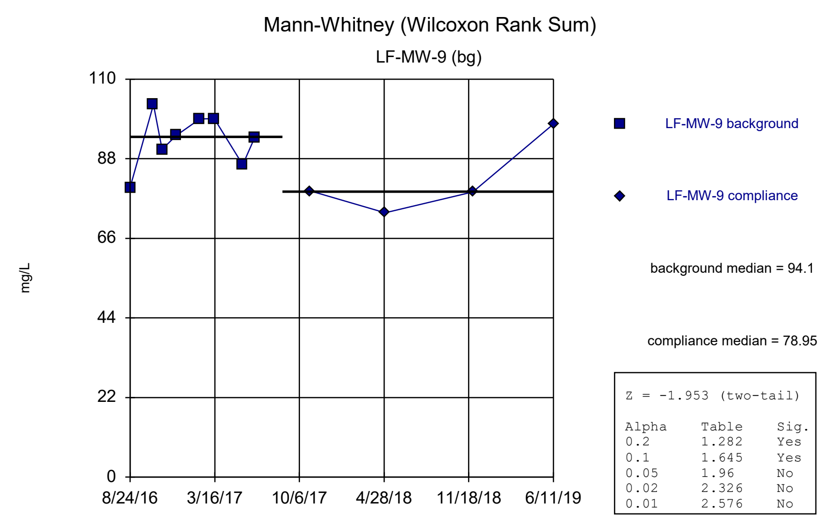
Constituent: Calcium, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Calcium, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

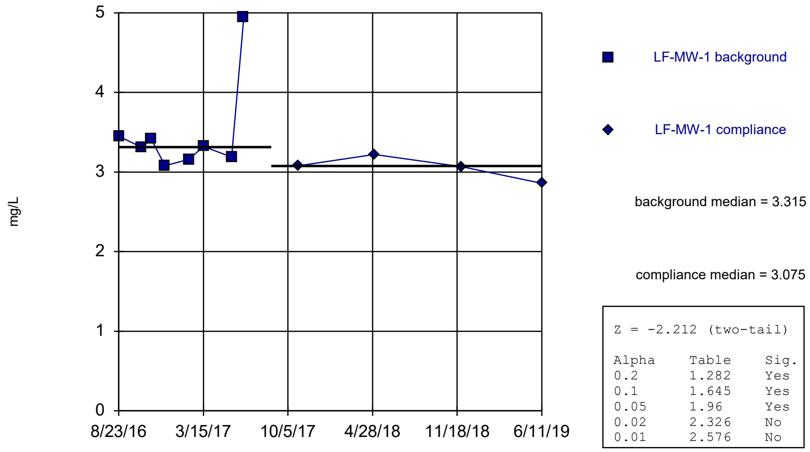


Constituent: Calcium, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-1

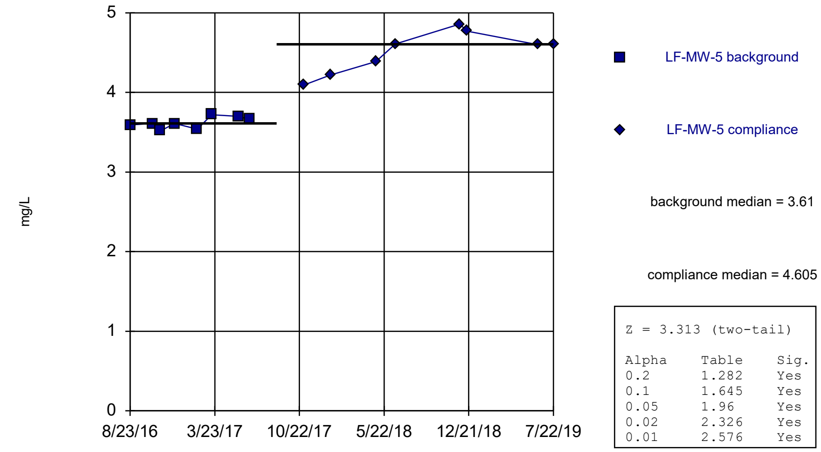


Constituent: Chloride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-5

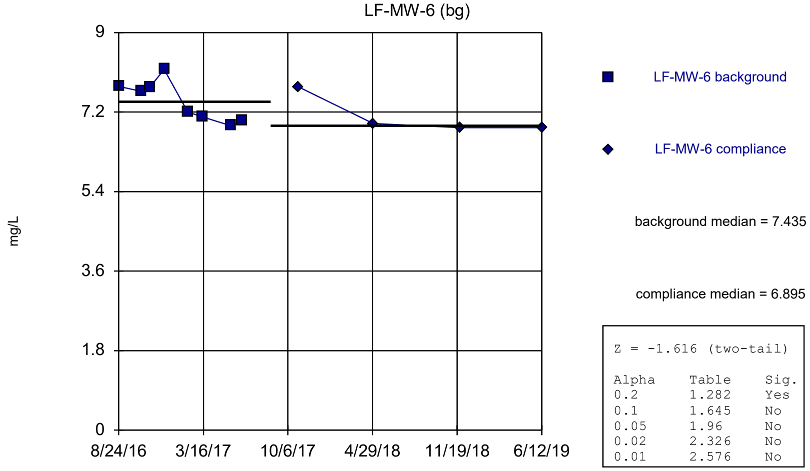


Constituent: Chloride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-6 (bg)

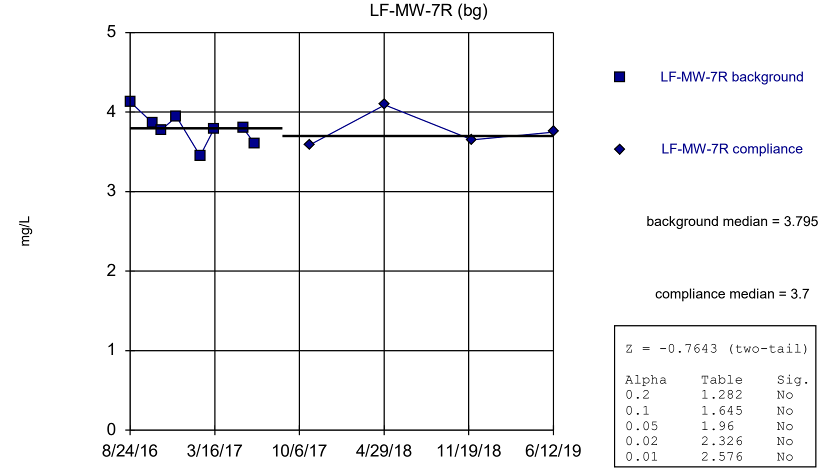


Constituent: Chloride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

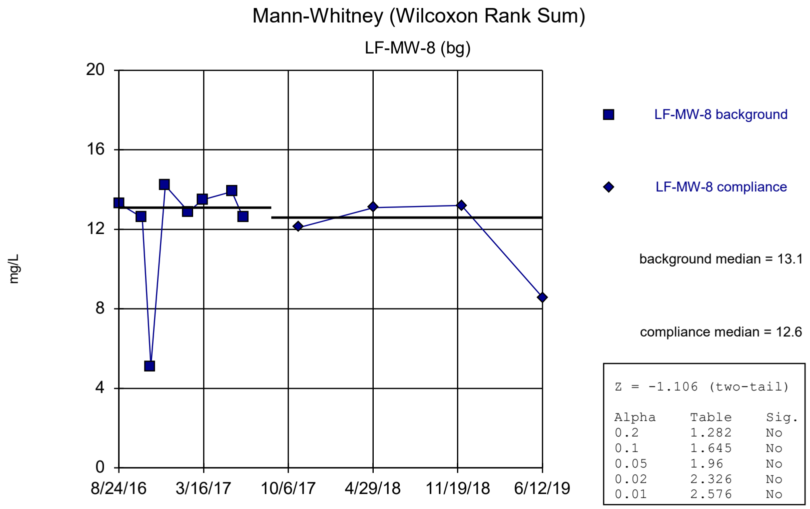
Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-7R (bg)



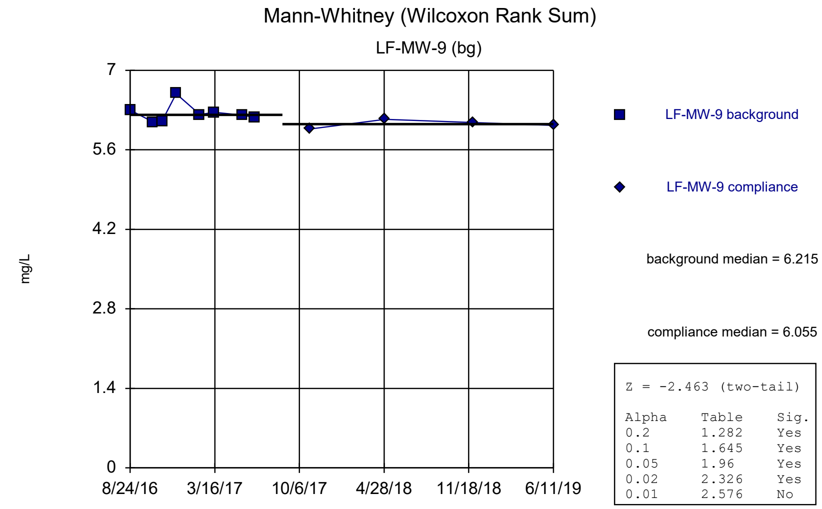
Constituent: Chloride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



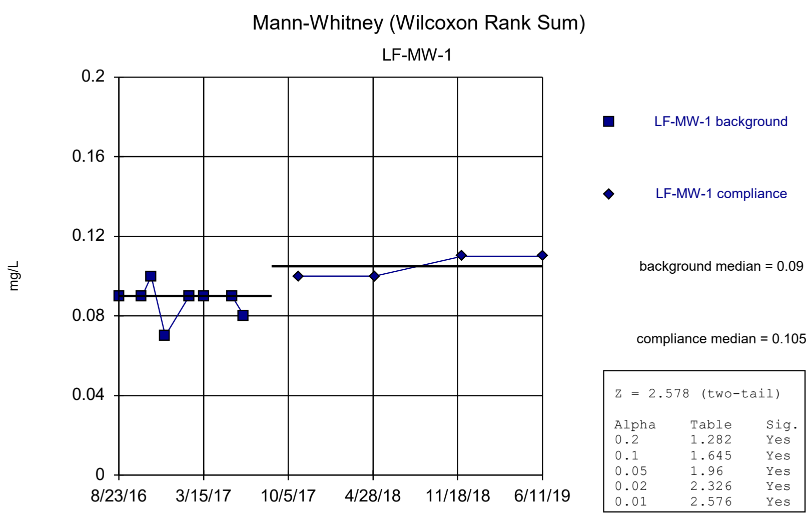
Constituent: Chloride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



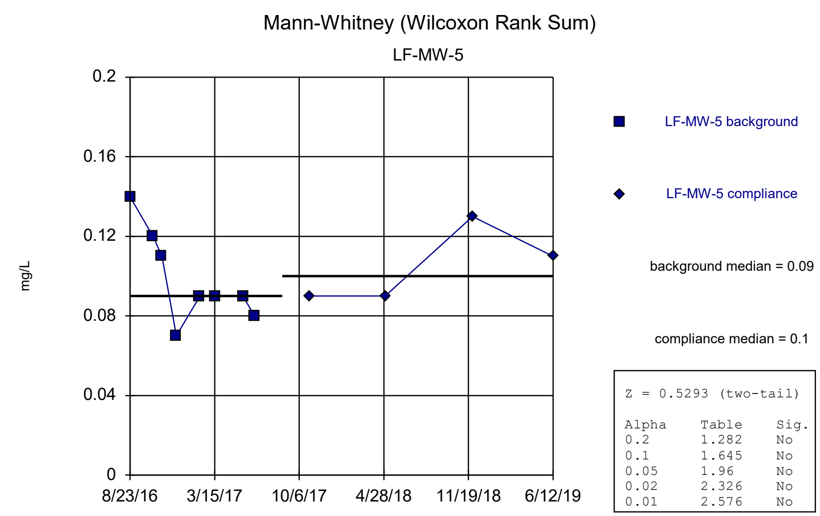
Constituent: Chloride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



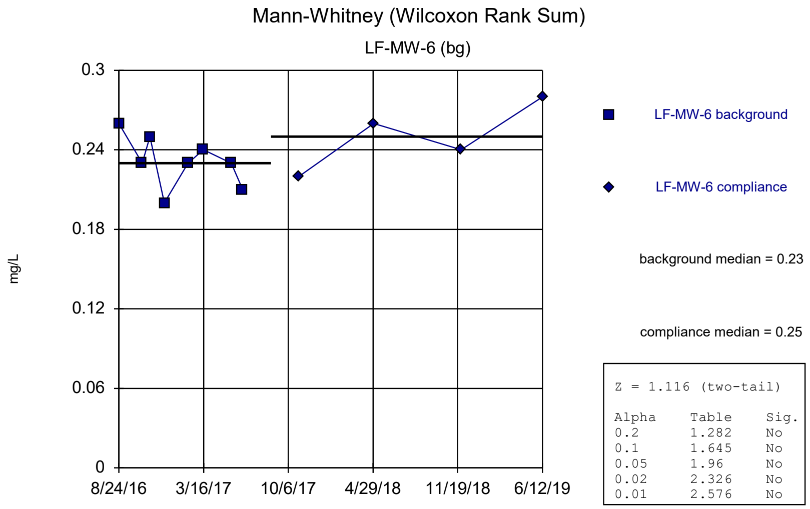
Constituent: Fluoride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



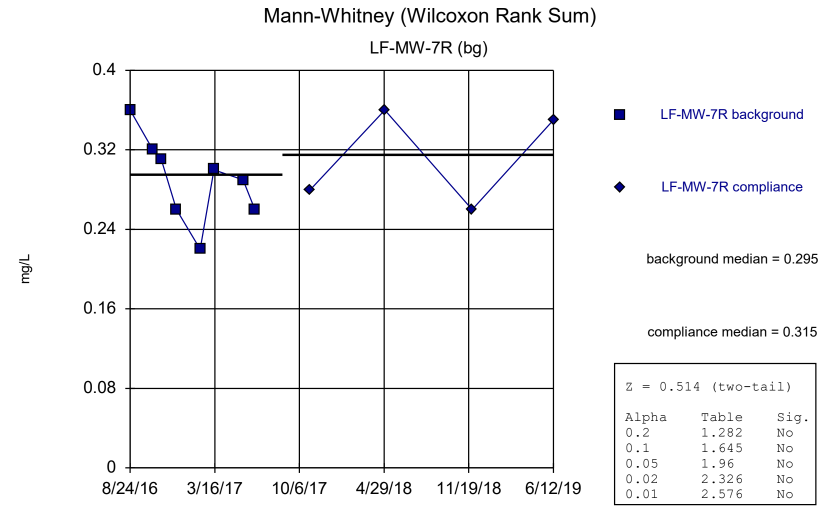
Constituent: Fluoride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



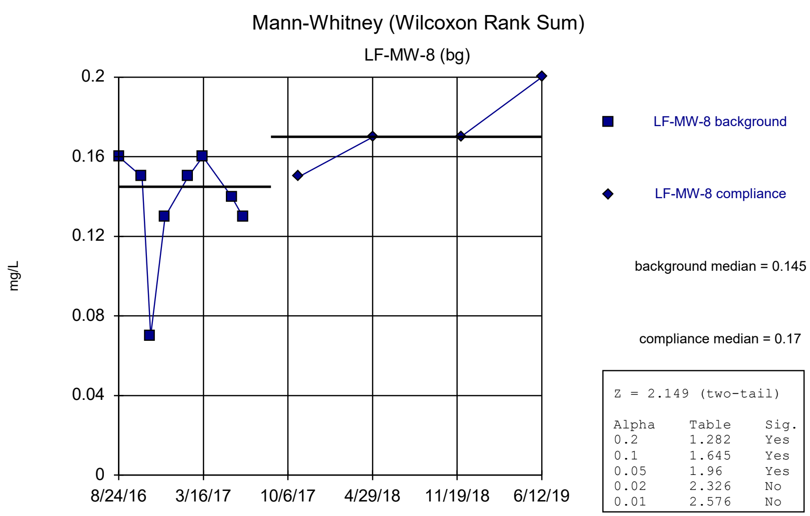
Constituent: Fluoride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



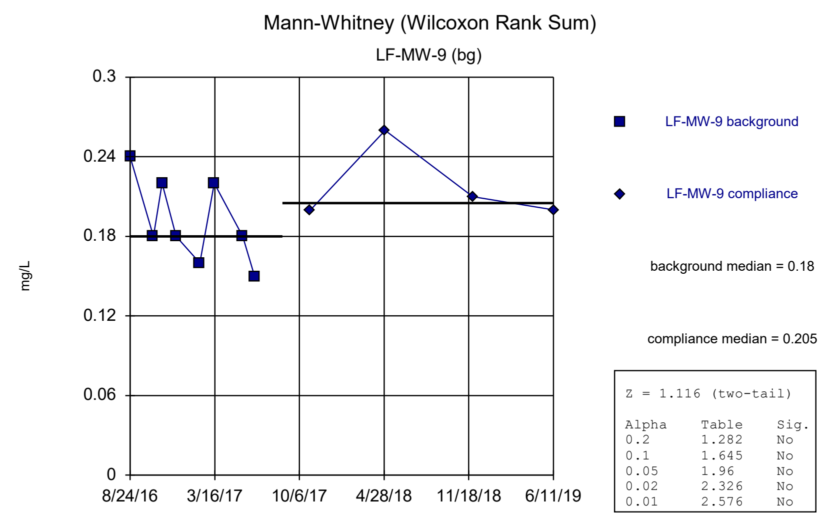
Constituent: Fluoride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Fluoride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

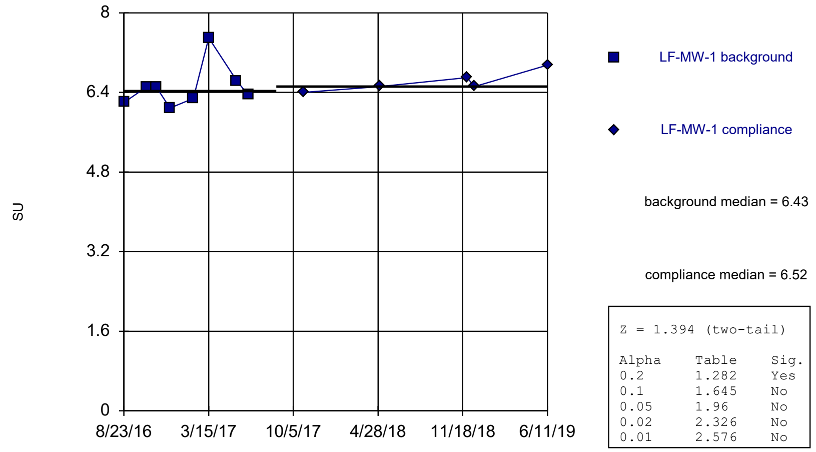


Constituent: Fluoride, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-1



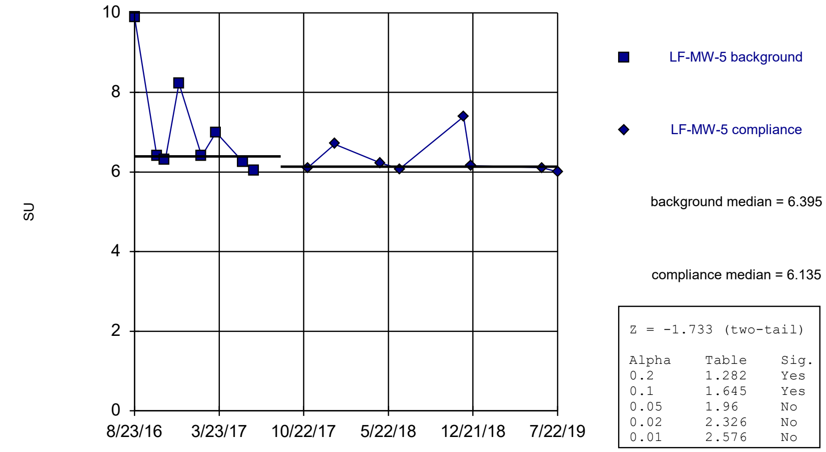
Constituent: pH, field Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-5



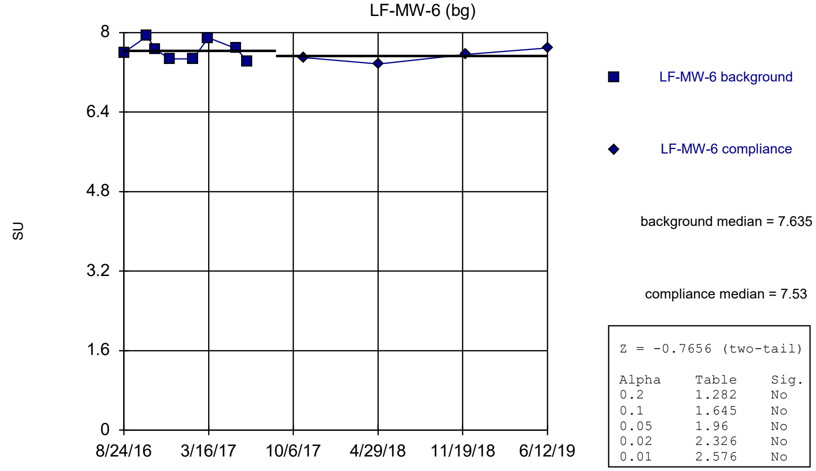
Constituent: pH, field Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-6 (bg)



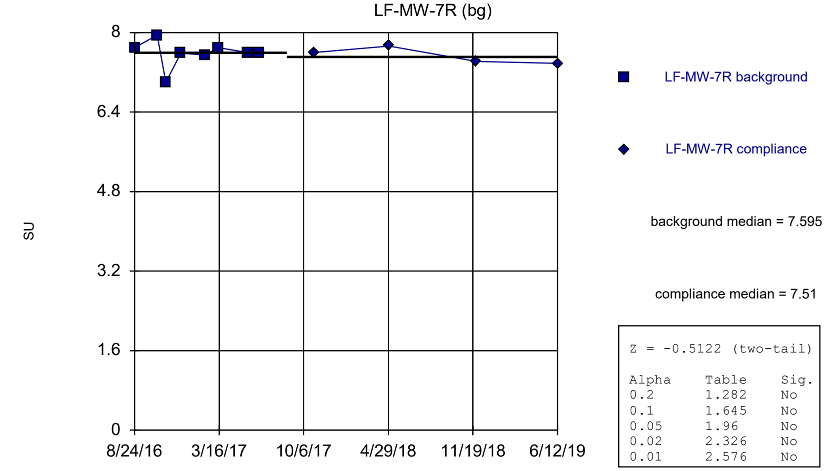
Constituent: pH, field Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-7R (bg)



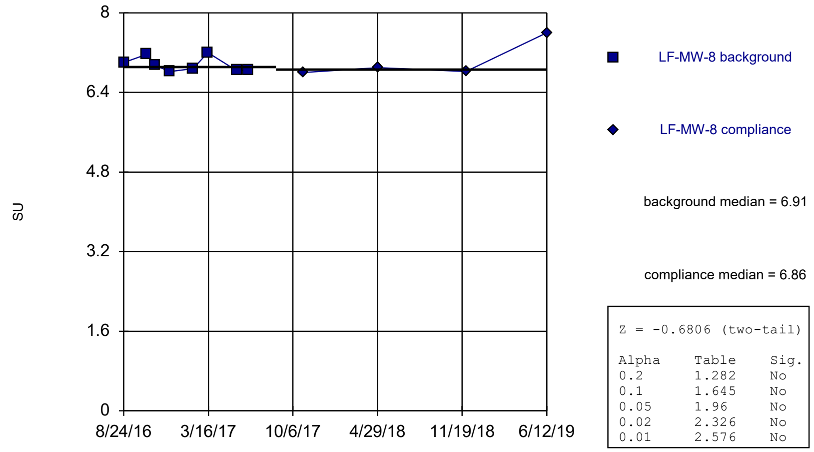
Constituent: pH, field Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-8 (bg)



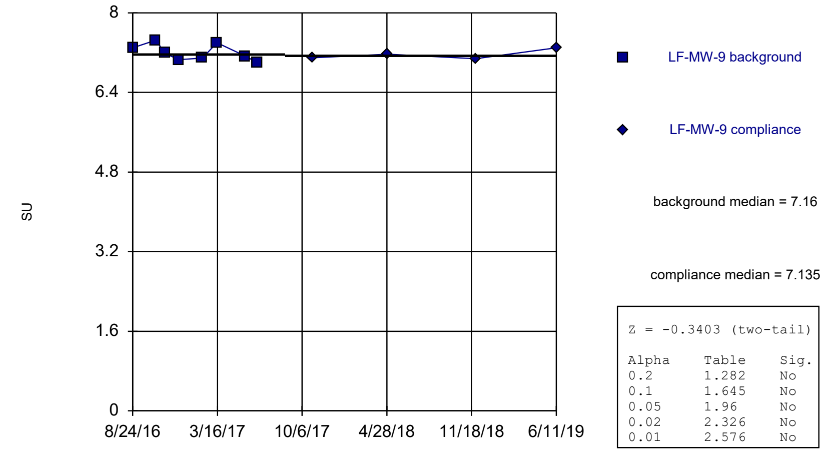
Constituent: pH, field Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-9 (bg)



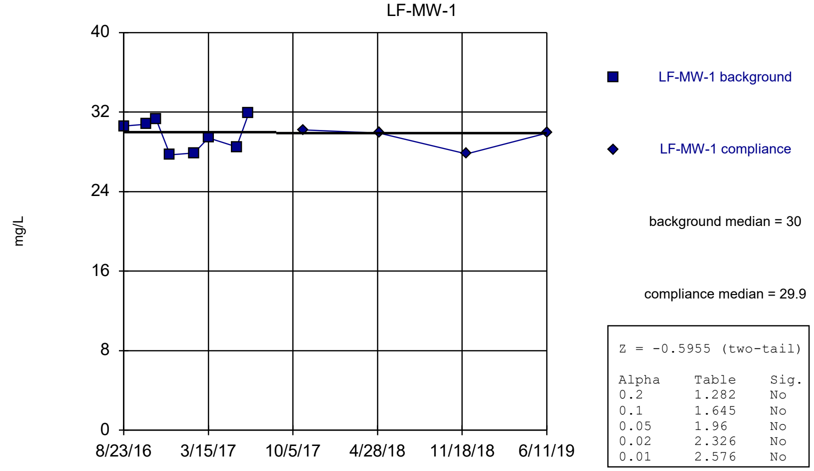
Constituent: pH, field Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

LF-MW-1



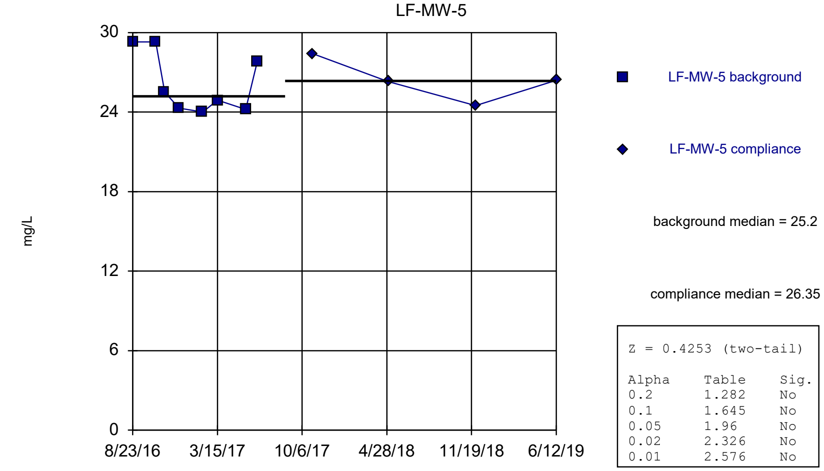
Constituent: Sulfate, total Analysis Run 1/9/2020 1:59 PM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

Mann-Whitney (Wilcoxon Rank Sum)

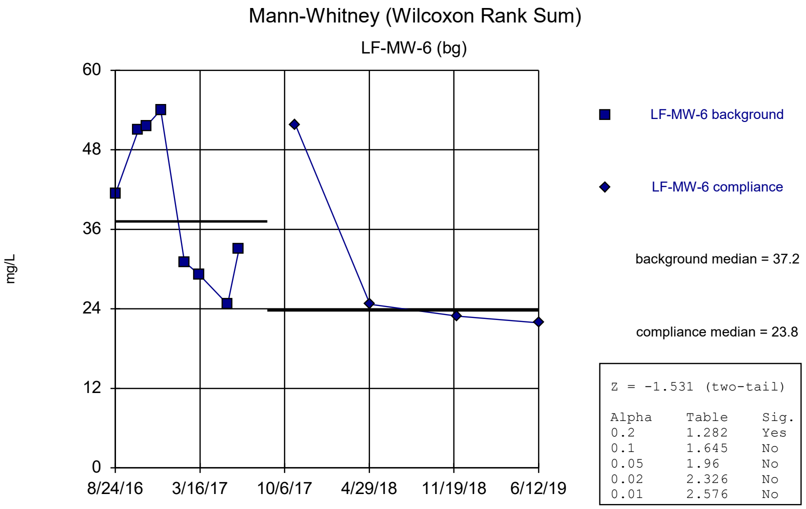
LF-MW-5



Constituent: Sulfate, total Analysis Run 1/9/2020 1:59 PM View: Group 2

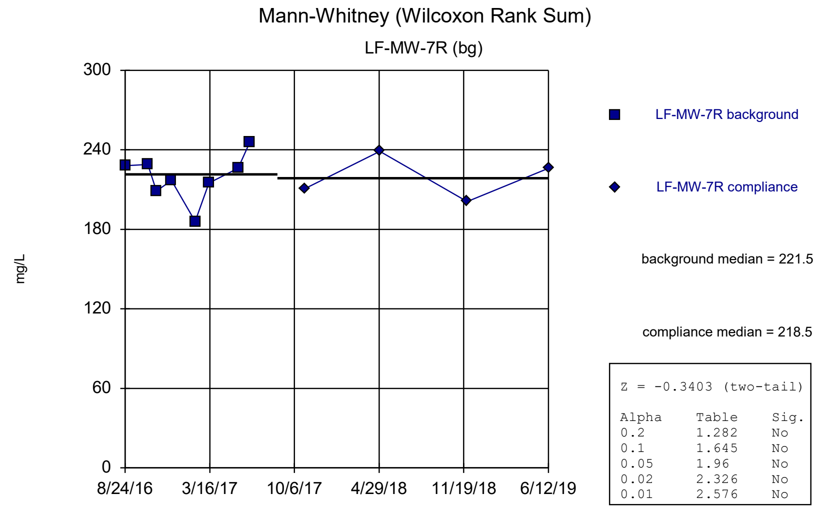
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



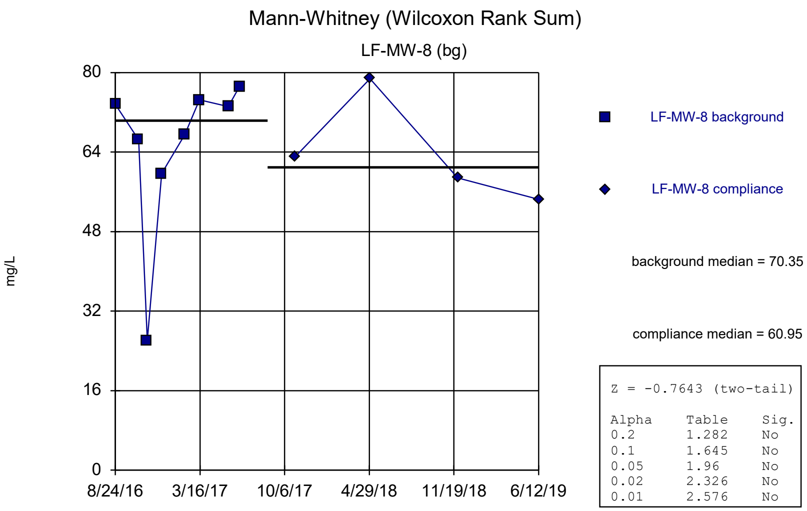
Constituent: Sulfate, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



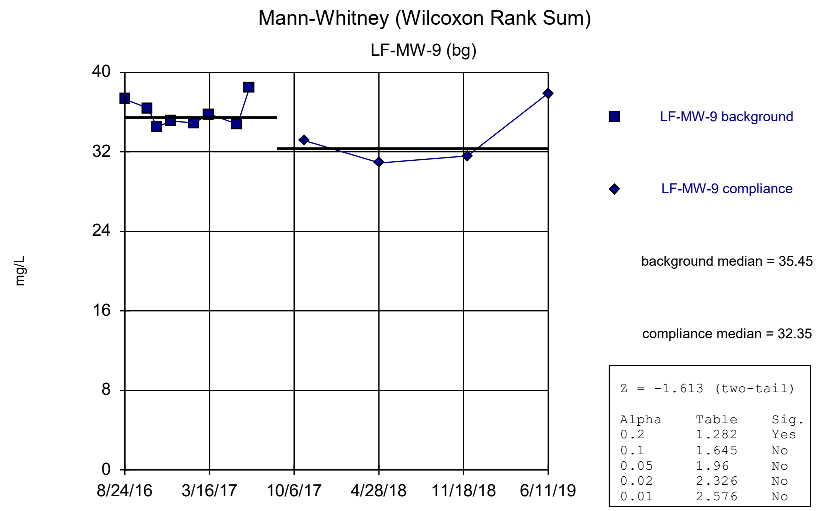
Constituent: Sulfate, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



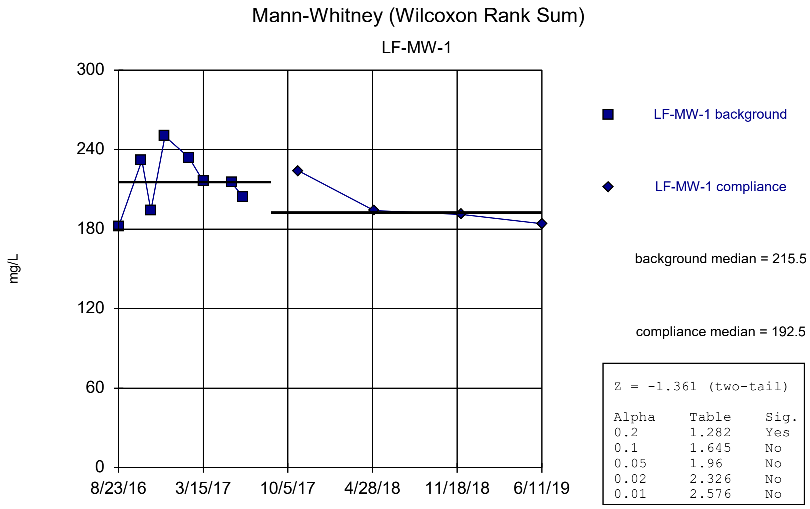
Constituent: Sulfate, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



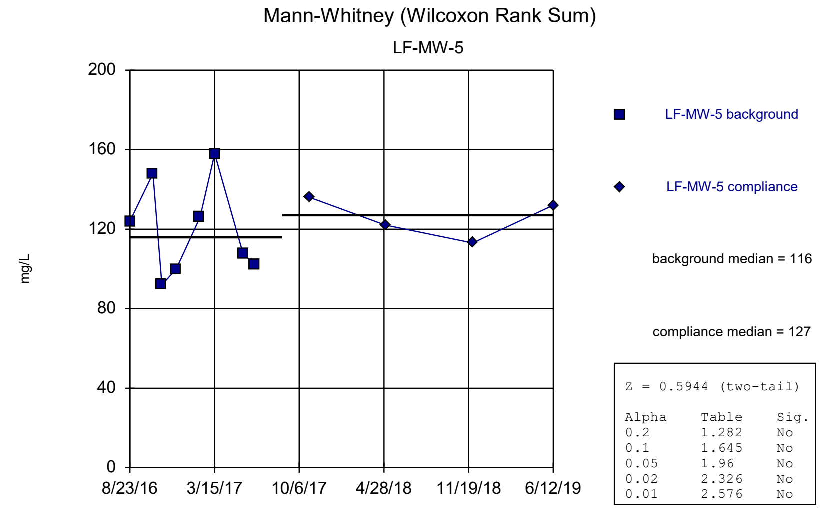
Constituent: Sulfate, total Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



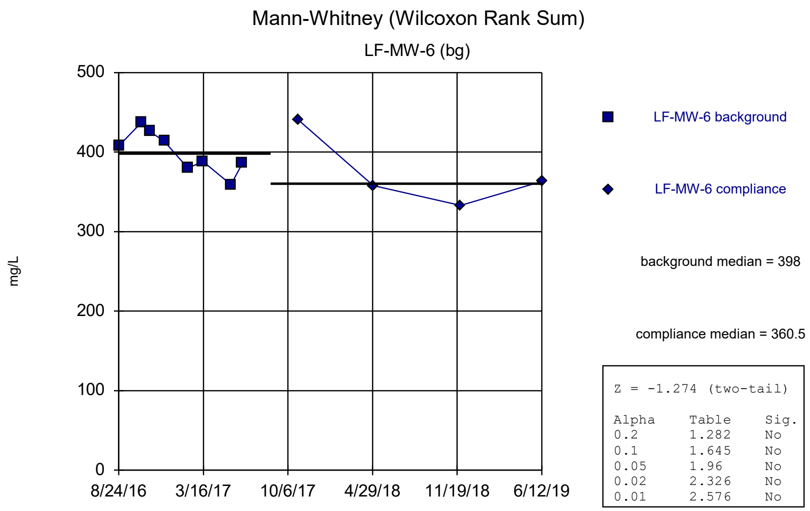
Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



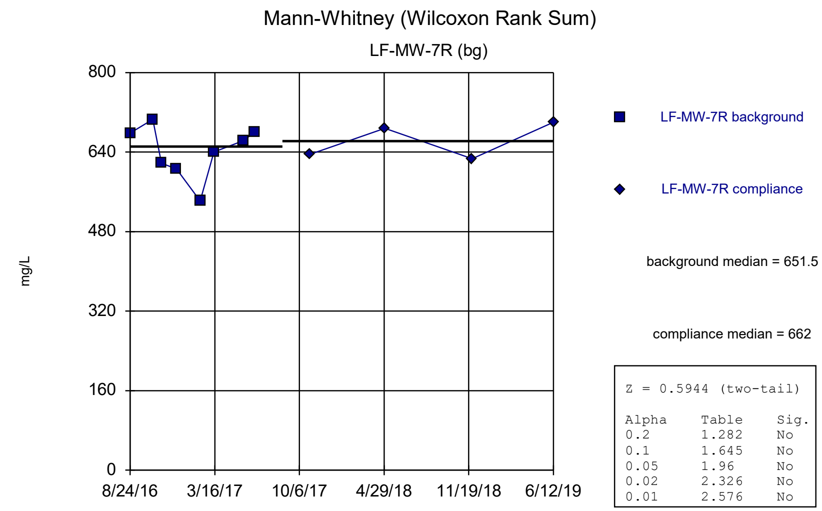
Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG

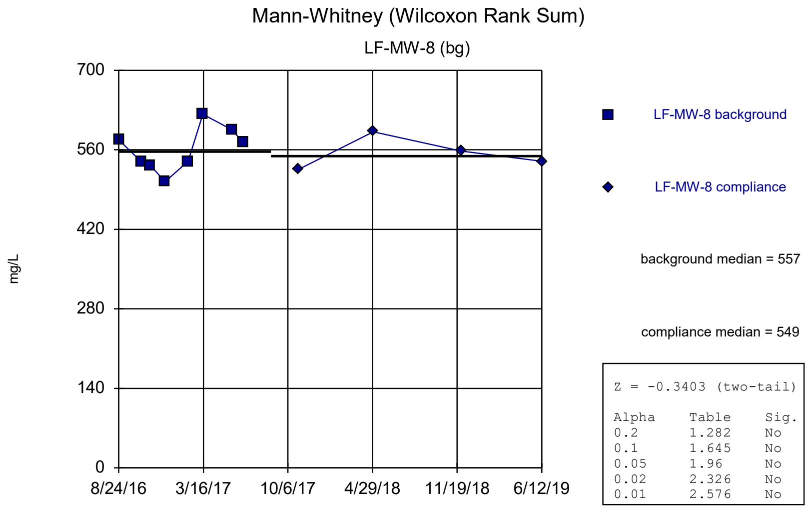


Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

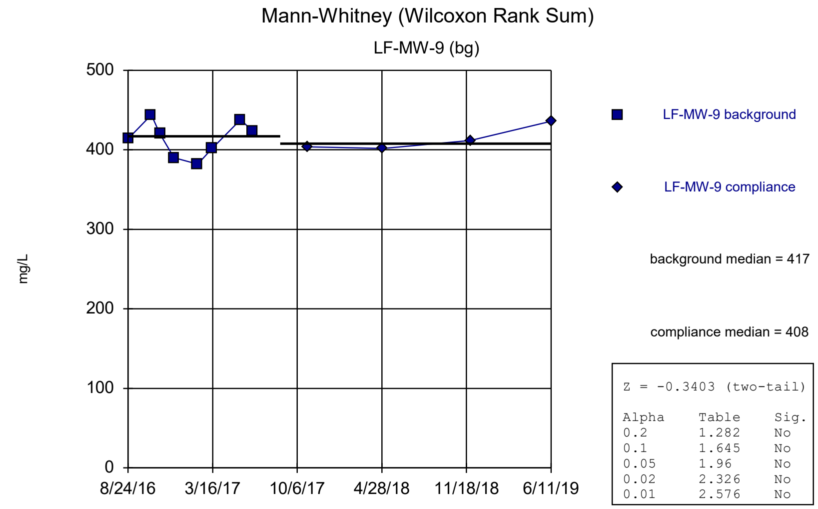
Sanitas™ v.9.6.24 Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill



Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill



Constituent: Total Dissolved Solids [TDS] Analysis Run 1/9/2020 1:59 PM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Intrawell Prediction Limit Summary Table - All Results - Group 1

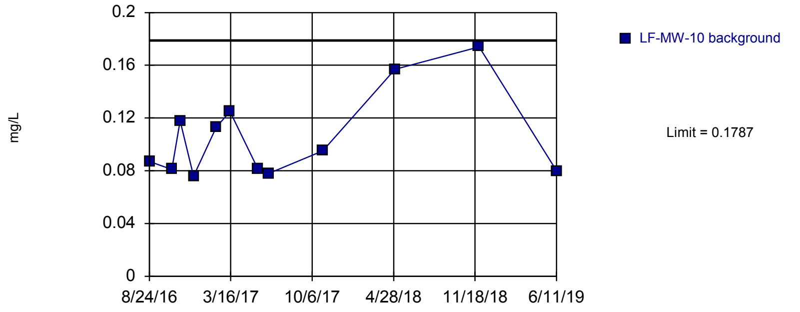
Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 10/24/2019, 4:13 PM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	LF-MW-10	0.1787	n/a	n/a	1 future	n/a	12	0.1054	0.03285	0	None	No	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-2	0.2466	n/a	n/a	1 future	n/a	13	0.2064	0.01836	0	None	No	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-4	0.2142	n/a	n/a	1 future	n/a	13	0.1775	0.01671	0	None	No	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-10	2.234	n/a	n/a	1 future	n/a	12	1.145	0.1569	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-2	2.101	n/a	n/a	1 future	n/a	12	1.691	0.1839	0	None	No	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-4	0.9119	n/a	n/a	1 future	n/a	12	0.8141	0.04383	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-10	6.148	n/a	n/a	1 future	n/a	12	4.827	0.5919	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-2	5.4	n/a	n/a	1 future	n/a	12	3.683	0.7693	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-4	15.87	n/a	n/a	1 future	n/a	12	14.64	0.5485	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-10	1.007	n/a	n/a	1 future	n/a	12	0.6167	0.1749	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-2	1.605	n/a	n/a	1 future	n/a	15	1.295	0.1463	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-4	1.524	n/a	n/a	1 future	n/a	13	1.406	0.05378	0	None	No	0.00188	Param Intra 1 of 2
pH, field (SU)	LF-MW-10	9.584	8.335	n/a	1 future	n/a	12	8.959	0.2798	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-2	9.019	8.174	n/a	1 future	n/a	16	8.596	0.2036	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-4	10.09	8.328	n/a	1 future	n/a	12	9.208	0.3942	0	None	No	0.0009398	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-10	19.74	n/a	n/a	1 future	n/a	12	15.83	1.748	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-2	12.93	n/a	n/a	1 future	n/a	12	9.1	1.714	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-4	12.23	n/a	n/a	1 future	n/a	12	9.042	1.428	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-10	551	n/a	n/a	1 future	n/a	12	505.5	20.38	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-2	394	n/a	n/a	1 future	n/a	13	362.1	14.55	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-4	422	n/a	n/a	1 future	n/a	12	388.3	15.14	0	None	No	0.00188	Param Intra 1 of 2

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



Background Data Summary: Mean=0.1054, Std. Dev.=0.03285, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.835, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

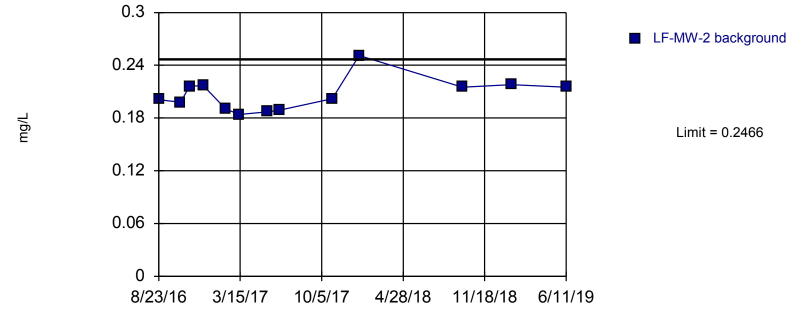
Constituent: Boron, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



Background Data Summary: Mean=0.2064, Std. Dev.=0.01836, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8908, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

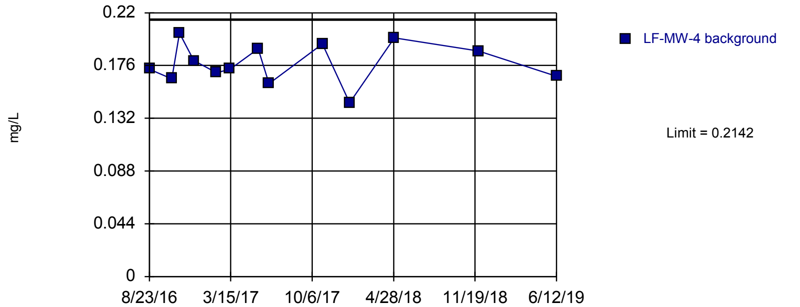
Constituent: Boron, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



Background Data Summary: Mean=0.1775, Std. Dev.=0.01671, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9699, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

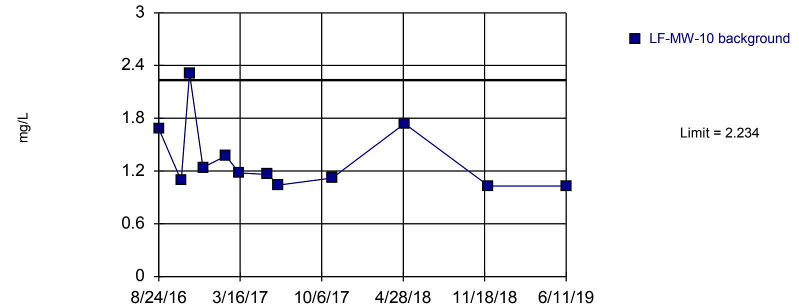
Constituent: Boron, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)

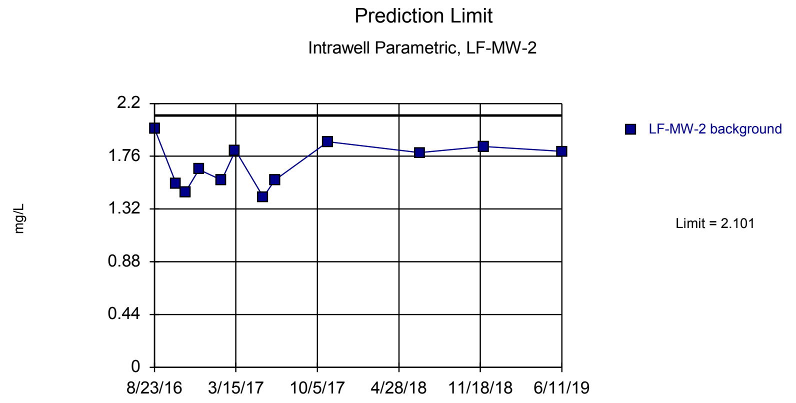


Background Data Summary (based on square root transformation): Mean=1.145, Std. Dev.=0.1569, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.809, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

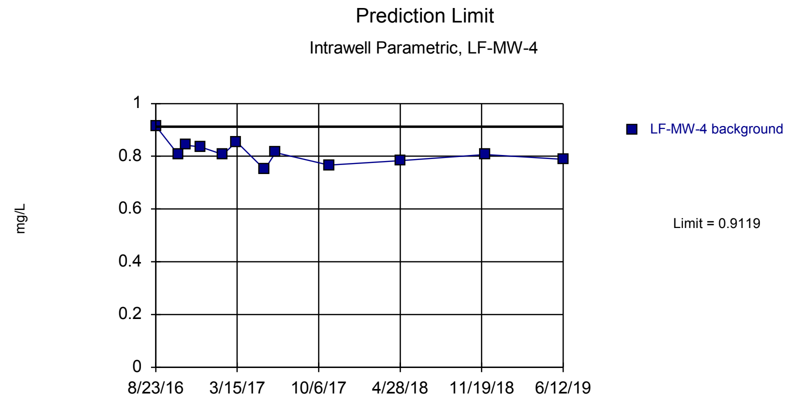
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=1.691, Std. Dev.=0.1839, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9376, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

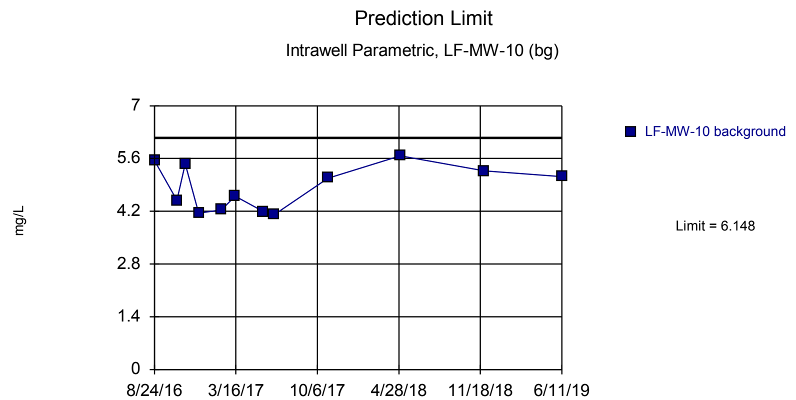
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=0.8141, Std. Dev.=0.04383, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9473, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

