

# **Annual Groundwater Monitoring Report**

Southwestern Electric Power Company

John W. Turk Power Plant

Landfill CCR Management Unit

Fulton, Arkansas

**January 2021**

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An **AEP** Company

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## I. Overview

This *Annual Groundwater Monitoring Report* (Report) has been prepared to report the status of activities for the preceding year for an existing CCR unit at Southwestern Electric Power Company's, a wholly-owned subsidiary of American Electric Power Company (AEP), Turk 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, 2021.

At the beginning of 2020 the landfill was in detection monitoring. At the end of 2020 the landfill was still in detection monitoring.

In general, the following activities were completed:

- Groundwater samples were collected and analyzed for Appendix III constituents, as specified in 40 CFR 257.94 *et seq.* and AEP's *Groundwater Sampling and Analysis Plan (2016)*;
- Groundwater data underwent various validation tests, including tests for completeness, valid values, transcription errors, and consistent units;
- The unit was in detection monitoring at the beginning and end of 2020;
- There were no statistically significant increases (SSIs) determined for the 1<sup>st</sup> half 2020 groundwater sampling and analysis event;
- There were no statistically significant increases (SSIs) determined for the 2<sup>nd</sup> half 2020 groundwater sampling and analysis event;
- Groundwater Monitoring Statistical Evaluation Reports to evaluate groundwater data were prepared and certified in accordance with 40 CFR 257.93. The statistical process was guided by USEPA's *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance* ("Unified Guidance," USEPA, 2009).

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

- A map, aerial photograph or a drawing showing the CCR management unit(s), all groundwater monitoring wells and monitoring well identification numbers;
- Identification of any monitoring wells that were installed or decommissioned during the preceding year, along with a statement as to why that happened;
- All of the monitoring data collected, including the rate and direction of groundwater flow, plus a summary showing the number of samples collected per monitoring well, the dates the samples were collected and whether the sample was collected as part of detection monitoring or assessment monitoring programs is included in **Appendix I**;

- A summary of any transition between monitoring programs or an alternate monitoring frequency, for example the date and circumstances for transitioning from detection monitoring to assessment monitoring, in addition to identifying the constituents detected at a statistically significant increase over background concentrations.
- Other information required to be included in the annual report such as alternate source demonstration or assessment of corrective measures, if applicable.

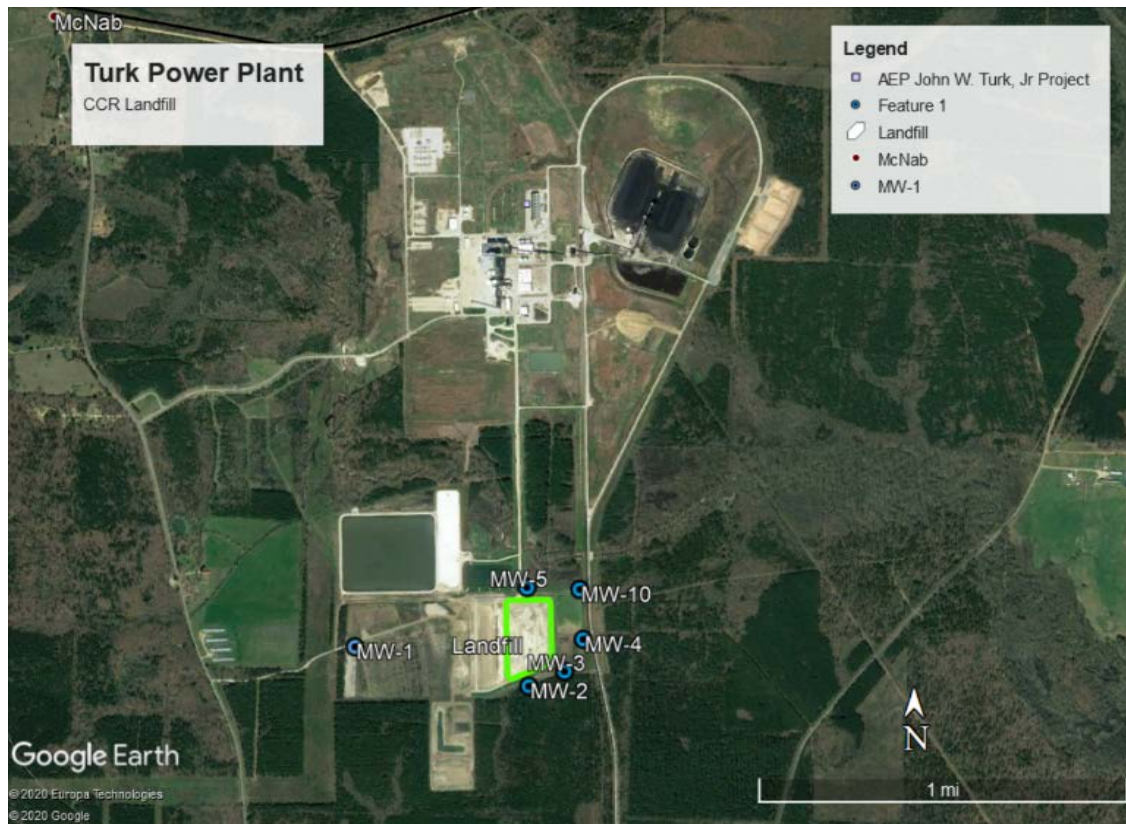
In addition, this report summarizes key actions completed, and where applicable, describes any problems encountered and actions taken to resolve those problems. The report includes a projection of key activities for the upcoming year.