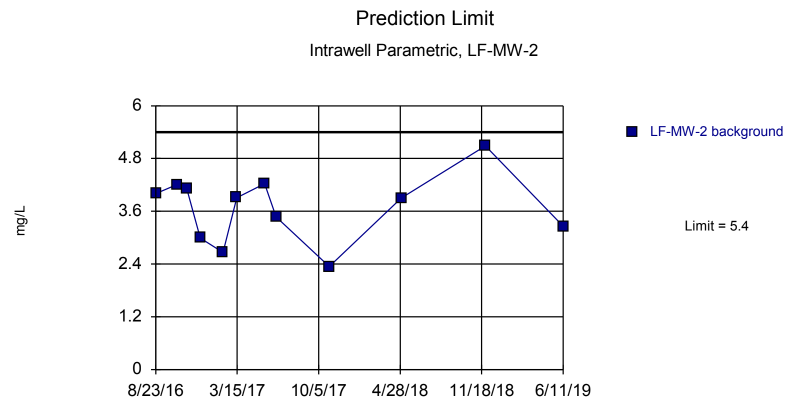
Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



Background Data Summary: Mean=4.827, Std. Dev.=0.5919, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8884, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG



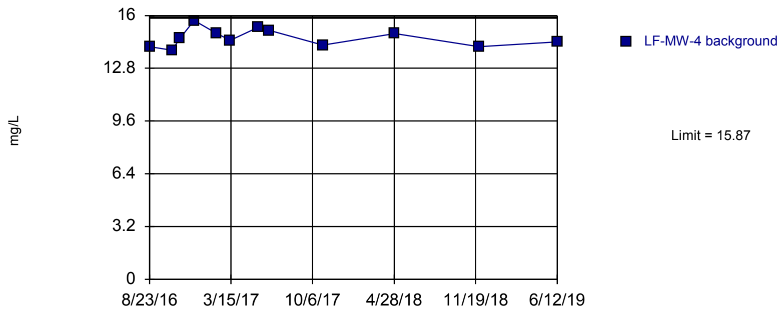
Background Data Summary: Mean=3.683, Std. Dev.=0.7693, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9609, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



Background Data Summary: Mean=14.64, Std. Dev.=0.5485, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9568, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

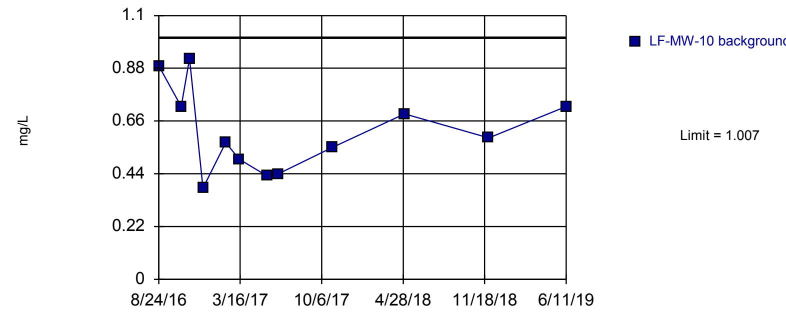
Constituent: Chloride, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



Background Data Summary: Mean=0.6167, Std. Dev.=0.1749, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9411, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

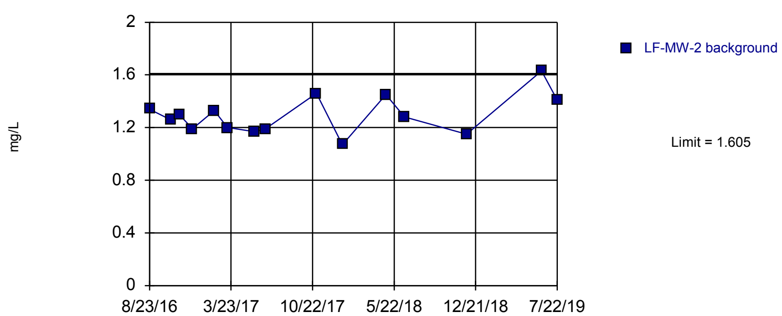
Constituent: Fluoride, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



Background Data Summary: Mean=1.295, Std. Dev.=0.1463, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9567, critical = 0.835. Kappa = 2.115 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

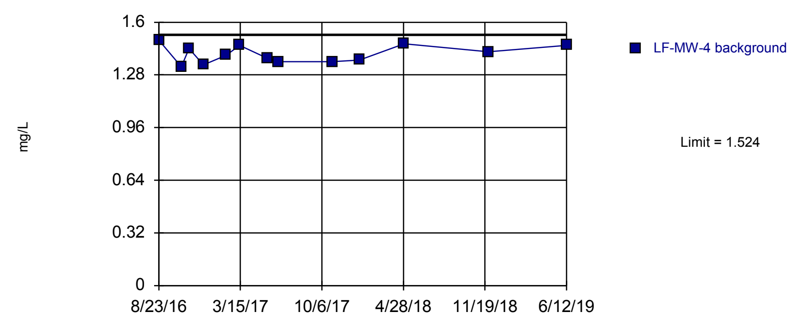
Constituent: Fluoride, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



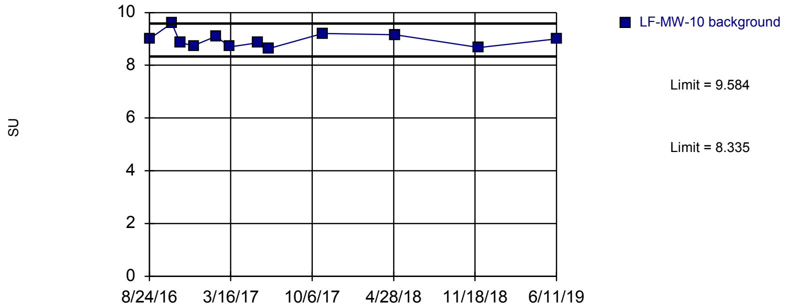
Background Data Summary: Mean=1.406, Std. Dev.=0.05378, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9336, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)

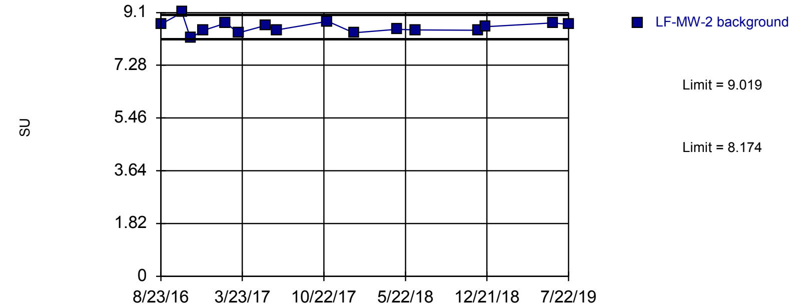


Background Data Summary: Mean=8.959, Std. Dev.=0.2798, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9208, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-2

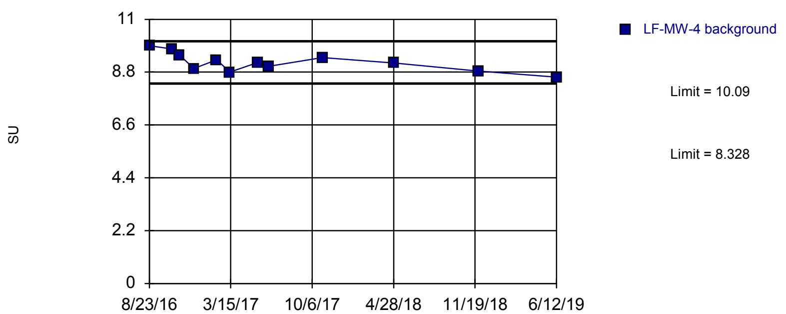


Background Data Summary: Mean=8.596, Std. Dev.=0.2036, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9506, critical = 0.844. Kappa = 2.076 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-4

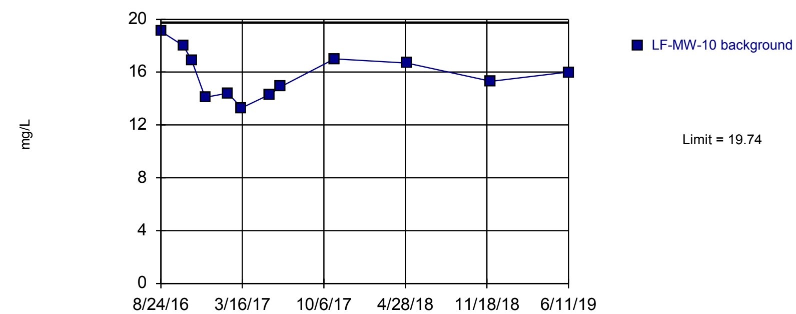


Background Data Summary: Mean=9.208, Std. Dev.=0.3942, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.978, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)

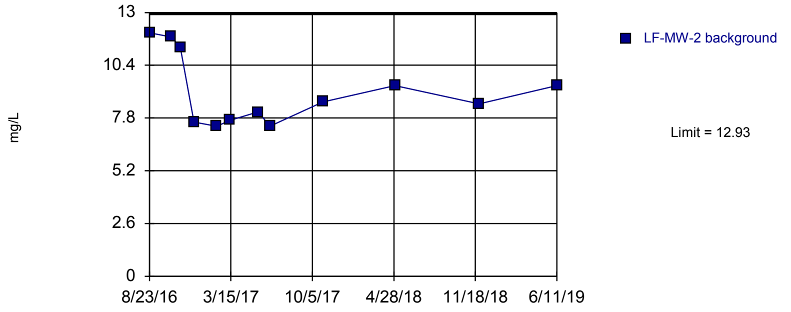


Background Data Summary: Mean=15.83, Std. Dev.=1.748, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9627, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-2

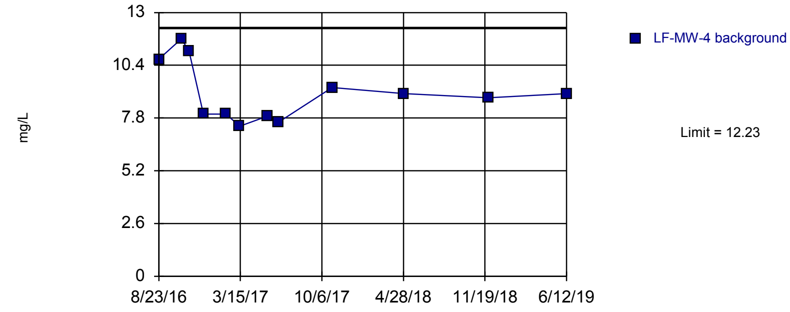


Background Data Summary: Mean=9.1, Std. Dev.=1.714, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8503, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-4

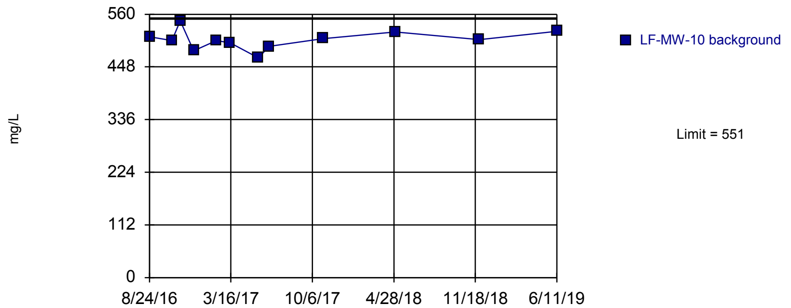


Background Data Summary: Mean=9.042, Std. Dev.=1.428, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8947, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)

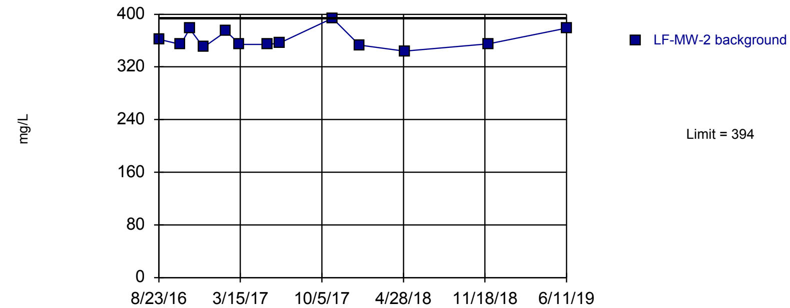


Background Data Summary: Mean=505.5, Std. Dev.=20.38, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9756, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-2



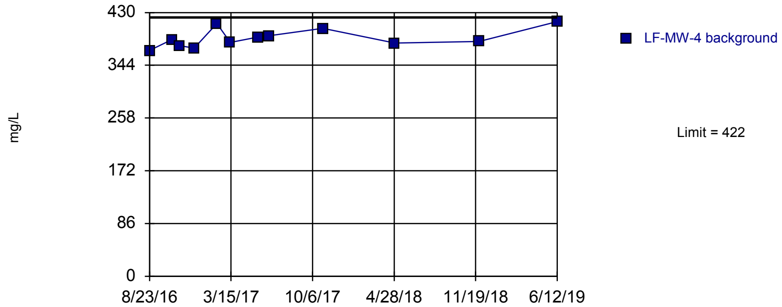
Background Data Summary: Mean=362.1, Std. Dev.=14.55, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8652, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:12 PM View: Group 1
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



Background Data Summary: Mean=388.3, Std. Dev.=15.14, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9298, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/24/2019 4:12 PM View: Group 1

Amos Landfill Client: Geosyntec Data: Amos Landfill

FIGURE E: INTRAWELL PREDICTION LIMITS

Intrawell Prediction Limit Summary Table - All Results - Group 2

Amos Landfill   Client: Geosyntec   Data: Amos Landfill   Printed 10/25/2019, 9:12 AM

Constituent	Well	Upper Lim.	Lower Lim.	Date	Observ.	Sig.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron, total (mg/L)	LF-MW-1	0.1619	n/a	n/a	1 future	n/a	13	0.2609	0.06449	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-5	0.1348	n/a	n/a	1 future	n/a	13	0.3377	0.07981	7.692	None	x^(1/3)	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-6	0.2019	n/a	n/a	1 future	n/a	12	0.1289	0.0327	0	None	No	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-7R	0.1445	n/a	n/a	1 future	n/a	12	0.09667	0.02144	0	None	No	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-8	0.09394	n/a	n/a	1 future	n/a	12	0.04258	0.02301	0	None	No	0.00188	Param Intra 1 of 2
Boron, total (mg/L)	LF-MW-9	0.1756	n/a	n/a	1 future	n/a	12	0.2748	0.06465	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-1	31.74	n/a	n/a	1 future	n/a	12	28.6	1.406	0	None	No	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-5	18.05	n/a	n/a	1 future	n/a	12	15.11	1.317	0	None	No	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-6	46.46	n/a	n/a	1 future	n/a	12	37.97	3.803	0	None	No	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-7R	43.01	n/a	n/a	1 future	n/a	12	5.8	0.3395	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-8	151.6	n/a	n/a	1 future	n/a	12	135	7.435	0	None	No	0.00188	Param Intra 1 of 2
Calcium, total (mg/L)	LF-MW-9	111.5	n/a	n/a	1 future	n/a	12	89.58	9.833	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-1	3.595	n/a	n/a	1 future	n/a	11	3.196	0.1734	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-5	5.367	n/a	n/a	1 future	n/a	9	4.423	0.3788	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-6	8.371	n/a	n/a	1 future	n/a	12	7.332	0.4657	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-7R	4.235	n/a	n/a	1 future	n/a	12	3.786	0.2013	0	None	No	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-8	15.55	n/a	n/a	1 future	n/a	11	164	33.87	0	None	x^2	0.00188	Param Intra 1 of 2
Chloride, total (mg/L)	LF-MW-9	6.539	n/a	n/a	1 future	n/a	12	6.181	0.1603	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-1	0.124	n/a	n/a	1 future	n/a	8	0.09625	0.01061	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-5	0.1479	n/a	n/a	1 future	n/a	12	0.1008	0.02109	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-6	0.288	n/a	n/a	1 future	n/a	12	0.2375	0.02261	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-7R	0.3969	n/a	n/a	1 future	n/a	12	0.2975	0.04454	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-8	0.2182	n/a	n/a	1 future	n/a	12	0.1483	0.03129	0	None	No	0.00188	Param Intra 1 of 2
Fluoride, total (mg/L)	LF-MW-9	0.2719	n/a	n/a	1 future	n/a	12	0.2	0.03219	0	None	No	0.00188	Param Intra 1 of 2
pH, field (SU)	LF-MW-1	7.344	5.759	n/a	1 future	n/a	13	6.552	0.3614	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-5	8.23	6.01	n/a	1 future	n/a	15	n/a	n/a	0	n/a	n/a	0.01507	NP Intra (normality) 1 of 2
pH, field (SU)	LF-MW-6	8.002	7.208	n/a	1 future	n/a	12	7.605	0.178	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-7R	8.085	7.05	n/a	1 future	n/a	12	7.568	0.2316	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-8	7.6	6.8	n/a	1 future	n/a	12	n/a	n/a	0	n/a	n/a	0.02155	NP Intra (normality) 1 of 2
pH, field (SU)	LF-MW-9	7.507	6.871	n/a	1 future	n/a	12	7.189	0.1424	0	None	No	0.0009398	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-1	32.82	n/a	n/a	1 future	n/a	12	29.66	1.418	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-5	30.71	n/a	n/a	1 future	n/a	12	26.24	2.004	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-6	64.81	n/a	n/a	1 future	n/a	12	36.44	12.71	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-7R	256.3	n/a	n/a	1 future	n/a	12	219.4	16.52	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-8	86.69	n/a	n/a	1 future	n/a	11	67.95	8.15	0	None	No	0.00188	Param Intra 1 of 2
Sulfate, total (mg/L)	LF-MW-9	40.28	n/a	n/a	1 future	n/a	12	35.06	2.338	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-1	258.9	n/a	n/a	1 future	n/a	12	210	21.92	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-5	166.1	n/a	n/a	1 future	n/a	12	121.8	19.88	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-6	468	n/a	n/a	1 future	n/a	12	391.1	34.47	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-7R	753.7	n/a	n/a	1 future	n/a	12	648.7	47.06	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-8	635.6	n/a	n/a	1 future	n/a	12	558.4	34.57	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids [TDS] (mg/L)	LF-MW-9	457	n/a	n/a	1 future	n/a	12	414	19.28	0	None	No	0.00188	Param Intra 1 of 2

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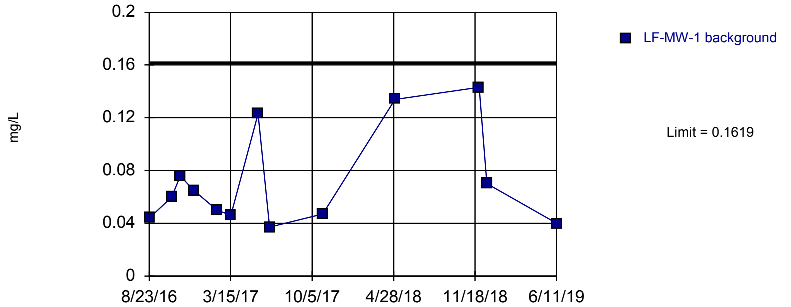
Prediction Limit

Intrawell Parametric, LF-MW-1



Background Data Summary (based on square root transformation): Mean=0.2609, Std. Dev.=0.06449, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8517, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron, total Analysis Run 10/25/2019 9:10 AM View: Group 2

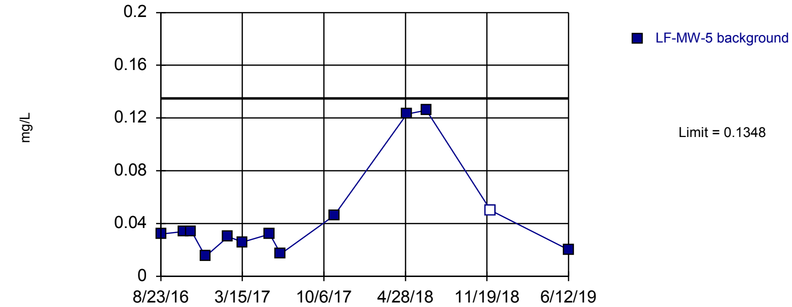
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Hollow symbols indicate censored values.

Prediction Limit

Intrawell Parametric, LF-MW-5



Background Data Summary (based on cube root transformation): Mean=0.3377, Std. Dev.=0.07981, n=13, 7.692% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8317, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

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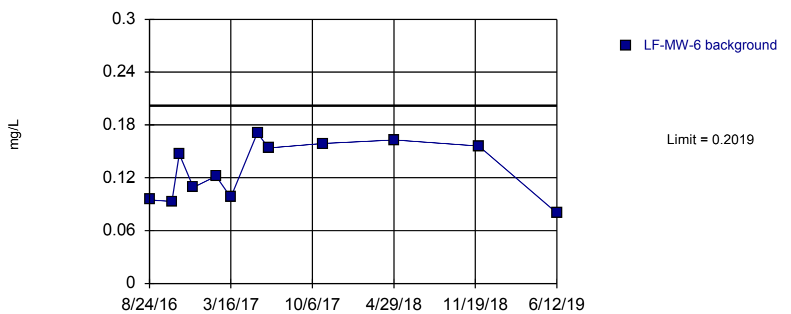
Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



Background Data Summary: Mean=0.1289, Std. Dev.=0.0327, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8885, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

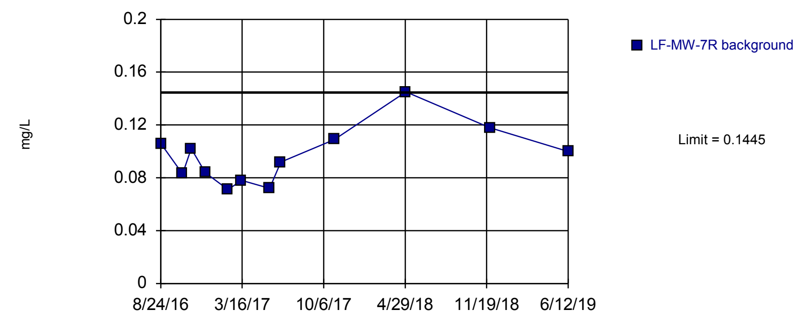
Constituent: Boron, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



Background Data Summary: Mean=0.09667, Std. Dev.=0.02144, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.932, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

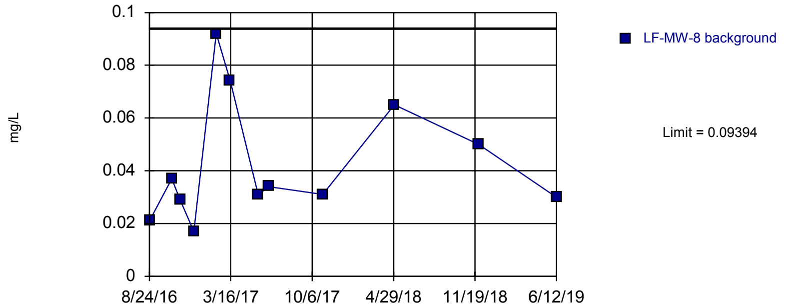
Constituent: Boron, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



Background Data Summary: Mean=0.04258, Std. Dev.=0.02301, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8645, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

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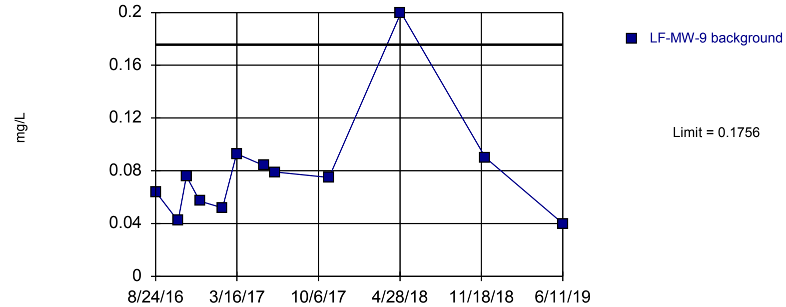
Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



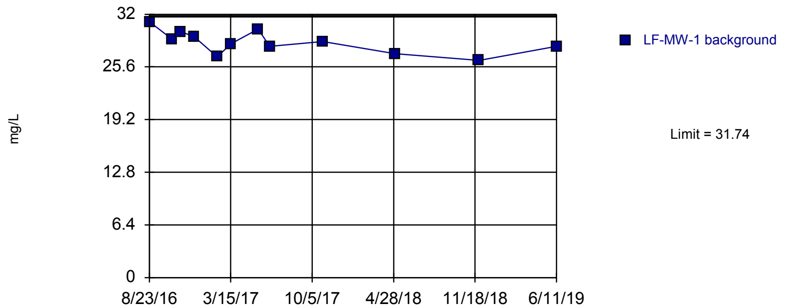
Background Data Summary (based on square root transformation): Mean=0.2748, Std. Dev.=0.06465, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8376, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-1



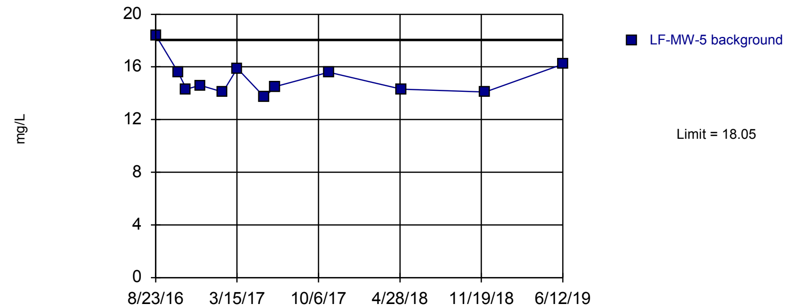
Background Data Summary: Mean=28.6, Std. Dev.=1.406, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9817, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-5



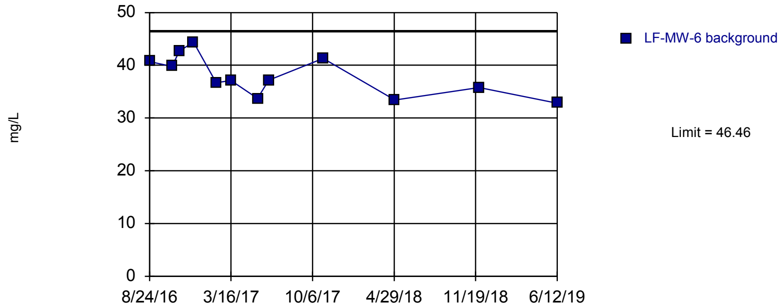
Background Data Summary: Mean=15.11, Std. Dev.=1.317, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8479, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



Background Data Summary: Mean=37.97, Std. Dev.=3.803, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9497, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

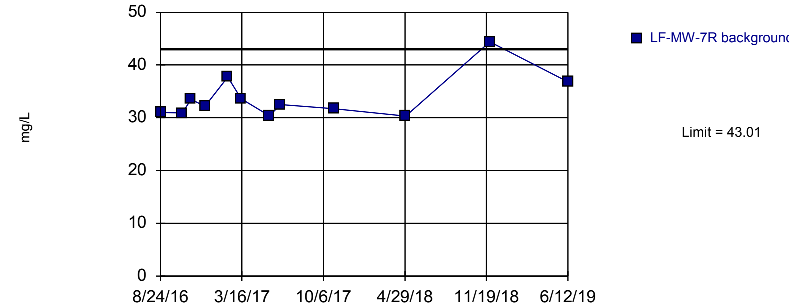
Constituent: Calcium, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



Background Data Summary (based on square root transformation): Mean=5.8, Std. Dev.=0.3395, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8101, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

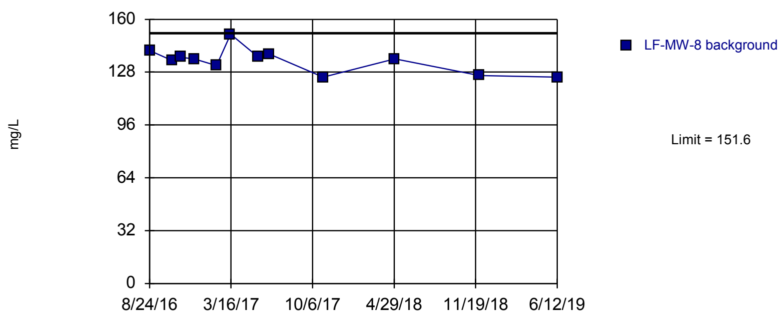
Constituent: Calcium, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



Background Data Summary: Mean=135, Std. Dev.=7.435, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9148, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

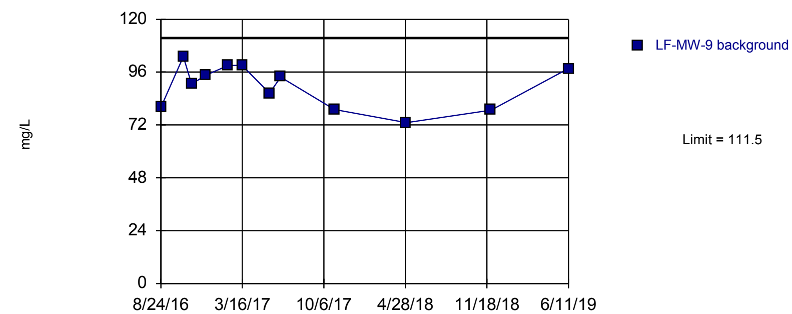
Constituent: Calcium, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



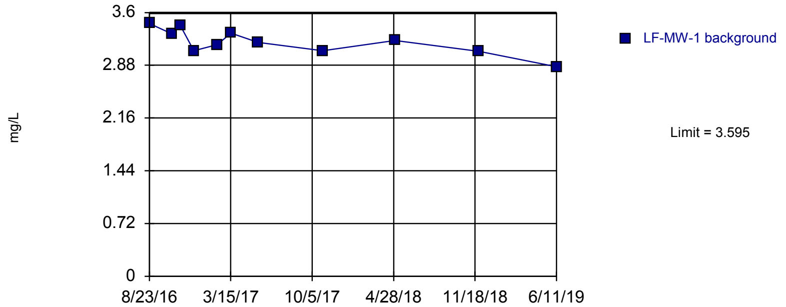
Background Data Summary: Mean=89.58, Std. Dev.=9.833, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9271, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium, total Analysis Run 10/25/2019 9:10 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-1



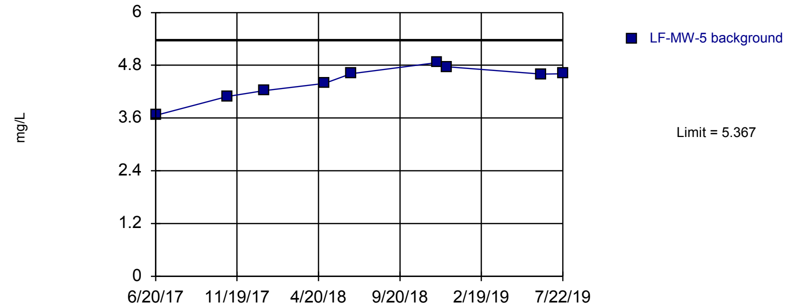
Background Data Summary: Mean=3.196, Std. Dev.=0.1734, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9619, critical = 0.792. Kappa = 2.3 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-5



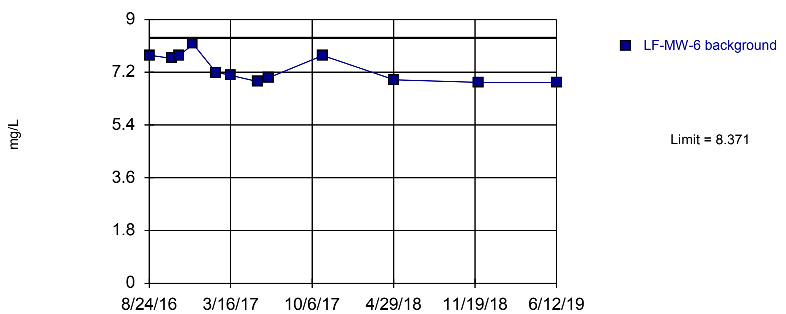
Background Data Summary: Mean=4.423, Std. Dev.=0.3788, n=9. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9153, critical = 0.764. Kappa = 2.492 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



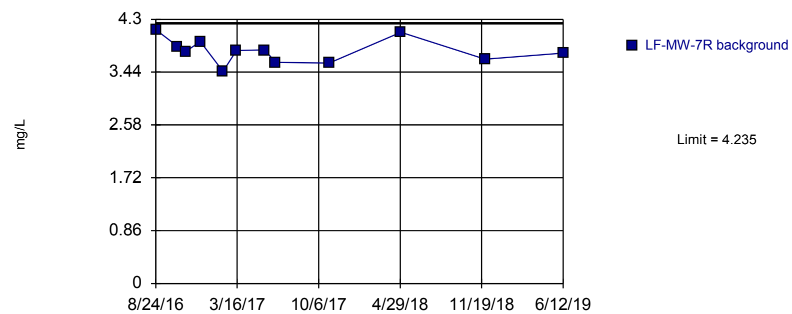
Background Data Summary: Mean=7.332, Std. Dev.=0.4657, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8604, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)

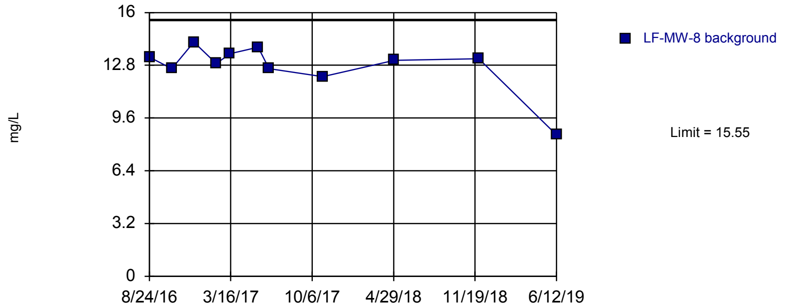


Background Data Summary: Mean=3.786, Std. Dev.=0.2013, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9668, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



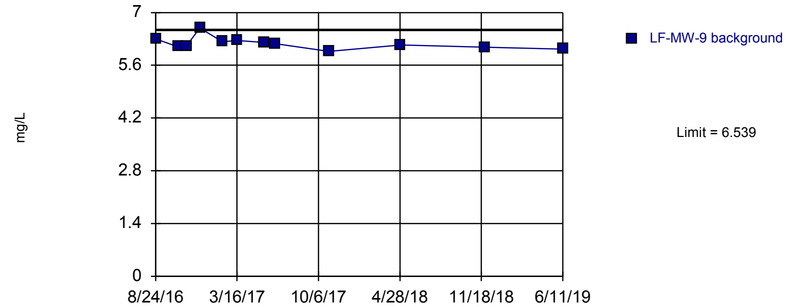
Background Data Summary (based on square transformation): Mean=164, Std. Dev.=33.87, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7978, critical = 0.792. Kappa = 2.3 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



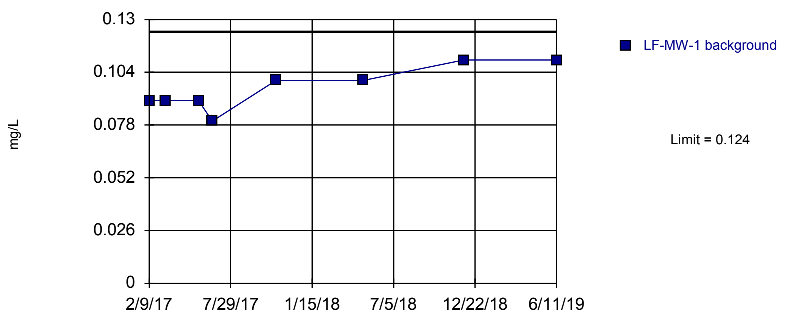
Background Data Summary: Mean=6.181, Std. Dev.=0.1603, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8922, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-1



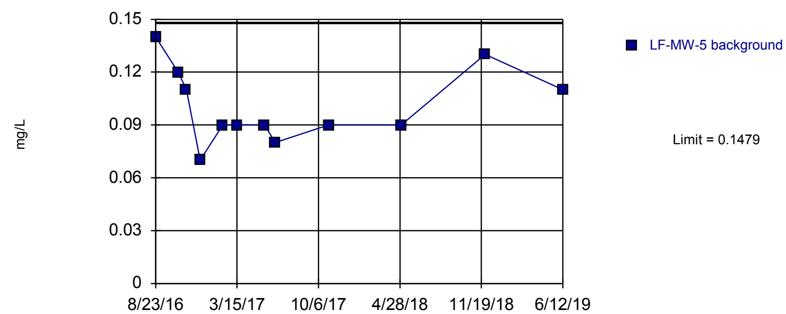
Background Data Summary: Mean=0.09625, Std. Dev.=0.01061, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9112, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-5

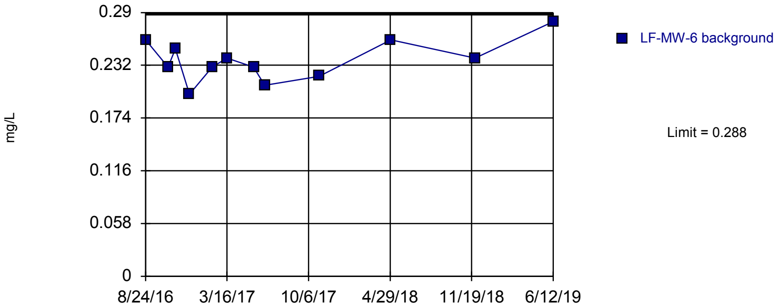


Background Data Summary: Mean=0.1008, Std. Dev.=0.02109, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9179, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)

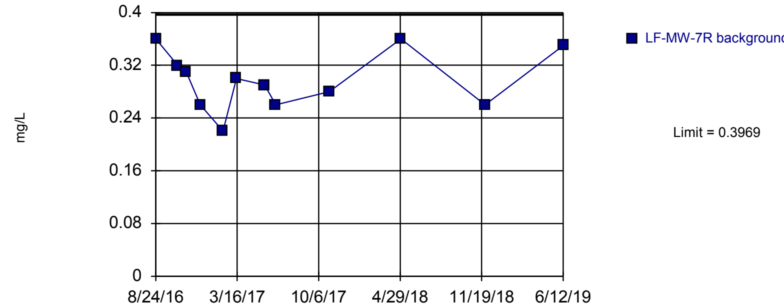


Background Data Summary: Mean=0.2375, Std. Dev.=0.02261, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.979, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)

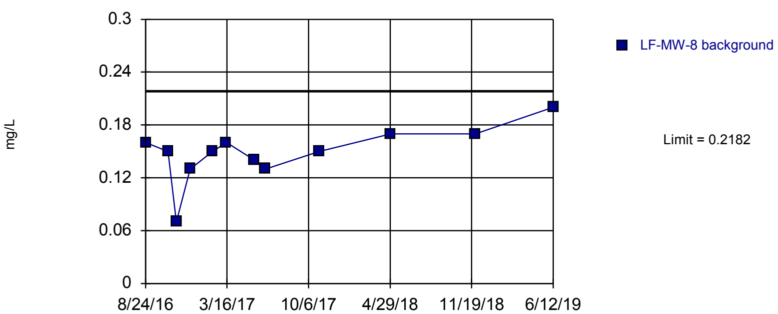


Background Data Summary: Mean=0.2975, Std. Dev.=0.04454, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9449, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)

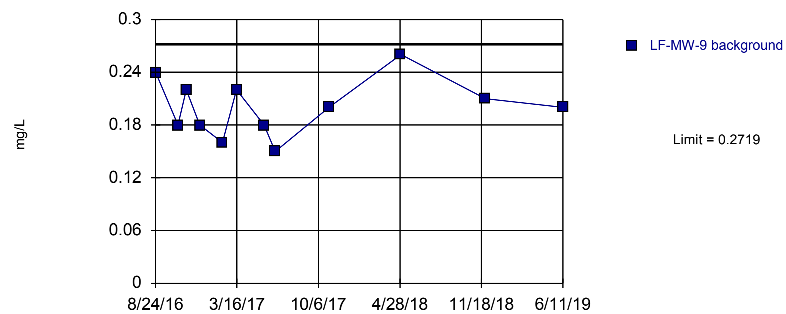


Background Data Summary: Mean=0.1483, Std. Dev.=0.03129, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8912, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)

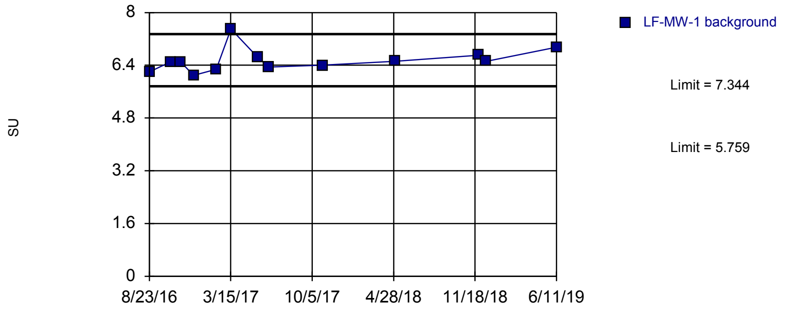


Background Data Summary: Mean=0.2, Std. Dev.=0.03219, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9731, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-1

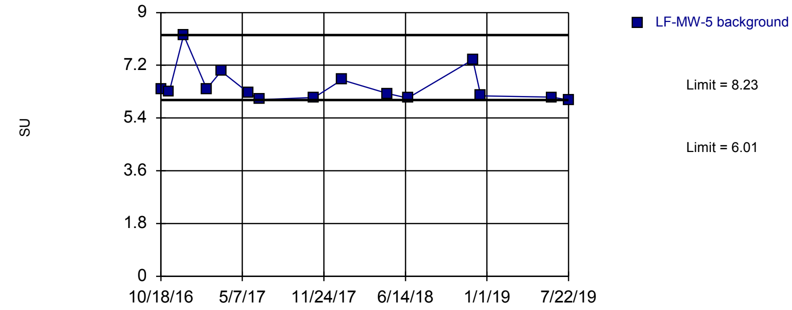


Background Data Summary: Mean=6.552, Std. Dev.=0.3614, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8726, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Non-parametric, LF-MW-5

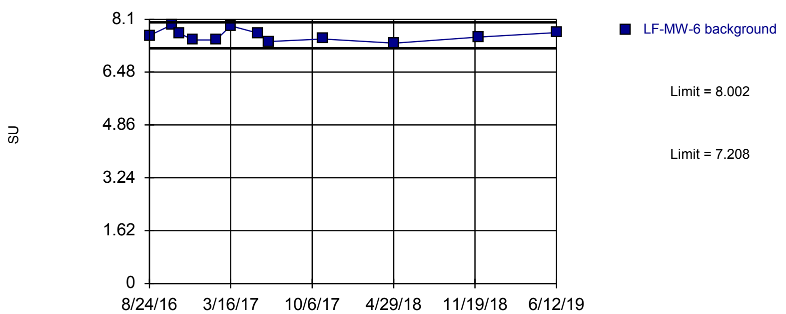


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 15 background values. Well-constituent pair annual alpha = 0.03002. Individual comparison alpha = 0.01507 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)

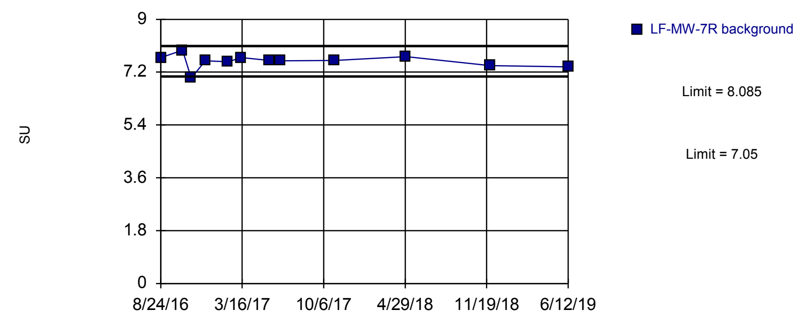


Background Data Summary: Mean=7.605, Std. Dev.=0.178, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9253, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



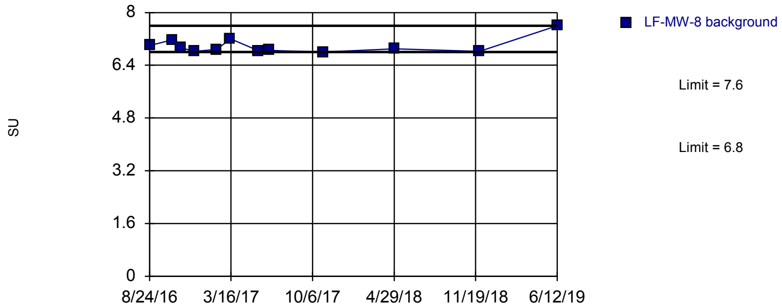
Background Data Summary: Mean=7.568, Std. Dev.=0.2316, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.896, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, LF-MW-8 (bg)



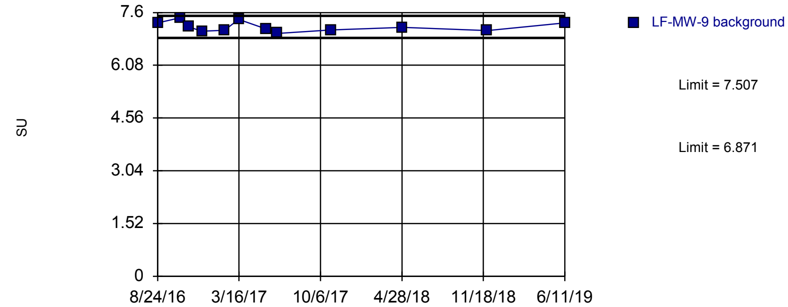
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 12 background values. Well-constituent pair annual alpha = 0.04286. Individual comparison alpha = 0.02155 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



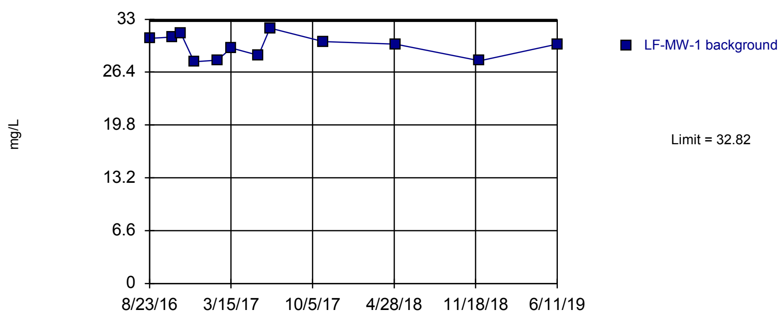
Background Data Summary: Mean=7.189, Std. Dev.=0.1424, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9234, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-1



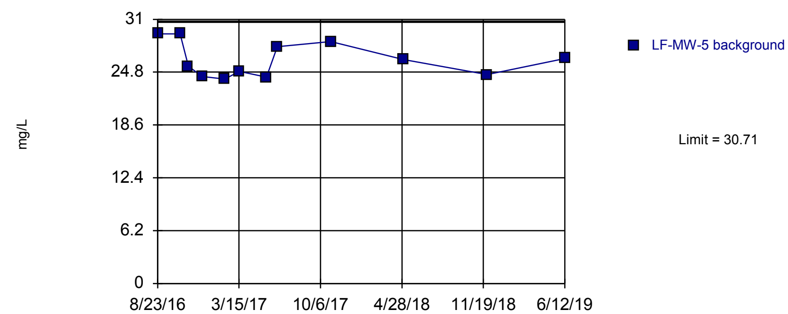
Background Data Summary: Mean=29.66, Std. Dev.=1.418, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9367, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-5

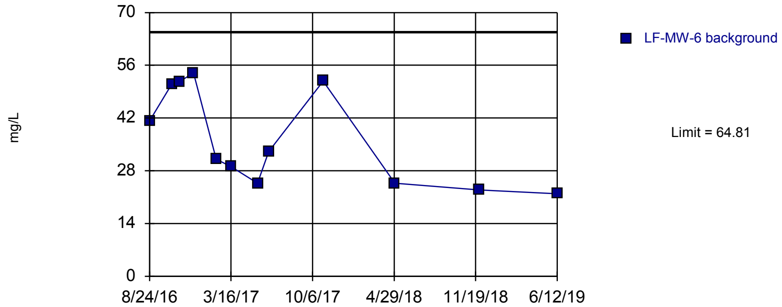


Background Data Summary: Mean=26.24, Std. Dev.=2.004, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8832, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



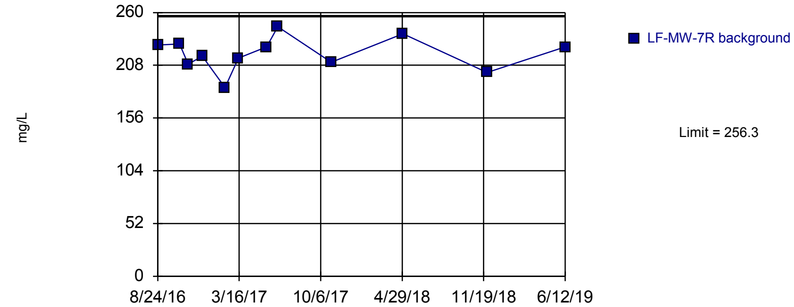
Background Data Summary: Mean=36.44, Std. Dev.=12.71, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8504, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



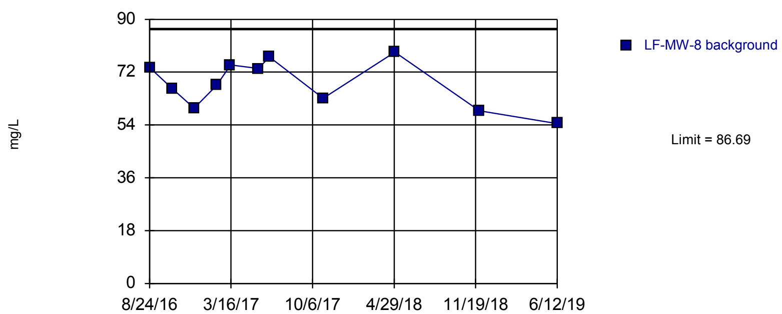
Background Data Summary: Mean=219.4, Std. Dev.=16.52, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9769, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



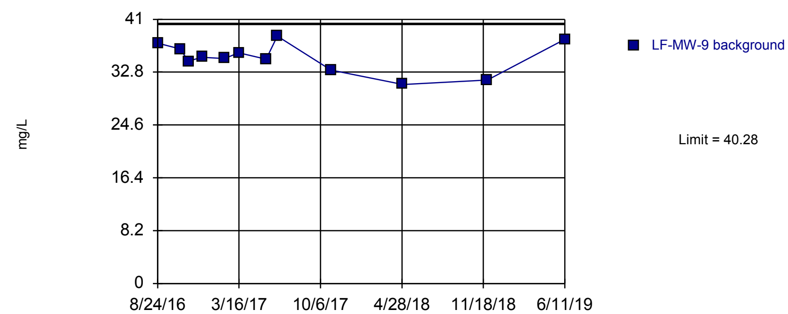
Background Data Summary: Mean=67.95, Std. Dev.=8.15, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9426, critical = 0.792. Kappa = 2.3 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Sanitas™ v.9.6.23 Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)

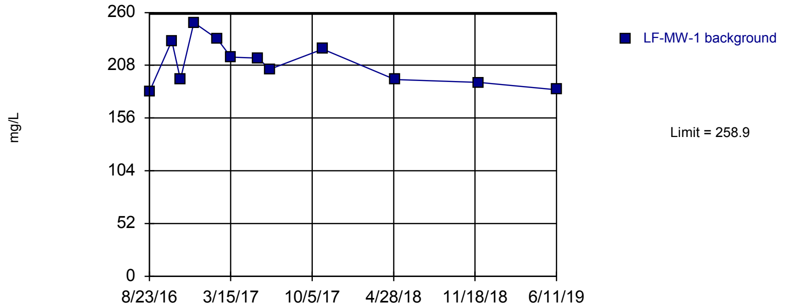


Background Data Summary: Mean=35.06, Std. Dev.=2.338, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9575, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate, total Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-1

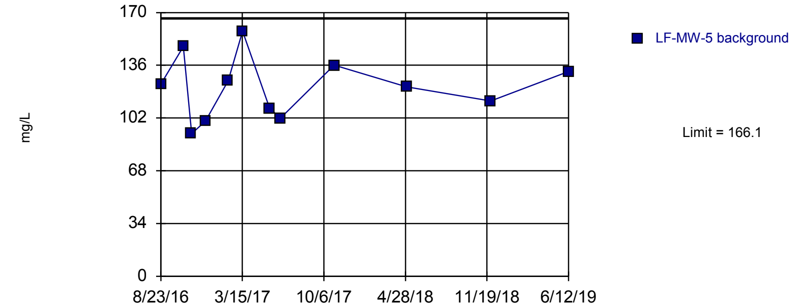


Background Data Summary: Mean=210, Std. Dev.=21.92, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9429, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-5

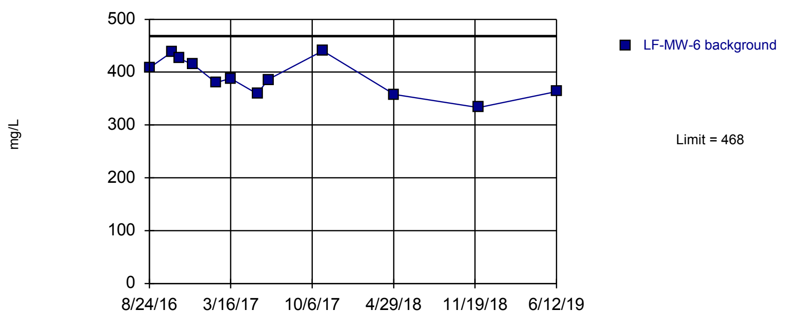


Background Data Summary: Mean=121.8, Std. Dev.=19.88, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9759, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)

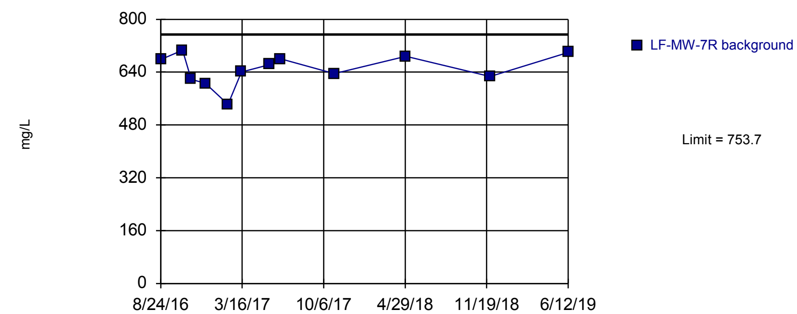


Background Data Summary: Mean=391.1, Std. Dev.=34.47, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9536, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/25/2019 9:10 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)

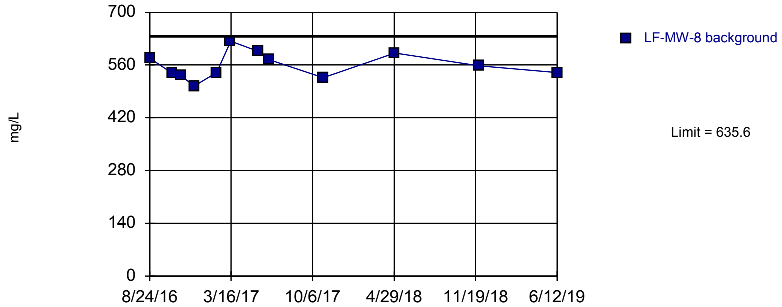


Background Data Summary: Mean=648.7, Std. Dev.=47.06, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9292, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/25/2019 9:11 AM View: Group 2
Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



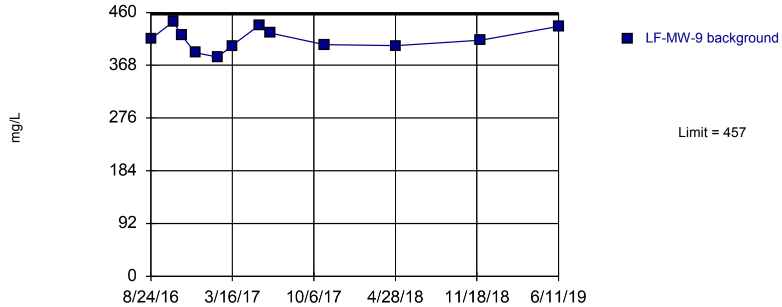
Background Data Summary: Mean=558.4, Std. Dev.=34.57, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9635, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/25/2019 9:11 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



Background Data Summary: Mean=414, Std. Dev.=19.28, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9681, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids [TDS] Analysis Run 10/25/2019 9:11 AM View: Group 2

Amos Landfill Client: Geosyntec Data: Amos Landfill

STATISTICAL ANALYSIS SUMMARY
Background Update Calculations
John E. Amos Plant
Landfill
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane
Suite 103
Columbus, Ohio 43221

July 8, 2020

CHA8500

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LIST OF ACRONYMS AND ABBREVIATIONS

ANOVA	Analysis of Variance
CCR	Coal Combustion Residuals
CCV	Continuing Calibration Value
CFR	Code of Federal Regulations
EPA	Environmental Protection Agency
LF	Landfill
LFB	Laboratory Fortified Blanks
LPL	Lower Prediction Limit
LRB	Laboratory Reagent Blanks
NELAP	National Environmental Laboratory Accreditation Program
PQL	Practical Quantitation Limit
QA	Quality Assurance
QC	Quality Control
SSI	Statistically Significant Increase
SWFPR	Site-Wide False Positive Rate
TDS	Total Dissolved Solids
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

EXECUTIVE SUMMARY

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR Subpart D, "CCR rule"), groundwater monitoring has been conducted at the lined landfill (LF), an existing CCR unit at the John E. Amos Power Plant located in Winfield, West Virginia.

The groundwater monitoring network was established, and eight monitoring events were completed prior to October 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Two monitoring wells, MW-1 and MW-5, were removed from the groundwater monitoring network and replaced with wells MW-1801 and MW-1802 (Arcadis, 2020). Inrawell tests were used to evaluate the Appendix III parameter results at the LF. Background concentrations were developed for MW-1801 and MW-1802 using the data obtained in eight sampling events. Groundwater data underwent several validation tests, including those for completeness, sample tracking accuracy, transcription errors, and consistent use of measurement units. No data quality issues were identified which would impact the usability of the data.

The detection monitoring data were submitted to Groundwater Stats Consulting, LLC for statistical analysis. The compliance data were reviewed for outliers, which were removed (when appropriate) prior to updating upper prediction limits (UPLs) for each Appendix III parameter to represent background values. Oversight on the use of statistical calculations was provided by Dr. Jim Loftis, senior advisor to Groundwater Stats Consulting, LLC. Certification of the selected statistical methods by a qualified professional engineer is documented in Attachment A.

SECTION 2

LANDFILL EVALUATION

2.1 Previous Background Calculations

Eight background monitoring events were completed from August 2016 through October 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule for the original groundwater monitoring network. The data were reviewed for outliers and trends prior to calculating UPLs for each Appendix III parameter. Lower prediction limits (LPLs) were also established for pH. Interwell prediction limits were initially selected for boron and fluoride, and intrawell prediction limits were initially selected for calcium, chloride, pH, sulfate, and TDS. Both the interwell and intrawell tests used a one-of-two resampling plan. The statistical analyses to establish background levels were previously documented in the January 2018 *Statistical Analysis Summary* report (Geosyntec, 2018a).

A review of groundwater geochemistry at the site identified two types of groundwater, which are referred to as Group 1 and Group 2. Group 1 groundwater is predominantly composed of sodium and bicarbonate, whereas Group 2 has higher concentrations of calcium and magnesium in addition to sodium and bicarbonate. Group 1 consists of upgradient well MW-10 and downgradient wells MW-2 and MW-4. Group 2 consists of upgradient wells MW-6, MW-7R, MW-8, and MW-9 and downgradient wells MW-1 and MW-5.

MW-2 and MW-4 had elevated boron concentrations relative to the upgradient wells prior to the placement of CCR at Amos LF. Fluoride data were not collected prior to CCR placement because it was not required by the state monitoring program. Because the two groups of groundwater have distinct geochemistries and because downgradient concentrations were elevated prior to CCR placement, the statistics for boron and fluoride were revised to an intrawell approach (Geosyntec, 2018b).

Four semiannual detection monitoring events were conducted at the LF between November 2017 and June 2019. These four detection monitoring events were evaluated for inclusion into the background dataset. Where appropriate, the background datasets were updated, and UPLs and LPLs were recalculated. Intrawell tests using a one-of-two retesting procedure were utilized for Appendix III parameters (Geosyntec, 2020).

Monitoring wells MW-1801 and MW-1802 were added to the groundwater network to replace MW-1 and MW-5 (Arcadis, 2020). Eight samples were collected from MW-1801 and MW-1802 between December 2018 and November 2019 to establish a background dataset for each well. Because MW-1 and MW-5 were removed from the groundwater network, results from those monitoring locations are not included in this statistical analysis. Groundwater at both MW-1801 and MW-1802 appear consistent with Group 2 concentrations at other locations, as shown in the Schoeller diagram provided in Figure 1.

2.2 Data Validation & QA/QC

A summary of data collected from MW-1801 and MW-1802 during the eight background monitoring events conducted between December 2018 and November 2019 may be found in Table 1.

Chemical analysis was completed by an analytical laboratory certified by the National Environmental Laboratory Accreditation Program (NELAP). Quality assurance and quality control (QA/QC) samples completed by the analytical laboratory included the use of laboratory reagent blanks (LRBs), continuing calibration verification (CCV) samples, and laboratory fortified blanks (LFBs).

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.25a statistics software. The export was checked against the analytical data for transcription errors and completeness. No QA/QC issues were noted which would impact data usability.

2.3 Statistical Analysis

The data used to conduct the statistical analyses described below are summarized in Table 1. Statistical analyses for the LF were conducted in accordance with the January 2017 *Statistical Analysis Plan* (AEP, 2017), except where noted below. The complete statistical analysis results are included in Attachment B.

Time series plots of Appendix III parameters are included in Attachment B and were used to evaluate concentrations over time and to provide an initial screening of suspected outliers and trends. Mann-Kendall analyses ($\alpha = 0.01$) were also conducted to evaluate trends in the background data for the Appendix III parameters at MW-1801 and MW-1802. No significant increasing or decreasing trends were observed. Box plots were also compiled to provide visual representation of variations between wells and within individual wells (Attachment B).

2.3.1 Outlier Evaluation

Potential outliers within the dataset were evaluated using Tukey's outlier test; i.e., data points were considered potential outliers if they met one of the following criteria:

$$x_i < \tilde{x}_{0.25} - 3 \times IQR \quad (1)$$

or

$$x_i > \tilde{x}_{0.75} + 3 \times IQR \quad (2)$$

where:

$x_i =$ individual data point
$\tilde{x}_{0.25} =$ first quartile
$\tilde{x}_{0.75} =$ third quartile
$IQR =$ the interquartile range $= \tilde{x}_{0.75} - \tilde{x}_{0.25}$

Only outliers within the MW-1801 and MW-1802 report are discussed here. The TDS value of 550 mg/L at MW-1801 on February 21, 2019, was flagged as an outlier by Tukey's test, but it was not removed from the dataset as it is similar to other measurements at the well and limited data is available at this time. Other outliers were not identified in the datasets for MW-1801 or MW-1802.

2.3.2 Updated Prediction Limits

As discussed in Section 2.1, two distinct types of groundwater (Group 1 and Group 2) were identified at the LF, and as a result, intrawell tests were selected to evaluate Appendix III parameter results. Now that MW-1 and MW-5 have been replaced with MW-1801 and MW-1802, Group 1 consists of upgradient well MW-10 and downgradient wells MW-2, MW-4, MW-1801, and MW-1802, and Group 2 consists of upgradient wells MW-6, MW-7R, MW-8, and MW-9. Because there is only one upgradient well in Group 1, spatial variation within Group 1 cannot be evaluated, further supporting the selection of intrawell tests for the LF.

A parametric or non-parametric analysis was selected for the MW-1801 and MW-1802 datasets based on the distribution of the data and the frequency of non-detect data. Estimated results less than the practical quantitation limit (PQL) – i.e., "J-flagged" data – were considered detections and the estimated results were used in the statistical analyses. Non-parametric analyses were selected for datasets with at least 50% non-detect data or datasets that could not be normalized. Parametric analyses were selected for datasets (either transformed or untransformed) that passed the Shapiro-Wilk / Shapiro-Francía test for normality. The Kaplan-Meier non-detect adjustment was applied to datasets with between 15% and 50% non-detect data. For datasets with fewer than 15% non-detect data, non-detect data were replaced with one half of the PQL. The selected analysis (i.e., parametric or non-parametric) and transformation (where applicable) for each background dataset are shown in Attachment B.

Intrawell UPLs were developed for new compliance wells MW-1801 and MW-1802 using the eight sample results collected at each of these two wells between December 2018 and November 2019. Intrawell LPLs were also generated for pH. The updated prediction limits are summarized in Table 2. Because MW-1801 and MW-1802 replaced MW-1 and MW-5 in the groundwater monitoring network, the total number of wells within the network remained the same. As a result, the per-test false positive rate was not changed to maintain a site-wide false positive rate (SWFPR) below 10%, and the UPLs for existing downgradient wells MW-2 and MW-4 remain unchanged. UPLs for MW-2 and MW-4 are also included in Table 2.

The intrawell UPLs were calculated for a one-of-two retesting procedure; i.e., if at least one sample in a series of two does not exceed the UPL, then it can be concluded that an SSI has not occurred. In practice, where the initial result does not exceed the UPL, a second sample will not be collected.

The retesting procedures allowed achieving an acceptably high statistical power to detect changes at downgradient wells for constituents evaluated using intrawell prediction limits.

2.4 Conclusions

Eight background monitoring events were completed in accordance with the CCR Rule for new monitoring wells MW-1801 and MW-1802. The laboratory and field data from these monitoring wells were reviewed prior to statistical analysis, with no QA/QC issues identified that impacted data usability. Intrawell prediction limits were developed for MW-1801 and MW-1802. Because MW-1801 and MW-1802 replaced MW-1 and MW-5 in the groundwater monitoring network, the total number of wells within the network remained the same. As a result, the per-test false positive rate was not changed to maintain a SWFPR below 10%, and the UPLs for existing downgradient wells MW-2 and MW-4 remain unchanged. UPLs and LPLs were recalculated using intrawell prediction limits with a one-of-two retesting procedure for all Appendix III parameters.

SECTION 3

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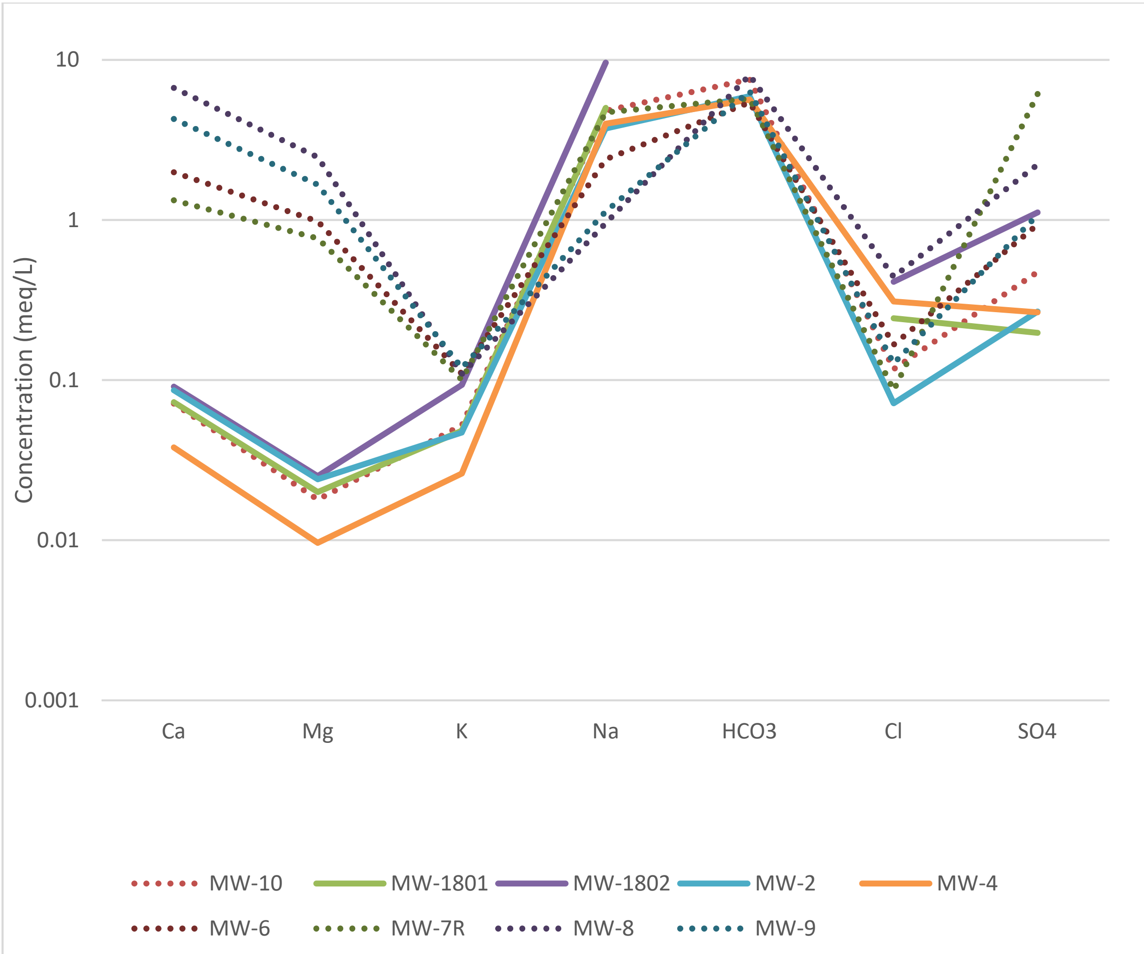
United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

FIGURES



Notes: Data is from the November 2019 sampling event at all locations. Dashed lines represent upgradient wells. Alkalinity data was not available at MW-1801 and MW-1802.

Groundwater Chemistry – Schoeller Diagram

Amos Landfill

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure

1

Columbus, Ohio

06-Jun-2020

TABLES

Table 1: Groundwater Data Summary - MW-1801 and MW-1802
Amos - Landfill

Component	Unit	MW-1801							
		12/18/2018	1/24/2019	2/21/2019	3/13/2019	4/23/2019	6/11/2019	7/23/2019	11/5/2019
		Background							
Boron	mg/L	0.273	0.247	0.219	0.251	0.246	0.26	0.246	0.255
Calcium	mg/L	1.76	1.59	1.38	1.55	1.50	1.45	1.41	1.46
Chloride	mg/L	10.4	10.8	11	11.1	11.3	10.4	10.8	11.7
Fluoride	mg/L	5.01	5.19	5.26	5.32	5.35	5.03	5.47	5.36
Total Dissolved Solids	mg/L	498	490	550	509	507	506	502	501
Sulfate	mg/L	8.1	7.2	6.8	6.6	8.2	6.5	7.2	7.0
pH	SU	8.9	8.9	9.0	9.0	9.1	9.4	8.8	8.7

Component	Unit	MW-1802							
		12/17/2018	1/25/2019	2/21/2019	3/13/2019	4/24/2019	6/12/2019	7/23/2019	11/5/2019
		Background							
Boron	mg/L	0.267	0.249	0.233	0.234	0.242	0.253	0.236	0.254
Calcium	mg/L	0.821	0.924	0.840	0.860	0.910	0.876	0.865	0.892
Chloride	mg/L	8.33	8.87	8.94	9.21	9.13	9.01	8.80	9.90
Fluoride	mg/L	4.79	4.82	4.87	4.75	5.04	4.54	5.16	4.84
Total Dissolved Solids	mg/L	482	451	532	477	478	476	476	460
Sulfate	mg/L	20.6	20.3	20.1	18.8	21.2	19.1	20.7	19.7
pH	SU	9.1	9.1	9.3	9.3	9.2	9.0	9.0	8.9

Notes:
mg/L: milligrams per liter
SU: standard unit

Table 2: Background Level Summary
Amos - Landfill

Analyte	Unit	Description	MW-2	MW-4	MW-1801	MW-1802
Boron	mg/L	Intrawell Background Value (UPL)	0.247	0.214	0.306	0.276
Calcium	mg/L	Intrawell Background Value (UPL)	2.10	0.912	1.83	0.978
Chloride	mg/L	Intrawell Background Value (UPL)	5.40	15.9	12.1	10.2
Fluoride	mg/L	Intrawell Background Value (UPL)	1.61	1.52	5.67	5.36
pH	SU	Intrawell Background Value (UPL)	9.0	10.1	9.5	9.5
		Intrawell Background Value (LPL)	8.2	8.3	8.5	8.7
Sulfate	mg/L	Intrawell Background Value (UPL)	12.9	12.2	8.88	22.4
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	394	422	550	522

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

ATTACHMENT A

Certification by a Qualified Professional Engineer

Certification by a Qualified Professional Engineer

I certify that the selected and above described statistical method is appropriate for evaluating the groundwater monitoring data for the John E. Amos Landfill CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

22663
License Number

WEST VIRGINIA
Licensing State

07.08.2020
Date

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

ATTACHMENT B

Statistical Analysis Output

GROUNDWATER STATS
CONSULTING

June 1, 2020

Geosyntec Consultants
Attn: Ms. Allison Kreinberg
941 Chatham Lane, #103
Columbus, OH 43221

RE: Amos Landfill Background Update

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the background update of the groundwater data through 2019 at American Electric Power's Amos Landfill. The analysis complies with the federal rule for the Disposal of Coal Combustion Residuals from Electric Utilities (CCR Rule, 2015) as well as with the USEPA Unified Guidance (2009).

Sampling began at Amos Landfill for the CCR program in 2016 for all wells except wells MW-1801 and MW-1802 which were installed in 2018, and at least 8 background samples have been collected at each of the groundwater monitoring wells. The monitoring well network, as provided by Geosyntec Consultants, includes the following:

- **Upgradient well:** MF-MW-6, LF-MW-7R, LF-MW-8, LF-MW-9, and LF-MW-10
- **Downgradient wells:** LF-MW-2, LF-MW-4, MW-1801, and MW-1802

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Jim Loftis, Civil & Environmental Engineering professor emeritus at Colorado State University and Senior Advisor to Groundwater Stats Consulting. The statistical analysis was performed according to the groundwater data screening that was performed in April 2018 by GSC and approved by Dr. Cameron, PhD Statistician with MacStat Consulting and primary author of the USEPA Unified Guidance.

The following constituents were evaluated during this background update:

- **Appendix III parameters** – boron, calcium, chloride, fluoride, pH, sulfate, and TDS

The following parameters were evaluated for existing wells during the initial background screening conducted in 2018:

- **Appendix IV parameters** – antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, combined radium 226 & 228, fluoride, lead, lithium, mercury, molybdenum, selenium and thallium

Time series plots for Appendix III parameters at all wells are provided for the purpose of updating prediction limits at these wells (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). The time series plots are used to initially screen for suspected outliers and trends, while the box plots provide visual representation of variation within individual wells and between all wells.

Data at existing wells were originally evaluated during the background screening conducted in March 2018 for Appendix III and IV parameters (summarized below) for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided with the previous screening to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

Summary of Statistical Methods:

1) Intrawell prediction limits, combined with a 1-of-2 resample plan for boron, calcium, chloride, fluoride, pH, sulfate and TDS

Parametric prediction limits are utilized when the screened historical data follow a normal or transformed-normal distribution. When data cannot be normalized or the majority of data are nondetects, a nonparametric test is utilized. The distribution of data is tested using the Shapiro-Wilk/Shapiro-Francia test for normality. After testing for normality and performing any adjustments as discussed below (US EPA, 2009), data are analyzed using either parametric or non-parametric prediction limits.

- No statistical analyses are required on wells and analytes containing 100% nondetects (USEPA Unified Guidance, 2009, Chapter 6).
- When data contain <15% nondetects in background, simple substitution of one-half the reporting limit is utilized in the statistical analysis. The reporting limit utilized for nondetects is the practical quantification limit (PQL) as reported by the laboratory.
- When data contain between 15-50% nondetects, the Kaplan-Meier nondetect adjustment is applied to the background data. This technique adjusts the mean and standard deviation of the historical concentrations to account for concentrations below the reporting limit.
- Nonparametric prediction limits are used on data containing greater than 50% nondetects.

Summary of Original Background Screening – April 2018

Outlier Evaluation

Time series plots are used to identify suspected outliers, or extreme values that would result in limits that are not conservative from a regulatory perspective, in proposed background data. Suspected outliers at existing wells for Appendix III parameters were formally tested using Tukey's box plot method and, when identified, flagged in the computer database with "o" and deselected prior to construction of statistical limits.

Tukey's outlier test was also used to evaluated Appendix IV parameters, but no values were flagged as outliers for the wells in the current well network. A summary of these results was included in the previous screening.

No true seasonal patterns were observed on the time series plots for any of the detected data; therefore, no deseasonalizing adjustments were made to the data. When seasonal patterns are observed, data may be deseasonalized so that the resulting limits will correctly account for the seasonality as a predictable pattern rather than random variation or a release.

While trends may be visual, a quantification of the trend and its significance is needed. The Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends. In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed Appendix III concentrations were stable over time with no statistically significant increasing or decreasing trends. A summary table of the trend test results accompanied the trend tests. Therefore, none of the data sets required any adjustments at that time.

Determination of Statistical Method - Appendix III Parameters

The Analysis of Variance (ANOVA) was used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying the most appropriate statistical approach. When variation exists among upgradient wells, intrawell methods, which used historical data within a given well to establish a limit for comparison of future compliance data at the same well, are recommended as the most appropriate statistical method when groundwater downgradient of the facility is not affected by practices at the facility.

Intrawell limits constructed from carefully screened background data from within each well serve to provide statistical limits that are conservative (i.e. lower) from a regulatory perspective, and that will rapidly identify a change in more recent compliance data from within a given well. This statistical method removes the element of variation from across wells and eliminates the chance of mistaking natural spatial variation for a release from the facility. Prior to performing intrawell prediction limits, several steps were required to reasonably demonstrate downgradient water quality does not have existing impacts from the practices of the facility.

Exploratory data analysis was used as a general comparison of concentrations in downgradient wells for all Appendix III parameters recommended for intrawell analyses to concentrations reported in upgradient wells. Upper tolerance limits were used in conjunction with confidence intervals to determine whether the estimated averages in downgradient wells are higher than observed levels upgradient of the facility. The upper tolerance limits were constructed to represent the extreme upper range of possible background levels at the site.

In cases where downgradient average concentrations are higher than observed concentrations upgradient for a given constituent, an independent study and hydrogeological investigation would be required to identify local geochemical conditions and expected groundwater quality for the region to justify an intrawell approach. Such an assessment is beyond the scope of services provided by Groundwater Stats Consulting. When there is not an obvious explanation for observed concentration differences in downgradient wells relative to reported concentrations in upgradient wells, interwell prediction limits were initially be selected for the statistical method until further evidence shows that concentrations are due to natural variation rather than a result of the facility.

Parametric tolerance limits were constructed with a target of 99% confidence and 95% coverage using pooled upgradient well data for each of the Appendix III parameters. The confidence and coverage levels for nonparametric tolerance limits are dependent upon the number of background samples. As more data are collected, the background population is better represented and the confidence and coverage levels increase.

Confidence intervals were constructed on downgradient wells for each of the Appendix III parameters, using the tolerance limits discussed above, to determine intrawell eligibility. When the entire confidence interval is above a background standard for a given parameter, interwell methods are initially recommended as the statistical method. Therefore, only parameters with confidence intervals which did not exceed background standards were eligible for intrawell prediction limits.

Confidence intervals for the majority of parameters were found to be within their respective background limits. Additionally, evidence provided by Geosyntec supported the use of intrawell analyses for all parameters at all wells based on additional studies conducted.

All available data through October 2017 at each well were used to establish intrawell background limits for each of the Appendix III parameters based on a 1-of-2 resample plan.

Background Update Summary

Prior to updating background data, samples were re-evaluated for all wells using Tukey's outlier test and visual screening on data collected through November 2019 (Figure C). While new wells MW-1801 and MW-1802 have data through November 2019, existing wells have data only through June/July 2019 for background. A few outliers were noted, and those values were flagged. The value identified of 550 mg/L for TDS identified as an outlier at well MW-1801 was similar to remaining measurements in this well and was not flagged at this time due to the limited data available.

While Tukey's test did not identify the following values as outliers, these values were flagged and deselected in the database as they are considerably lower than the majority of measurements within each well: pH well MW-4; and chloride and sulfate in well MW-8.

As mentioned above, flagged data are displayed in a lighter font and as a disconnected symbol on the time series reports, as well as in a lighter font on the accompanying data pages. An updated summary of Tukey's test results and flagged outliers follows this letter (Figure C).

The Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data for existing wells through October 2017 to the new compliance samples at each well through June/July 2019 to evaluate whether the groups are statistically similar at the 95% confidence level, in which case background data may be updated with compliance data (Figure D). Statistically significant differences were noted for boron in upgradient well LF-MW-7R and downgradient well LF-MW-2; and fluoride in upgradient well LF-MW-8. Because two of the three significant differences were noted in upgradient wells, and all more recent medians were similar to the majority of reported historical concentrations, all records were updated to include data through June/July 2019.

Typically, when the test concludes that the medians of the two groups are significantly different, particularly in the downgradient wells, the background are not updated to include the newer data but will be reconsidered in the future. A summary of these results follows this letter.

For newer wells MW-1801 and MW-1802, the Sen's Slope/Mann Kendall trend test was used to evaluate all data at each well to identify statistically significant increasing or decreasing trends (Figure E). In the absence of suspected contamination, significant trending data are typically not included as part of the background data used for construction of prediction limits. This step serves to eliminate the trend and, thus, reduce variation in background. When statistically significant decreasing trends are present, earlier data are evaluated to determine whether earlier concentration levels are significantly different than current reported concentrations and will be deselected as necessary. When the historical records of data are truncated for the reasons above, a summary report will be provided to show the date ranges used in construction of the statistical limits.

The results of the trend analyses showed that Appendix III concentrations are stable over time with no statistically significant increasing or decreasing trends. Therefore, none of the data sets required any adjustments at this time, The reported fluoride concentrations are highest at the newer wells but are similar to or slightly higher than the established Maximum Concentration Level of 4 mg/L for fluoride. Concentrations for all other parameters are similar to or lower than those reported upgradient of the Landfill.

Intrawell prediction limits using all historical data through June/July 2019 for existing wells and through November 2019 for new wells, combined with a 1-of-2 resample plan, were constructed, and a summary of the updated limits follows this letter (Figure F). Future compliance observations at each well will be compared to these background limits during each subsequent semi-annual sampling event.

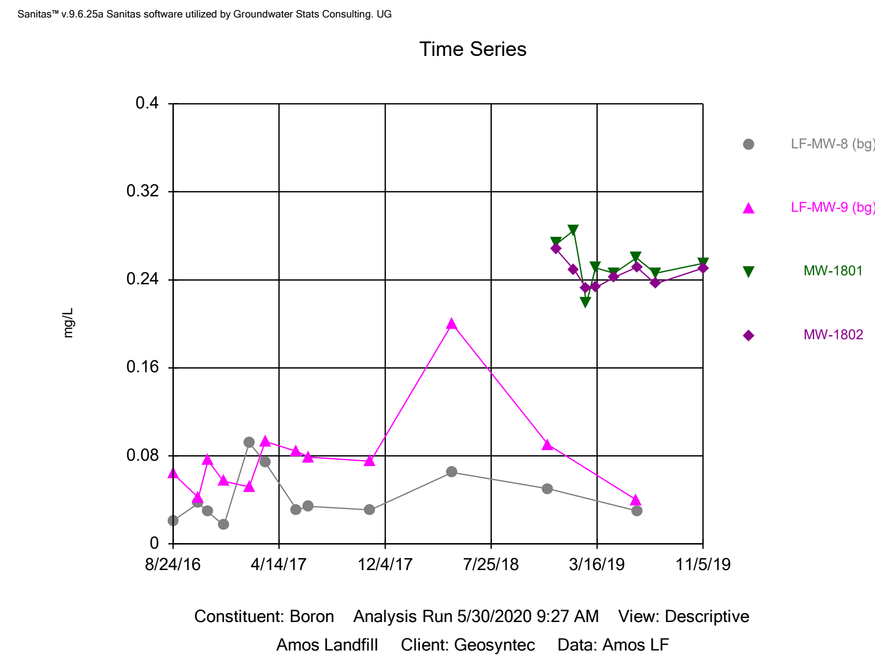
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Amos Landfill. If you have any questions or comments, please feel free to contact us.

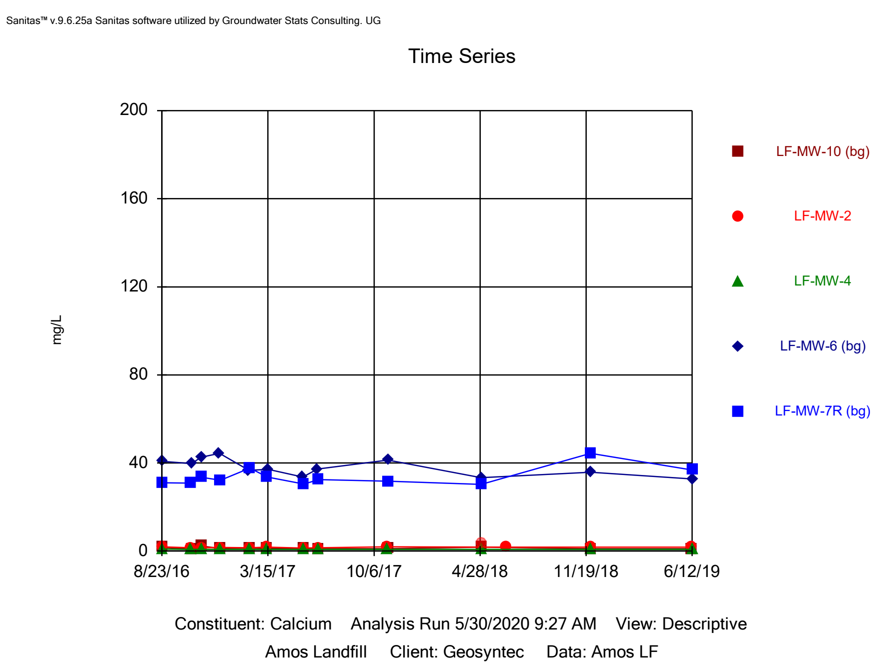
For Groundwater Stats Consulting,

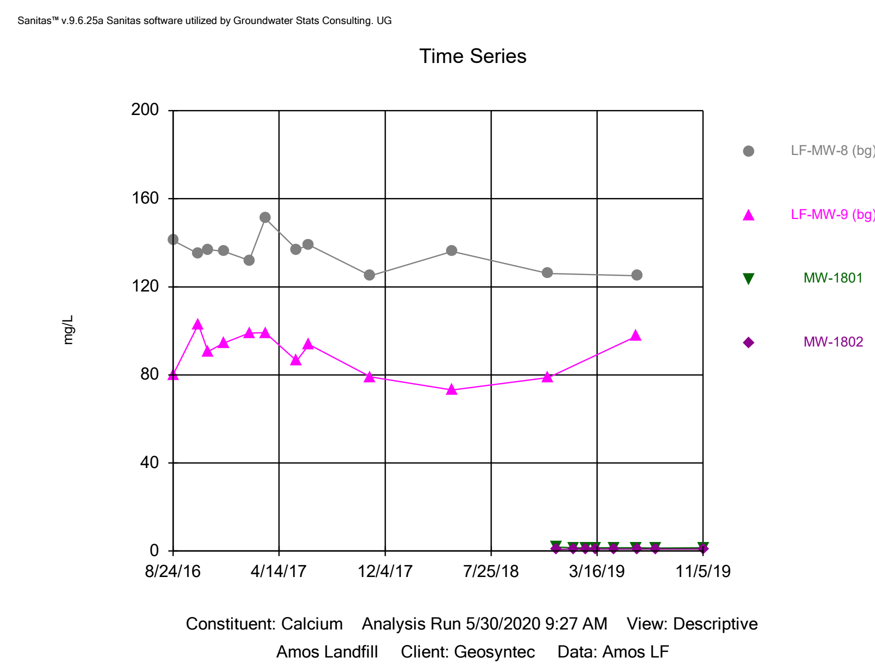
Kristina Rayner

Kristina L. Rayner
Groundwater Statistician

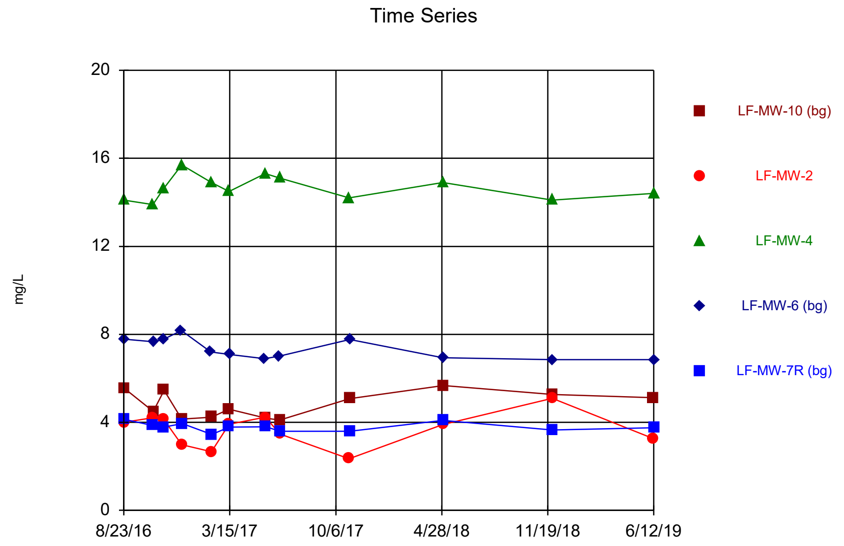

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
0.4
0.32
0.24
0.16
0.08
0
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
LF-MW-6 (bg)
LF-MW-7R (bg)
Constituent: Boron Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
0.4
0.32
0.24
0.16
0.08
0
8/24/16
4/14/17
12/4/17
7/25/18
3/16/19
11/5/19
LF-MW-8 (bg)
LF-MW-9 (bg)
MW-1801
MW-1802
Constituent: Boron Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
LF-MW-6 (bg)
LF-MW-7R (bg)
Constituent: Calcium Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

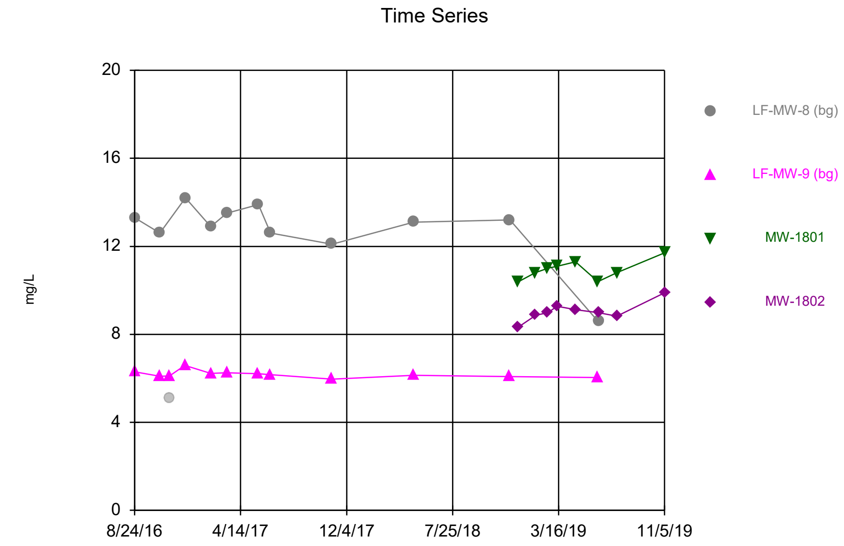

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
mg/L
200
160
120
80
40
0
8/24/16
4/14/17
12/4/17
7/25/18
3/16/19
11/5/19
LF-MW-8 (bg)
LF-MW-9 (bg)
MW-1801
MW-1802
Constituent: Calcium Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



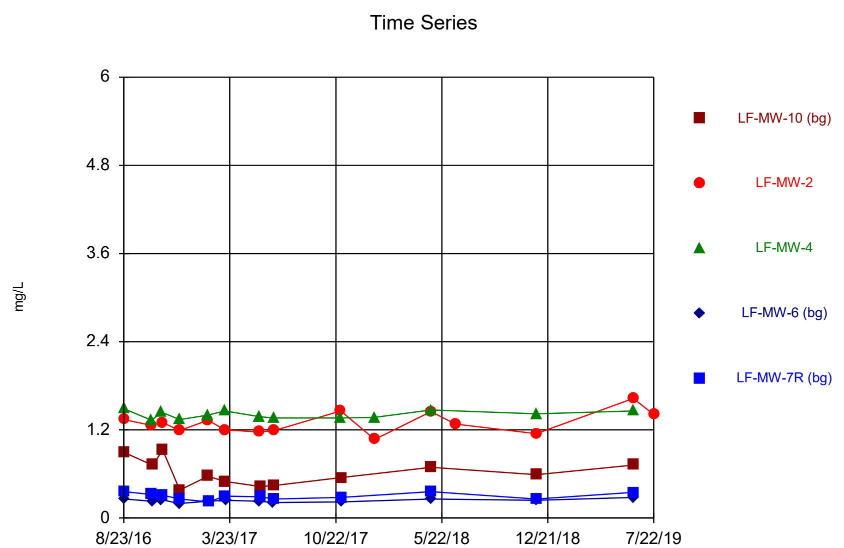
Constituent: Chloride Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



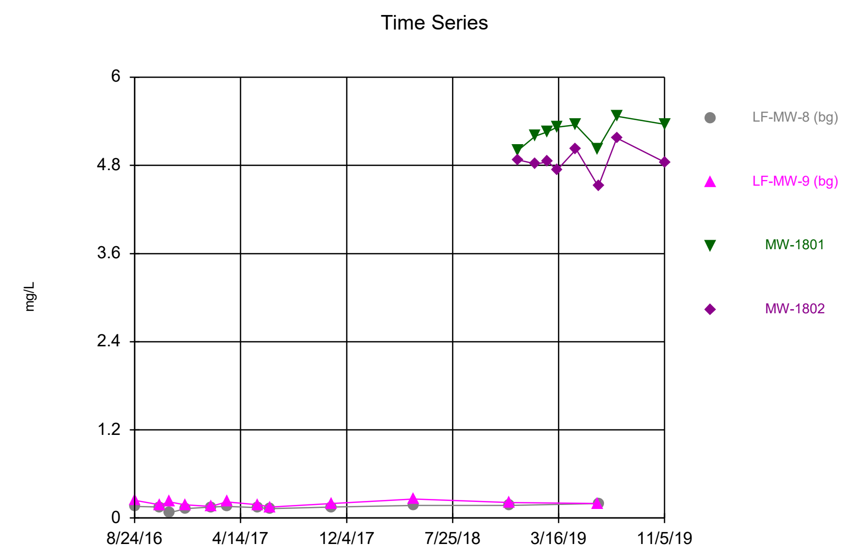
Constituent: Chloride Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

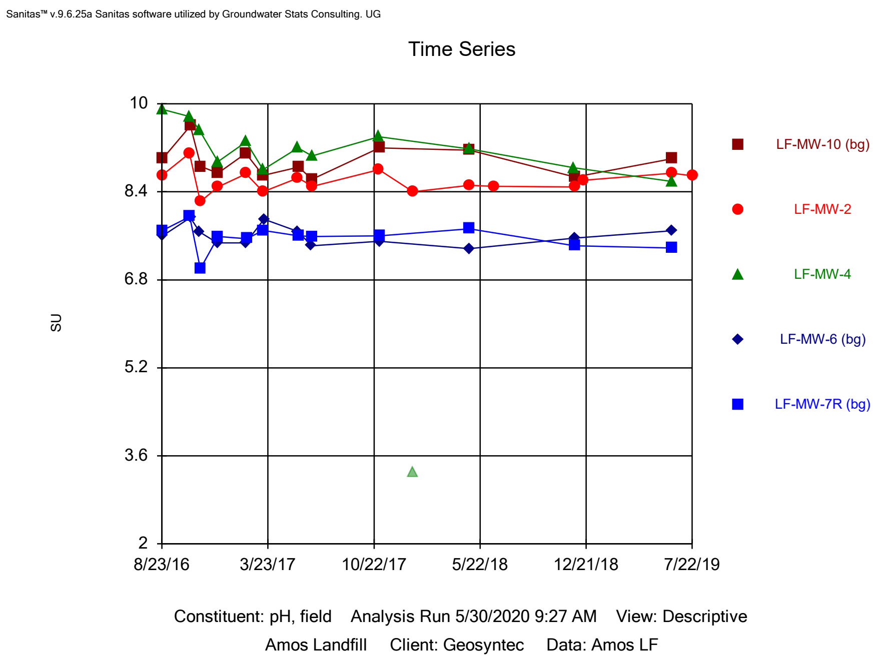


Constituent: Fluoride Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

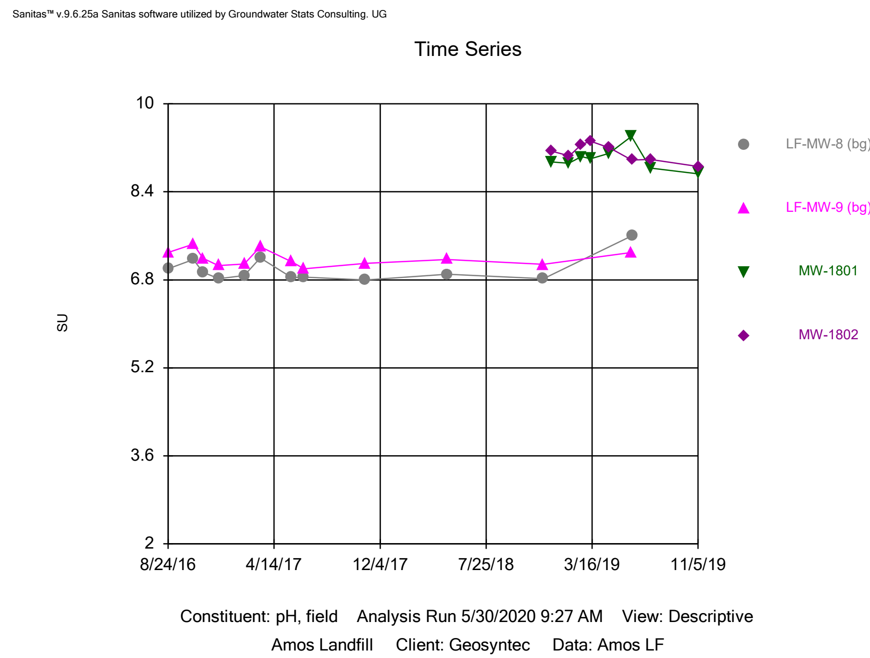
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



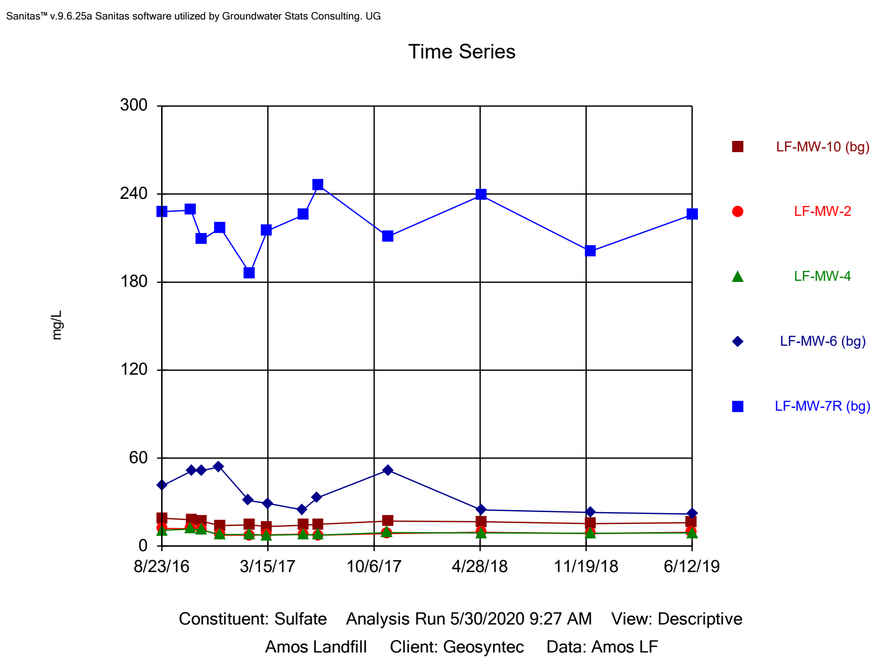
Constituent: Fluoride Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



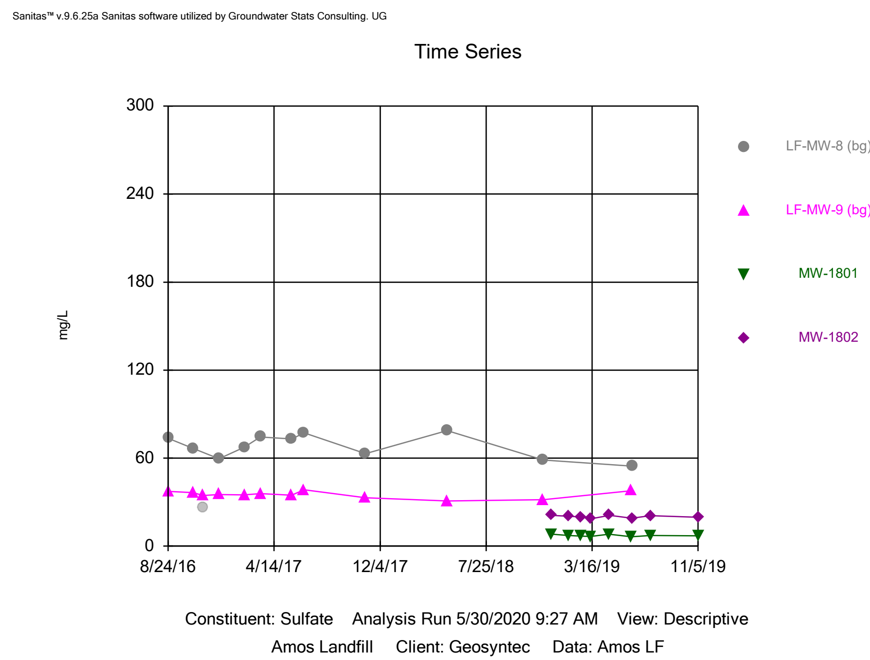
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
10
8.4
6.8
5.2
3.6
2
SU
8/23/16
3/23/17
10/22/17
5/22/18
12/21/18
7/22/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
LF-MW-6 (bg)
LF-MW-7R (bg)
Constituent: pH, field Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
10
8.4
6.8
5.2
3.6
2
SU
8/24/16
4/14/17
12/4/17
7/25/18
3/16/19
11/5/19
LF-MW-8 (bg)
LF-MW-9 (bg)
MW-1801
MW-1802
Constituent: pH, field Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