## II. Groundwater Monitoring Well Locations and Identification Numbers

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

Landfill Monitoring Wells	
Up Gradient	Down Gradient
MW-1	MW-2
	MW-3
	MW-4
	MW-5
	MW-10



## III. Monitoring Wells Installed or Decommissioned

There were no monitoring wells installed or decommissioned this year.

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

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

The verification sample after the 1<sup>st</sup> half 2020 groundwater sampling event showed a flow more similar to the potentiometric map for the 2<sup>nd</sup> half sampling event with MW-2 showing a lower groundwater elevation than MW-3.

The verification sample after the 2<sup>nd</sup> half 2020 groundwater sampling event showed a flow to the east with MW-2 showing a lower groundwater elevation than MW-3.

**V. Statistical Evaluation of 2020 Events**

The three statistical analysis report available for this reporting period is included in **Appendix II**.

Four semiannual detection monitoring events were conducted between August 2017 and April 2019. Data from these four events, including both initial and verification results, were evaluated for inclusion in the background dataset (*STATISTICAL ANALYSIS SUMMARY- Background Update Calculations Landfill*).

There were no statistically significant increases (SSIs) determined for the 1<sup>st</sup> half 2020 groundwater sampling and analysis event.

There were no SSIs determined for the 2<sup>nd</sup> half 2020 groundwater sampling and analysis event.

**VI. Alternate Source Demonstration**

No alternate source demonstration were prepared in 2020.

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

There were no groundwater program transitions this year. The detection monitoring program remains in effect.

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

**VIII. Other Information Required**

No other information applies at this time.

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

No problems were encountered this year.

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

Key activities for the next include:

- Detection monitoring on a twice per year schedule;
- Evaluation of the detection monitoring results from a statistical analysis viewpoint, looking for any SSIs above background;
- Responding to any new data received in light of CCR rule requirements;
- Preparation of the next annual groundwater report.

## APPENDIX I

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

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

**Turk - 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
6/1/2016	Background	0.247	218	284	1.1734	7.0	478	1,752
7/25/2016	Background	0.274	247	294	0.7506 J	6.5	767	2,245
9/1/2016	Background	0.258	251	271	1.0888	6.5	469	1,742
11/2/2016	Background	0.321	275	360	0.5629 J	6.6	1,479	3,008
12/15/2016	Background	0.333	310	350	2	6.7	830	2,328
2/1/2017	Background	0.212	230	331	2	7.0	461	1,812
2/21/2017	Background	0.184	215	281	1.1213	7.0	407	1,660
5/2/2017	Background	0.137	176	230	1.23	7.4	334	1,020
6/29/2017	Background	0.135	177	202	1.1529	7.4	301	1,374
7/19/2017	Background	0.17	183	226	1.1435	6.7	407	1,504
8/10/2017	Detection	0.181	207	243	0.9589 J	7.0	417	1,600
4/26/2018	Detection	0.126	153	166	1.657	7.3	294	1,220
9/5/2018	Detection	0.098	198	216	< 0.083 U	7.1	280	1,216
4/17/2019	Detection	0.120	160	197	1.51	7.5	317	1,188
9/19/2019	Detection	0.242	244	239	1.03	7.4	463	1,462
5/27/2020	Detection	0.109	157	172	1.37	8.1	269	1,120
11/9/2020	Detection	0.086	156	186	1.52	8.1	274	1,160
12/22/2020	Detection	--	--	--	--	7.3	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