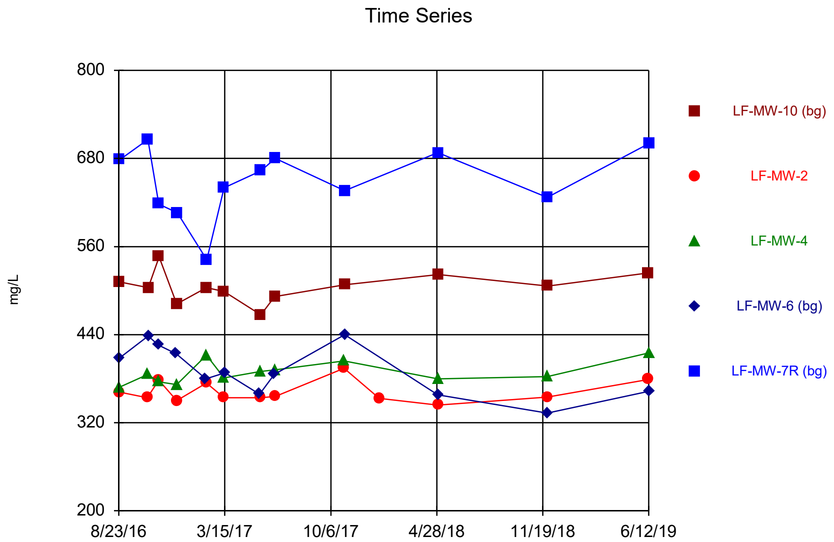


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
300
240
180
120
60
0
mg/L
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
LF-MW-10 (bg)
LF-MW-2
LF-MW-4
LF-MW-6 (bg)
LF-MW-7R (bg)
Constituent: Sulfate Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



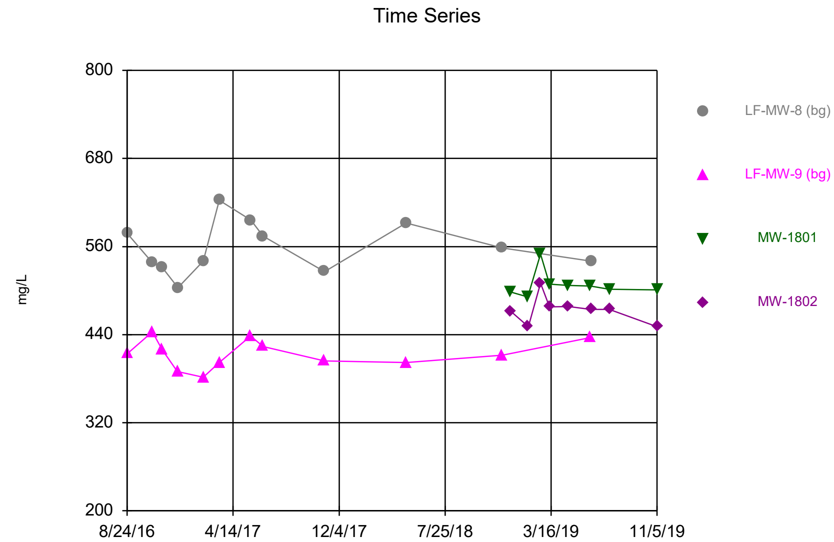
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Time Series
300
240
180
120
60
0
mg/L
8/24/16
4/14/17
12/4/17
7/25/18
3/16/19
11/5/19
LF-MW-8 (bg)
LF-MW-9 (bg)
MW-1801
MW-1802
Constituent: Sulfate Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



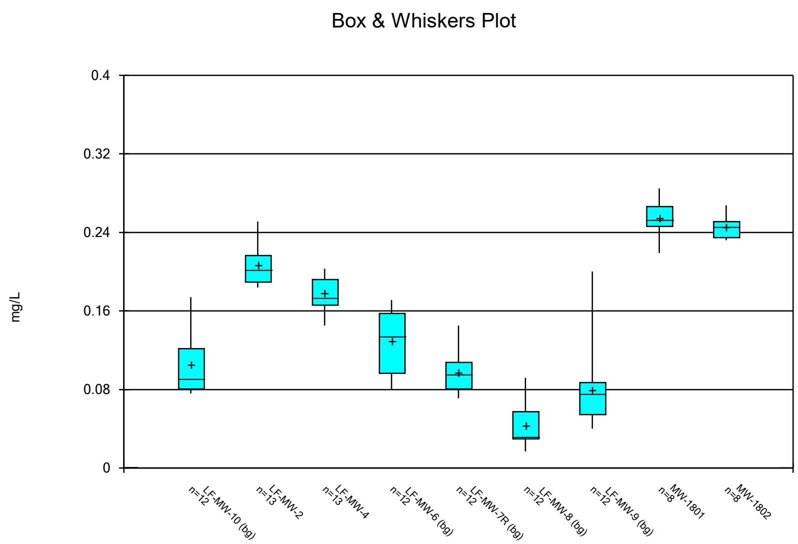
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



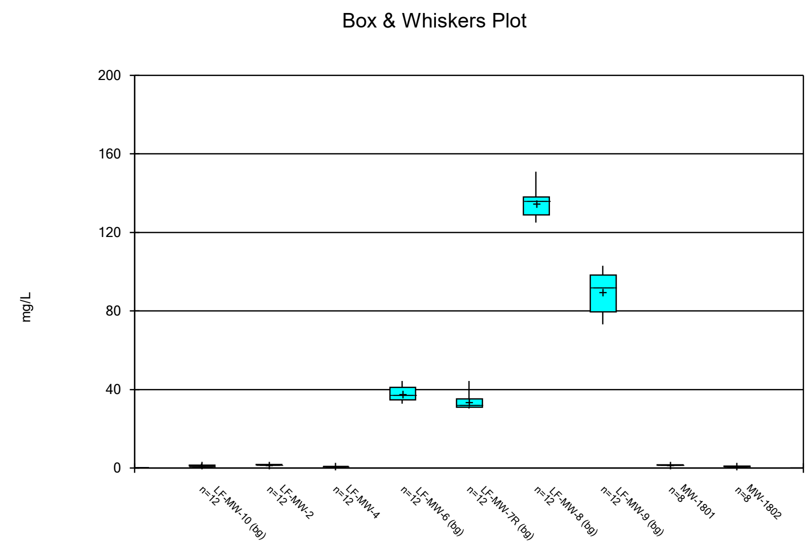
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:27 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



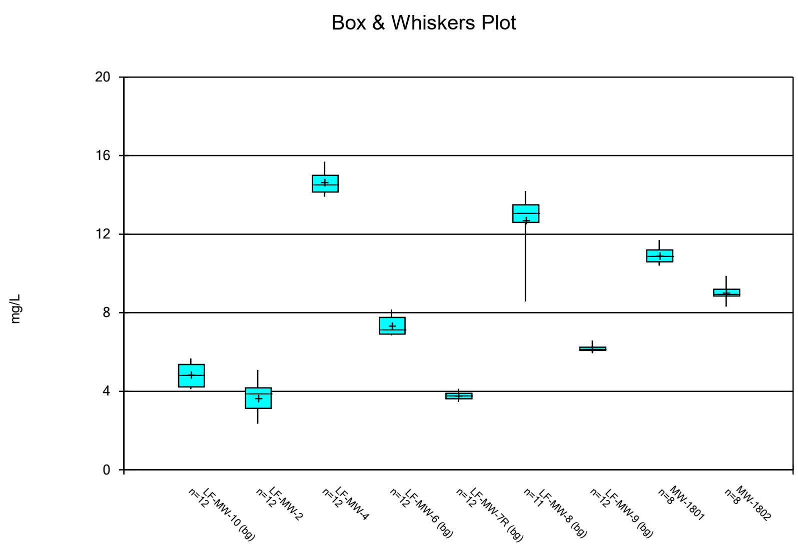
Constituent: Boron Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



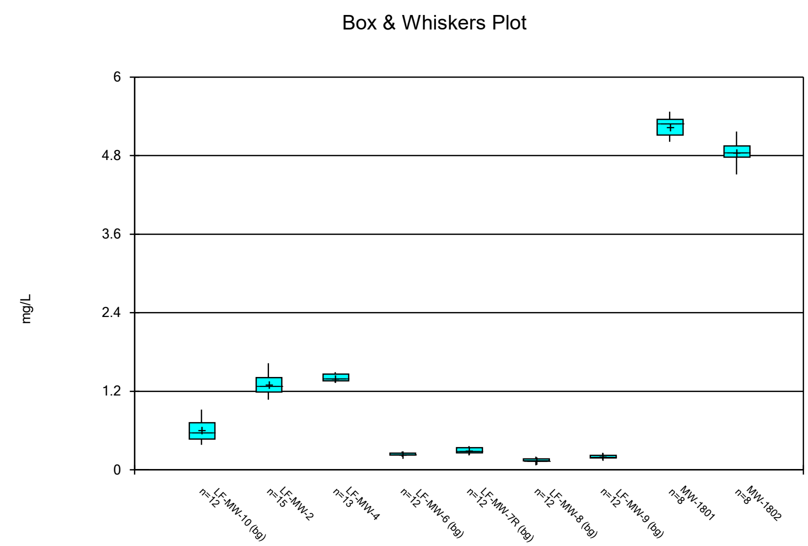
Constituent: Calcium Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Chloride Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

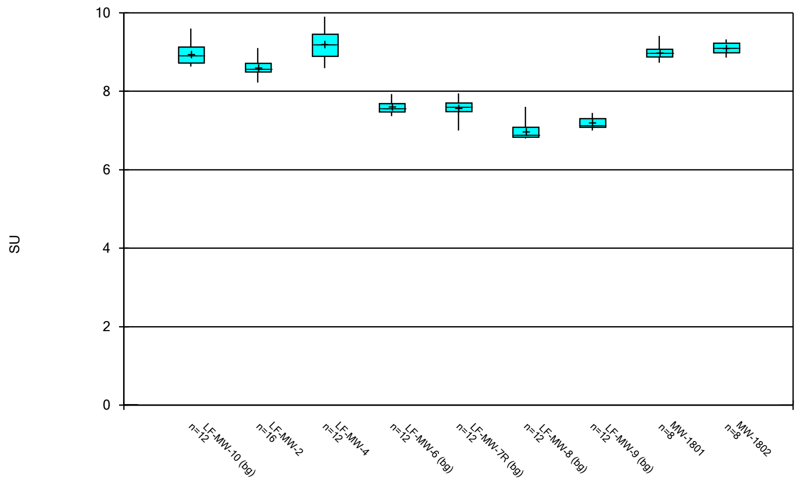
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

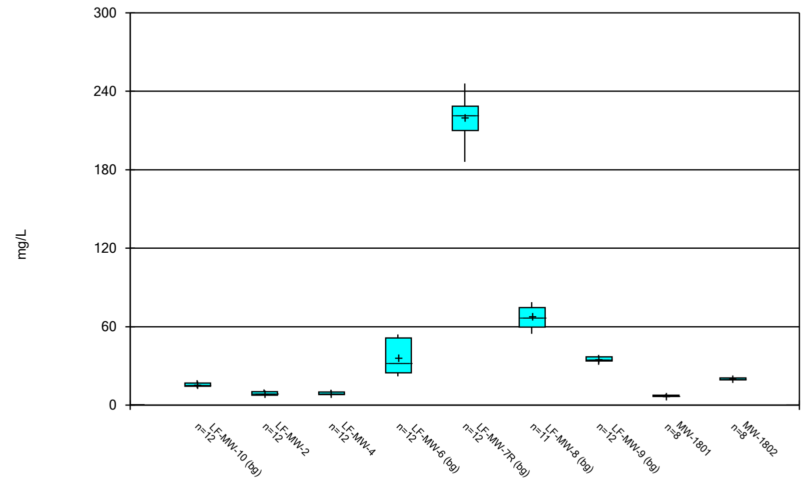
Box & Whiskers Plot



Constituent: pH, field Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

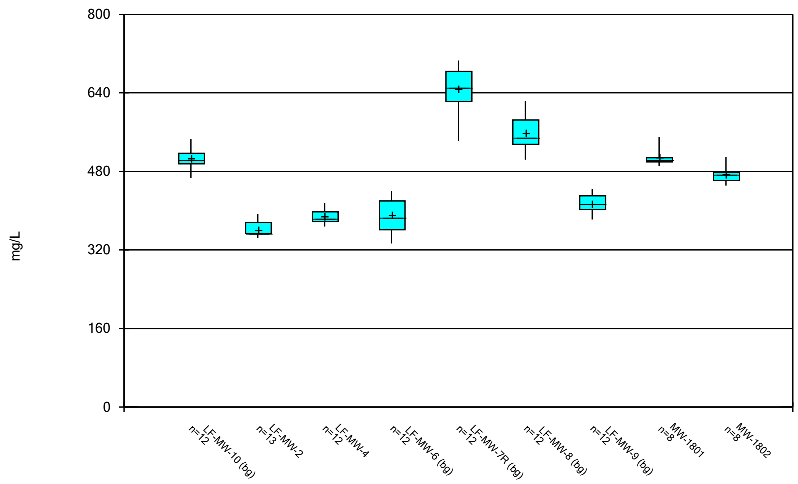
Box & Whiskers Plot



Constituent: Sulfate Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Box & Whiskers Plot



Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:54 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Outlier Summary

Amos Landfill   Client: Geosyntec   Data: Amos LF   Printed 5/30/2020, 10:52 AM

	LF-MW-2 Boron (mg/L)	LF-MW-2 Calcium (mg/L)	LF-MW-8 Chloride (mg/L)	LF-MW-4 pH, field (SU)	LF-MW-8 Sulfate (mg/L)
11/9/2016			5.12 (o)		26.1 (o)
1/8/2018				3.3 (o)	
5/1/2018		3.5 (o)			
6/19/2018	0.338 (o)				

Outlier Analysis - Significant Results

Amos Landfill   Client: Geosyntec   Data: Amos LF   Printed 5/30/2020, 9:48 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	**LF-MW-2**	**Yes**	**0.338**	**6/19/2018**	**NP**	**14**	**0.2158**	**0.03935**	**ln(x)**	**ShapiroWilk**
Calcium (mg/L)	**LF-MW-2**	**Yes**	**3.5**	**5/1/2018**	**NP**	**13**	**1.83**	**0.5318**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	**MW-1801**	**Yes**	**550**	**2/21/2019**	**NP**	**8**	**508.1**	**17.84**	**ln(x)**	**ShapiroWilk**

Outlier Analysis - All Results

Amos Landfill Client: Geosyntec Data: Amos LF Printed 5/30/2020, 9:48 AM

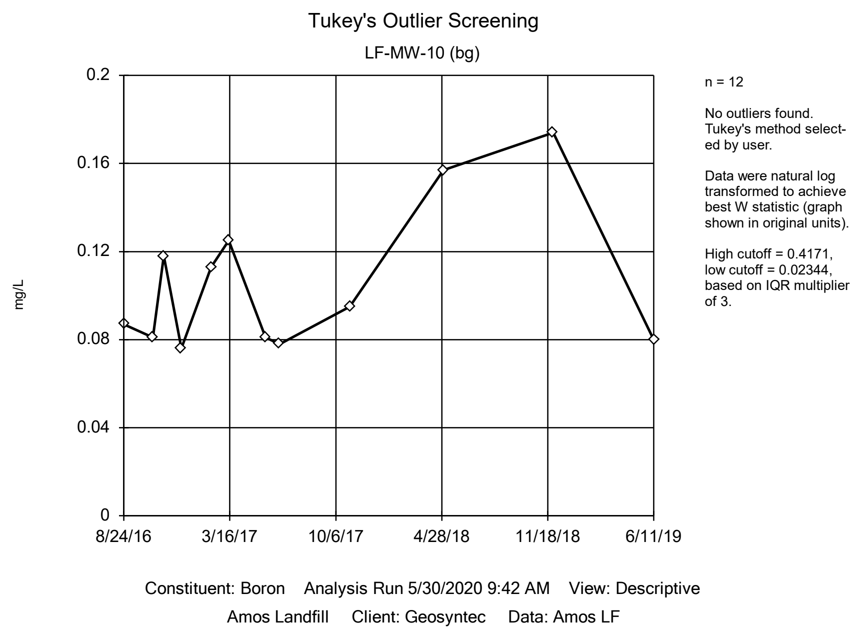
Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	0.1054	0.03285	ln(x)	ShapiroWilk
Boron (mg/L)	**LF-MW-2**	**Yes**	**0.338**	**6/19/2018**	**NP**	**14**	**0.2158**	**0.03935**	**ln(x)**	**ShapiroWilk**
Boron (mg/L)	LF-MW-4	No	n/a	n/a	NP	13	0.1775	0.01671	x^2	ShapiroWilk
Boron (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	0.1289	0.0327	normal	ShapiroWilk
Boron (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	0.09667	0.02144	ln(x)	ShapiroWilk
Boron (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	0.04258	0.02301	ln(x)	ShapiroWilk
Boron (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	0.07933	0.04192	ln(x)	ShapiroWilk
Boron (mg/L)	MW-1801	No	n/a	n/a	NP	8	0.2544	0.01971	x^2	ShapiroWilk
Boron (mg/L)	MW-1802	No	n/a	n/a	NP	8	0.2453	0.01187	ln(x)	ShapiroWilk
Calcium (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	1.333	0.3906	ln(x)	ShapiroWilk
Calcium (mg/L)	**LF-MW-2**	**Yes**	**3.5**	**5/1/2018**	**NP**	**13**	**1.83**	**0.5318**	**ln(x)**	**ShapiroWilk**
Calcium (mg/L)	LF-MW-4	No	n/a	n/a	NP	12	0.8141	0.04383	ln(x)	ShapiroWilk
Calcium (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	37.97	3.803	ln(x)	ShapiroWilk
Calcium (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	33.75	4.105	ln(x)	ShapiroWilk
Calcium (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	135	7.435	ln(x)	ShapiroWilk
Calcium (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	89.58	9.833	x^4	ShapiroWilk
Calcium (mg/L)	MW-1801	No	n/a	n/a	NP	8	1.511	0.1208	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-1802	No	n/a	n/a	NP	8	0.8776	0.03836	x^6	ShapiroWilk
Chloride (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	4.827	0.5919	x^2	ShapiroWilk
Chloride (mg/L)	LF-MW-2	No	n/a	n/a	NP	12	3.683	0.7693	normal	ShapiroWilk
Chloride (mg/L)	LF-MW-4	No	n/a	n/a	NP	12	14.64	0.5485	ln(x)	ShapiroWilk
Chloride (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	7.332	0.4657	ln(x)	ShapiroWilk
Chloride (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	3.786	0.2013	ln(x)	ShapiroWilk
Chloride (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	12.09	2.62	x^6	ShapiroWilk
Chloride (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	6.181	0.1603	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-1801	No	n/a	n/a	NP	8	10.94	0.4406	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-1802	No	n/a	n/a	NP	8	9.032	0.4442	ln(x)	ShapiroWilk
Fluoride (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	0.6167	0.1749	ln(x)	ShapiroWilk
Fluoride (mg/L)	LF-MW-2	No	n/a	n/a	NP	15	1.295	0.1463	ln(x)	ShapiroWilk
Fluoride (mg/L)	LF-MW-4	No	n/a	n/a	NP	13	1.406	0.05378	ln(x)	ShapiroWilk
Fluoride (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	0.2375	0.02261	ln(x)	ShapiroWilk
Fluoride (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	0.2975	0.04454	x^(1/3)	ShapiroWilk
Fluoride (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	0.1483	0.03129	x^2	ShapiroWilk
Fluoride (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	0.2	0.03219	x^(1/3)	ShapiroWilk
Fluoride (mg/L)	MW-1801	No	n/a	n/a	NP	8	5.25	0.1621	x^6	ShapiroWilk
Fluoride (mg/L)	MW-1802	No	n/a	n/a	NP	8	4.854	0.1921	x^2	ShapiroWilk
pH, field (SU)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	8.959	0.2798	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-2	No	n/a	n/a	NP	16	8.596	0.2036	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-4	No	n/a	n/a	NP	13	8.754	1.682	x^6	ShapiroWilk
pH, field (SU)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	7.605	0.178	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	7.568	0.2316	x^6	ShapiroWilk
pH, field (SU)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	6.985	0.2349	ln(x)	ShapiroWilk
pH, field (SU)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	7.189	0.1424	ln(x)	ShapiroWilk
pH, field (SU)	MW-1801	No	n/a	n/a	NP	8	8.996	0.204	ln(x)	ShapiroWilk
pH, field (SU)	MW-1802	No	n/a	n/a	NP	8	9.1	0.1568	x^2	ShapiroWilk
Sulfate (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	15.83	1.748	ln(x)	ShapiroWilk
Sulfate (mg/L)	LF-MW-2	No	n/a	n/a	NP	12	9.1	1.714	ln(x)	ShapiroWilk
Sulfate (mg/L)	LF-MW-4	No	n/a	n/a	NP	12	9.042	1.428	ln(x)	ShapiroWilk
Sulfate (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	36.44	12.71	ln(x)	ShapiroWilk
Sulfate (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	219.4	16.52	x^3	ShapiroWilk
Sulfate (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	64.46	14.36	x^4	ShapiroWilk
Sulfate (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	35.06	2.338	x^4	ShapiroWilk
Sulfate (mg/L)	MW-1801	No	n/a	n/a	NP	8	7.206	0.6394	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-1802	No	n/a	n/a	NP	8	20.07	0.9008	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	LF-MW-10 (bg)	No	n/a	n/a	NP	12	505.5	20.38	sqrt(x)	ShapiroWilk

Outlier Analysis - All Results

Amos Landfill   Client: Geosyntec   Data: Amos LF   Printed 5/30/2020, 9:48 AM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Total Dissolved Solids (mg/L)	LF-MW-2	No	n/a	n/a	NP	13	362.1	14.55	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	LF-MW-4	No	n/a	n/a	NP	12	388.3	15.14	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	LF-MW-6 (bg)	No	n/a	n/a	NP	12	391.1	34.47	x^(1/3)	ShapiroWilk
Total Dissolved Solids (mg/L)	LF-MW-7R (bg)	No	n/a	n/a	NP	12	648.7	47.06	x^6	ShapiroWilk
Total Dissolved Solids (mg/L)	LF-MW-8 (bg)	No	n/a	n/a	NP	12	558.4	34.57	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	LF-MW-9 (bg)	No	n/a	n/a	NP	12	414	19.28	ln(x)	ShapiroWilk
Total Dissolved Solids (mg/L)	**MW-1801**	**Yes**	**550**	**2/21/2019**	**NP**	**8**	**508.1**	**17.84**	**ln(x)**	**ShapiroWilk**
Total Dissolved Solids (mg/L)	MW-1802	No	n/a	n/a	NP	8	473.7	18.49	ln(x)	ShapiroWilk

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



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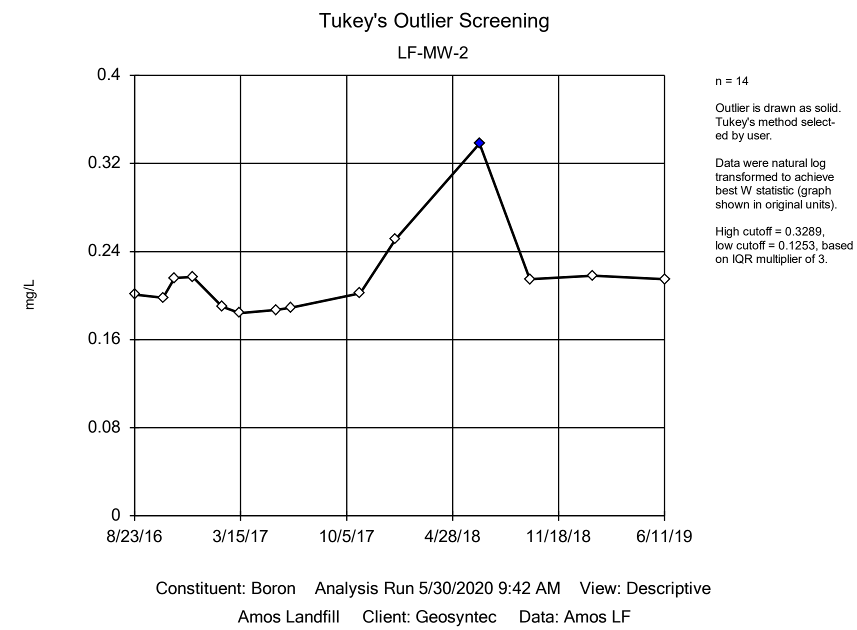
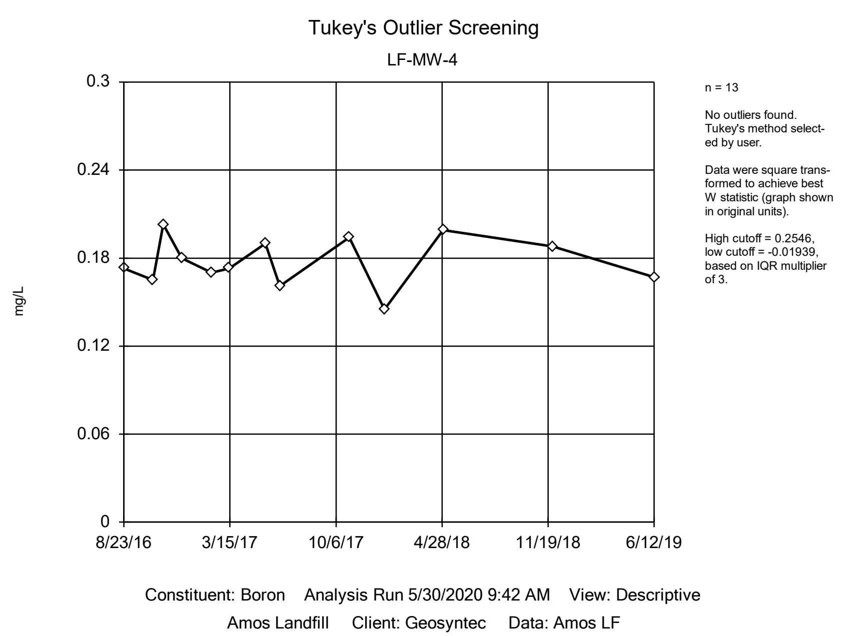
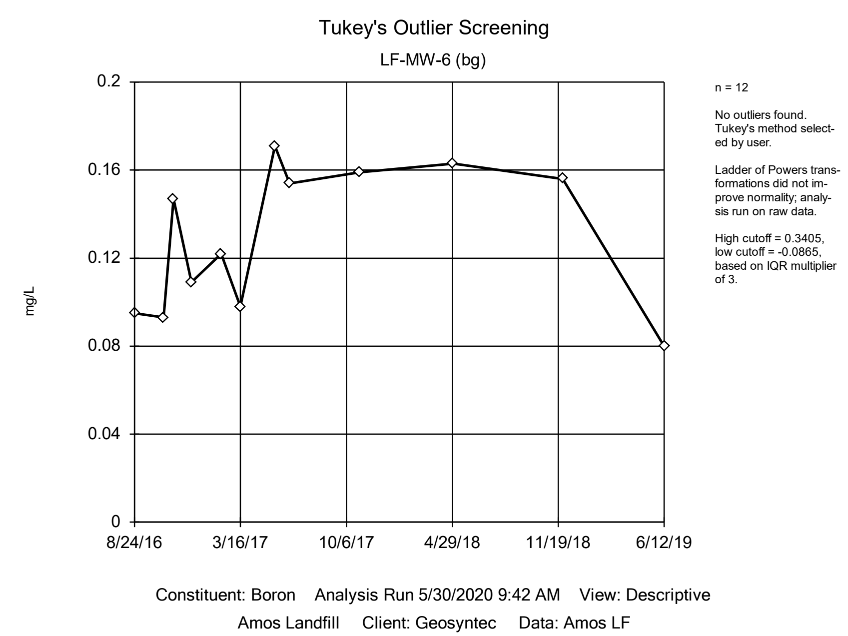


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



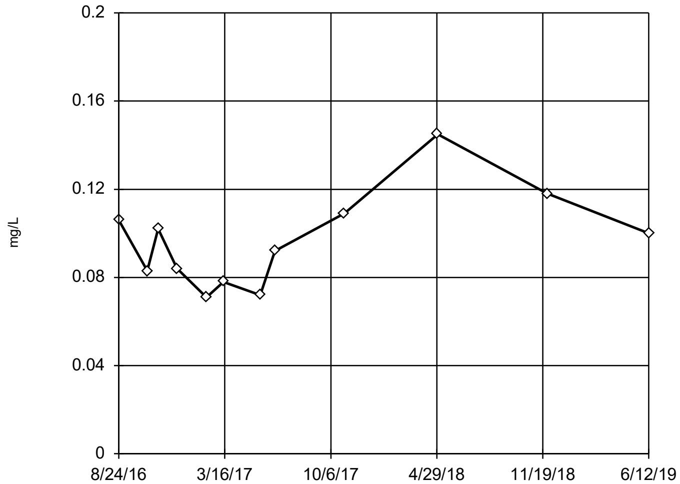
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-7R (bg)



n = 12

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

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

High cutoff = 0.2563, low cutoff = 0.03375, based on IQR multiplier of 3.

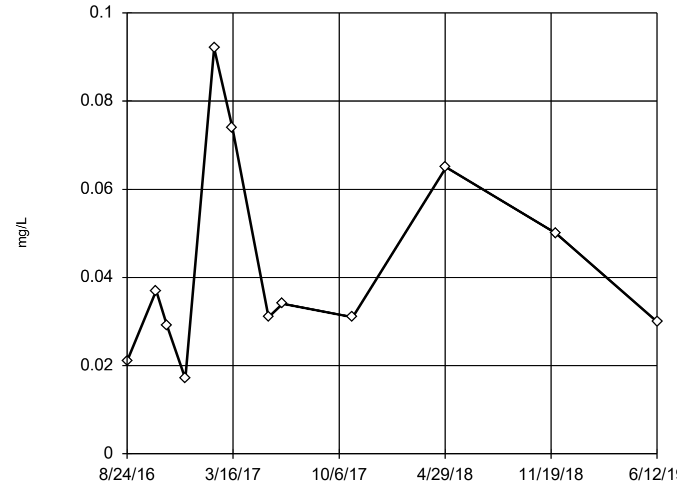
Constituent: Boron   Analysis Run 5/30/2020 9:42 AM   View: Descriptive

Amos Landfill   Client: Geosyntec   Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-8 (bg)



n = 12

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

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

High cutoff = 0.4116, low cutoff = 0.004085, based on IQR multiplier of 3.

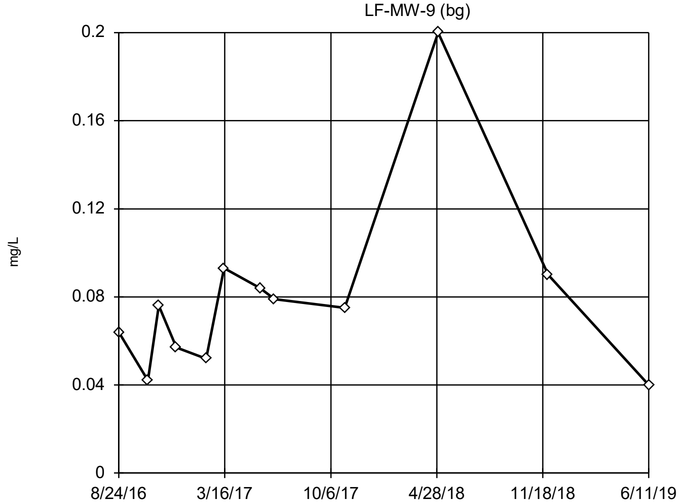
Constituent: Boron   Analysis Run 5/30/2020 9:42 AM   View: Descriptive

Amos Landfill   Client: Geosyntec   Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-9 (bg)



n = 12

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

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

High cutoff = 0.3542, low cutoff = 0.01337, based on IQR multiplier of 3.

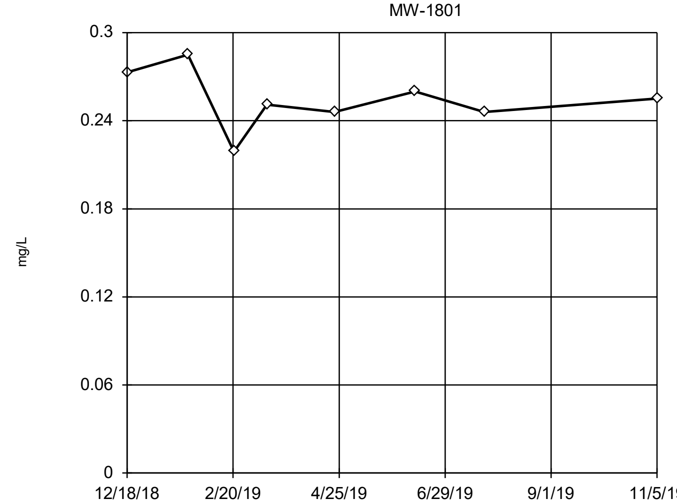
Constituent: Boron   Analysis Run 5/30/2020 9:42 AM   View: Descriptive

Amos Landfill   Client: Geosyntec   Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1801



n = 8

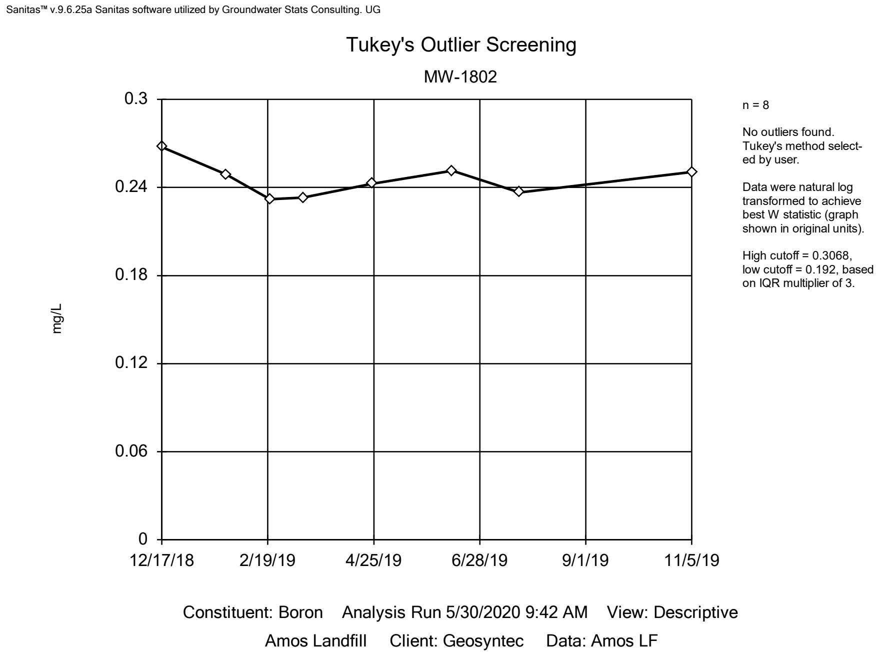
No outliers found. Tukey's method selected by user.

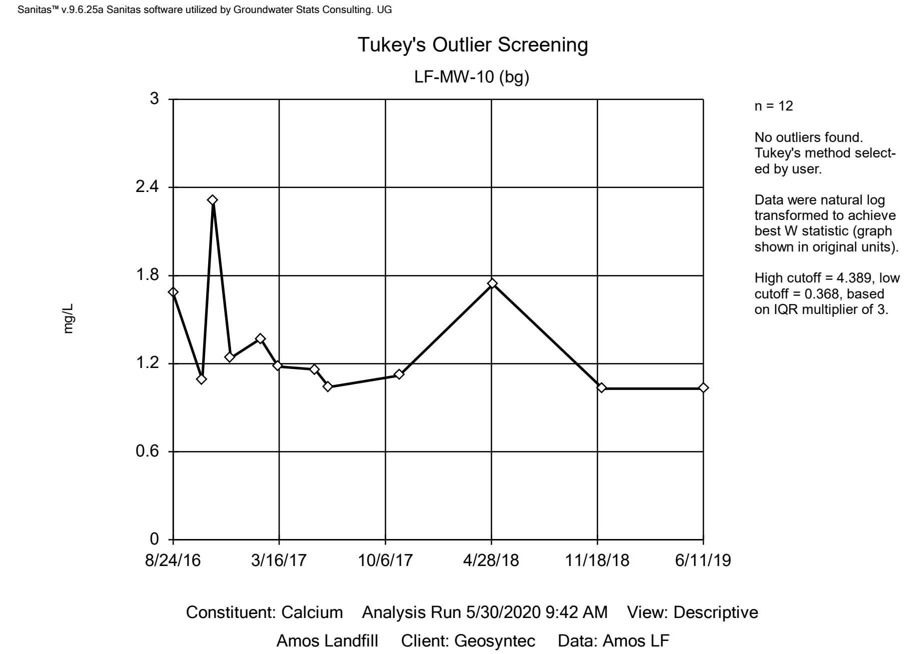
Data were square transformed to achieve best W statistic (graph shown in original units).

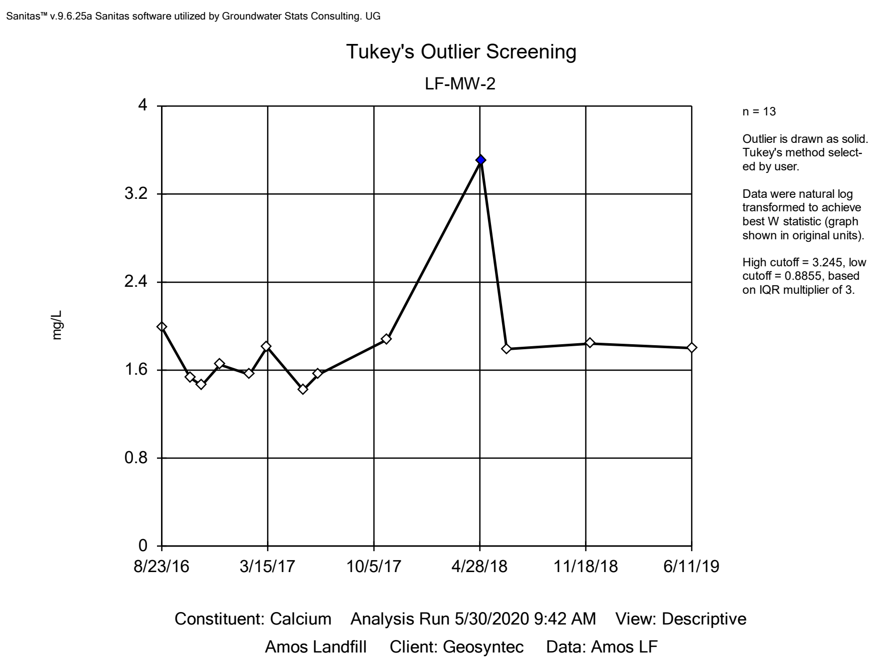
High cutoff = 0.3205, low cutoff = 0.1699, based on IQR multiplier of 3.

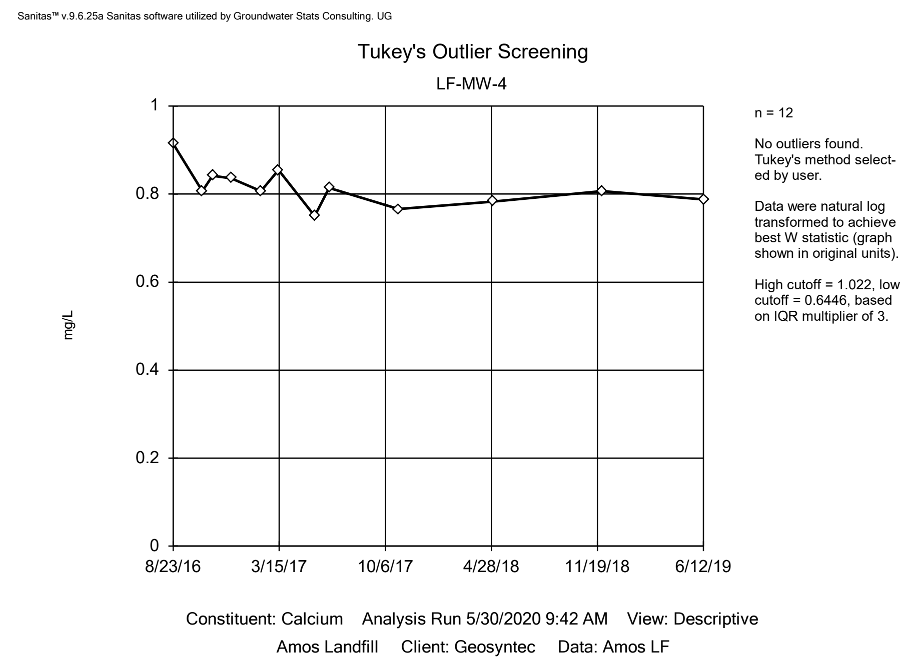
Constituent: Boron   Analysis Run 5/30/2020 9:42 AM   View: Descriptive

Amos Landfill   Client: Geosyntec   Data: Amos LF

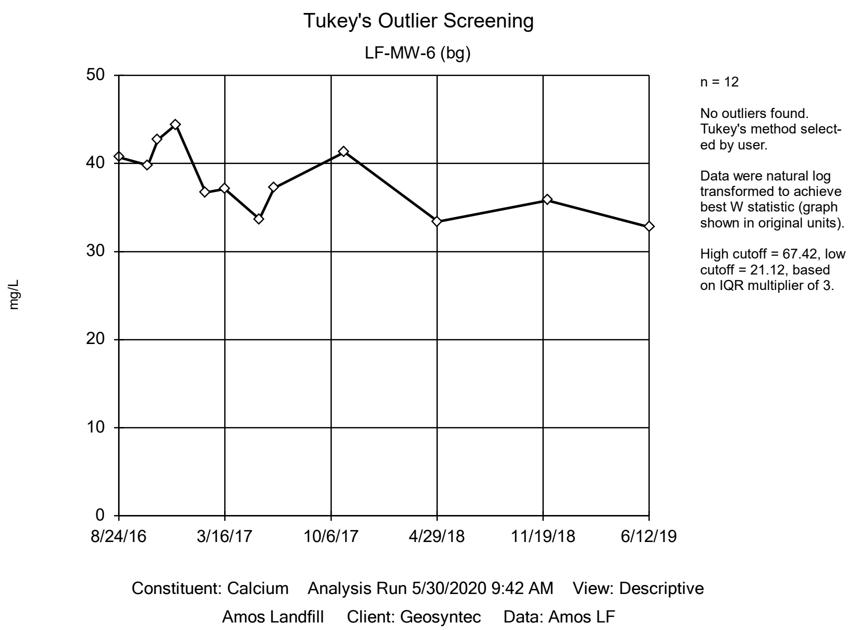

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1802
mg/L
0.3
0.24
0.18
0.12
0.06
0
12/17/18
2/19/19
4/25/19
6/28/19
9/1/19
11/5/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.3068, low cutoff = 0.192, based on IQR multiplier of 3.
Constituent: Boron Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-10 (bg)
mg/L
3
2.4
1.8
1.2
0.6
0
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 4.389, low cutoff = 0.368, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

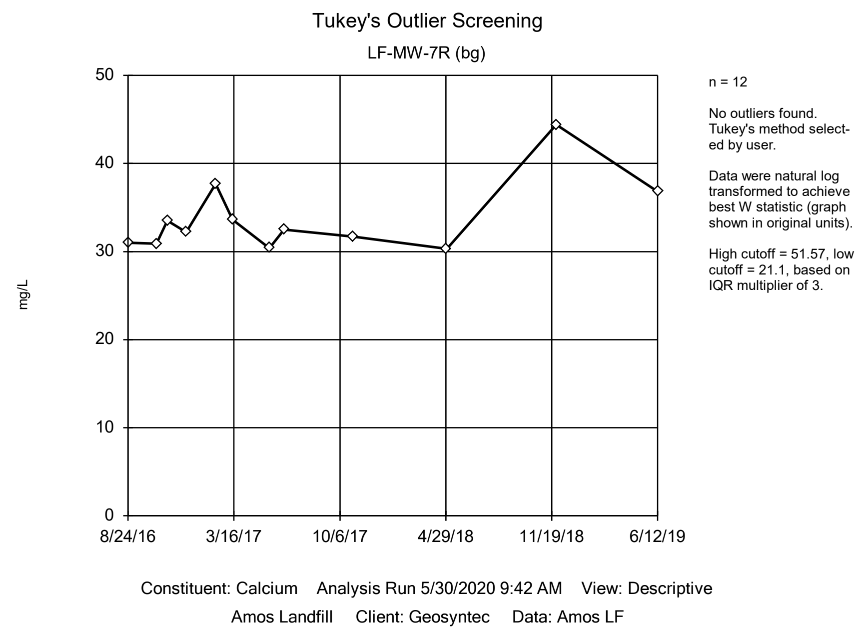

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-2
mg/L
4
3.2
2.4
1.6
0.8
0
8/23/16
3/15/17
10/5/17
4/28/18
11/18/18
6/11/19
n = 13
Outlier is drawn as solid. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 3.245, low cutoff = 0.8855, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-4
mg/L
1
0.8
0.6
0.4
0.2
0
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 1.022, low cutoff = 0.6446, based on IQR multiplier of 3.
Constituent: Calcium Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

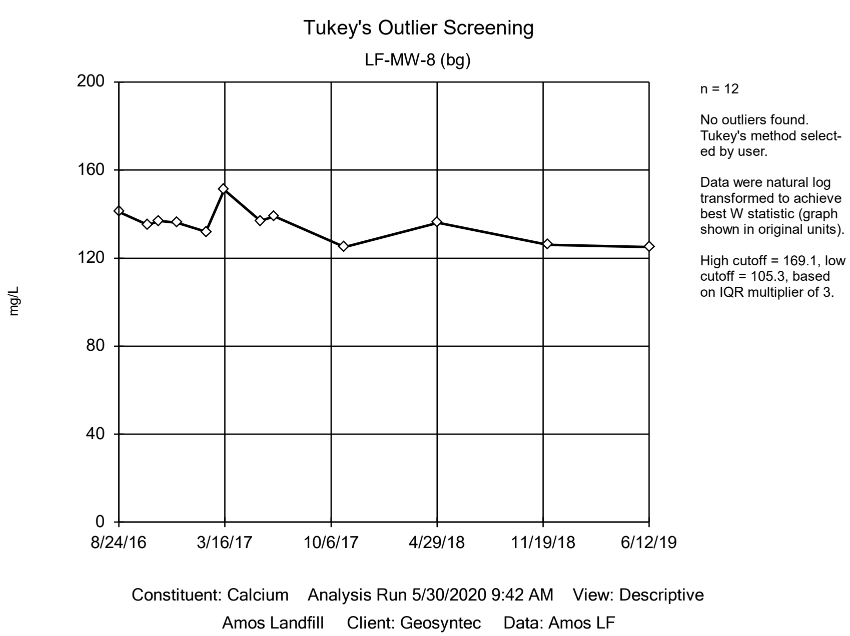
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



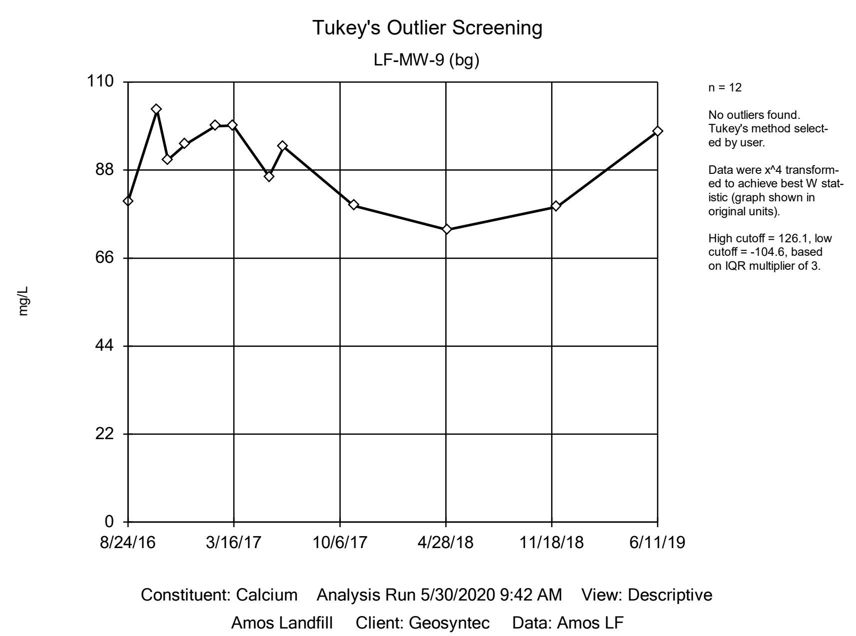
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



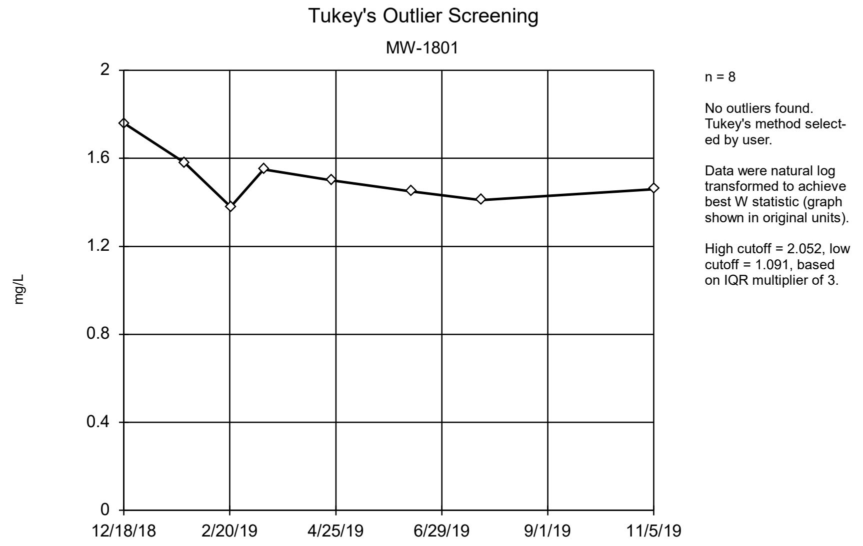
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

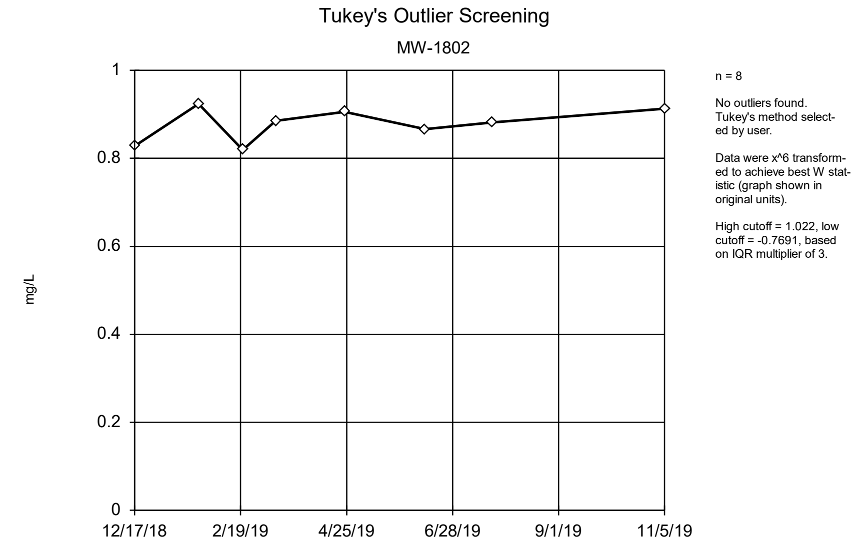


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



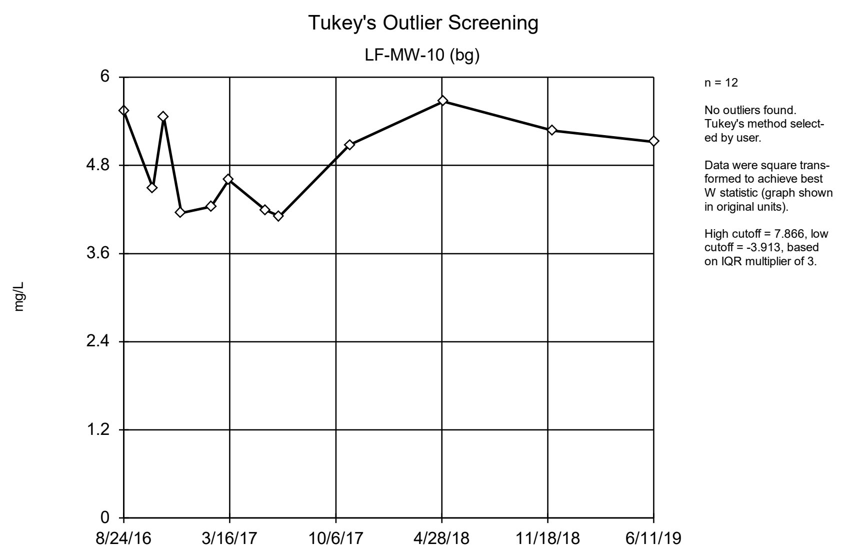
Constituent: Calcium Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



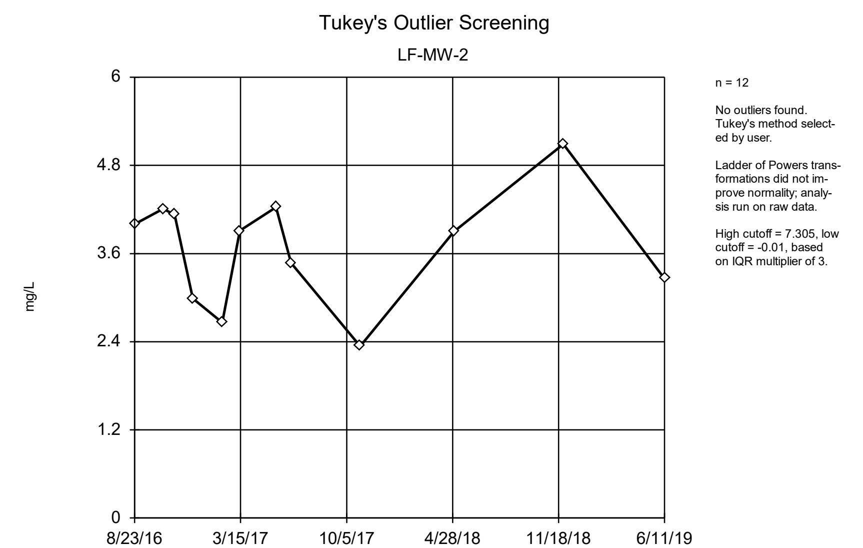
Constituent: Calcium Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

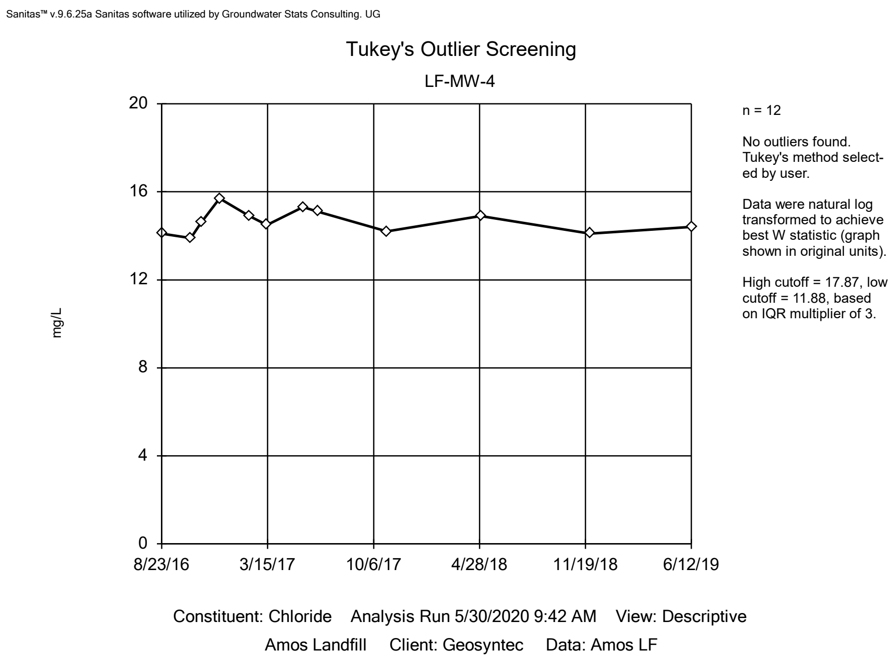


Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

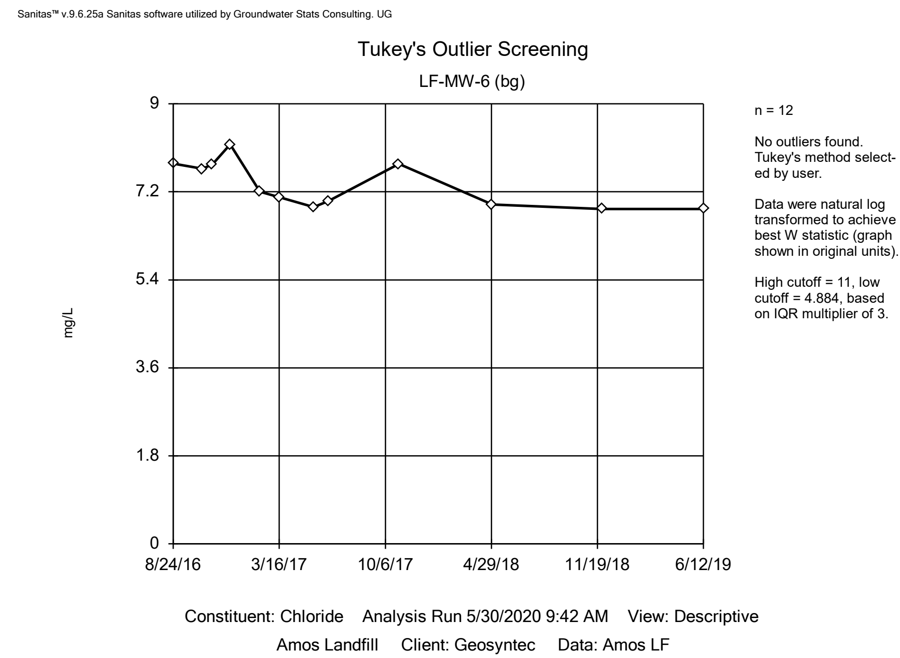
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



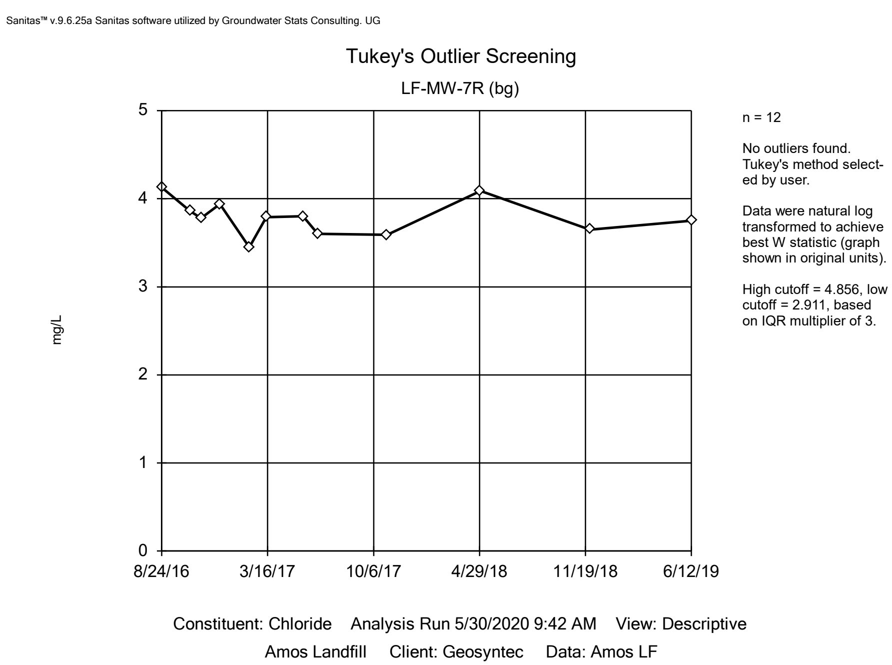
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



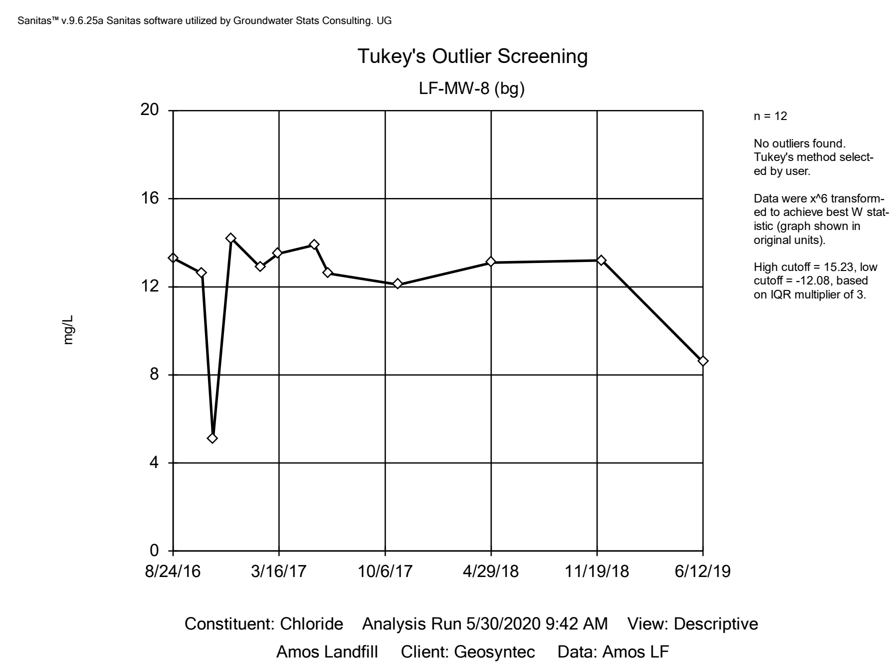
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-4
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 17.87, low cutoff = 11.88, based on IQR multiplier of 3.
mg/L
20
16
12
8
4
0
8/23/16
3/15/17
10/6/17
4/28/18
11/19/18
6/12/19
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



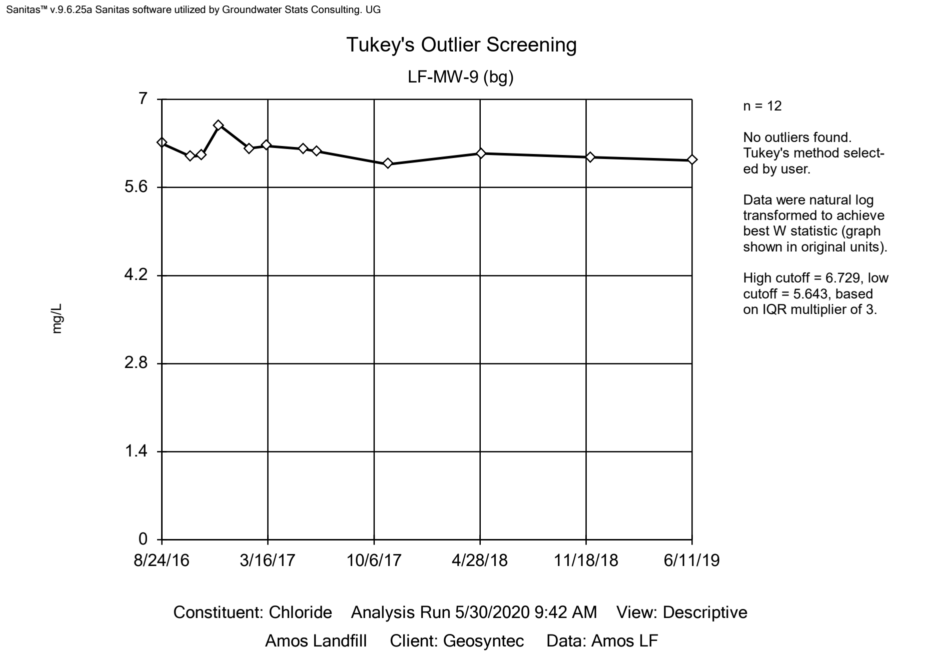
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-6 (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 11, low cutoff = 4.884, based on IQR multiplier of 3.
mg/L
9
7.2
5.4
3.6
1.8
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



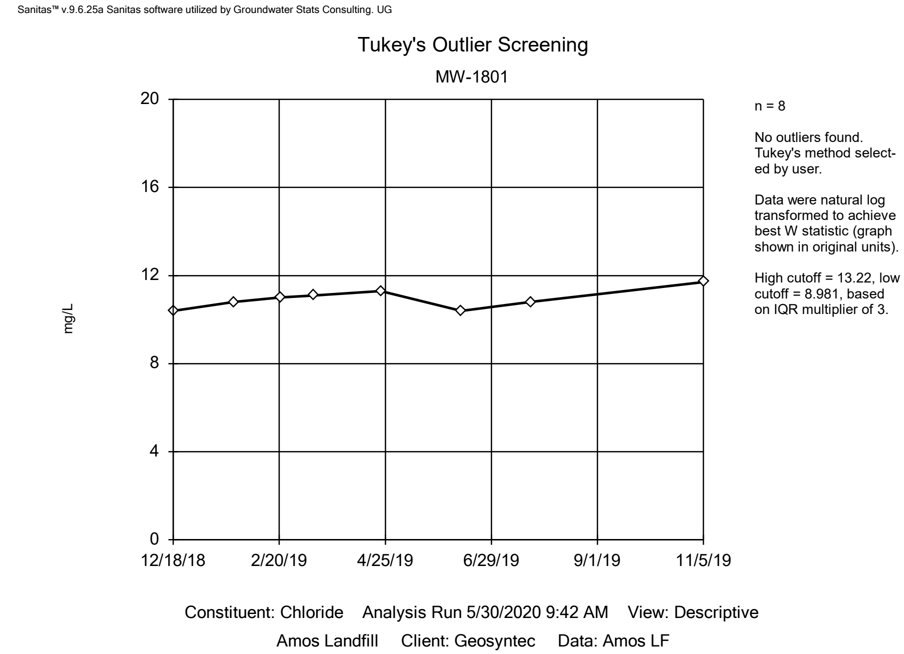
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-7R (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 4.856, low cutoff = 2.911, based on IQR multiplier of 3.
mg/L
5
4
3
2
1
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



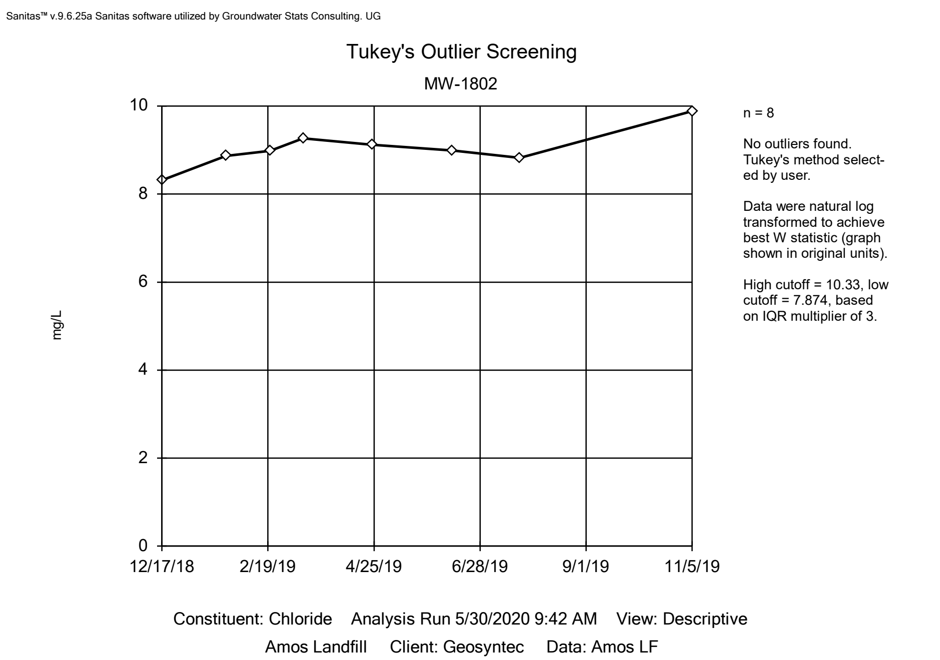
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-8 (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 15.23, low cutoff = -12.08, based on IQR multiplier of 3.
mg/L
20
16
12
8
4
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



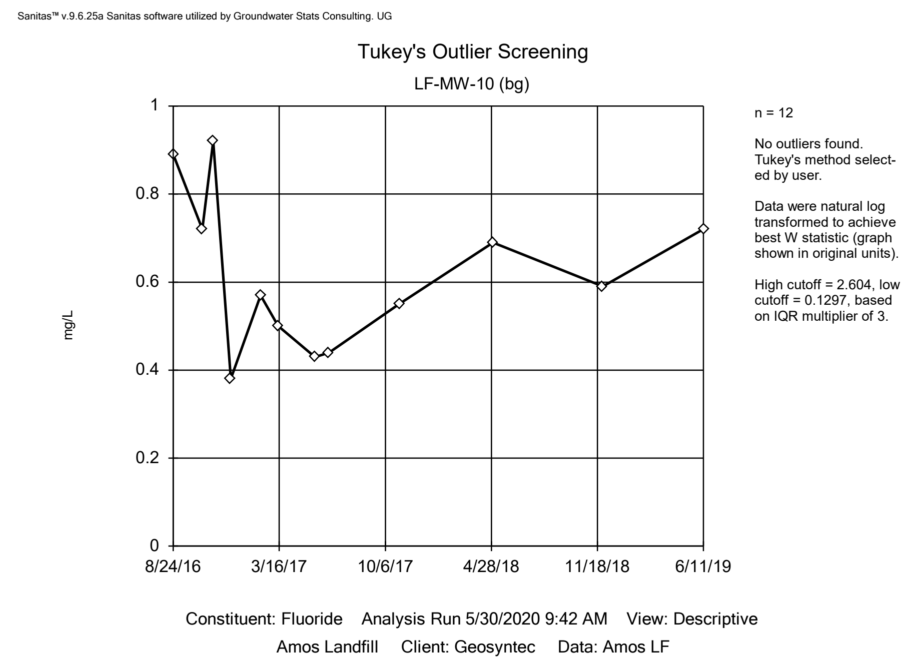
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-9 (bg)
mg/L
7
5.6
4.2
2.8
1.4
0
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 6.729, low cutoff = 5.643, based on IQR multiplier of 3.
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1801
mg/L
20
16
12
8
4
0
12/18/18
2/20/19
4/25/19
6/29/19
9/1/19
11/5/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 13.22, low cutoff = 8.981, based on IQR multiplier of 3.
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1802
mg/L
10
8
6
4
2
0
12/17/18
2/19/19
4/25/19
6/28/19
9/1/19
11/5/19
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 10.33, low cutoff = 7.874, based on IQR multiplier of 3.
Constituent: Chloride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

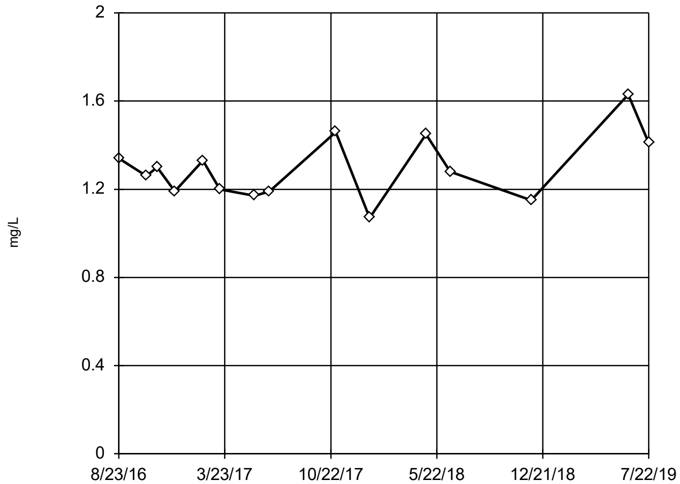


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-10 (bg)
mg/L
1
0.8
0.6
0.4
0.2
0
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 2.604, low cutoff = 0.1297, based on IQR multiplier of 3.
Constituent: Fluoride Analysis Run 5/30/2020 9:42 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-2



n = 15

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

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

High cutoff = 2.346, low cutoff = 0.7154, based on IQR multiplier of 3.

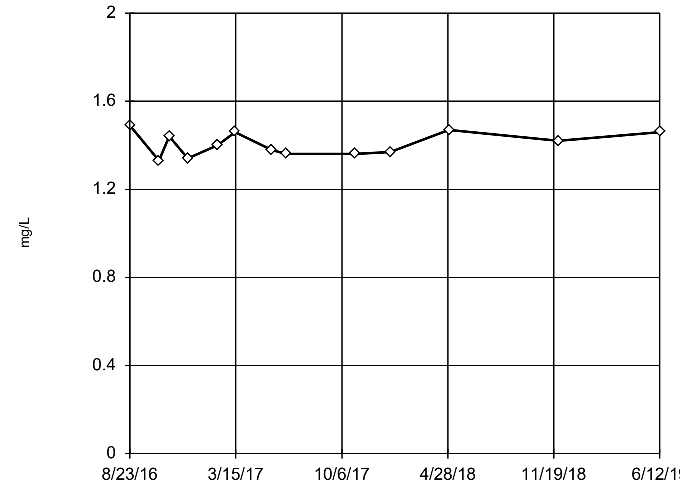
Constituent: Fluoride Analysis Run 5/30/2020 9:42 AM View: Descriptive

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-4



n = 13

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

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

High cutoff = 1.806, low cutoff = 1.099, based on IQR multiplier of 3.

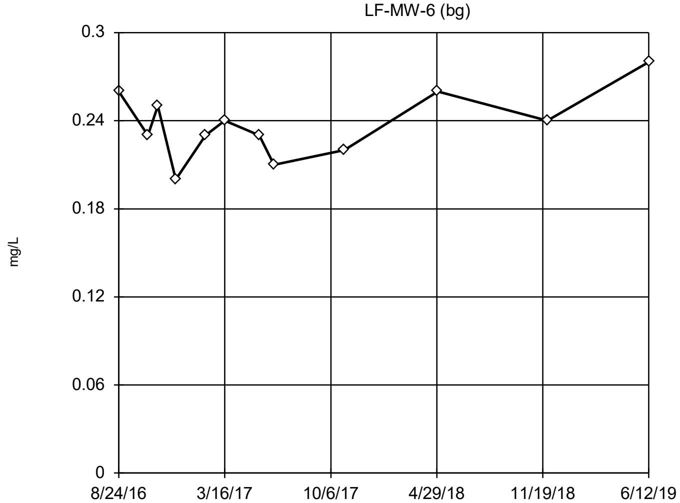
Constituent: Fluoride Analysis Run 5/30/2020 9:42 AM View: Descriptive

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-6 (bg)



n = 12

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

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

High cutoff = 0.3712, low cutoff = 0.1545, based on IQR multiplier of 3.

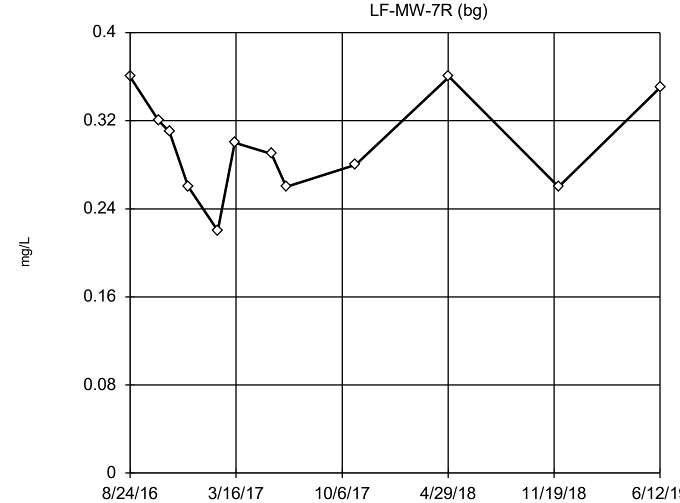
Constituent: Fluoride Analysis Run 5/30/2020 9:42 AM View: Descriptive

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-7R (bg)



n = 12

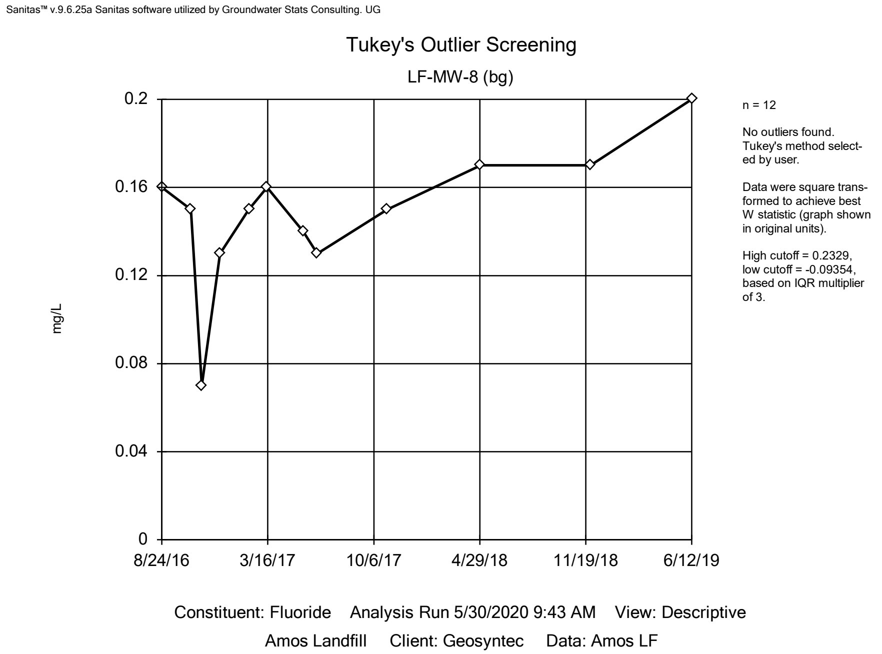
No outliers found. Tukey's method selected by user.

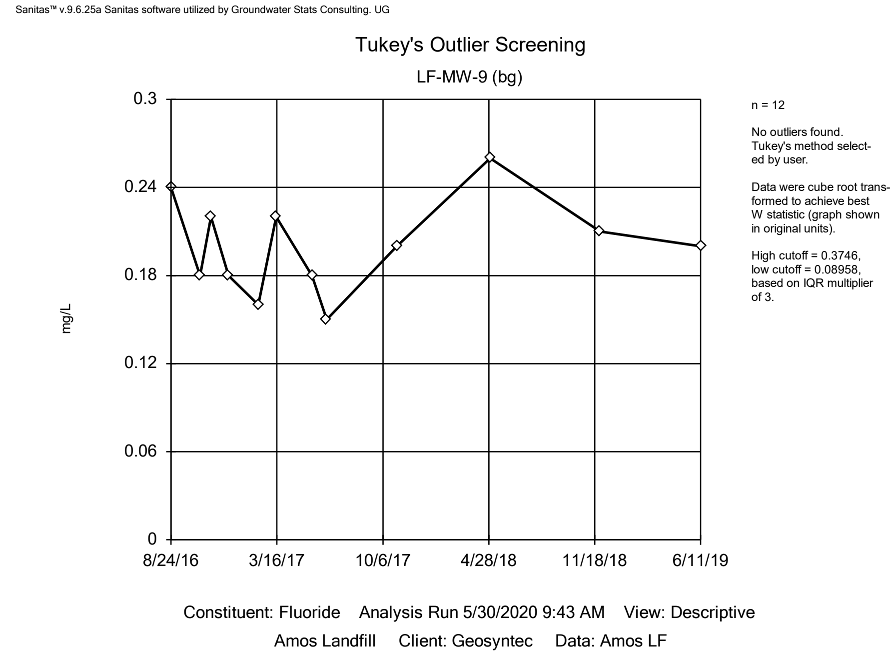
Data were cube root transformed to achieve best W statistic (graph shown in original units).

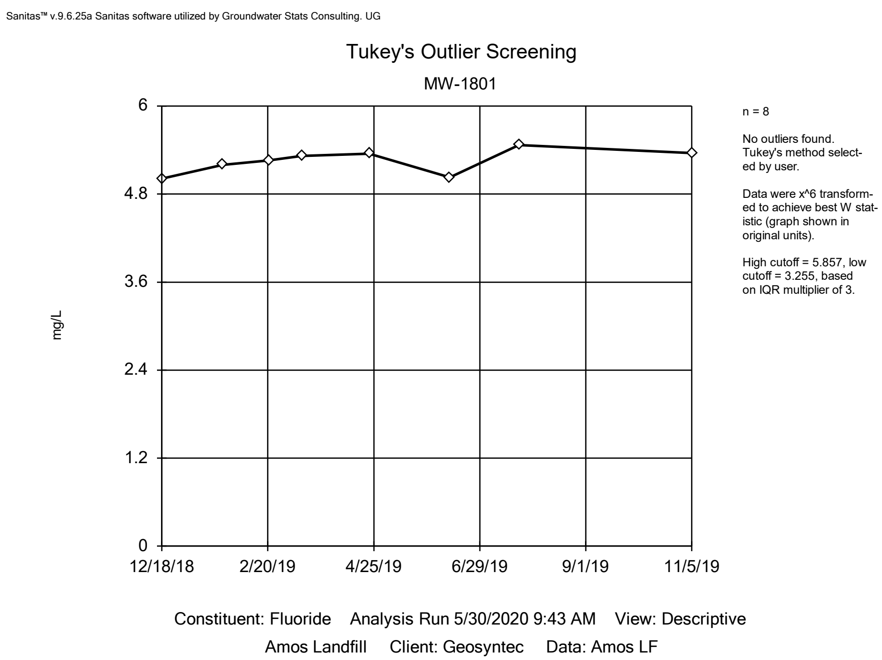
High cutoff = 0.642, low cutoff = 0.1038, based on IQR multiplier of 3.

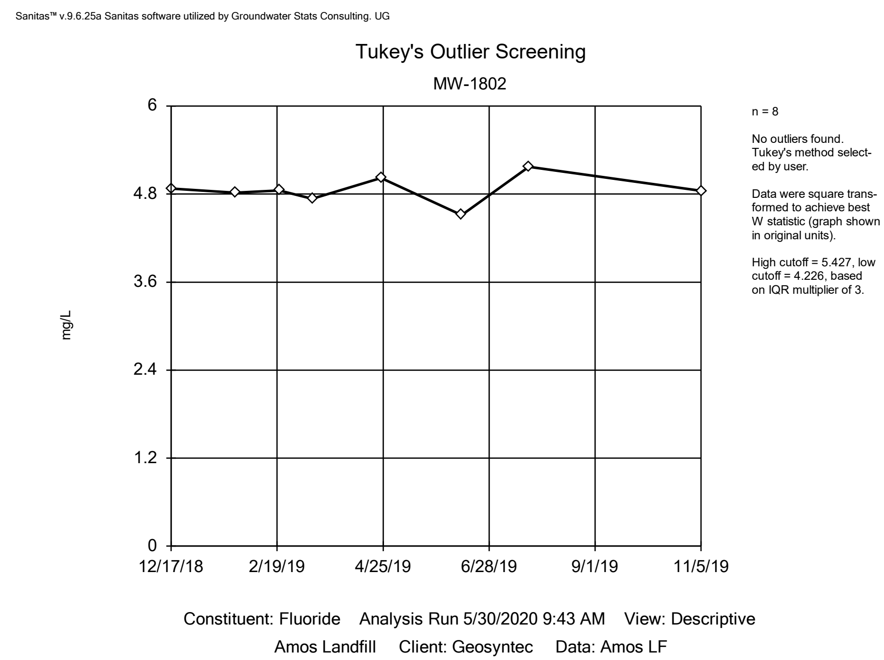
Constituent: Fluoride Analysis Run 5/30/2020 9:43 AM View: Descriptive

Amos Landfill Client: Geosyntec Data: Amos LF

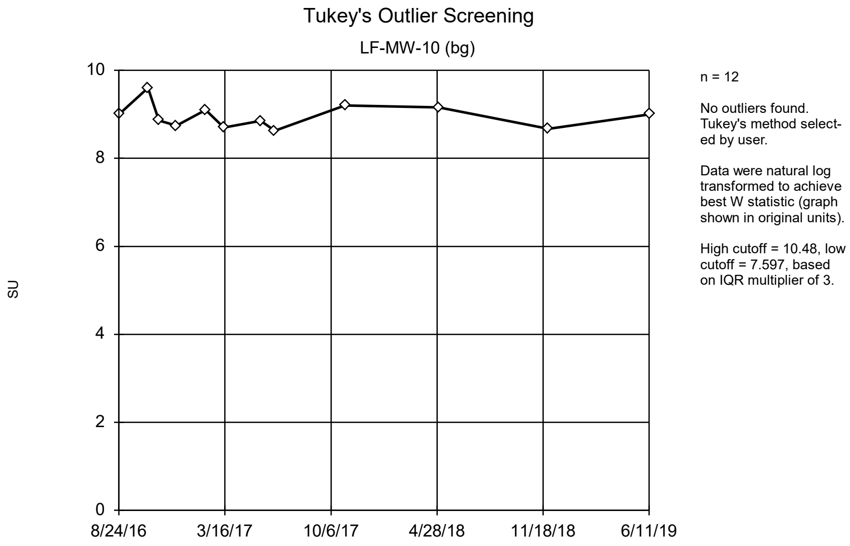

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-8 (bg)
mg/L
0.2
0.16
0.12
0.08
0.04
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
n = 12
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.2329, low cutoff = -0.09354, based on IQR multiplier of 3.
Constituent: Fluoride Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-9 (bg)
mg/L
0.3
0.24
0.18
0.12
0.06
0
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
n = 12
No outliers found. Tukey's method selected by user.
Data were cube root transformed to achieve best W statistic (graph shown in original units).
High cutoff = 0.3746, low cutoff = 0.08958, based on IQR multiplier of 3.
Constituent: Fluoride Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1801
mg/L
6
4.8
3.6
2.4
1.2
0
12/18/18
2/20/19
4/25/19
6/29/19
9/1/19
11/5/19
n = 8
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 5.857, low cutoff = 3.255, based on IQR multiplier of 3.
Constituent: Fluoride Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

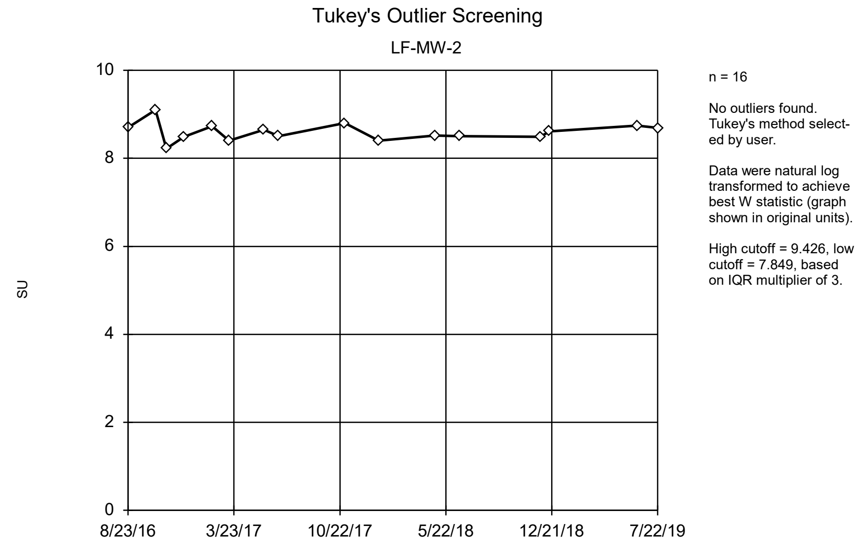

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1802
mg/L
6
4.8
3.6
2.4
1.2
0
12/17/18
2/19/19
4/25/19
6/28/19
9/1/19
11/5/19
n = 8
No outliers found. Tukey's method selected by user.
Data were square transformed to achieve best W statistic (graph shown in original units).
High cutoff = 5.427, low cutoff = 4.226, based on IQR multiplier of 3.
Constituent: Fluoride Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



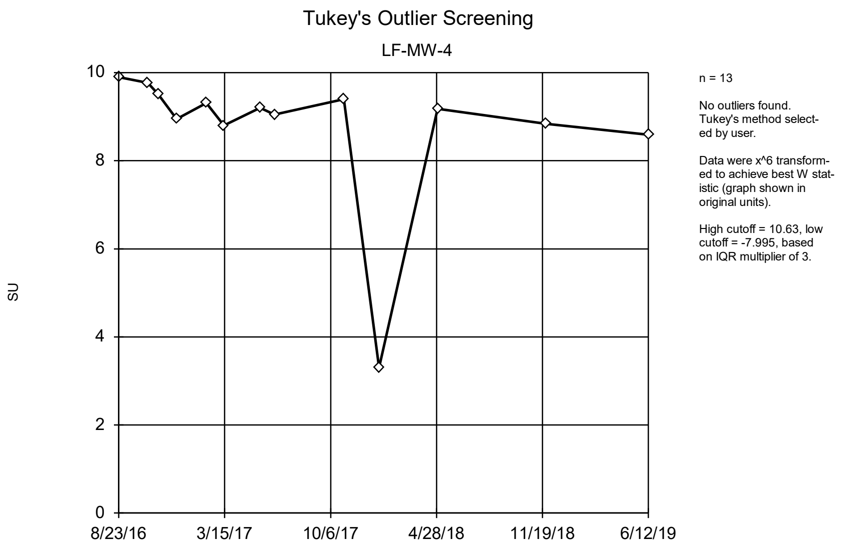
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



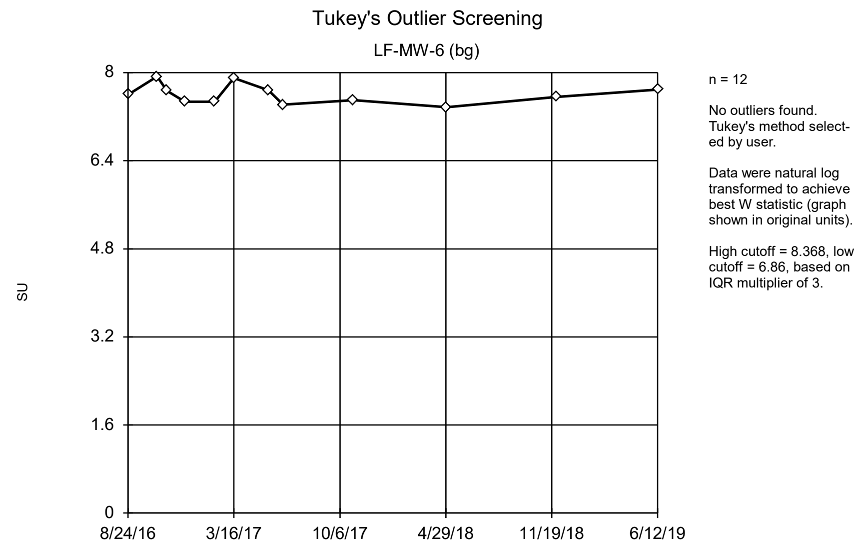
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

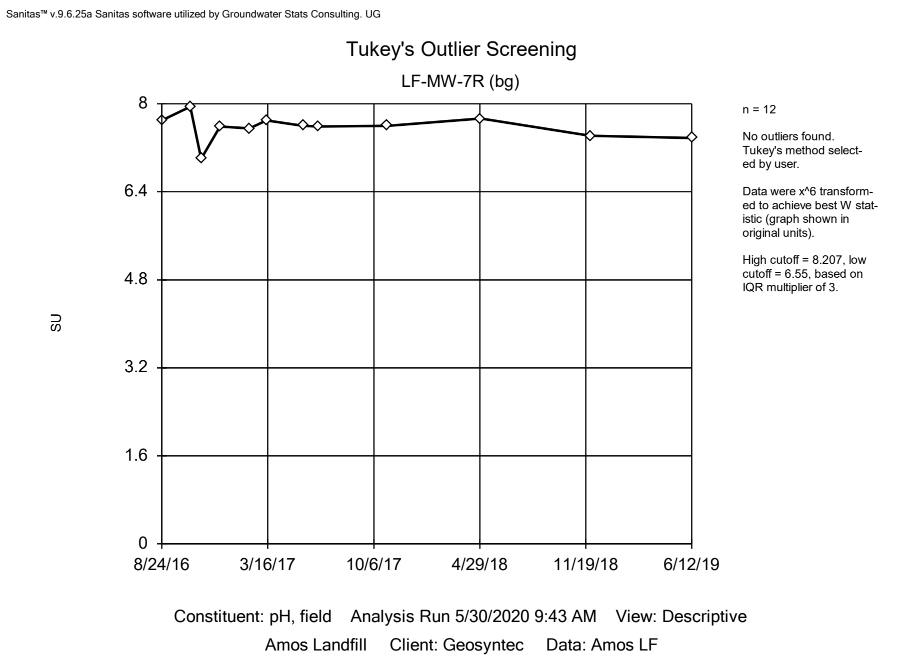


Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

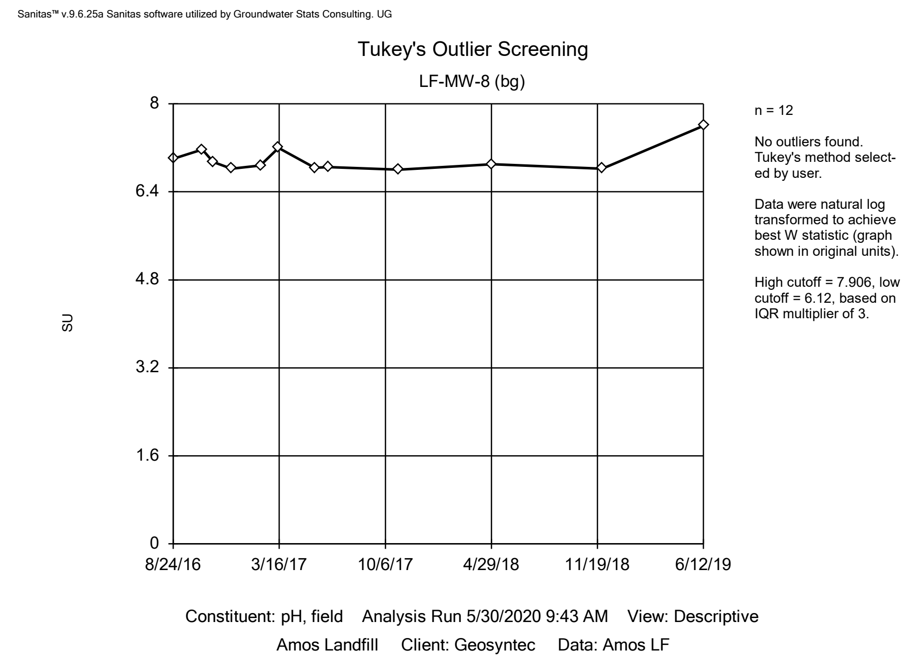
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



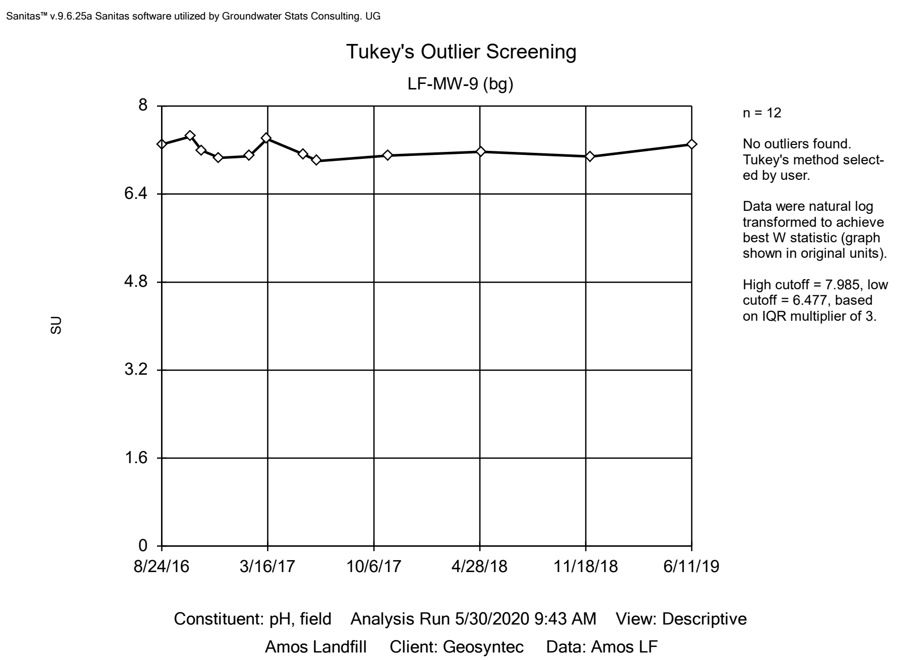
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



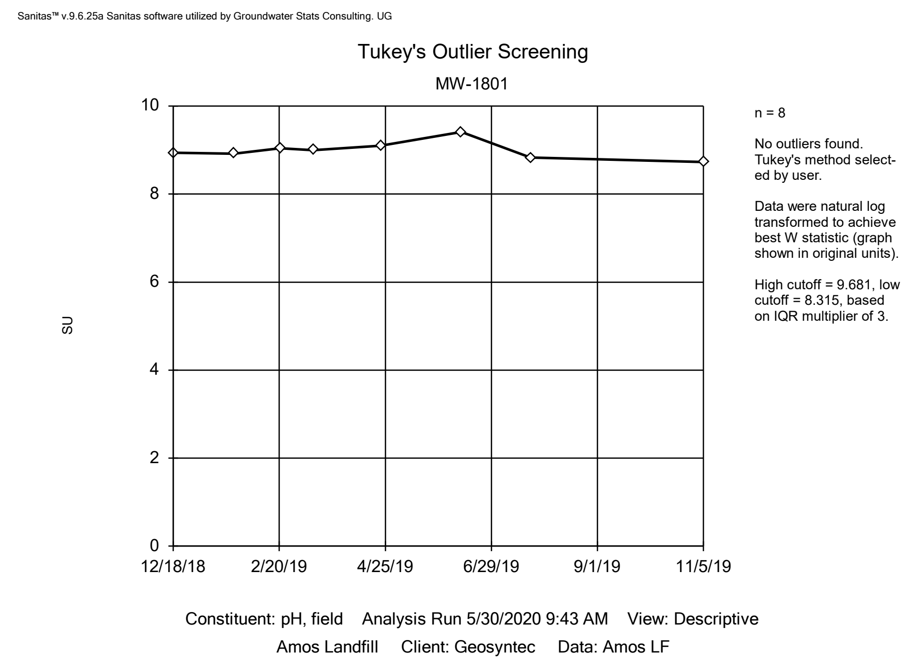
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-7R (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were x^6 transformed to achieve best W statistic (graph shown in original units).
High cutoff = 8.207, low cutoff = 6.55, based on IQR multiplier of 3.
SU
8
6.4
4.8
3.2
1.6
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-8 (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 7.906, low cutoff = 6.12, based on IQR multiplier of 3.
SU
8
6.4
4.8
3.2
1.6
0
8/24/16
3/16/17
10/6/17
4/29/18
11/19/18
6/12/19
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF



Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-9 (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 7.985, low cutoff = 6.477, based on IQR multiplier of 3.
SU
8
6.4
4.8
3.2
1.6
0
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

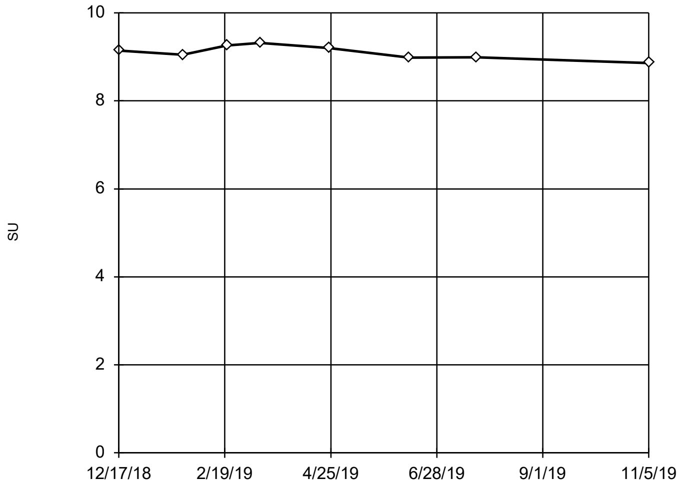


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1801
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 9.681, low cutoff = 8.315, based on IQR multiplier of 3.
SU
10
8
6
4
2
0
12/18/18
2/20/19
4/25/19
6/29/19
9/1/19
11/5/19
Constituent: pH, field Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

MW-1802



n = 8

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

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

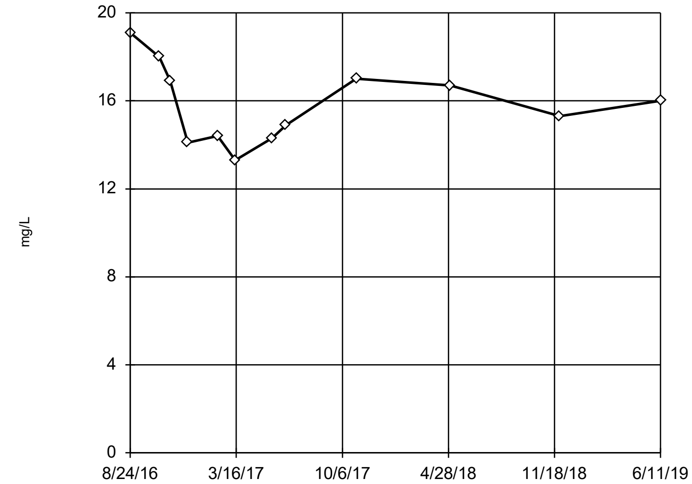
High cutoff = 9.929, low cutoff = 8.206, based on IQR multiplier of 3.