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

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

--: Not analyzed

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

**Turk - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
6/1/2016	Background	< 0.93 U	< 1.05 U	38	0.0809225 J	< 0.07 U	1	1.08847 J	--	1.1734	1.15566 J	0.099	0.01991 J	2.54209 J	2.09098 J	1.23972 J
7/25/2016	Background	< 0.93 U	< 1.05 U	49	0.159579 J	< 0.07 U	1	1.25472 J	--	0.7506 J	< 0.68 U	0.118	0.01078 J	3.09725 J	3.00699 J	< 0.86 U
9/1/2016	Background	1.45614 J	< 1.05 U	41	0.16559 J	0.810967 J	0.406151 J	0.950716 J	1.844	1.0888	< 0.68 U	0.087	0.01003 J	4.13353 J	3.88471 J	< 0.86 U
11/2/2016	Background	3.5 J	< 1.05 U	42.76	< 0.02 U	< 0.07 U	0.9 J	1.1 J	1.287	0.5629 J	< 0.68 U	0.105	< 0.005 U	1.57 J	3.33 J	< 0.86 U
12/15/2016	Background	0.950637 J	< 1.05 U	39	< 0.02 U	< 0.07 U	< 0.23 U	0.605475 J	2.076	2	< 0.68 U	0.102	< 0.005 U	1.57771 J	< 0.99 U	< 0.86 U
2/1/2017	Background	< 0.93 U	< 1.05 U	32	< 0.02 U	< 0.07 U	< 0.23 U	0.688421 J	1.203	2	< 0.68 U	0.081	0.01216 J	1.43338 J	< 0.99 U	< 0.86 U
2/21/2017	Background	< 0.93 U	< 1.05 U	31	< 0.02 U	< 0.07 U	< 0.23 U	0.564016 J	0.899	1.1213	< 0.68 U	0.078	0.00711 J	1.7175 J	2.52261 J	< 0.86 U
5/2/2017	Background	< 0.93 U	< 1.05 U	29.84	< 0.02 U	< 0.07 U	< 0.23 U	0.57 J	1.114	1.23	0.74 J	0.06633	< 0.005 U	2.15 J	3.43 J	< 0.86 U
6/29/2017	Background	< 0.93 U	< 1.05 U	27.71	< 0.02 U	< 0.07 U	< 0.23 U	0.33 J	4.687	1.1529	< 0.68 U	0.05943	< 0.005 U	1.68 J	< 0.99 U	< 0.86 U
7/19/2017	Background	< 0.93 U	< 1.05 U	30.71	< 0.02 U	< 0.07 U	0.24 J	0.78 J	0.842	1.1435	0.71 J	0.06479	< 0.005 U	1.82 J	< 0.99 U	< 0.86 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**