Constituent: pH, field   Analysis Run 5/30/2020 9:43 AM   View: Descriptive
Amos Landfill   Client: Geosyntec   Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-10 (bg)



n = 12

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

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

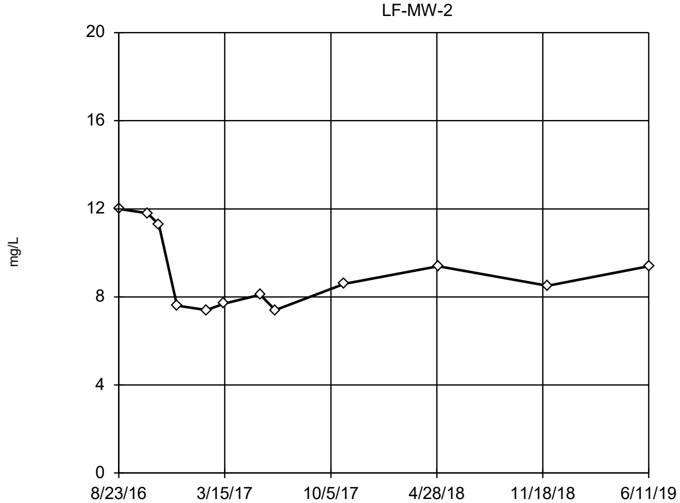
High cutoff = 27.93, low cutoff = 8.708, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 5/30/2020 9:43 AM   View: Descriptive
Amos Landfill   Client: Geosyntec   Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-2



n = 12

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

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

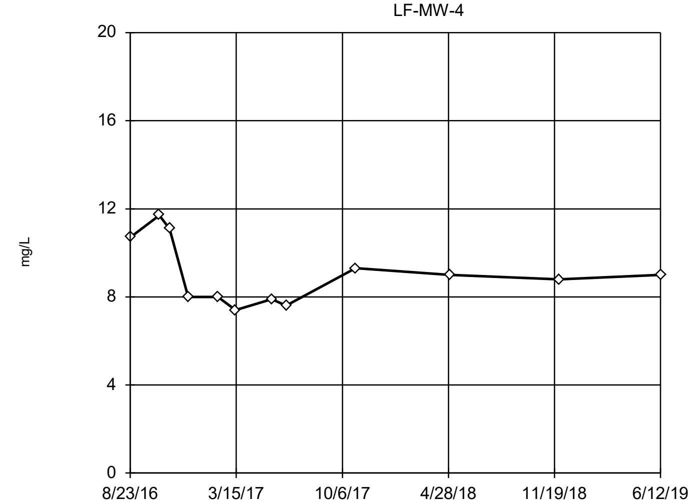
High cutoff = 25.2, low cutoff = 3.128, based on IQR multiplier of 3.

Constituent: Sulfate   Analysis Run 5/30/2020 9:43 AM   View: Descriptive
Amos Landfill   Client: Geosyntec   Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Tukey's Outlier Screening

LF-MW-4



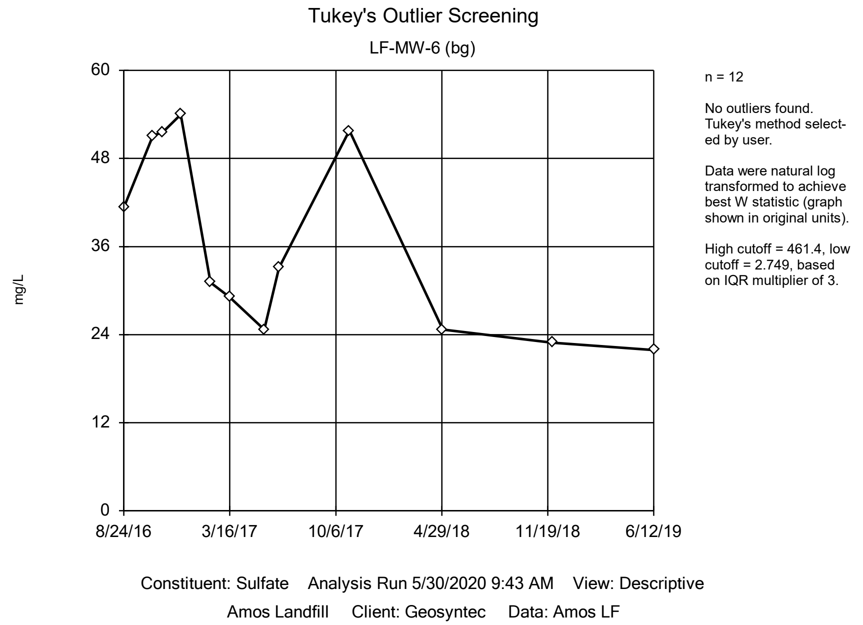
n = 12

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

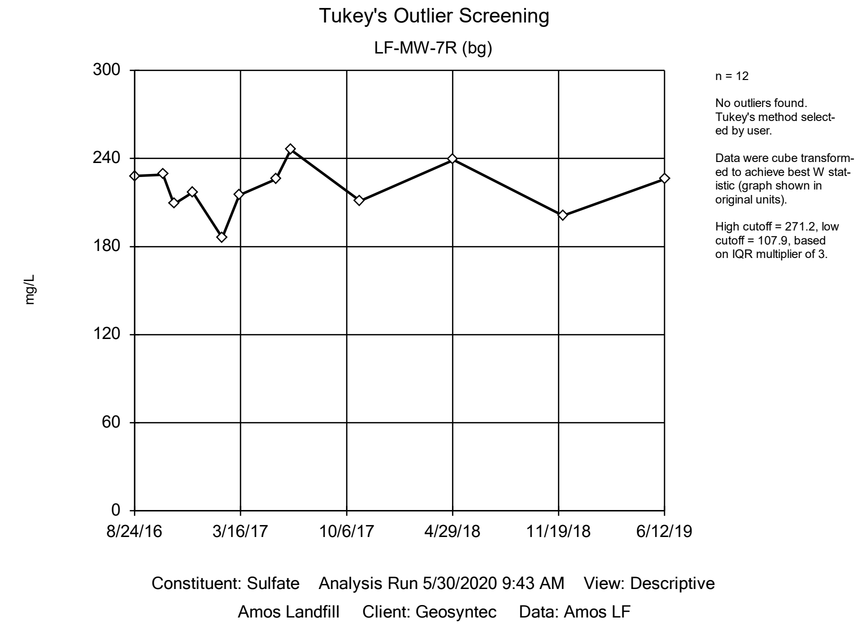
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 19.71, low cutoff = 4.024, based on IQR multiplier of 3.

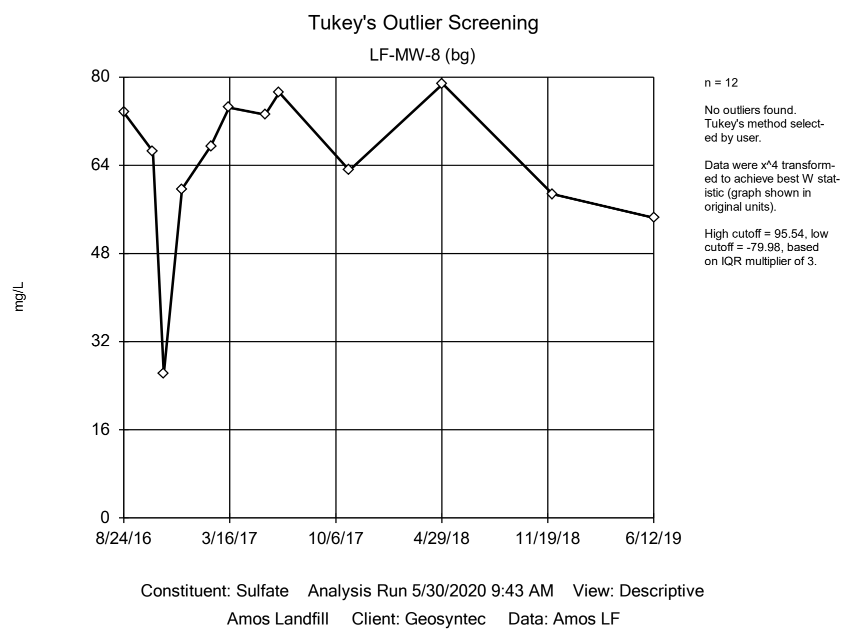
Constituent: Sulfate   Analysis Run 5/30/2020 9:43 AM   View: Descriptive
Amos Landfill   Client: Geosyntec   Data: Amos LF



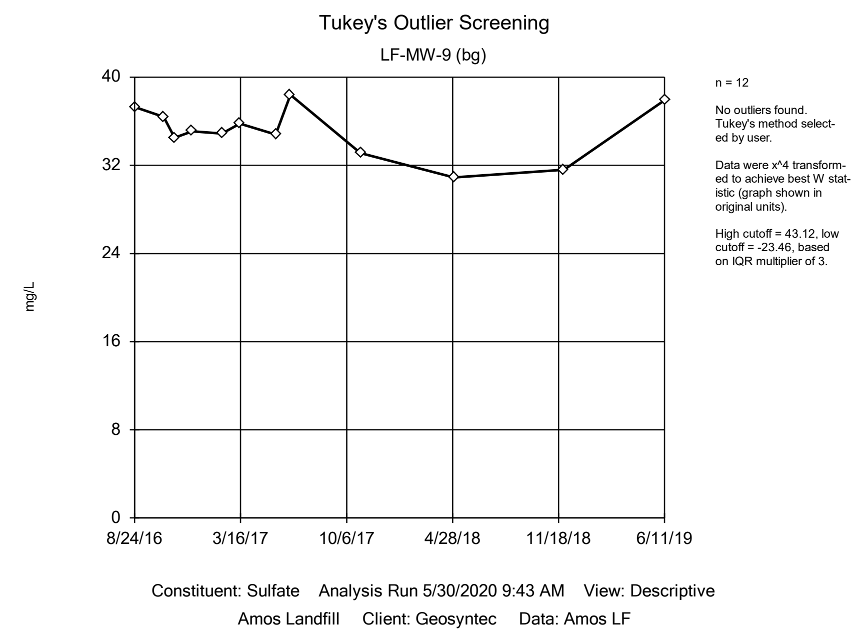
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

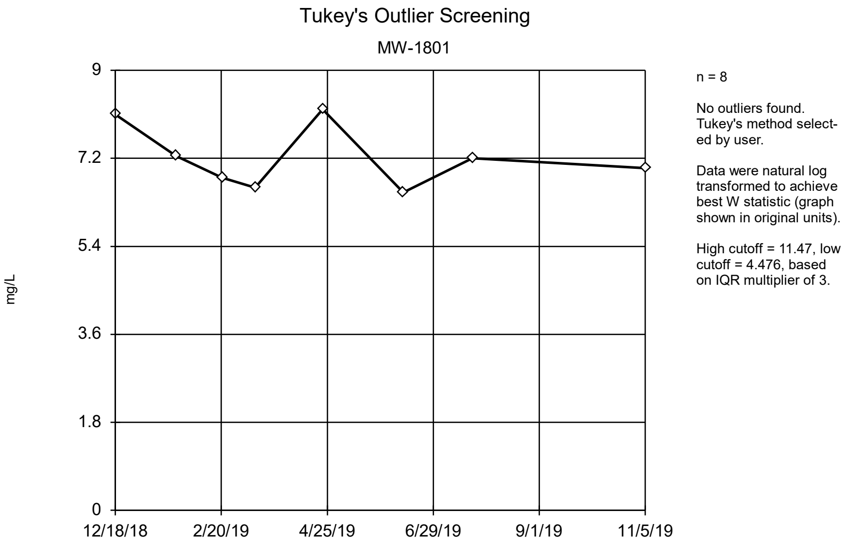


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



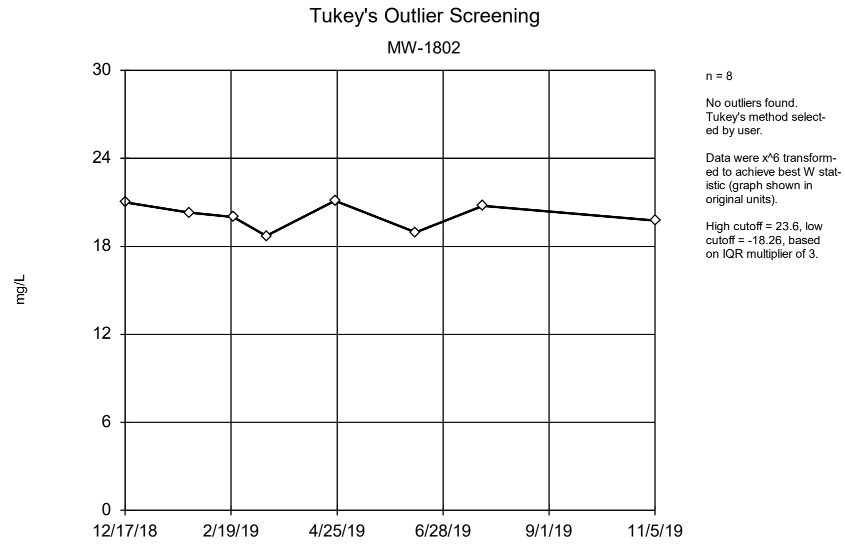
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG





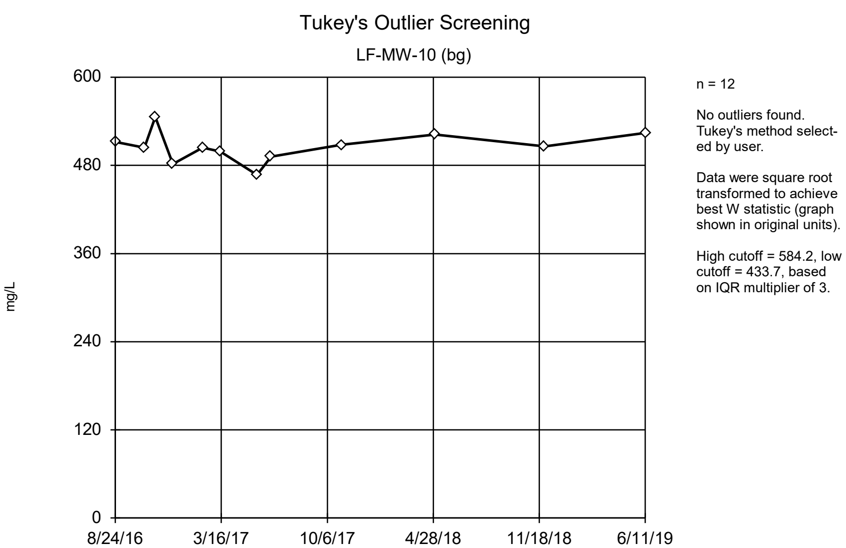
Constituent: Sulfate Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



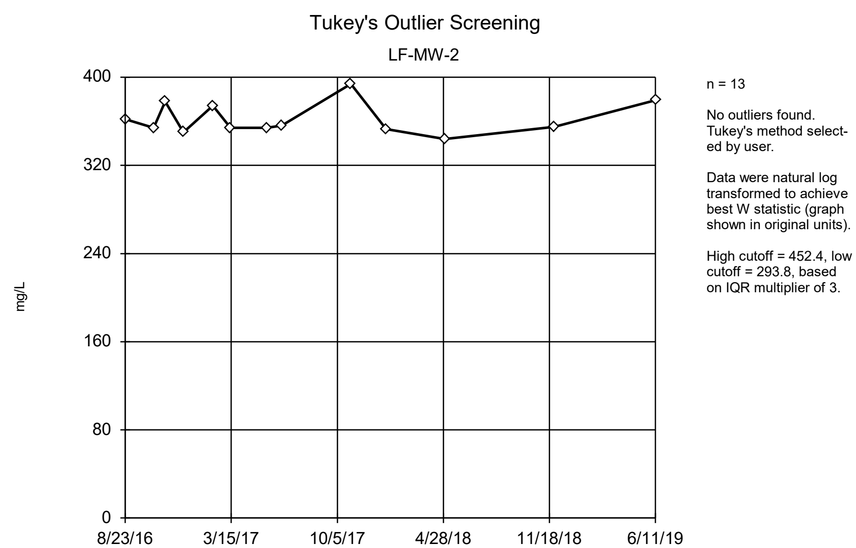
Constituent: Sulfate Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



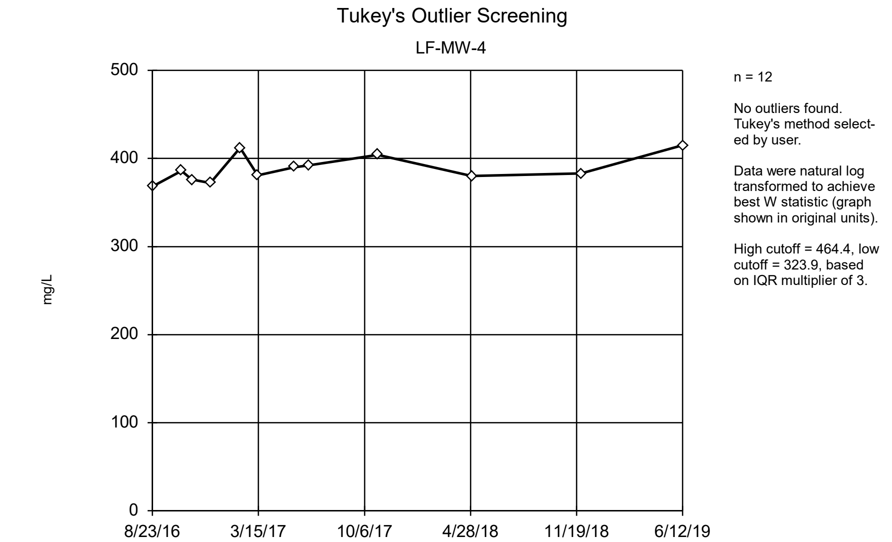
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



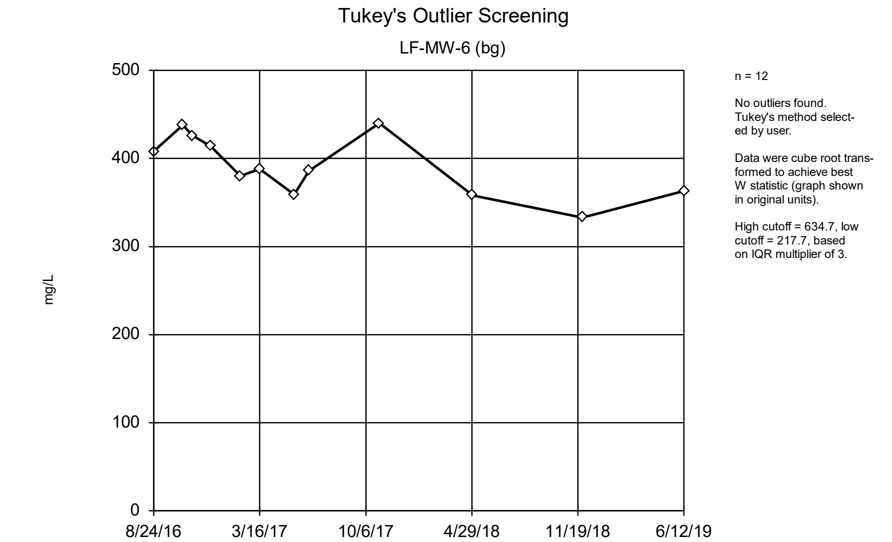
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



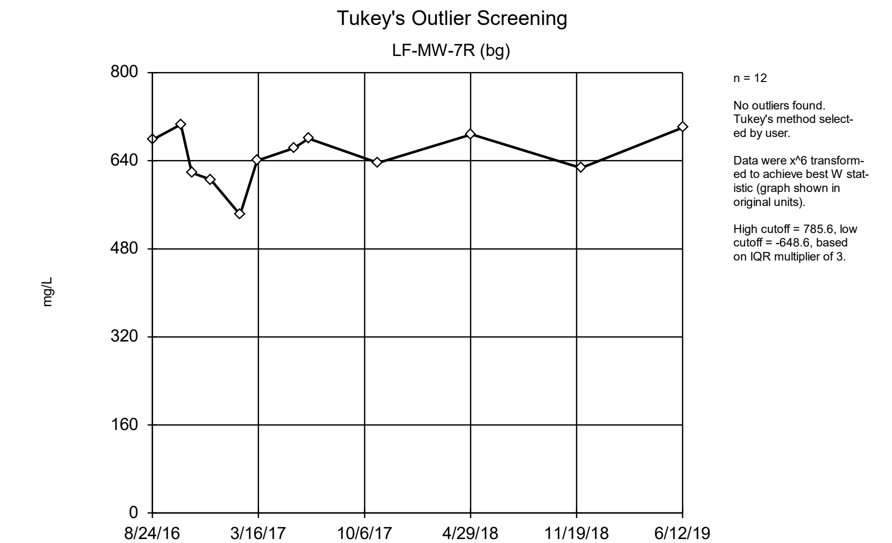
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



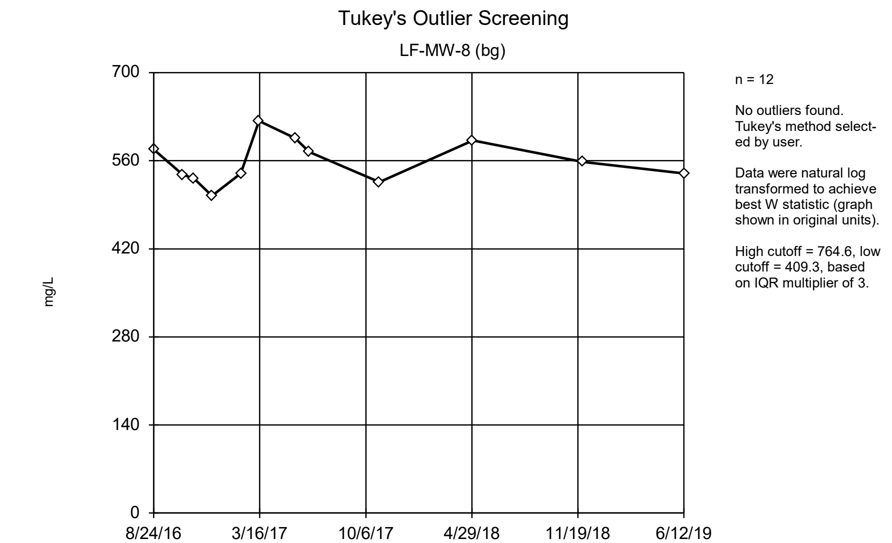
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

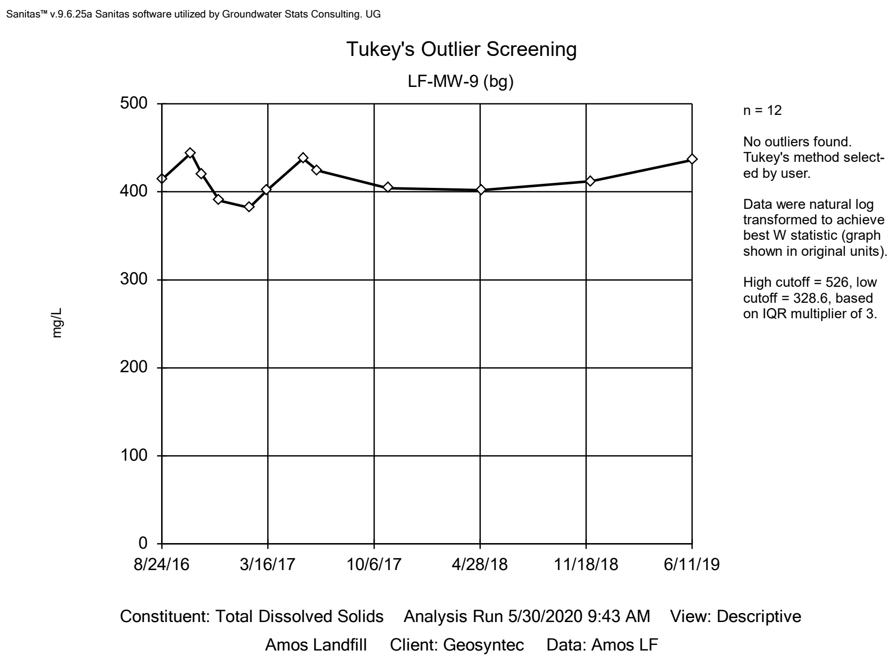


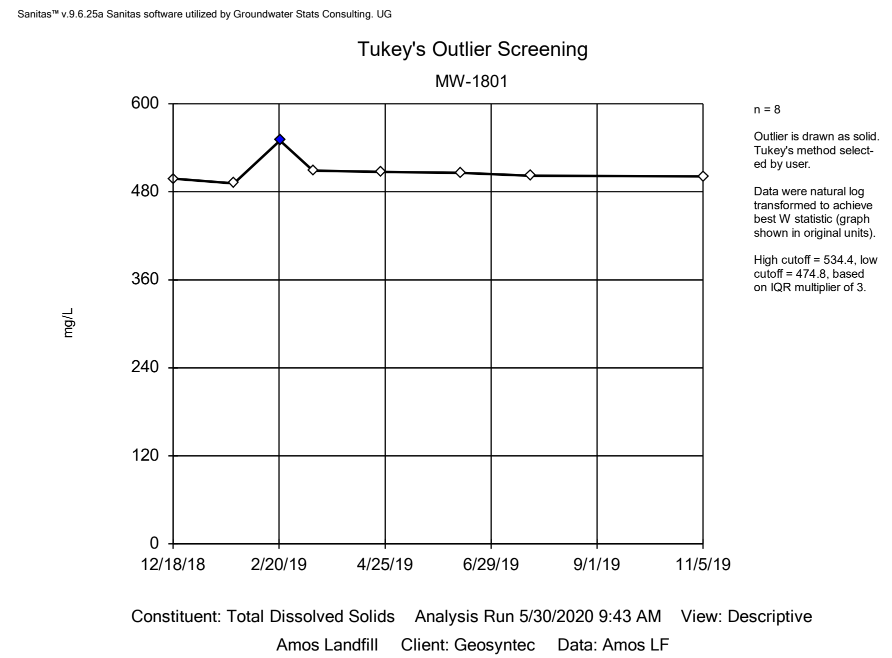
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

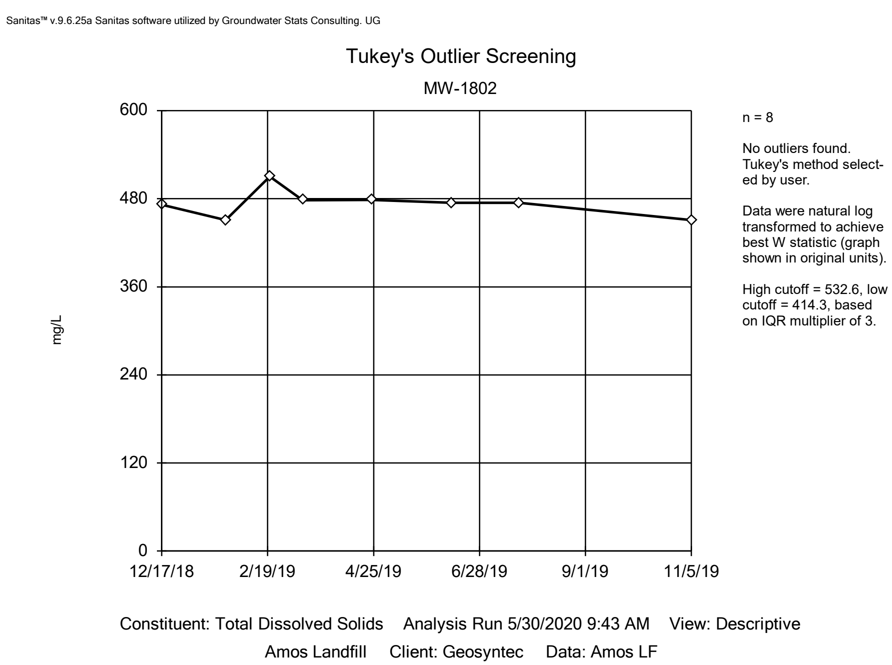
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
LF-MW-9 (bg)
n = 12
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 526, low cutoff = 328.6, based on IQR multiplier of 3.
mg/L
8/24/16
3/16/17
10/6/17
4/28/18
11/18/18
6/11/19
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1801
n = 8
Outlier is drawn as solid. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 534.4, low cutoff = 474.8, based on IQR multiplier of 3.
mg/L
12/18/18
2/20/19
4/25/19
6/29/19
9/1/19
11/5/19
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF


Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG
Tukey's Outlier Screening
MW-1802
n = 8
No outliers found. Tukey's method selected by user.
Data were natural log transformed to achieve best W statistic (graph shown in original units).
High cutoff = 532.6, low cutoff = 414.3, based on IQR multiplier of 3.
mg/L
12/17/18
2/19/19
4/25/19
6/28/19
9/1/19
11/5/19
Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:43 AM View: Descriptive
Amos Landfill Client: Geosyntec Data: Amos LF

Mann-Whitney - Significant Results

Amos Landfill   Client: Geosyntec   Data: Amos LF   Printed 6/1/2020, 10:11 AM

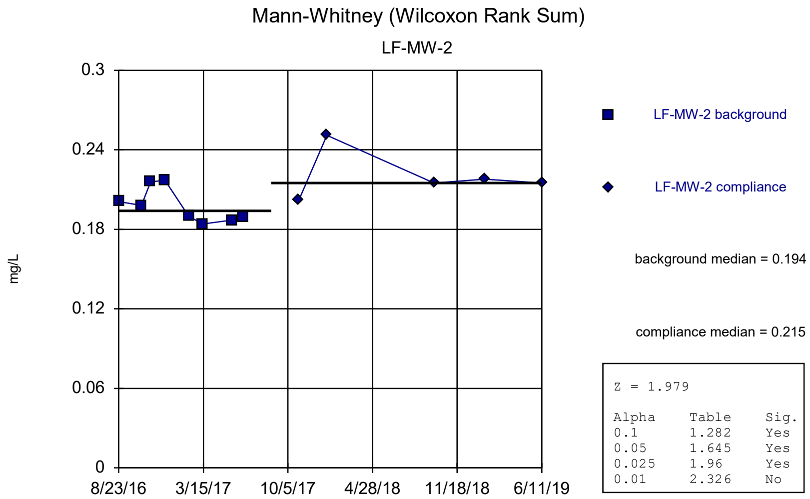
Constituent	Well	Calc.	0.05	Sig.	Method
Boron (mg/L)	**LF-MW-2**	**1.979**	**Yes**	**Yes**	**Mann-W**
Boron (mg/L)	**LF-MW-7R (bg)**	**2.293**	**Yes**	**Yes**	**Mann-W**
Fluoride (mg/L)	**LF-MW-8 (bg)**	**2.149**	**Yes**	**Yes**	**Mann-W**

Mann-Whitney - All Results

Amos Landfill Client: Geosyntec Data: Amos LF Printed 6/1/2020, 10:11 AM

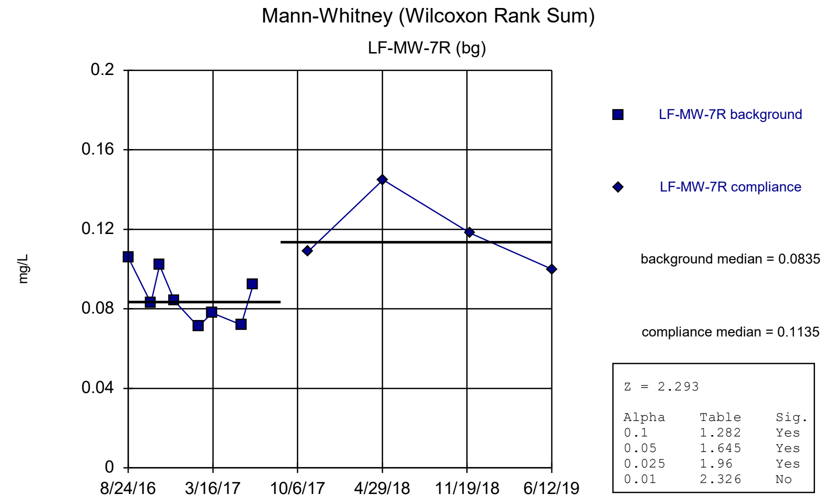
Constituent	Well	Calc.	0.05	Sig.	Method
Boron (mg/L)	LF-MW-10 (bg)	1.106	No	No	Mann-W
Boron (mg/L)	**LF-MW-2**	**1.979**	**Yes**	**Yes**	**Mann-W**
Boron (mg/L)	LF-MW-4	0.2199	No	No	Mann-W
Boron (mg/L)	LF-MW-6 (bg)	0.7643	No	No	Mann-W
Boron (mg/L)	**LF-MW-7R (bg)**	**2.293**	**Yes**	**Yes**	**Mann-W**
Boron (mg/L)	LF-MW-8 (bg)	0.3403	No	No	Mann-W
Boron (mg/L)	LF-MW-9 (bg)	0.4246	No	No	Mann-W
Calcium (mg/L)	LF-MW-10 (bg)	-1.276	No	No	Mann-W
Calcium (mg/L)	LF-MW-2	1.616	No	No	Mann-W
Calcium (mg/L)	LF-MW-4	-1.967	No	No	Mann-W
Calcium (mg/L)	LF-MW-6 (bg)	-1.613	No	No	Mann-W
Calcium (mg/L)	LF-MW-7R (bg)	0.2548	No	No	Mann-W
Calcium (mg/L)	LF-MW-8 (bg)	-2.39	No	No	Mann-W
Calcium (mg/L)	LF-MW-9 (bg)	-1.953	No	No	Mann-W
Chloride (mg/L)	LF-MW-10 (bg)	1.613	No	No	Mann-W
Chloride (mg/L)	LF-MW-2	-0.5944	No	No	Mann-W
Chloride (mg/L)	LF-MW-4	-1.108	No	No	Mann-W
Chloride (mg/L)	LF-MW-6 (bg)	-1.616	No	No	Mann-W
Chloride (mg/L)	LF-MW-7R (bg)	-0.7643	No	No	Mann-W
Chloride (mg/L)	LF-MW-8 (bg)	-1.61	No	No	Mann-W
Chloride (mg/L)	LF-MW-9 (bg)	-2.463	No	No	Mann-W
Fluoride (mg/L)	LF-MW-10 (bg)	0.5104	No	No	Mann-W
Fluoride (mg/L)	LF-MW-2	0.9846	No	No	Mann-W
Fluoride (mg/L)	LF-MW-4	0.5138	No	No	Mann-W
Fluoride (mg/L)	LF-MW-6 (bg)	1.116	No	No	Mann-W
Fluoride (mg/L)	LF-MW-7R (bg)	0.514	No	No	Mann-W
Fluoride (mg/L)	**LF-MW-8 (bg)**	**2.149**	**Yes**	**Yes**	**Mann-W**
Fluoride (mg/L)	LF-MW-9 (bg)	1.116	No	No	Mann-W
pH, field (SU)	LF-MW-10 (bg)	0.6806	No	No	Mann-W
pH, field (SU)	LF-MW-2	0.2105	No	No	Mann-W
pH, field (SU)	LF-MW-4	-1.274	No	No	Mann-W
pH, field (SU)	LF-MW-6 (bg)	-0.7656	No	No	Mann-W
pH, field (SU)	LF-MW-7R (bg)	-0.5122	No	No	Mann-W
pH, field (SU)	LF-MW-8 (bg)	-0.6806	No	No	Mann-W
pH, field (SU)	LF-MW-9 (bg)	-0.3403	No	No	Mann-W
Sulfate (mg/L)	LF-MW-10 (bg)	0.7643	No	No	Mann-W
Sulfate (mg/L)	LF-MW-2	0.5965	No	No	Mann-W
Sulfate (mg/L)	LF-MW-4	0.5965	No	No	Mann-W
Sulfate (mg/L)	LF-MW-6 (bg)	-1.531	No	No	Mann-W
Sulfate (mg/L)	LF-MW-7R (bg)	-0.3403	No	No	Mann-W
Sulfate (mg/L)	LF-MW-8 (bg)	-1.228	No	No	Mann-W
Sulfate (mg/L)	LF-MW-9 (bg)	-1.613	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-10 (bg)	1.616	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-2	0.0736	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-4	0.9341	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-6 (bg)	-1.274	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-7R (bg)	0.5944	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-8 (bg)	-0.3403	No	No	Mann-W
Total Dissolved Solids (mg/L)	LF-MW-9 (bg)	-0.3403	No	No	Mann-W

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



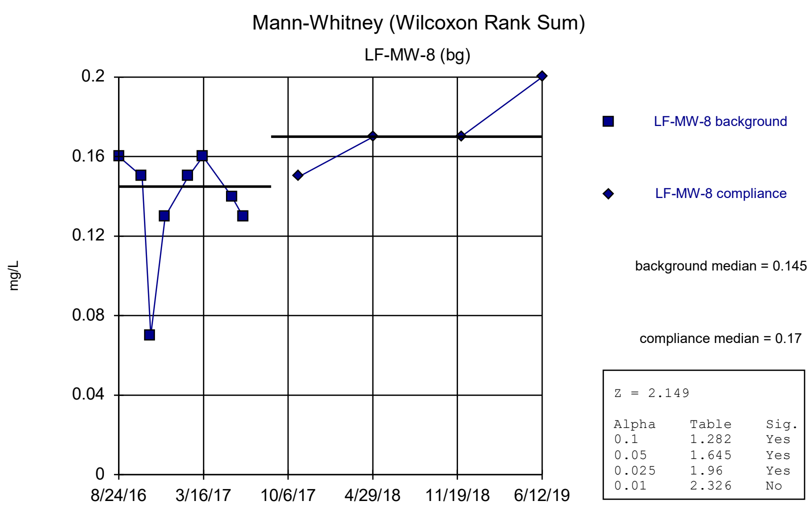
Constituent: Boron Analysis Run 6/1/2020 10:08 AM View: Mann Whitney
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Boron Analysis Run 6/1/2020 10:08 AM View: Mann Whitney
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Constituent: Fluoride Analysis Run 6/1/2020 10:08 AM View: Mann Whitney
Amos Landfill Client: Geosyntec Data: Amos LF

Trend Test Summary - All Results (No Significant)

Amos Landfill Client: Geosyntec Data: Amos LF Printed 5/30/2020, 9:40 AM

Constituent	Well	Slope	Calc.	Critical	Sig.	N	%NDs	Normality	Xform	Alpha	Method
Boron (mg/L)	MW-1801	-0.01711	-5	-21	No	8	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-1802	-0.0002861	0	21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1801	-0.3443	-14	-21	No	8	0	n/a	n/a	0.01	NP
Calcium (mg/L)	MW-1802	0.0849	6	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-1801	1.313	12	21	No	8	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-1802	1.152	12	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	MW-1801	0.4928	18	21	No	8	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	MW-1802	0.01251	0	21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	MW-1801	-0.1838	-2	-21	No	8	0	n/a	n/a	0.01	NP
pH, field (SU)	MW-1802	-0.3232	-12	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1801	-0.8453	-8	-21	No	8	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1802	-1.06	-6	-21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	MW-1801	-9.311	-4	-21	No	8	0	n/a	n/a	0.01	NP
Total Dissolved Solids (mg/L)	MW-1802	-11.86	-4	-21	No	8	0	n/a	n/a	0.01	NP

Intrawell Prediction Limits

Amos Landfill Client: Geosyntec Data: Amos LF Printed 5/30/2020, 10:02 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	LF-MW-10	0.1787	n/a	12	0.1054	0.03285	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	LF-MW-2	0.2466	n/a	13	0.2064	0.01836	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	LF-MW-4	0.2142	n/a	13	0.1775	0.01671	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	LF-MW-6	0.2019	n/a	12	0.1289	0.0327	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	LF-MW-7R	0.1445	n/a	12	0.09667	0.02144	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	LF-MW-8	0.09394	n/a	12	0.04258	0.02301	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	LF-MW-9	0.1756	n/a	12	0.2748	0.06465	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Boron (mg/L)	MW-1801	0.3059	n/a	8	0.2544	0.01971	0	None	No	0.00188	Param Intra 1 of 2
Boron (mg/L)	MW-1802	0.2764	n/a	8	0.2453	0.01187	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-10	2.234	n/a	12	1.145	0.1569	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-2	2.101	n/a	12	1.691	0.1839	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-4	0.9119	n/a	12	0.8141	0.04383	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-6	46.46	n/a	12	37.97	3.803	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-7R	43.01	n/a	12	5.8	0.3395	0	None	sqrt(x)	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-8	151.6	n/a	12	135	7.435	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	LF-MW-9	111.5	n/a	12	89.58	9.833	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-1801	1.827	n/a	8	1.511	0.1208	0	None	No	0.00188	Param Intra 1 of 2
Calcium (mg/L)	MW-1802	0.978	n/a	8	0.8776	0.03836	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-10	6.148	n/a	12	4.827	0.5919	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-2	5.4	n/a	12	3.683	0.7693	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-4	15.87	n/a	12	14.64	0.5485	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-6	8.371	n/a	12	7.332	0.4657	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-7R	4.235	n/a	12	3.786	0.2013	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-8	15.55	n/a	11	164	33.87	0	None	x^2	0.00188	Param Intra 1 of 2
Chloride (mg/L)	LF-MW-9	6.539	n/a	12	6.181	0.1603	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-1801	12.09	n/a	8	10.94	0.4406	0	None	No	0.00188	Param Intra 1 of 2
Chloride (mg/L)	MW-1802	10.19	n/a	8	9.032	0.4442	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-10	1.007	n/a	12	0.6167	0.1749	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-2	1.605	n/a	15	1.295	0.1463	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-4	1.524	n/a	13	1.406	0.05378	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-6	0.288	n/a	12	0.2375	0.02261	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-7R	0.3969	n/a	12	0.2975	0.04454	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-8	0.2182	n/a	12	0.1483	0.03129	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	LF-MW-9	0.2719	n/a	12	0.2	0.03219	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-1801	5.674	n/a	8	5.25	0.1621	0	None	No	0.00188	Param Intra 1 of 2
Fluoride (mg/L)	MW-1802	5.356	n/a	8	4.854	0.1921	0	None	No	0.00188	Param Intra 1 of 2
pH, field (SU)	LF-MW-10	9.584	8.335	12	8.959	0.2798	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-2	9.019	8.174	16	8.596	0.2036	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-4	10.09	8.328	12	9.208	0.3942	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-6	8.002	7.208	12	7.605	0.178	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-7R	8.085	7.05	12	7.568	0.2316	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	LF-MW-8	7.6	6.8	12	n/a	n/a	0	n/a	n/a	0.02155	NP Intra (normality) 1 of 2
pH, field (SU)	LF-MW-9	7.507	6.871	12	7.189	0.1424	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	MW-1801	9.53	8.463	8	8.996	0.204	0	None	No	0.0009398	Param Intra 1 of 2
pH, field (SU)	MW-1802	9.51	8.69	8	9.1	0.1568	0	None	No	0.0009398	Param Intra 1 of 2
Sulfate (mg/L)	LF-MW-10	19.74	n/a	12	15.83	1.748	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	LF-MW-2	12.93	n/a	12	9.1	1.714	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	LF-MW-4	12.23	n/a	12	9.042	1.428	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	LF-MW-6	64.81	n/a	12	36.44	12.71	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	LF-MW-7R	256.3	n/a	12	219.4	16.52	0	None	No	0.00188	Param Intra 1 of 2

Intrawell Prediction Limits

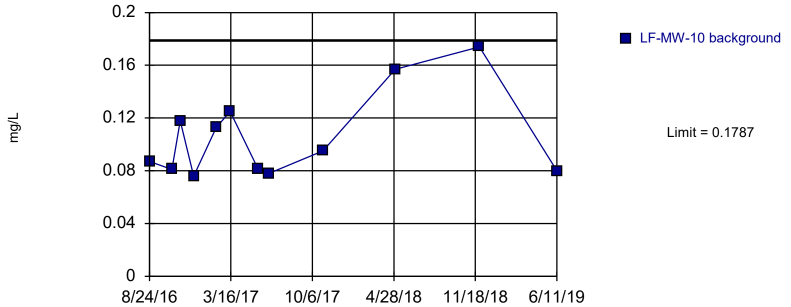
Amos Landfill Client: Geosyntec Data: Amos LF Printed 5/30/2020, 10:02 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Sulfate (mg/L)	LF-MW-8	86.69	n/a	11	67.95	8.15	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	LF-MW-9	40.28	n/a	12	35.06	2.338	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-1801	8.879	n/a	8	7.206	0.6394	0	None	No	0.00188	Param Intra 1 of 2
Sulfate (mg/L)	MW-1802	22.43	n/a	8	20.07	0.9008	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-10	551	n/a	12	505.5	20.38	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-2	394	n/a	13	362.1	14.55	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-4	422	n/a	12	388.3	15.14	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-6	468	n/a	12	391.1	34.47	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-7R	753.7	n/a	12	648.7	47.06	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-8	635.6	n/a	12	558.4	34.57	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	LF-MW-9	457	n/a	12	414	19.28	0	None	No	0.00188	Param Intra 1 of 2
Total Dissolved Solids (mg/L)	MW-1801	550	n/a	8	n/a	n/a	0	n/a	n/a	0.02144	NP Intra (normality) 1 of 2
Total Dissolved Solids (mg/L)	MW-1802	522.1	n/a	8	473.7	18.49	0	None	No	0.00188	Param Intra 1 of 2

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



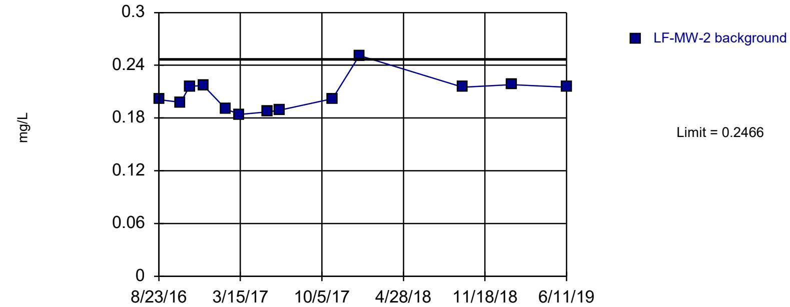
Background Data Summary: Mean=0.1054, Std. Dev.=0.03285, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.835, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



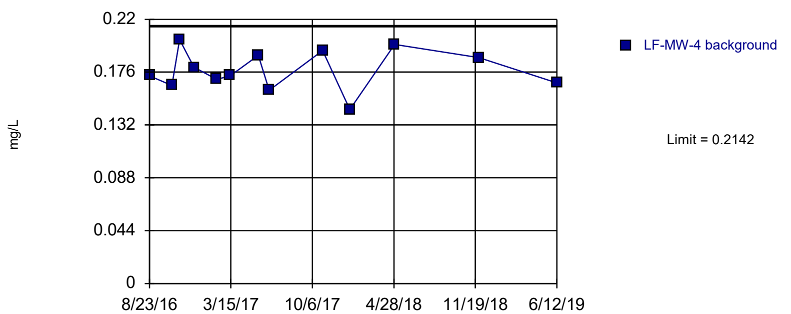
Background Data Summary: Mean=0.2064, Std. Dev.=0.01836, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8908, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



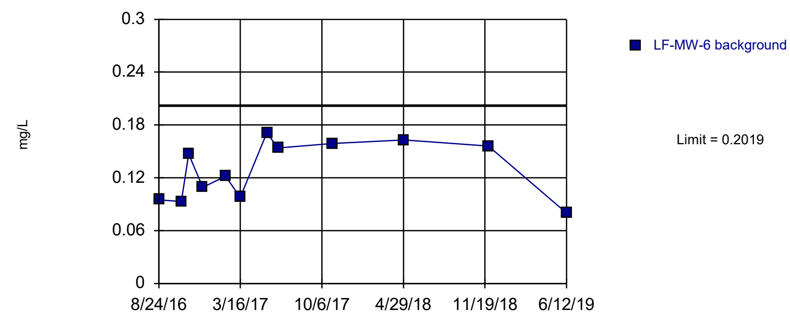
Background Data Summary: Mean=0.1775, Std. Dev.=0.01671, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9699, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



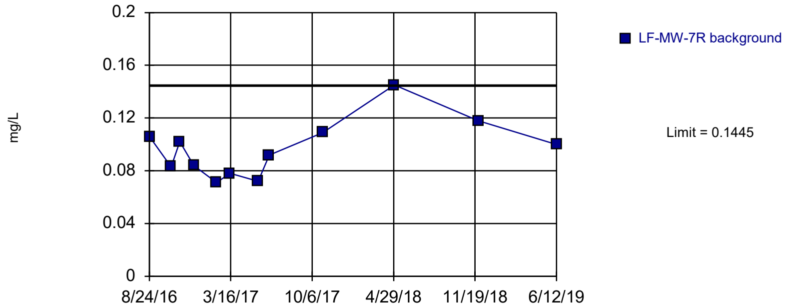
Background Data Summary: Mean=0.1289, Std. Dev.=0.0327, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8885, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



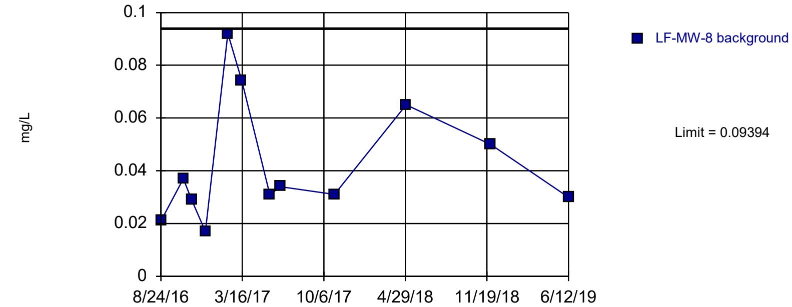
Background Data Summary: Mean=0.09667, Std. Dev.=0.02144, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.932, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



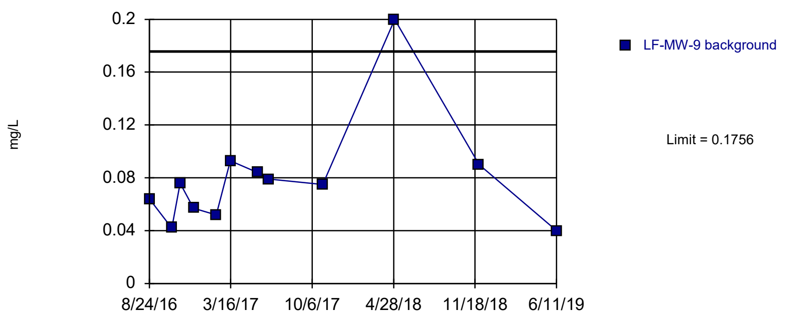
Background Data Summary: Mean=0.04258, Std. Dev.=0.02301, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8645, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



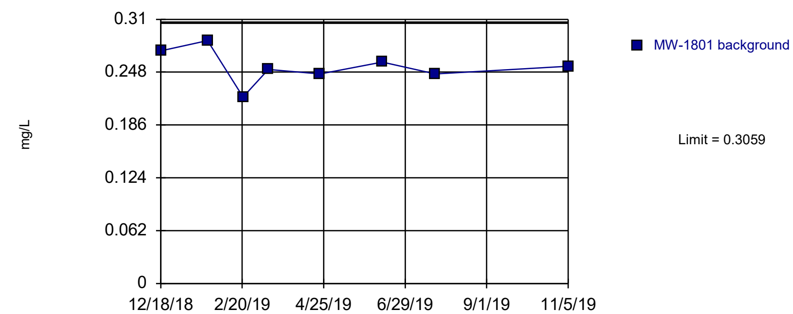
Background Data Summary (based on square root transformation): Mean=0.2748, Std. Dev.=0.06465, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8376, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1801



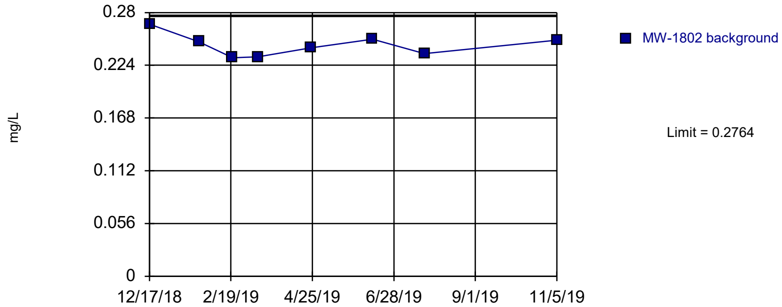
Background Data Summary: Mean=0.2544, Std. Dev.=0.01971, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.962, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



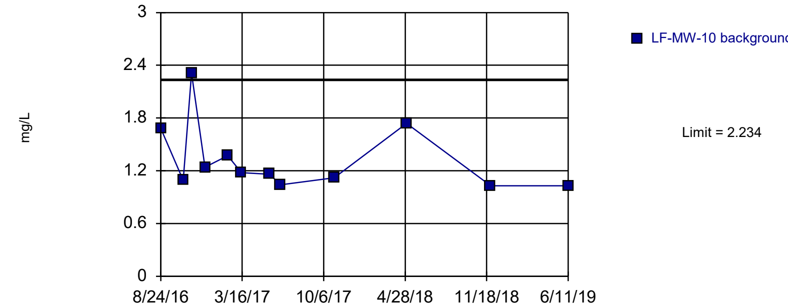
Background Data Summary: Mean=0.2453, Std. Dev.=0.01187, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.922, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Boron Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



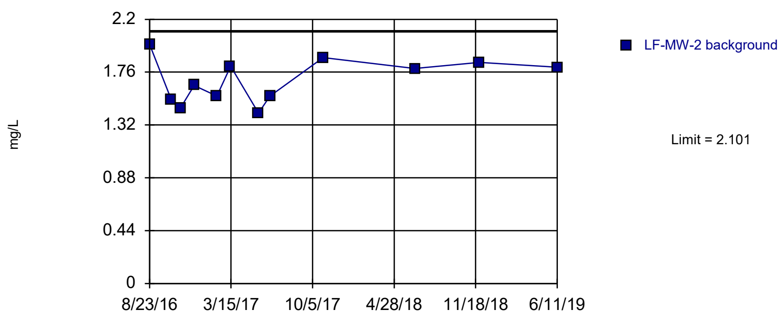
Background Data Summary (based on square root transformation): Mean=1.145, Std. Dev.=0.1569, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.809, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



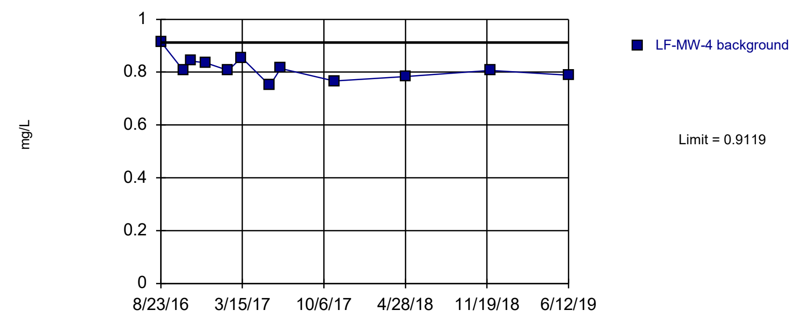
Background Data Summary: Mean=1.691, Std. Dev.=0.1839, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9376, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



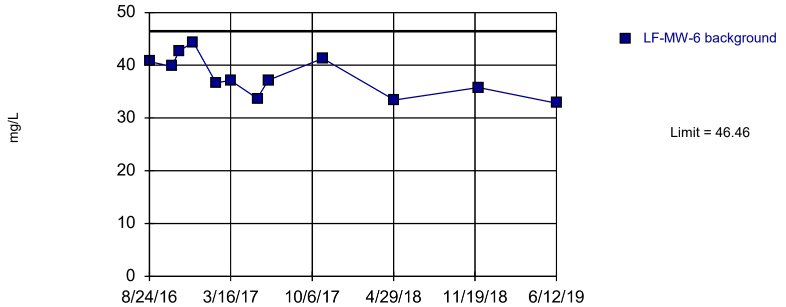
Background Data Summary: Mean=0.8141, Std. Dev.=0.04383, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9473, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



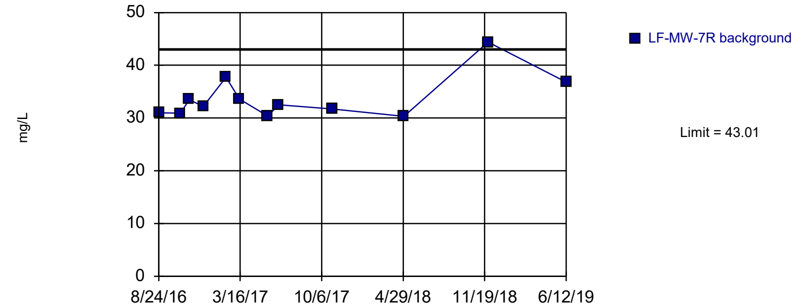
Background Data Summary: Mean=37.97, Std. Dev.=3.803, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9497, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



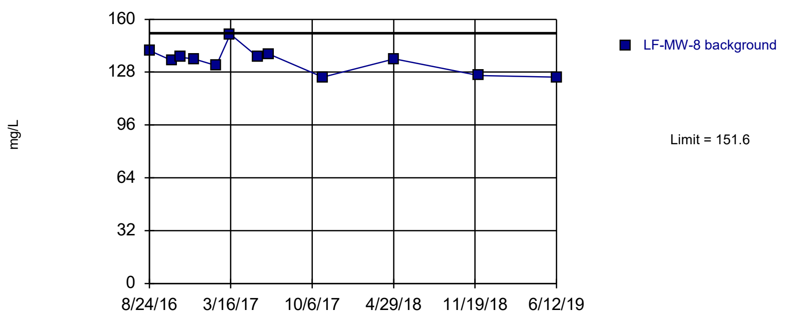
Background Data Summary (based on square root transformation): Mean=5.8, Std. Dev.=0.3395, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8101, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:55 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



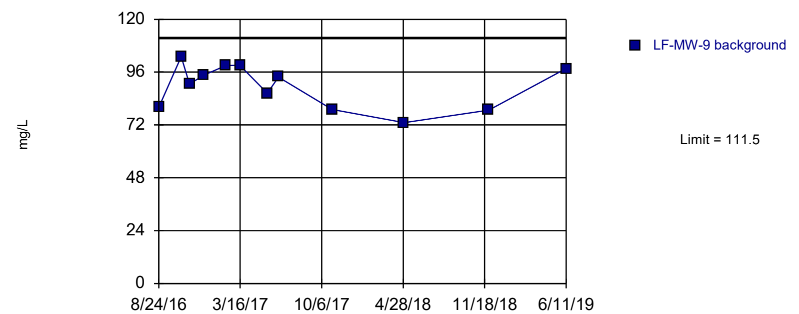
Background Data Summary: Mean=135, Std. Dev.=7.435, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9148, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



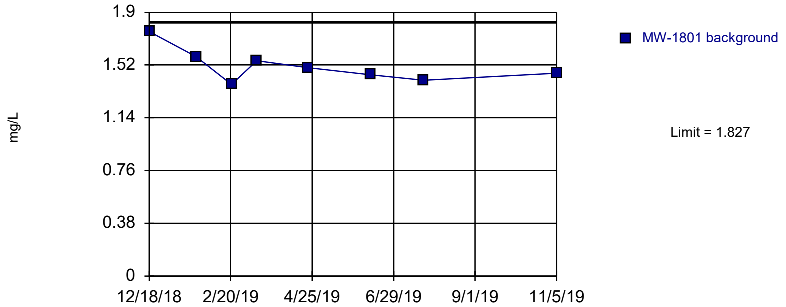
Background Data Summary: Mean=89.58, Std. Dev.=9.833, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9271, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Calcium Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1801



Background Data Summary: Mean=1.511, Std. Dev.=0.1208, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9019, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

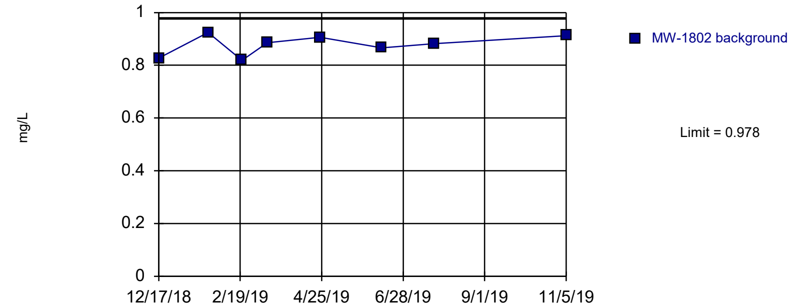
Constituent: Calcium Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



Background Data Summary: Mean=0.8776, Std. Dev.=0.03836, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9235, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

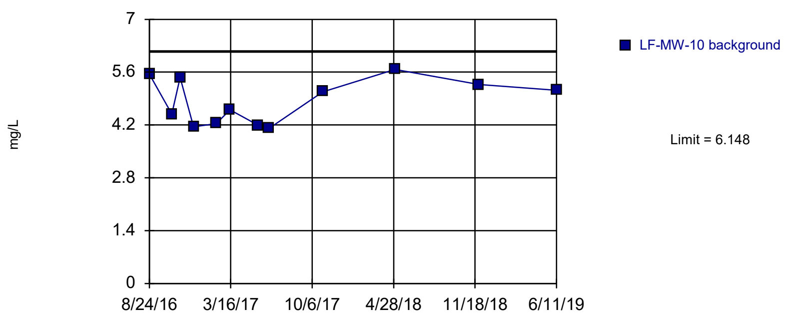
Constituent: Calcium Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



Background Data Summary: Mean=4.827, Std. Dev.=0.5919, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8884, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

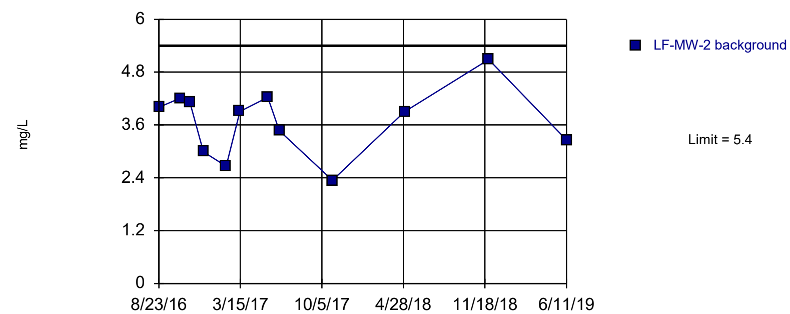
Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



Background Data Summary: Mean=3.683, Std. Dev.=0.7693, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9609, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

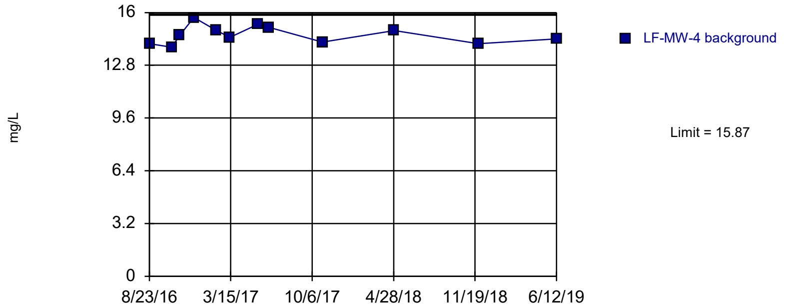
Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



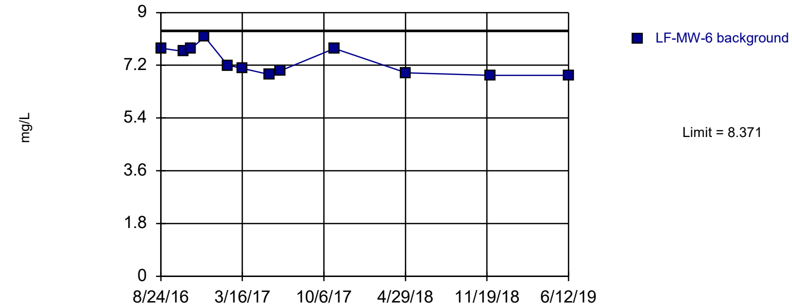
Background Data Summary: Mean=14.64, Std. Dev.=0.5485, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9568, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



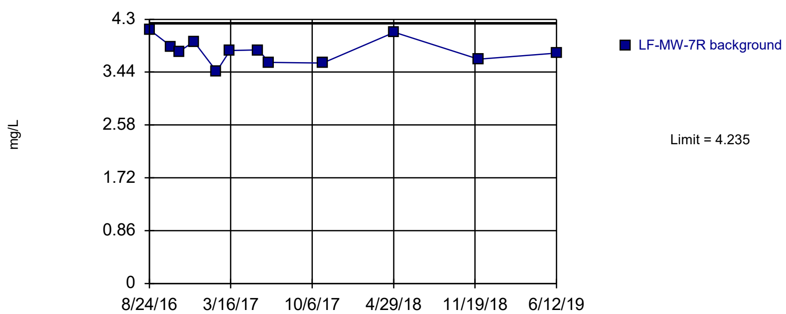
Background Data Summary: Mean=7.332, Std. Dev.=0.4657, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8604, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



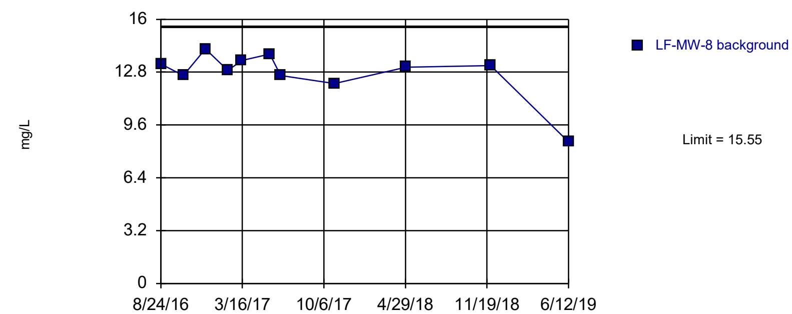
Background Data Summary: Mean=3.786, Std. Dev.=0.2013, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9668, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



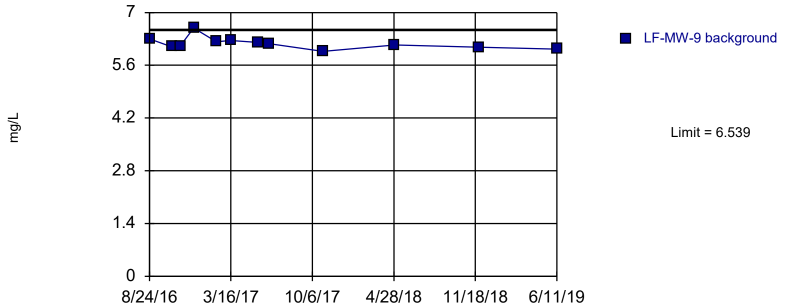
Background Data Summary (based on square transformation): Mean=164, Std. Dev.=33.87, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.7978, critical = 0.792. Kappa = 2.3 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



Background Data Summary: Mean=6.181, Std. Dev.=0.1603, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8922, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

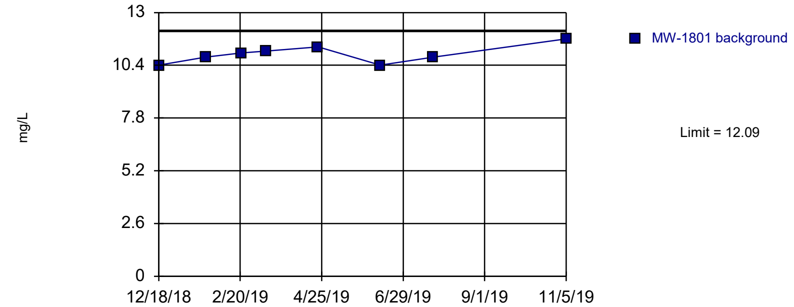
Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1801



Background Data Summary: Mean=10.94, Std. Dev.=0.4406, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9481, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

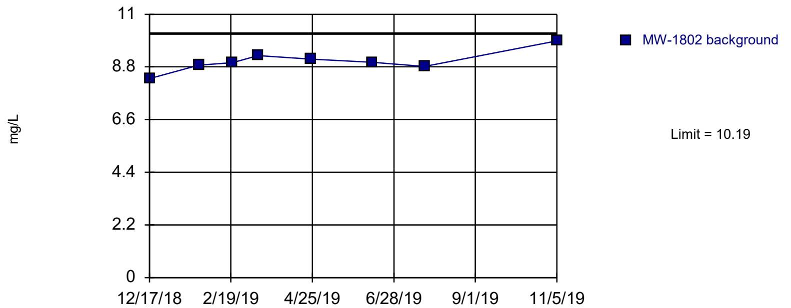
Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



Background Data Summary: Mean=9.032, Std. Dev.=0.4442, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.935, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

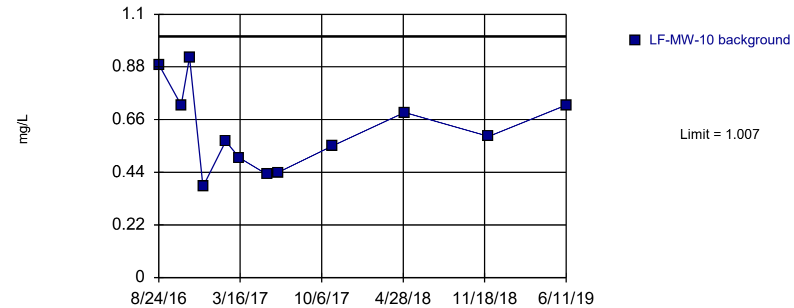
Constituent: Chloride Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)

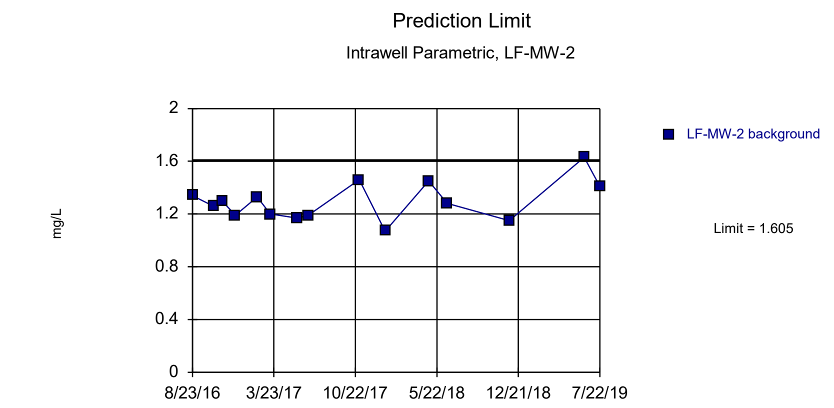


Background Data Summary: Mean=0.6167, Std. Dev.=0.1749, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9411, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

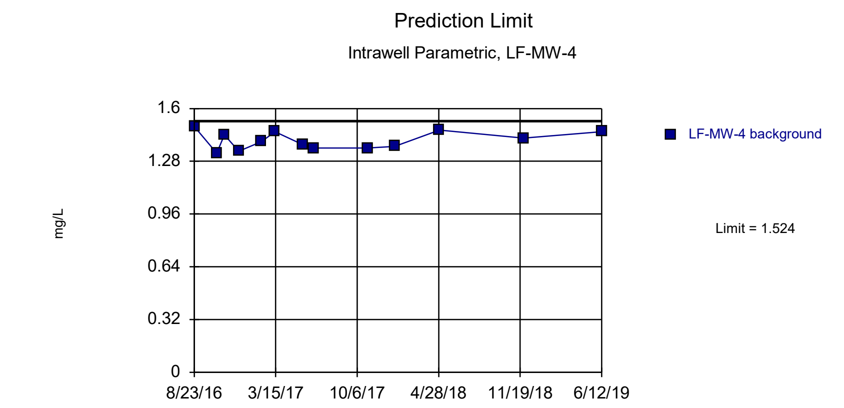
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=1.295, Std. Dev.=0.1463, n=15. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9567, critical = 0.835. Kappa = 2.115 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

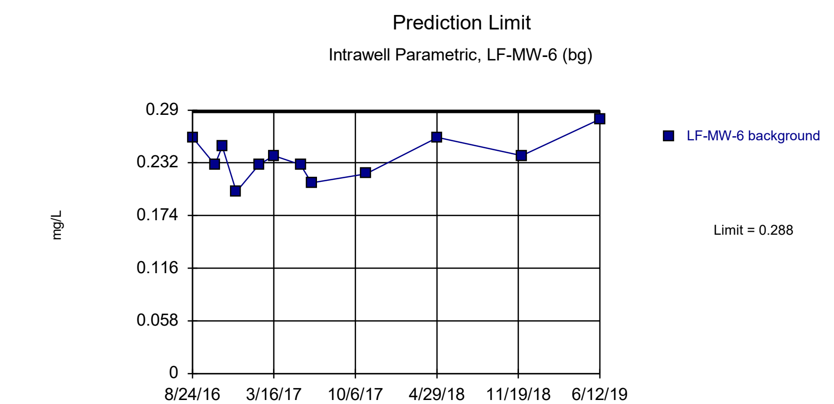
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=1.406, Std. Dev.=0.05378, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9336, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

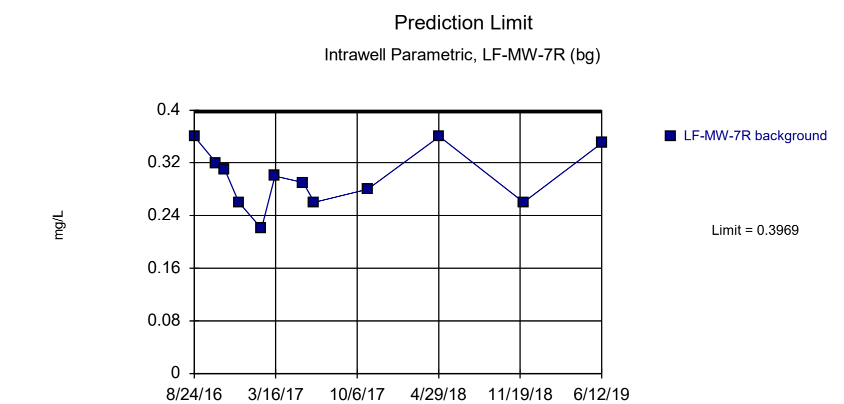
Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



Background Data Summary: Mean=0.2375, Std. Dev.=0.02261, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.979, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG



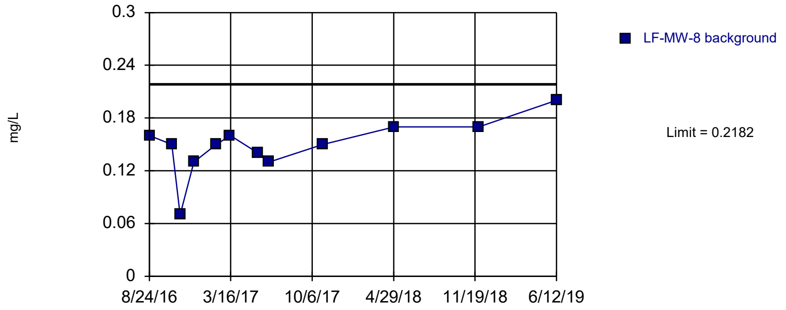
Background Data Summary: Mean=0.2975, Std. Dev.=0.04454, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9449, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



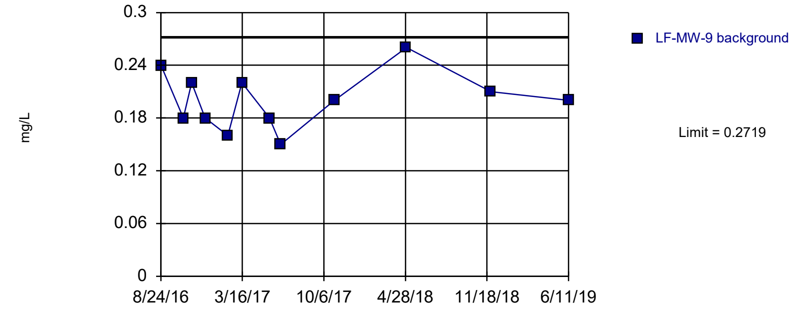
Background Data Summary: Mean=0.1483, Std. Dev.=0.03129, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8912, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



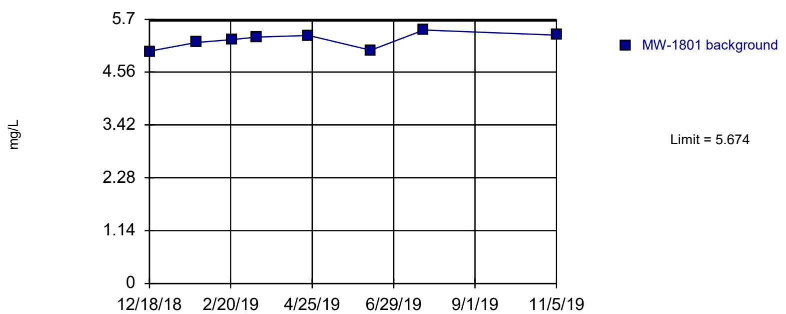
Background Data Summary: Mean=0.2, Std. Dev.=0.03219, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9731, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1801



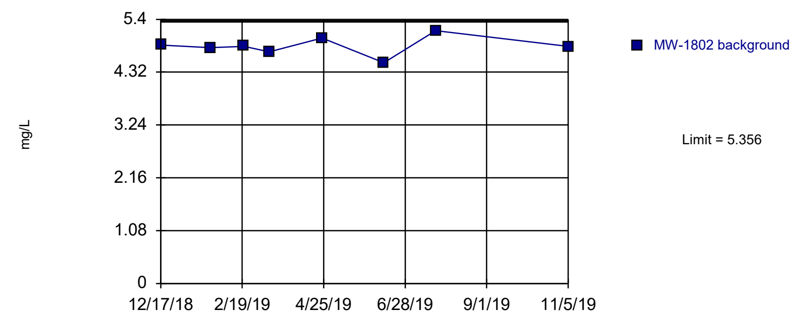
Background Data Summary: Mean=5.25, Std. Dev.=0.1621, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9239, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



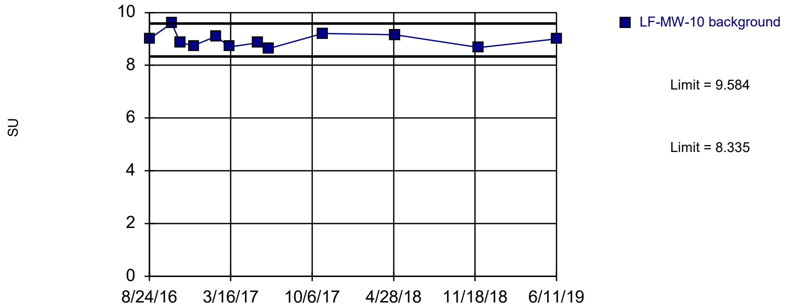
Background Data Summary: Mean=4.854, Std. Dev.=0.1921, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9546, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Fluoride Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



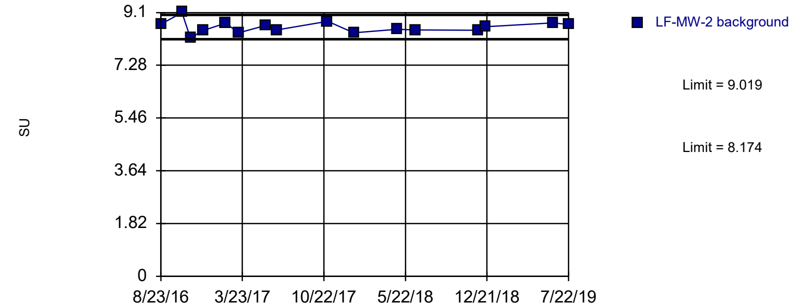
Background Data Summary: Mean=8.959, Std. Dev.=0.2798, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9208, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



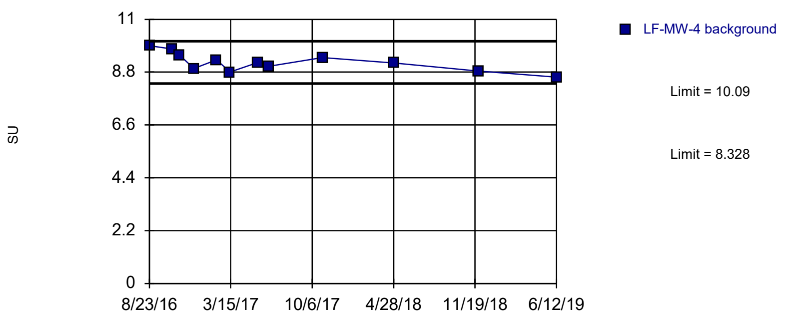
Background Data Summary: Mean=8.596, Std. Dev.=0.2036, n=16. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9506, critical = 0.844. Kappa = 2.076 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



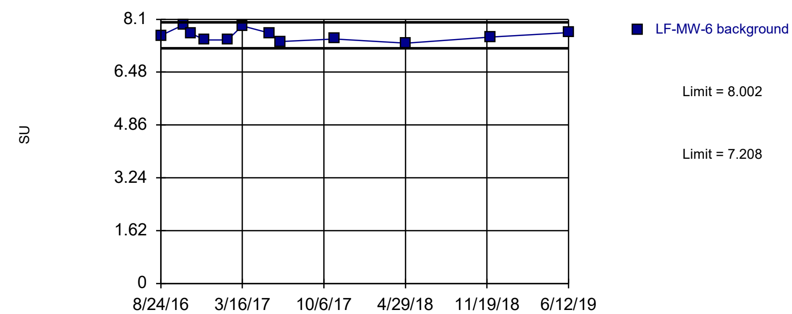
Background Data Summary: Mean=9.208, Std. Dev.=0.3942, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.978, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)

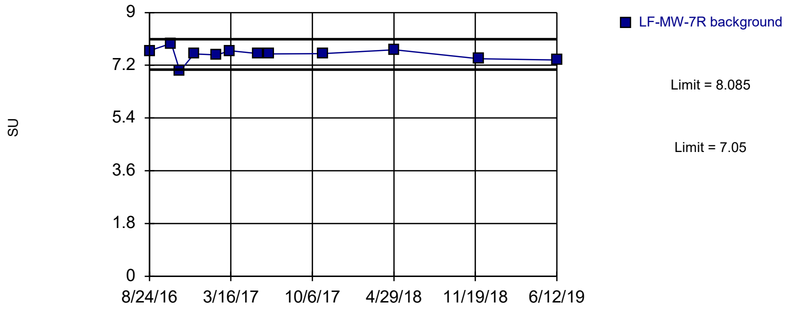


Background Data Summary: Mean=7.605, Std. Dev.=0.178, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9253, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)

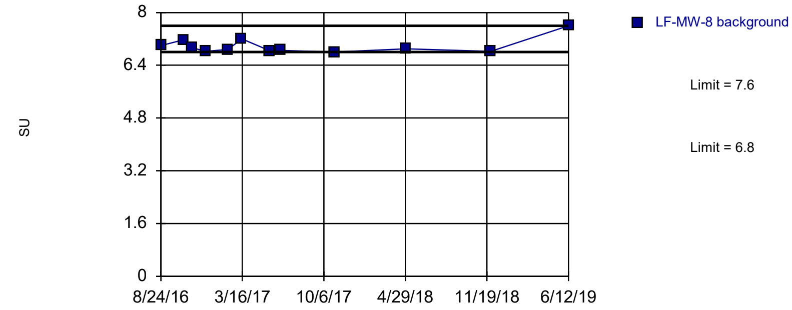


Background Data Summary: Mean=7.568, Std. Dev.=0.2316, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.896, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Prediction Limit

Intrawell Non-parametric, LF-MW-8 (bg)

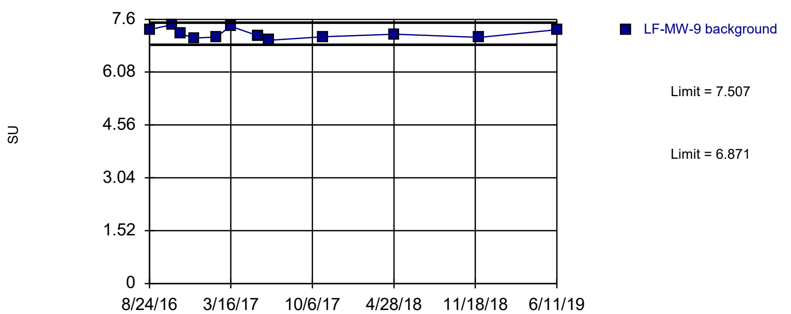


Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limits are highest and lowest of 12 background values. Well-constituent pair annual alpha = 0.04286. Individual comparison alpha = 0.02155 (1 of 2). Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)

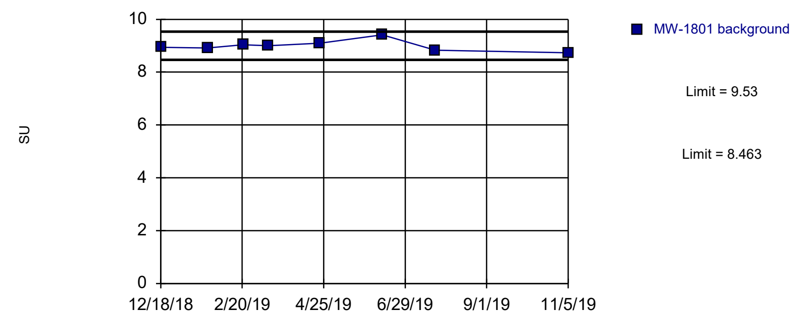


Background Data Summary: Mean=7.189, Std. Dev.=0.1424, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9234, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Prediction Limit

Intrawell Parametric, MW-1801



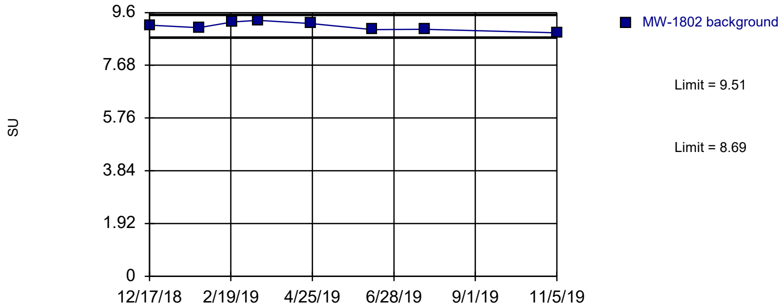
Background Data Summary: Mean=8.996, Std. Dev.=0.204, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9324, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



Background Data Summary: Mean=9.1, Std. Dev.=0.1568, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9697, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

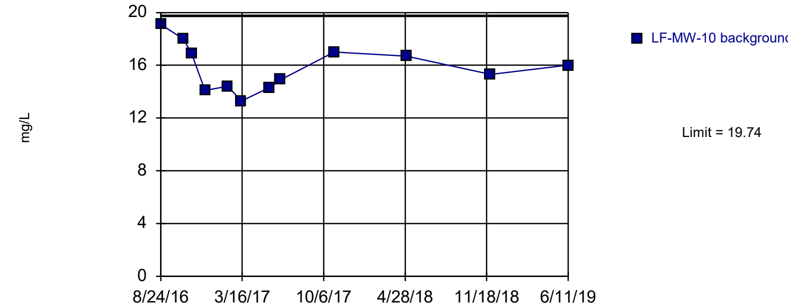
Constituent: pH, field Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



Background Data Summary: Mean=15.83, Std. Dev.=1.748, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9627, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

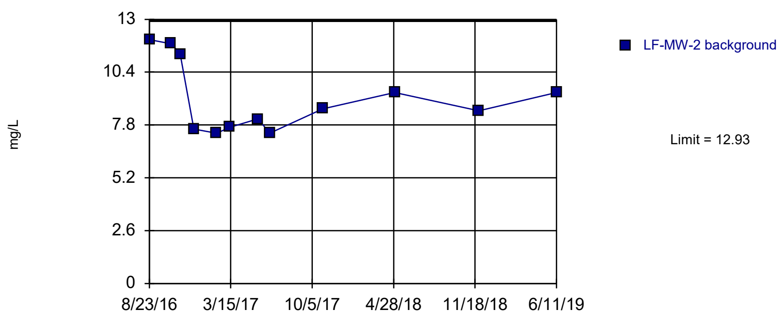
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



Background Data Summary: Mean=9.1, Std. Dev.=1.714, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8503, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

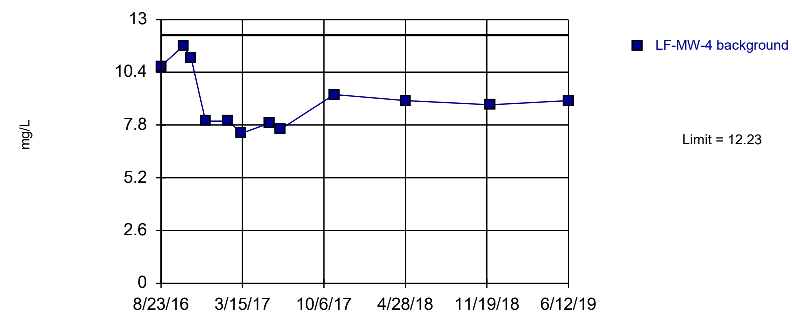
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



Background Data Summary: Mean=9.042, Std. Dev.=1.428, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8947, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

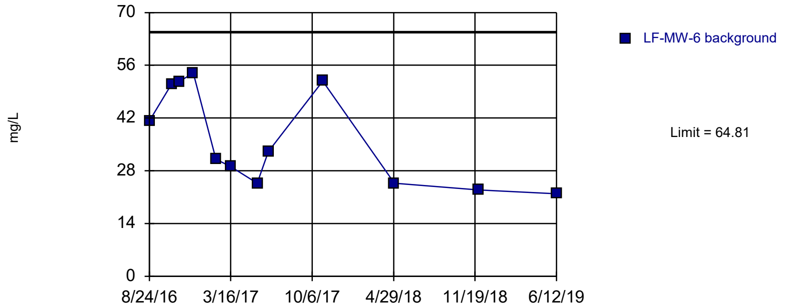
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



Background Data Summary: Mean=36.44, Std. Dev.=12.71, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8504, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

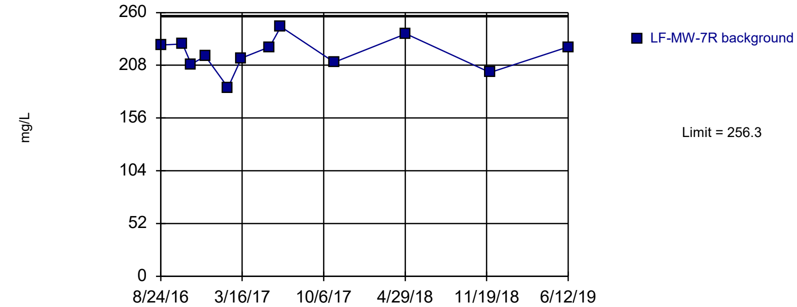
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



Background Data Summary: Mean=219.4, Std. Dev.=16.52, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9769, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

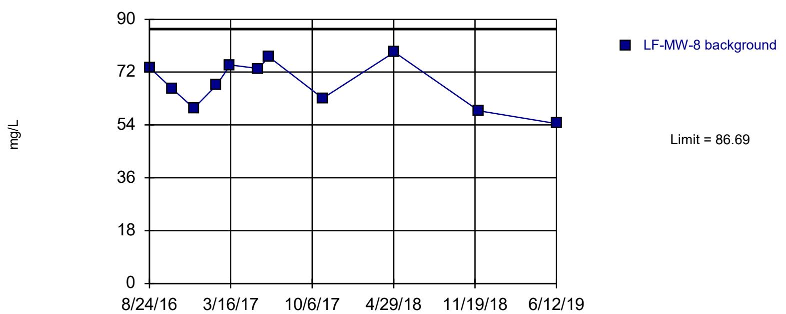
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



Background Data Summary: Mean=67.95, Std. Dev.=8.15, n=11. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9426, critical = 0.792. Kappa = 2.3 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

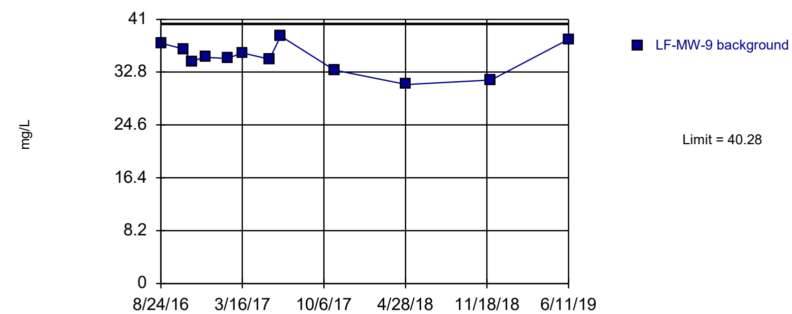
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



Background Data Summary: Mean=35.06, Std. Dev.=2.338, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9575, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

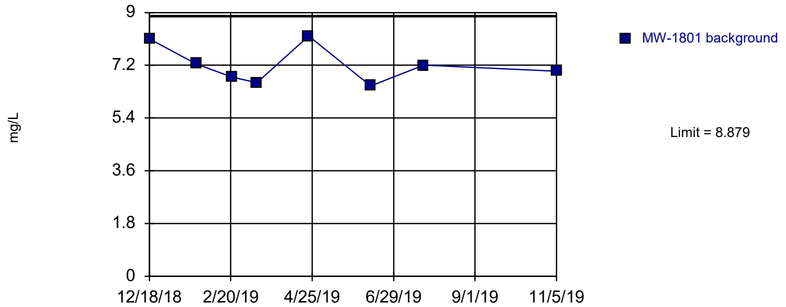
Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs

Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1801



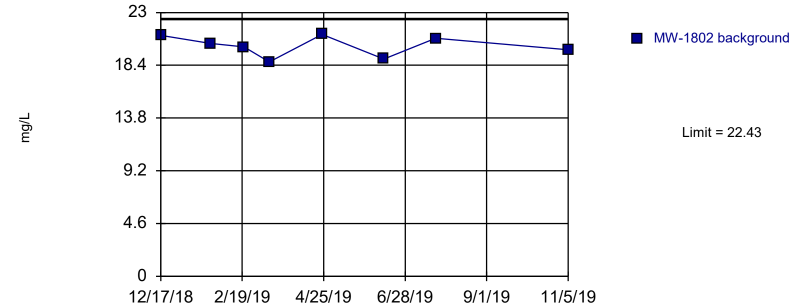
Background Data Summary: Mean=7.206, Std. Dev.=0.6394, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8867, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



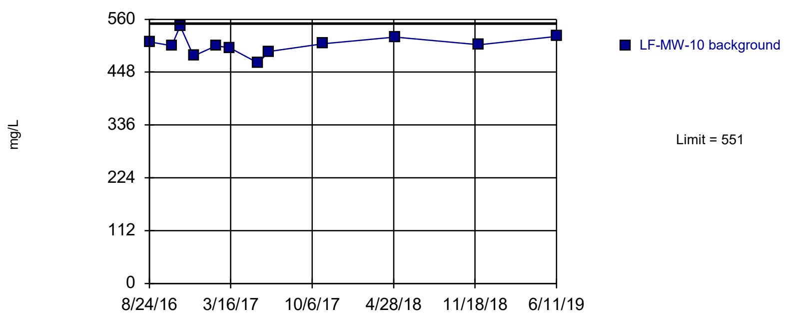
Background Data Summary: Mean=20.07, Std. Dev.=0.9008, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9251, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Sulfate Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-10 (bg)



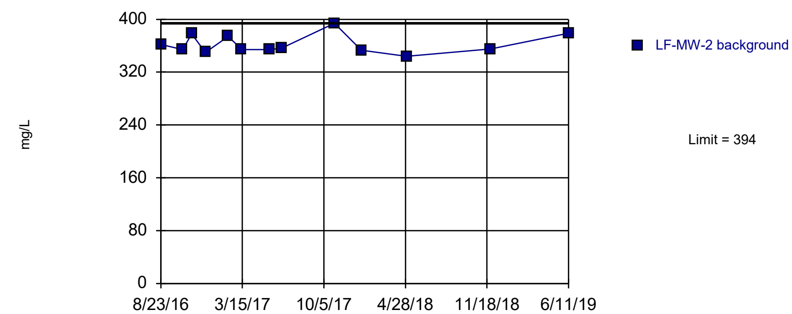
Background Data Summary: Mean=505.5, Std. Dev.=20.38, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9756, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-2



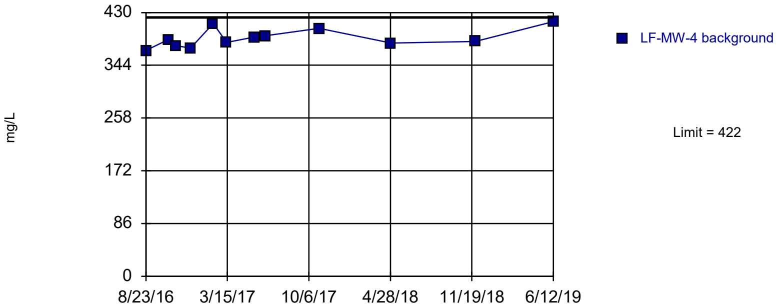
Background Data Summary: Mean=362.1, Std. Dev.=14.55, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8652, critical = 0.814. Kappa = 2.193 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-4



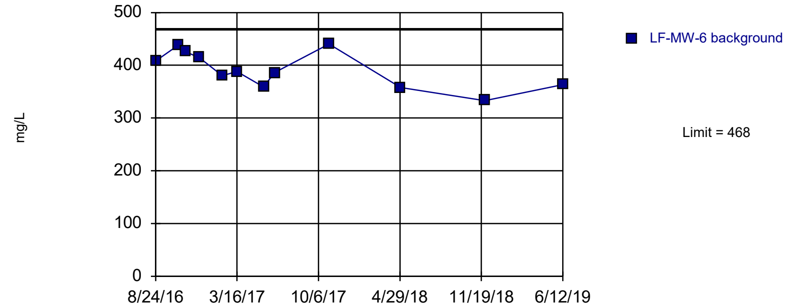
Background Data Summary: Mean=388.3, Std. Dev.=15.14, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9298, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-6 (bg)



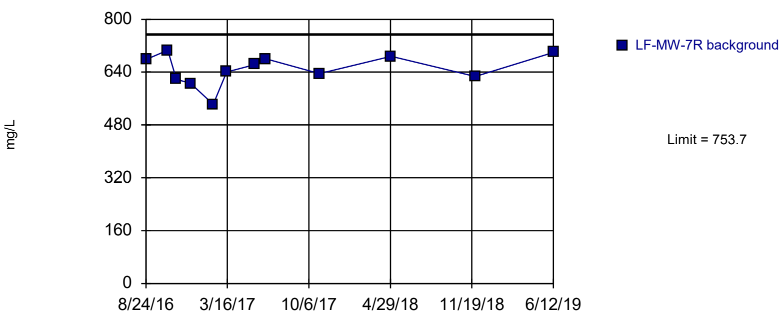
Background Data Summary: Mean=391.1, Std. Dev.=34.47, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9536, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-7R (bg)



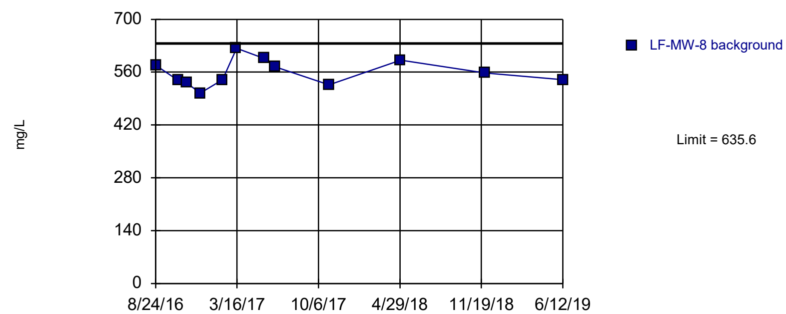
Background Data Summary: Mean=648.7, Std. Dev.=47.06, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9292, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-8 (bg)



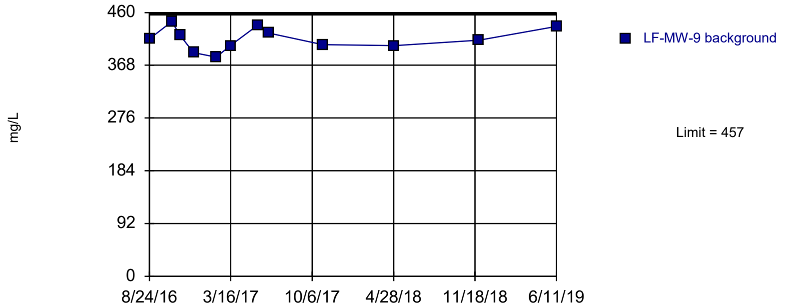
Background Data Summary: Mean=558.4, Std. Dev.=34.57, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9635, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, LF-MW-9 (bg)



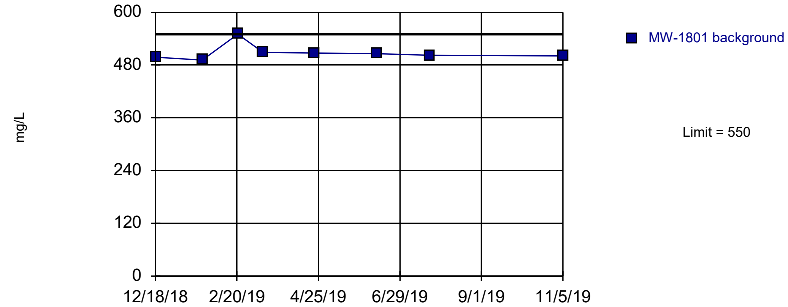
Background Data Summary: Mean=414, Std. Dev.=19.28, n=12. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9681, critical = 0.805. Kappa = 2.232 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Non-parametric, MW-1801



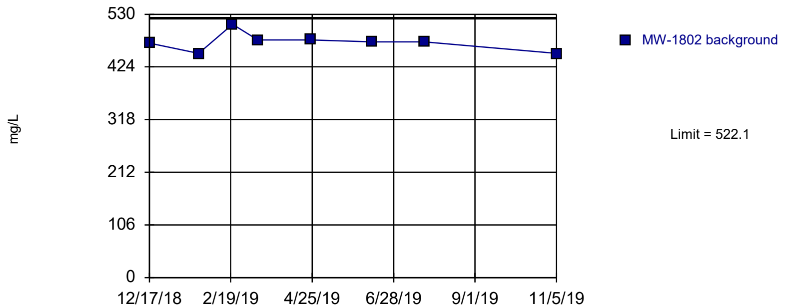
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 8 background values. Well-constituent pair annual alpha = 0.04242. Individual comparison alpha = 0.02144 (1 of 2). Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Sanitas™ v.9.6.25a Sanitas software utilized by Groundwater Stats Consulting. UG

Prediction Limit

Intrawell Parametric, MW-1802



Background Data Summary: Mean=473.7, Std. Dev.=18.49, n=8. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.863, critical = 0.749. Kappa = 2.616 (c=7, w=4, 1 of 2, event alpha = 0.05132). Report alpha = 0.00188. Assumes 1 future value.

Constituent: Total Dissolved Solids Analysis Run 5/30/2020 9:56 AM View: PLs
Amos Landfill Client: Geosyntec Data: Amos LF

Geosyntec consultants

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Memorandum

Date:	April 3, 2020
To:	David Miller (AEP)
Copies to:	Benjamin Kepchar (AEP)
From:	Allison Kreinberg (Geosyntec)
Subject:	Evaluation of Detection Monitoring Data at Amos Plant's Landfill (LF)

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the second semi-annual detection monitoring event at the Landfill (LF), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia was completed on November 5-6, 2019. Based on the results, verification sampling was completed on February 11, 2020.

Background values for the LF were previously calculated in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background and the dataset was updated as appropriate. Revised upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated February 27, 2020.

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 concluded only if both samples in a series of two exceed the UPL (or are below the LPL for pH). 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.

- Calcium concentrations exceeded the intrawell UPL of 18.1 mg/L in both the initial (18.3 mg/L) and second (18.5 mg/L) samples collected at MW-5. While the results of the duplicate sample collected during the second event (17.1 mg/L) were below the UPL, an SSI over background is concluded for calcium at MW-5 based on the results of the parent sample.

In response to the exceedance noted above, the Amos LF CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for calcium will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Amos LF will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Landfill

Parameter	Unit	Description	MW-1	MW-2		MW-4	MW-5	MW-5
			11/6/2019	11/6/2019	2/11/2020	11/6/2019	11/5/2019	2/11/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.162	0.247		0.214	0.135	
		Detection Monitoring Result	0.0400	0.203	--	0.173	0.0300	--
Calcium	mg/L	Intrawell Background Value (UPL)	31.7	2.10		0.912	18.1	
		Detection Monitoring Result	30.1	1.73	--	0.761	**18.3**	**18.5***
Chloride	mg/L	Intrawell Background Value (UPL)	3.60	5.40		15.9	5.37	
		Detection Monitoring Result	3.20	3.44	--	14.9	5.21	--
Fluoride	mg/L	Intrawell Background Value (UPL)	0.124	1.61		1.52	0.148	
		Detection Monitoring Result	0.100	**1.66**	1.37	1.49	0.100	--
pH	SU	Intrawell Background Value (UPL)	7.3	9.0		10.1	8.2	
		Intrawell Background Value (LPL)	5.8	8.2		8.3	6.0	
		Detection Monitoring Result	6.2	8.6	--	9.2	6.0	--
Sulfate	mg/L	Intrawell Background Value (UPL)	32.8	12.9		12.2	30.7	
		Detection Monitoring Result	29.4	9.50	--	9.40	28.3	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	259	394		422	166	
		Detection Monitoring Result	193	379	--	382	131	--

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
*Duplicate sample result was 17.1 mg/L, which is below 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 February 27, 2020 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

22663	WEST VIRGINIA	04.06.2020
License Number	Licensing State	Date

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Memorandum

Date: July 29, 2020

To: David Miller (AEP)

Copies to: Benjamin Kepchar (AEP)

From: Allison Kreinberg (Geosyntec)

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

In accordance with the United States Environmental Protection Agency's (USEPA's) regulations regarding the disposal of coal combustion residuals (CCR) in landfills and surface impoundments (40 CFR 257 Subpart D, "CCR rule"), the first semi-annual detection monitoring event at the Landfill (LF), an existing CCR unit at the Amos Power Plant located in Winfield, West Virginia, was completed on May 5-7, 2020. Based on the results, verification sampling was completed on July 7, 2020.

Background values for the LF were previously calculated in January 2018. After a minimum of four detection monitoring events, the results of those events were compared to the existing background and the dataset was updated as appropriate. Revised upper prediction limits (UPLs) were calculated for each Appendix III parameter to represent background values. Lower prediction limits (LPLs) were also calculated for pH. Details on the calculation of these revised background values are described in Geosyntec's *Statistical Analysis Summary* report, dated February 27, 2020. In May 2020, monitoring wells MW-1 and MW-5 were removed from the groundwater monitoring network and replaced with wells MW-1801 and MW-1802. Following completion of eight background monitoring events, UPLs and LPLs were calculated for MW-1801 and MW-1802, as described in Geosyntec's *Statistical Analysis Summary – Background Update Calculations* report, dated July 8, 2020.

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 concluded only if both samples in a series of two exceed the UPL (or are below the LPL for pH). 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.

- Calcium concentrations exceeded the intrawell UPL of 2.10 mg/L in both the initial (2.76 mg/L) and second (2.74 mg/L) samples collected at MW-2. Thus, an SSI over background is concluded for calcium at MW-2.

In response to the exceedance noted above, the Amos LF CCR unit will either transition to assessment monitoring or an alternative source demonstration (ASD) for calcium will be conducted in accordance with 40 CFR 257.94(e)(2). If the ASD is successful, the Amos LF will remain in detection monitoring.

The statistical analysis was conducted within 90 days of completion of sampling and analysis in accordance with 40 CFR 257.93(h)(2). A certification of these statistics by a qualified professional engineer is provided in Attachment A.

Table 1: Detection Monitoring Data Evalation
Amos Plant - Landfill

Parameter	Unit	Description	MW-2		MW-4	MW-1801	MW-1802
			5/5/2020	7/7/2020	5/5/2020	5/7/2020	5/7/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.247		0.214	0.306	0.276
		Detection Monitoring Result	0.174	--	0.150	0.252	0.258
Calcium	mg/L	Intrawell Background Value (UPL)	2.10		0.912	1.83	0.978
		Detection Monitoring Result	**2.76**	**2.74**	0.790	1.65	0.963
Chloride	mg/L	Intrawell Background Value (UPL)	5.40		15.9	12.1	10.2
		Detection Monitoring Result	5.08	--	15.2	11.6	9.12
Fluoride	mg/L	Intrawell Background Value (UPL)	1.61		1.52	5.67	5.36
		Detection Monitoring Result	1.37	--	1.37	4.98	4.91
pH	SU	Intrawell Background Value (UPL)	9.0		10.1	9.5	9.5
		Intrawell Background Value (LPL)	8.2		8.3	8.5	8.7
		Detection Monitoring Result	8.6	--	9.2	8.9	8.8
Total Dissolved Solids (TDS)	mg/L	Intrawell Background Value (UPL)	394		422	550	522
		Detection Monitoring Result	368	--	397	541	490
Sulfate	mg/L	Intrawell Background Value (UPL)	12.9		12.2	8.88	22.4
		Detection Monitoring Result	7.8	--	8.4	6.8	15.2

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

ATTACHMENT A

Certification by a Qualified Professional Engineer

CERTIFICATION BY QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected statistical method, described above and in the July 8, 2020 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Amos LF CCR management area and that the requirements of 40 CFR 257.93(f) have been met.

DAVID ANTHONY MILLER
Printed Name of Licensed Professional Engineer

David Anthony Miller
Signature

DAVID ANTHONY MILLER
REGISTERED
22663
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

22663
License Number

WEST VIRGINIA
Licensing State

08.03.2020
Date

APPENDIX 3

The alternative source demonstrations follow.

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Amos Plant Landfill
Winfield, West Virginia

Submitted to

AMERICAN ELECTRIC POWER

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

June 25, 2020

CHA8495

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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
mg/L	Milligram per liter
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

1.1 Introduction

This Alternative Source Demonstration (ASD) report has been prepared to address a statistically significant increase (SSI) for calcium at the Amos Plant Landfill (Landfill) following the second semi-annual detection monitoring event of 2019.

Following completion of four detection monitoring events, the previously calculated upper prediction limits (UPLs) for the Landfill were recalculated for each Appendix III parameter to represent background values (Geosyntec, 2020). A lower prediction limit (LPL) was also recalculated for pH. The revised prediction limits were calculated based on a one-of-two retesting procedure in accordance with the Unified Guidance (USEPA, 2009) and the statistical analysis plan developed for the site (AEP, 2017). With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL, or in the case of pH are below the LPL.

The second semi-annual detection monitoring event of 2019 was performed in November 2019 (initial sampling event) and February 2020 (verification sampling event) and the results were compared to the recalculated prediction limits. During this detection monitoring event, an SSI was identified for calcium at MW-5 based on an intrawell comparison. A summary of the detection monitoring analytical results for all constituents listed in 40 CFR Part 257 Appendix III and the calculated prediction limits to which they were compared is provided in **Table 1**.

1.2 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (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 2019 was completed in November 2019 and February 2020 to identify SSIs over background limits. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report to identify whether the SSL identified for calcium at MW-5 is from a source other than the Landfill.

1.3 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:

- 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 assess whether the increase in calcium at MW-5 was based on a Type IV cause (Natural Variation) and not by a release from the Amos Plant Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

A brief description of the site geology, ASD evaluation methodology, and the proposed alternative source are described below.

2.1 Site Geology Summary

The Amos Plant Landfill site consists of a northern valley and southern valley, both of which are surrounded on all sides by bedrock ridges (**Figure 1**). A topographic high point separates the two valleys (Arcadis, 2016), as shown in **Figure 2**. MW-5 is a downgradient well for the northern valley, which is hydrologically separate from the southern valley. MW-5 is screened from 5 to 10 feet below ground surface within a perched aquifer consisting of shallow alluvium (**Figure 3**).

Bedrock beneath MW-5 consists of a combination of gray siltstone, silty shale, and red claystone. These lithologies make up part of the Pennsylvanian Monongahela and Conemaugh Formations. Groundwater flows through these formations primarily in stress relief fractures that are associated with erosion (Arcadis, 2016).

2.2 Examination of Alternative Sources

Initial review of site geochemistry, site historical data, and laboratory QA/QC did not identify an ASD due to Type I (sampling) or Type II (laboratory) causes. A review of the statistical methods used did not identify any Type III (statistical) causes. As described below, the SSI was attributed to natural variation, which is a Type IV cause.

Calcium concentrations at upgradient wells MW-8 and MW-9, both of which are also located on the northern side of the topographic divide, have consistently been above those observed at MW-5 (**Figure 4**). The high calcium concentrations as MW-8 and MW-9 also indicate that the native geologic material (which is predominantly claystone and sandstone) contains calcium that may be released into solution at higher concentrations than typically found at MW-5. Because MW-5 is set within a perched zone, it is particularly likely to be influenced by seasonal variations in groundwater migration and surface water intrusion through material that is not typically saturated. For these reasons, MW-5 was removed from the groundwater monitoring network and replaced with a well screened within the continuous upper aquifer (Arcadis, 2020).

A duplicate sample was collected at MW-5 during the verification sampling event in February 2020. The reported calcium concentration for the duplicate sample was 17.1 milligrams per liter (mg/L), which is below the calcium UPL of 18.1 mg/L (**Table 1**). The analytical results for the verification sampling event are provided in **Attachment A**. The results of this duplicate sample provide an additional line of evidence that the reported increase in calcium during the semiannual detection monitoring event is affected by variability instead of a release from the LF.

2.3 Sampling Requirements

The conclusions of this ASD support the determination that the identified SSI is from natural variation and not due to a release from the Landfill. Therefore, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semiannual 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 conclusion that the SSI for calcium at MW-5 is attributed to natural variation. Based on the results of the duplicate sample collected during verification monitoring, and the calcium concentrations in MW-8 and -9, the SSI for calcium should not be attributed to a release from the Landfill. Therefore, no further action is warranted, and the Amos Plant Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment B**.

SECTION 4

REFERENCES

AEP, 2017. Statistical Analysis Plan – John E. Amos Plant. January.

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

Arcadis, 2020. FGD Landfill – CCR Revised Groundwater Monitoring Well Network Evaluation. May.

Geosyntec Consultants, 2020. Statistical Analysis Summary – Background Update Calculations. John E. Amos Plant Landfill. Winfield, West Virginia. February.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March

USEPA, 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

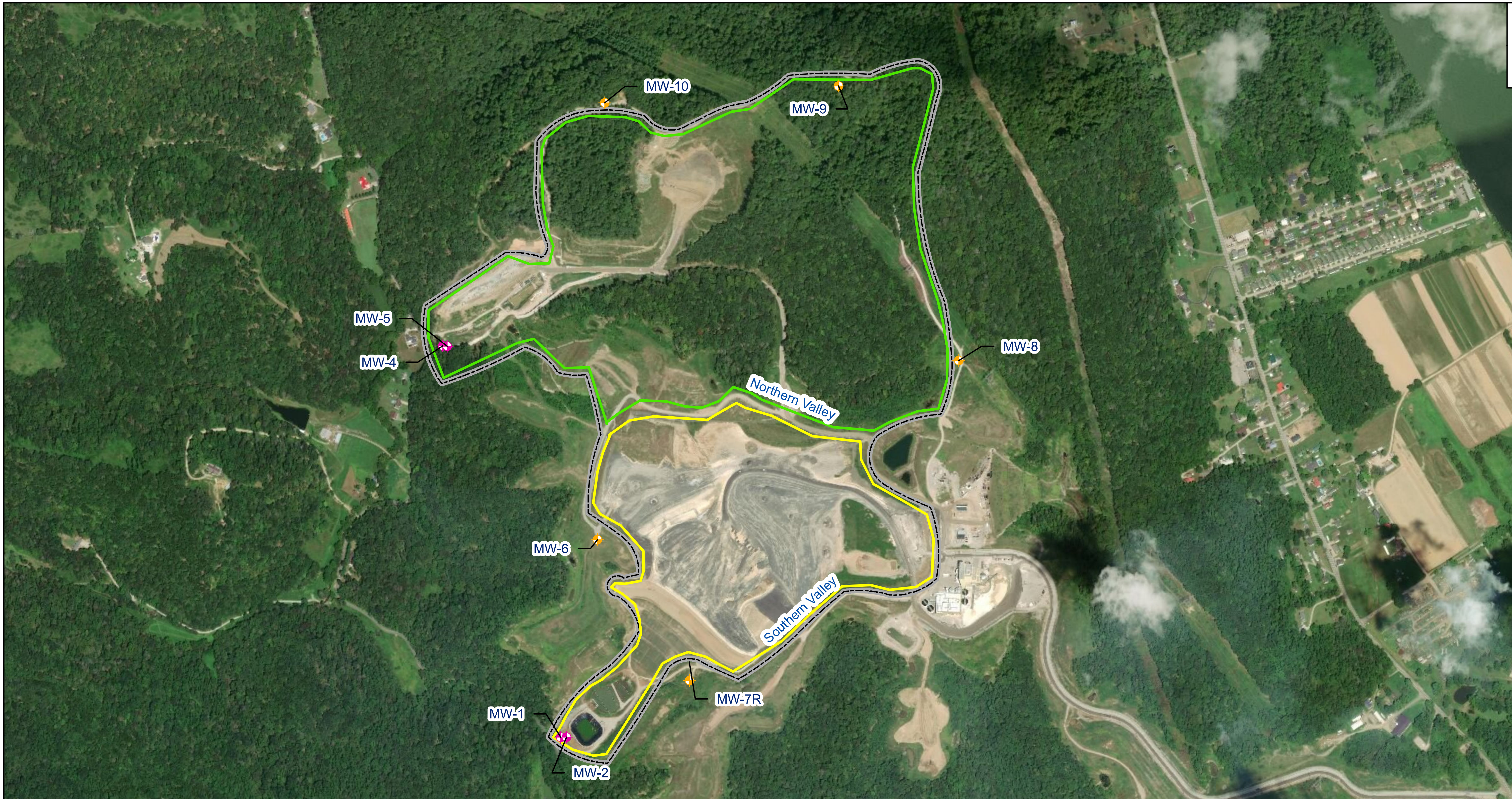
DRAFT - PRIVILEGED AND CONFIDENTIAL
PREPARED AT REQUEST OF COUNSEL

Table 1: Detection Monitoring Data Evaluation
Amos Plant - Landfill

Parameter	Unit	Description	MW-1	MW-2		MW-4	MW-5	MW-5
			11/6/2019	11/6/2019	2/11/2020	11/6/2019	11/5/2019	2/11/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.162	0.247		0.214	0.135	
		Detection Monitoring Result	0.0400	0.203	--	0.173	0.0300	--
Calcium	mg/L	Intrawell Background Value (UPL)	31.7	2.10		0.912	18.1	
		Detection Monitoring Result	30.1	1.73	--	0.761	**18.3**	**18.5***
Chloride	mg/L	Intrawell Background Value (UPL)	3.60	5.40		15.9	5.37	
		Detection Monitoring Result	3.20	3.44	--	14.9	5.21	--
Fluoride	mg/L	Intrawell Background Value (UPL)	0.124	1.61		1.52	0.148	
		Detection Monitoring Result	0.100	**1.66**	1.37	1.49	0.100	--
pH	SU	Intrawell Background Value (UPL)	7.3	9.0		10.1	8.2	
		Intrawell Background Value (LPL)	5.8	8.2		8.3	6.0	
		Detection Monitoring Result	6.2	8.6	--	9.2	6.0	--
Sulfate	mg/L	Intrawell Background Value (UPL)	32.8	12.9		12.2	30.7	
		Detection Monitoring Result	29.4	9.50	--	9.40	28.3	--
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	259	394		422	166	
		Detection Monitoring Result	193	379	--	382	131	--

Notes:
UPL: Upper prediction limit
LPL: Lower prediction limit
Bold values exceed the background value.
Background values are shaded gray.
*Duplicate sample result was 17.1 mg/L, which is below the UPL.

FIGURES



Legend

- Upgradient Sampling Location
- Downgradient Sampling Location

Name

- Northern Valley
- Southern Valley
- FGD Landfill Permitted Limits

Notes

- Monitoring well coordinates provided by AEP.
- Aerial imagery provided by DigitalGlobe and dated 8/302/2016.

Site Layout
FGD Landfill

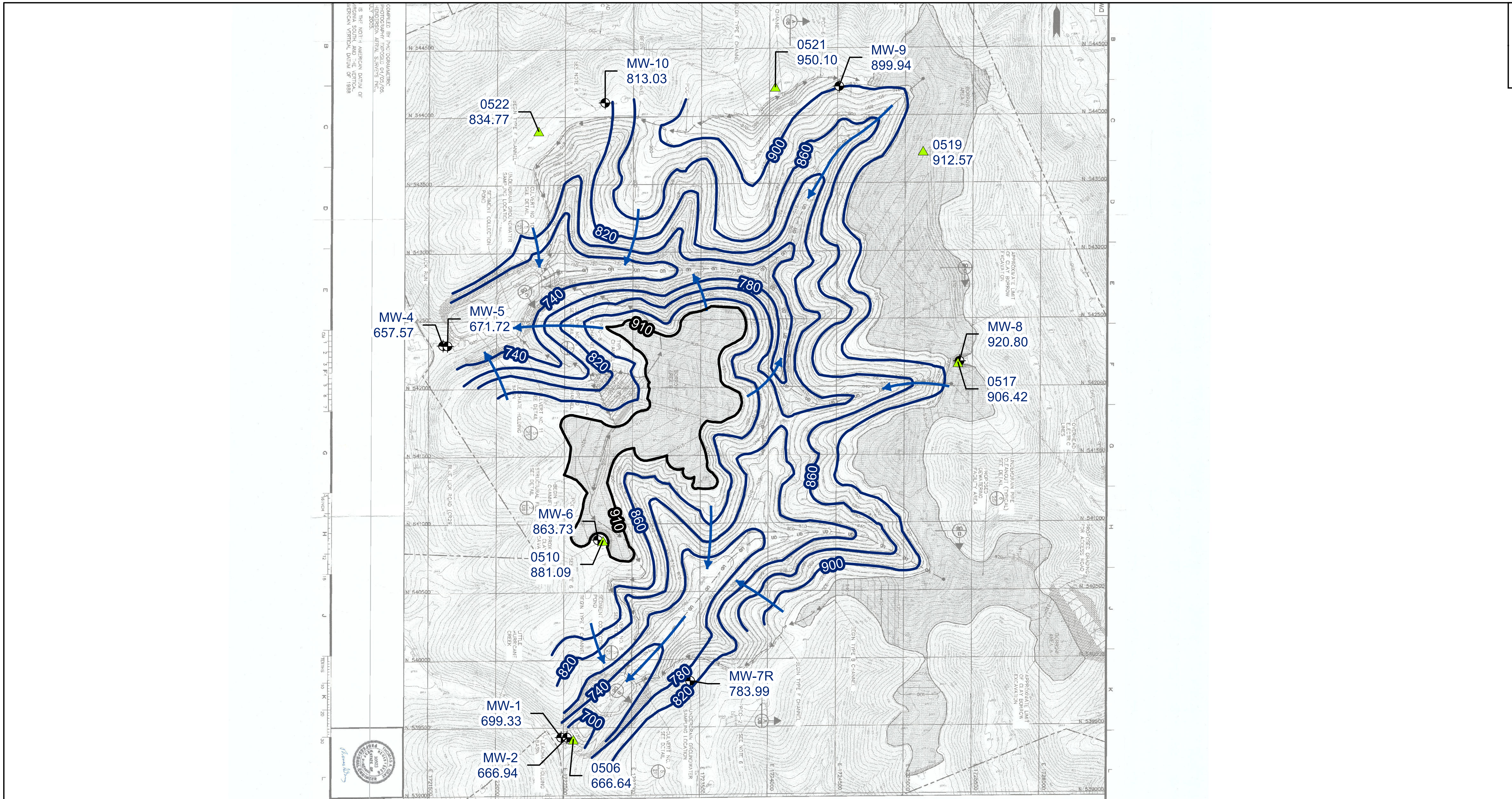
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/06/01

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_Site_Layout_GW Flow_2018-04_April.mxd. BAres. 9/28/2018. CHA8423/04/08.



Legend

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

Notes

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

700 350 0 700 Feet

Potentiometric Surface Map - Uppermost Aquifer
November 2019

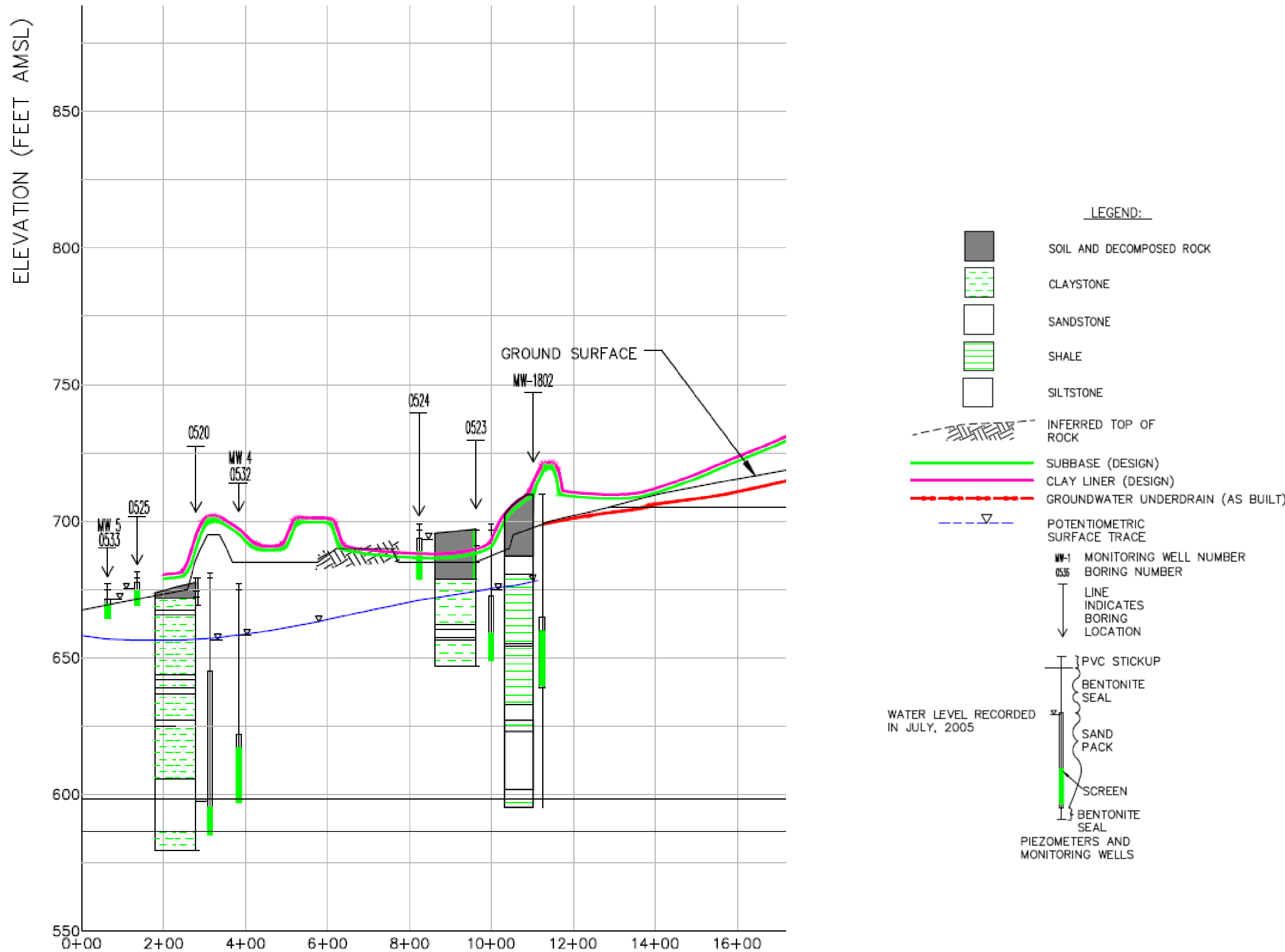
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Figure **2**

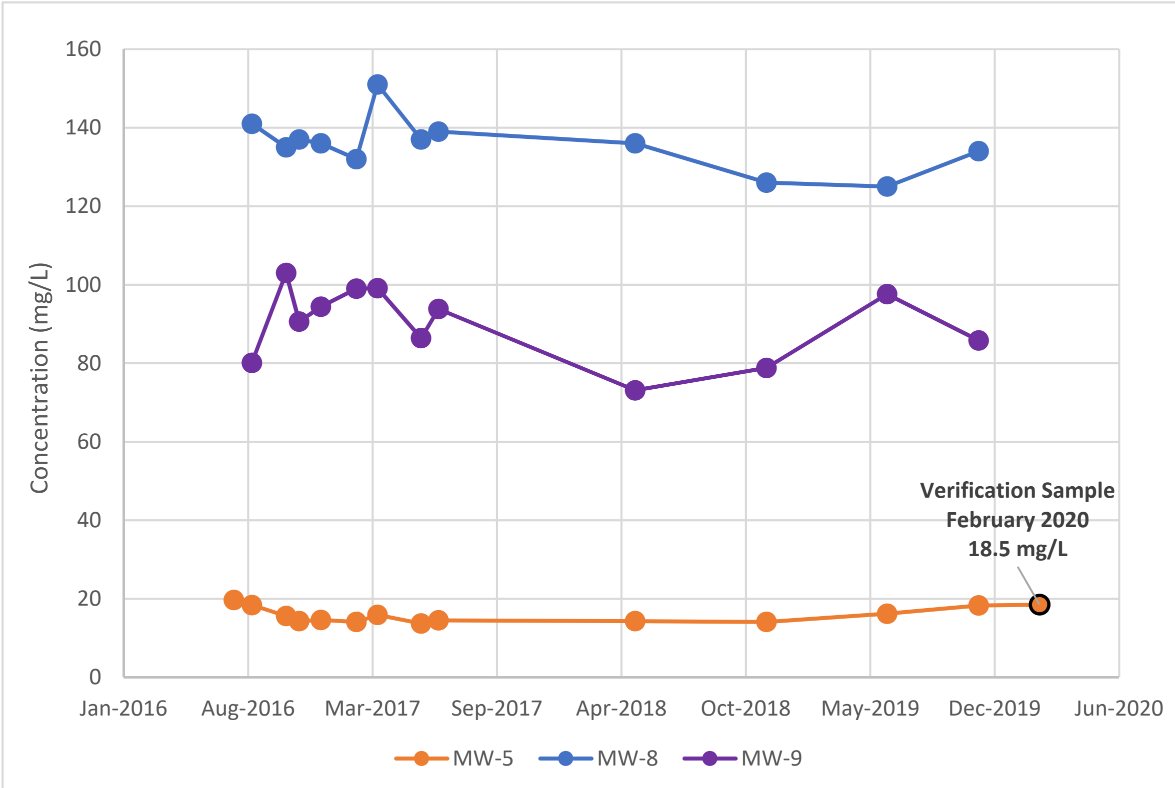
Columbus, Ohio | 2020/06/05

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



Notes:
MW-5 is located in a perched aquifer on the left side of the cross-section segment. The topographic high is located beyond the extend of the figure to the NE (right side). Source figure provided by Arcadis (Figure 6B, Groundwater Monitoring Well Network Evaluation, May 2020).

Northern Valley Cross Section Segment AEP Amos Generating Plant Winfield, West Virginia	
Geosyntec consultants	Figure 3
Columbus, Ohio — 2020/06/01	



Notes: MW-8 and MW-9 are upgradient monitoring locations. Calcium data were collected under the federal CCR rule and represent total calcium in groundwater. A duplicate sample collected at the same time as the MW-5 verification sample had a reported calcium concentration of 17.1 milligrams per liter (mg/L).

Calcium Comparison to Upgradient Wells

AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure 4

Columbus, Ohio

2020/06/05

internal info: path, date revised, author

ATTACHMENT A

February 2020 Verification Sampling Analytical Laboratory Report

Form REP-703
Rev. 1, 11/2013

AEP AMERICAN ELECTRIC POWER

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: 2/19/2020***

CCR LF MW-2

Sample Number: **200457-001** **Date Collected:** **02/11/2020 12:15** **Date Received:** **2/12/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Fluoride, F	1.37	mg/L		0.2	0.04	CRJ	02/12/2020 16:03	EPA 300.1-1997, Rev. 1.0

CCR LF MW-5

Sample Number: **200457-002** **Date Collected:** **02/11/2020 09:55** **Date Received:** **2/12/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Calcium, Ca	18.5	mg/L		0.3	0.1	DAM	02/14/2020 16:11	EPA 200.7-1994, Rev. 4.4

Dup-1

Sample Number: **200457-003** **Date Collected:** **02/11/2020** **Date Received:** **2/12/2020**

Parameter	Result	Units	Data Qual	RL	MDL	Analysis By	Analysis Date/Time	Method
Calcium, Ca	17.1	mg/L		0.3	0.1	DAM	02/14/2020 16:15	EPA 200.7-1994, Rev. 4.4

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

Michael S Ohlinger (signature)

Michael Ohlinger, Chemist
Email msohlinger@aep.com *Tel.*
Fax 614-836-4168 *Audinet 8-210-*

ATTACHMENT B

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 Plant Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

John Seymour
Printed Name of Licensed Professional Engineer

[signature]
Signature

017091
License Number

West Virginia
Licensing State

JOHN P. SEYMOUR
REGISTERED
17091
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

6/25/2020
Date

ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

Amos Plant Landfill
Winfield, West Virginia

Submitted to

American Electric Power

1 Riverside Plaza
Columbus, Ohio 43215-2372

Submitted by

Geosyntec consultants

engineers | scientists | innovators

941 Chatham Lane, Suite 103
Columbus, Ohio 43221

October 26, 2020

CHA8495

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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
LPL	Lower Prediction Limit
mg/L	Milligram per liter
QC	Quality Control
SSI	Statistically Significant Increase
UPL	Upper Prediction Limit
USEPA	United States Environmental Protection Agency

SECTION 1

INTRODUCTION AND SUMMARY

1.1 Introduction

This Alternative Source Demonstration (ASD) report has been prepared to address a statistically significant increase (SSI) for calcium at the Amos Plant Landfill (Landfill) following the first semi-annual detection monitoring event of 2020.

Following completion of four detection monitoring events, the previously calculated upper prediction limits (UPLs) for the Landfill were recalculated for each Appendix III parameter to represent background values (Geosyntec, 2020). A lower prediction limit (LPL) was also recalculated for pH. The revised prediction limits were calculated based on a one-of-two retesting procedure in accordance with the Unified Guidance (USEPA, 2009) and the statistical analysis plan developed for the site (AEP, 2017). With this procedure, a statistically significant increase (SSI) is concluded only if both samples in a series of two exceed the UPL, or in the case of pH are below the LPL.

The first semi-annual detection monitoring event of 2020 was performed in May 2020 (initial sampling event) and July 2020 (verification sampling event) and the results were compared to the recalculated prediction limits. During this detection monitoring event, an SSI was identified for calcium at MW-2 based on an intrawell comparison. A summary of the detection monitoring analytical results for all constituents listed in 40 CFR Part 257 Appendix III and the calculated prediction limits to which they were compared is provided in **Table 1**.

1.2 CCR Rule Requirements

In accordance with the United States Environmental Protection Agency (USEPA) regulations regarding the disposal of coal combustion residuals (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 first semi-annual detection monitoring event for 2020 was completed in May 2020 and July 2020 to identify SSIs over background limits. Pursuant to 40 CFR 257.94(e)(2), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report to identify whether the SSI identified for calcium at MW-2 is from a source other than the Landfill.

1.3 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:

- 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 assess whether the increase in calcium at MW-2 was based on a Type IV cause (Natural Variation) and not by a release from the Amos Plant Landfill.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

A brief description of the site geology, ASD evaluation methodology, and the proposed alternative source are described below.

2.1 Site Geology Summary

The Amos Plant Landfill site consists of a northern valley and southern valley, both of which are surrounded on all sides by bedrock ridges (**Figure 1**). A topographic high point separates the two valleys (Arcadis, 2020), as shown in **Figure 2**. MW-2 is a downgradient well for the southern valley, which is hydrologically separate from the northern valley. Bedrock in the vicinity of MW-2 consists of a combination of gray siltstone, silty shale, and red claystone. These lithologies make up part of the Pennsylvanian Monongahela and Conemaugh Formations. These formations contain a system of stress relief fractures that are associated with a decline in stress and erosion (Arcadis, 2020). Groundwater flows through these formations primarily in these stress fractures. Bedrock groundwater flow generally follows surface topography, flowing downslope of ridges towards valley floors (Arcadis, 2020).

2.2 Examination of Alternative Sources

Initial review of site geochemistry, site historical data, and laboratory QA/QC did not identify an ASD due to Type I (sampling) or Type II (laboratory) causes. A review of the statistical methods used did not identify any Type III (statistical) causes. Therefore, natural variation, which is a Type IV cause, was examined as a potential cause of the SSI.

Calcium concentrations at upgradient wells MW-6 and MW-7R, both of which are also located on the southern side of the topographic divide, have consistently been above those observed at MW-2 (**Figure 3**). The high calcium concentrations at MW-6 and MW-7R indicate that the native geologic material (which is predominantly claystone and sandstone) contains calcium that may be released into solution at higher concentrations than those typically found at MW-2. Thus, the changes in calcium concentration at MW-2 are attributable to natural variation.

2.3 Sampling Requirements

The conclusions of this ASD support the determination that the identified SSI is from natural variation and not due to a release from the Landfill. Therefore, the unit will remain in the detection monitoring program. Groundwater at the unit will be sampled for Appendix III parameters on a semiannual 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 conclusion that the SSI for calcium at MW-2 is attributed to natural variation. Therefore, no further action is warranted, and the Amos Plant Landfill will remain in the detection monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment A**.

SECTION 4

REFERENCES

AEP, 2017. Statistical Analysis Plan – John E. Amos Plant. January.

Arcadis, 2020. FGD Landfill – CCR Revised Groundwater Monitoring Well Network Evaluation. May.

Geosyntec Consultants, 2020. Statistical Analysis Summary – Background Update Calculations. John E. Amos Plant Landfill. Winfield, West Virginia. February.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March

USEPA, 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

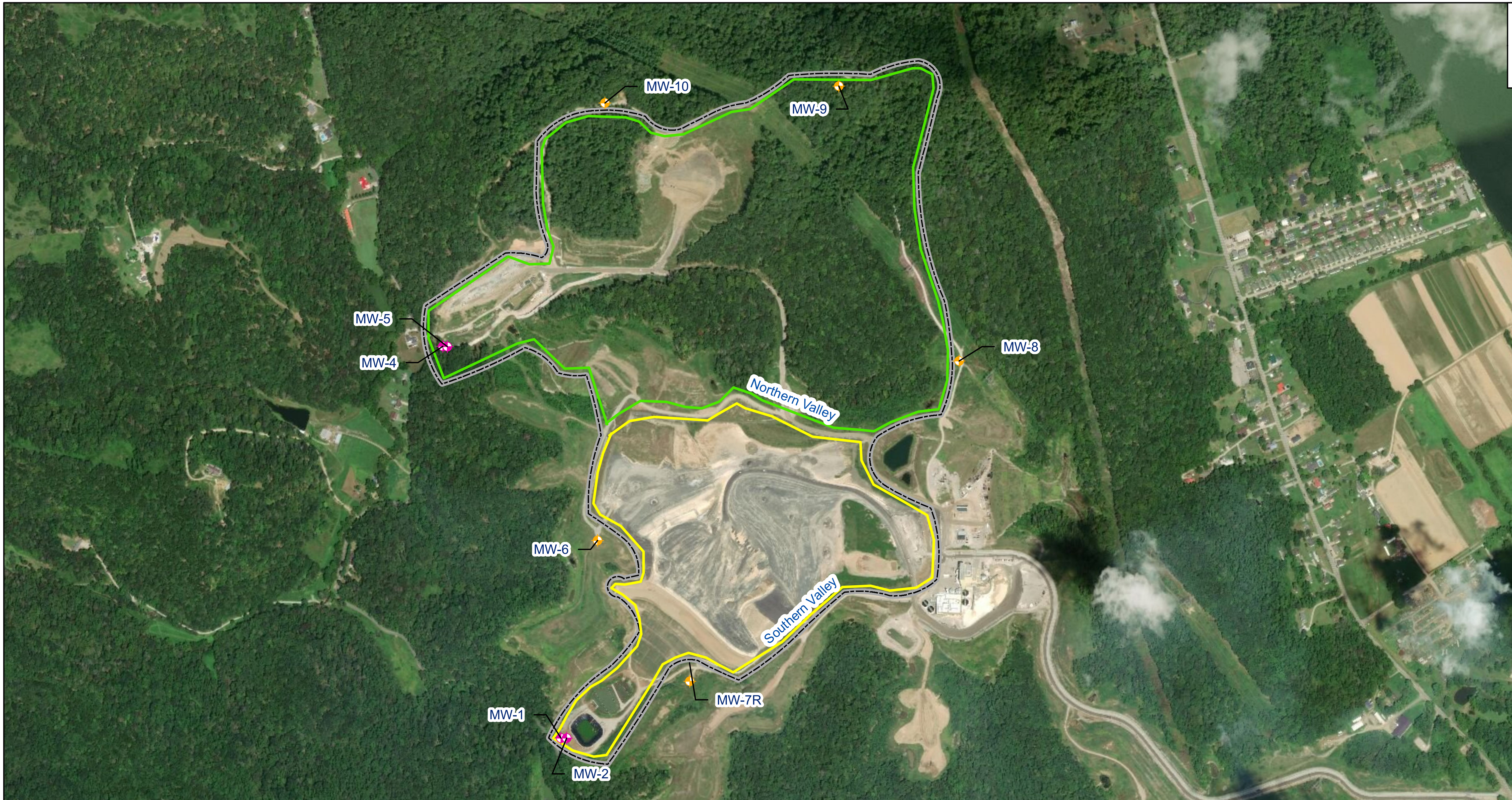
Geosyntec Consultants, Inc.

Table 1: Detection Monitoring Data Evalation
Amos Plant - Landfill

Parameter	Unit	Description	MW-2		MW-4	MW-1801	MW-1802
			5/5/2020	7/7/2020	5/5/2020	5/7/2020	5/7/2020
Boron	mg/L	Intrawell Background Value (UPL)	0.247		0.214	0.306	0.276
		Detection Monitoring Result	0.174	--	0.150	0.252	0.258
Calcium	mg/L	Intrawell Background Value (UPL)	2.10		0.912	1.83	0.978
		Detection Monitoring Result	**2.76**	**2.74**	0.790	1.65	0.963
Chloride	mg/L	Intrawell Background Value (UPL)	5.40		15.9	12.1	10.2
		Detection Monitoring Result	5.08	--	15.2	11.6	9.12
Fluoride	mg/L	Intrawell Background Value (UPL)	1.61		1.52	5.67	5.36
		Detection Monitoring Result	1.37	--	1.37	4.98	4.91
pH	SU	Intrawell Background Value (UPL)	9.0		10.1	9.5	9.5
		Intrawell Background Value (LPL)	8.2		8.3	8.5	8.7
		Detection Monitoring Result	8.6	--	9.2	8.9	8.8
Total Dissolved Solids (TDS)	mg/L	Intrawell Background Value (UPL)	394		422	550	522
		Detection Monitoring Result	368	--	397	541	490
Sulfate	mg/L	Intrawell Background Value (UPL)	12.9		12.2	8.88	22.4
		Detection Monitoring Result	7.8	--	8.4	6.8	15.2

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

FIGURES



Legend

- Upgradient Sampling Location
- Downgradient Sampling Location

Name

- Northern Valley
- Southern Valley
- FGD Landfill Permitted Limits

Notes

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

Site Layout
FGD Landfill

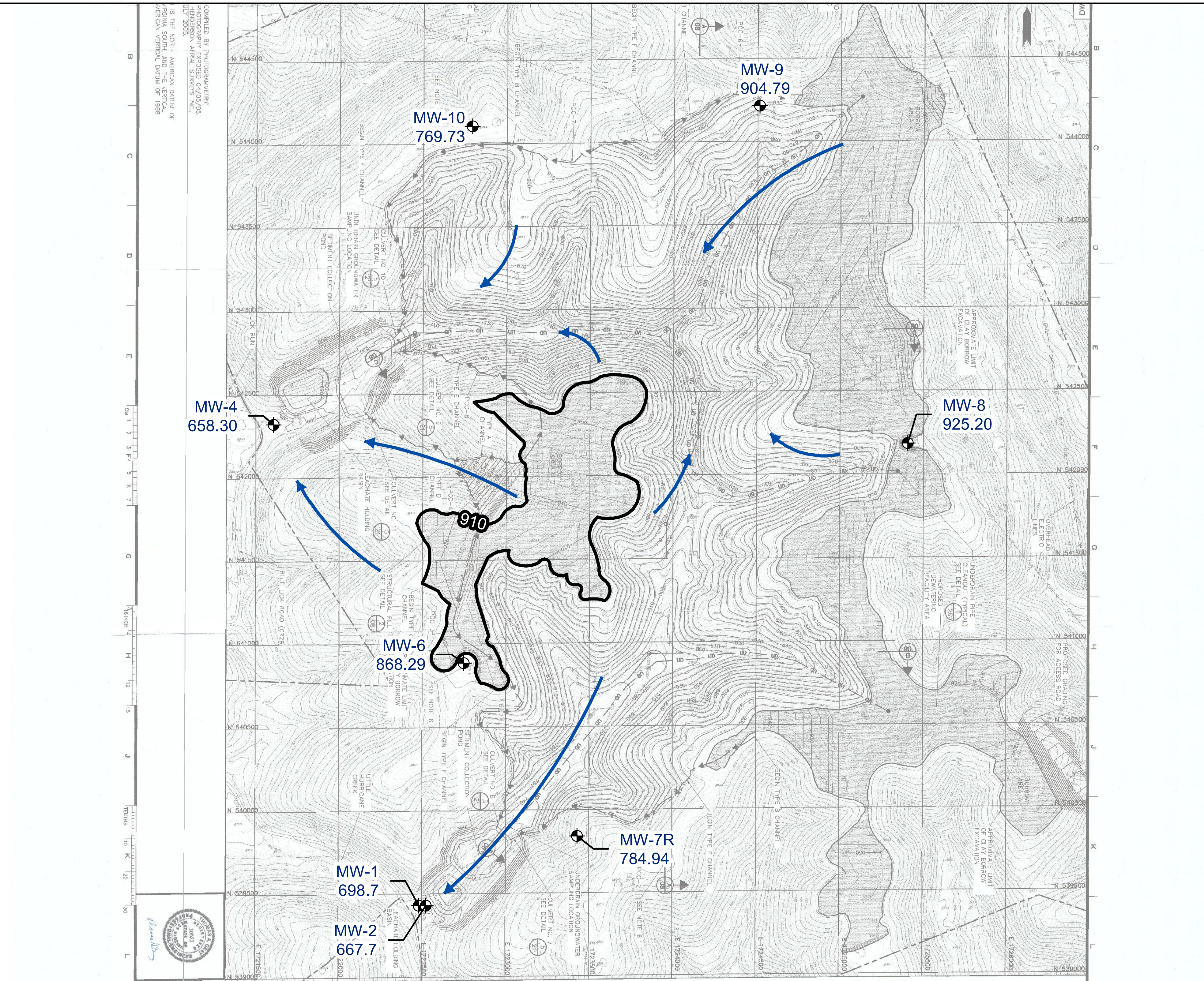
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/09/17

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\AEP-Amos_Landfill_Site_Layout_GW Flow_2018-04_April.mxd. BAres. 9/28/2018. CHA8423/04/08.



Legend

- Groundwater Monitoring Well
- Flow Direction
- Ridge Peak Contour - Drainage Divide

Notes

- Monitoring well coordinates and water level data (collected on May 4, 2020) provided by AEP.
- 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.
- The black line indicates the maximum elevation of the central ridge.

700 350 0 700 Feet

Groundwater Flow Direction Map
Uppermost Aquifer - May 2020

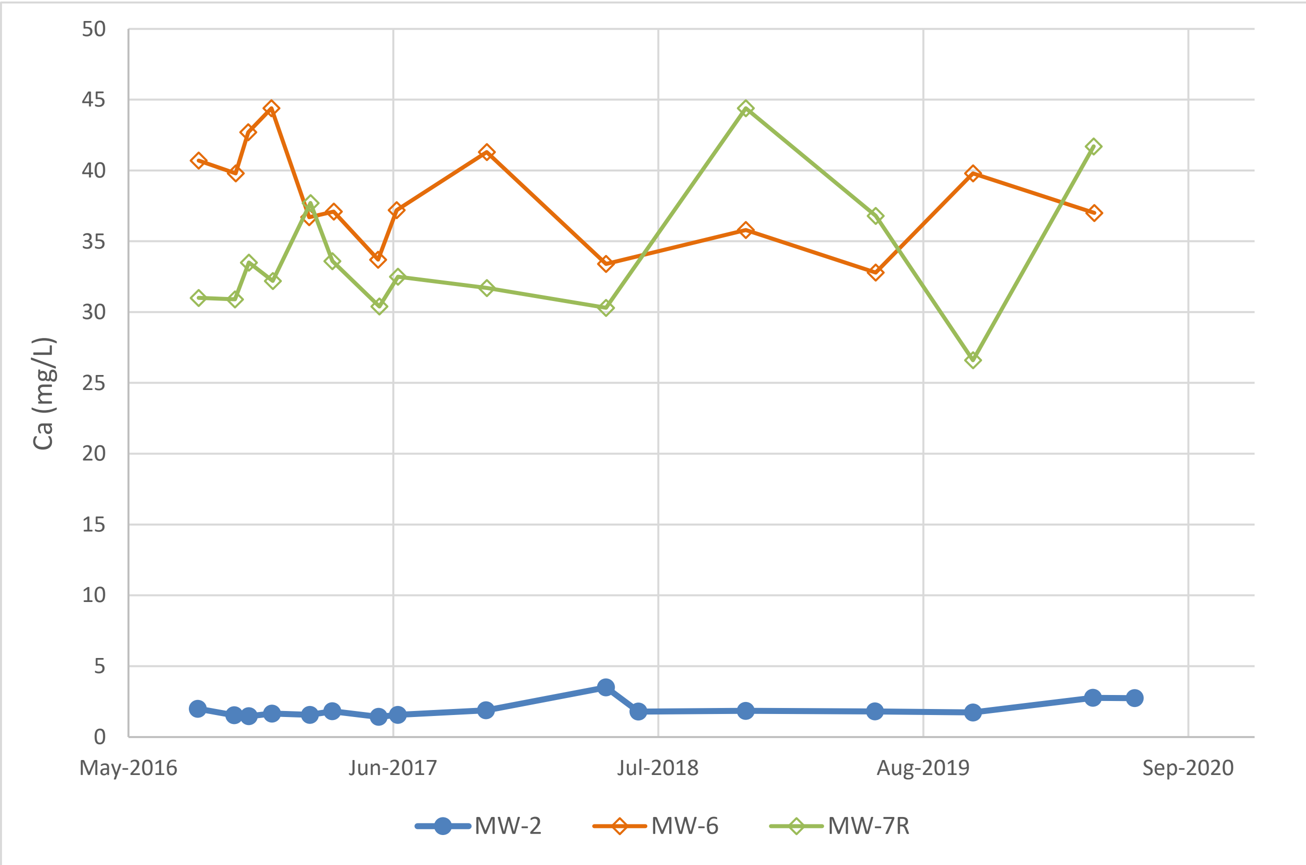
AEP Amos Generating Plant
Winfield, West Virginia

Geosyntec consultants

Columbus, Ohio | 2020/10/26

Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Amos\2020\No Contour ASD_edit_AEP-Amos_Landfill_GW_2020-05.mxd. BAres. 10/26/2020. CHA8423/04/08.



Notes: MW-6 and MW-7R are upgradient monitoring locations. Calcium data were collected under the federal CCR rule and represent total calcium in groundwater. All three wells are screened in the Pennsylvanian Monongahela and Conemaugh Formations.

Calcium Comparison to Upgradient Wells

Mitchell Landfill

Geosyntec consultants

AMERICAN ELECTRIC POWER

Figure **3**

Columbus, Ohio

17-September-2020

internal info: path, date revised, author

ATTACHMENT A

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 Plant Landfill CCR management area and that the requirements of 40 CFR 257.94(e)(2) have been met.

JOHN P. SEYMOUR
REGISTERED
17091
STATE OF
WEST VIRGINIA
PROFESSIONAL ENGINEER

John Seymour
Printed Name of Licensed Professional Engineer

Signature

017091	West Virginia	October 29, 2020
License Number	Licensing State	Date

APPENDIX 4

Not applicable.

APPENDIX 5

Not applicable.