**Turk - 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
6/1/2016	Background	0.07	57.4	12	0.5064 J	7.9	42	343
7/25/2016	Background	0.152	120	10	0.4781 J	6.9	121	486
9/1/2016	Background	0.128	109	15	0.4811 J	6.9	108	514
11/2/2016	Background	0.369	398	25	0.493 J	6.9	346	960
12/15/2016	Background	0.109	95.2	47	0.5233 J	7.0	79	562
2/1/2017	Background	0.05	38.9	9	0.5086 J	7.5	28	248
2/21/2017	Background	0.05	40.8	10	< 0.083 U	7.9	33	252
5/2/2017	Background	0.04823	51.2	5	0.52 J	7.9	19	208
6/29/2017	Background	0.05514	59.6	7	0.4428 J	7.9	48	336
7/19/2017	Background	0.08324	65.5	8	0.4694 J	7.5	44	332
8/10/2017	Detection	0.07471	62.9	10	0.451 J	7.5	25	304
4/26/2018	Detection	0.04343	51.8	6	< 0.083 U	7.6	22	264
9/5/2018	Detection	0.098	111	13	< 0.083 U	7.4	66	348
4/17/2019	Detection	0.037	76.8	5.86	0.34	7.9	18.6	310
9/19/2019	Detection	0.098	113	10.1	0.30	8.0	76.8	416
5/27/2020	Detection	0.051	75.7	6.17	0.28	8.5	17.2	311
7/14/2020	Detection	--	--	--	--	7.9	--	--
11/9/2020	Detection	0.059	89.9	7.55	0.34	8.5	52.9	332
12/22/2020	Detection	--	--	--	--	7.8	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

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

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

--: Not analyzed

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

**Turk - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
6/1/2016	Background	< 0.93 U	1.75982 J	120	0.122549 J	< 0.07 U	2	0.904166 J	--	0.5064 J	2.01553 J	0.015	0.01145 J	2.82795 J	1.14538 J	< 0.86 U
7/25/2016	Background	< 0.93 U	1.39254 J	152	0.131235 J	< 0.07 U	0.862157 J	1.21412 J	--	0.4781 J	< 0.68 U	0.048	0.00701 J	4.69255 J	< 0.99 U	< 0.86 U
9/1/2016	Background	5	< 1.05 U	162	0.141798 J	< 0.07 U	3	1.1267 J	3.045	0.4811 J	1.22736 J	0.031	0.01382 J	6	3.91967 J	< 0.86 U
11/2/2016	Background	1.91737 J	< 1.05 U	107	0.0819 J	< 0.07 U	3	1.53886 J	1.939	0.493 J	1.26945 J	0.088	0.00947 J	5	1.45298 J	< 0.86 U
12/15/2016	Background	1.7294 J	< 1.05 U	158	< 0.02 U	< 0.07 U	< 0.23 U	0.355698 J	1.919	0.5233 J	< 0.68 U	0.028	< 0.005 U	2.15202 J	1.67636 J	< 0.86 U
2/1/2017	Background	< 0.93 U	< 1.05 U	80	< 0.02 U	< 0.07 U	< 0.23 U	0.217505 J	0.933	0.5086 J	< 0.68 U	0.011	< 0.005 U	2.91607 J	< 0.99 U	< 0.86 U
2/21/2017	Background	< 0.93 U	< 1.05 U	83	< 0.02 U	< 0.07 U	< 0.23 U	0.233088 J	1.335	< 0.083 U	< 0.68 U	0.012	< 0.005 U	2.62555 J	< 0.99 U	< 0.86 U
5/2/2017	Background	1.46 J	1.37 J	93	< 0.02 U	< 0.07 U	< 0.23 U	0.32 J	1.935	0.52 J	< 0.68 U	0.00925	< 0.005 U	1.08 J	1.32 J	< 0.86 U
6/29/2017	Background	< 0.93 U	< 1.05 U	101	< 0.02 U	< 0.07 U	< 0.23 U	0.58 J	3.373	0.4428 J	< 0.68 U	0.01089	< 0.005 U	0.87 J	< 0.99 U	< 0.86 U
7/19/2017	Background	< 0.93 U	< 1.05 U	97.5	0.02 J	< 0.07 U	0.76 J	0.71 J	2.712	0.4694 J	1.14 J	0.01387	0.005 J	1.18 J	< 0.99 U	< 0.86 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-3**

**Turk - 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
6/1/2016	Background	0.04	93.9	3	0.3926 J	7.6	17	357
7/25/2016	Background	0.168	393	37	0.4403 J	7.4	699	1,612
9/1/2016	Background	0.09	149	14	0.4288 J	7.3	119	564
11/2/2016	Background	0.151	264	48	0.5852 J	7.4	424	1,188
12/15/2016	Background	0.06	67.8	15	0.6047 J	7.4	43	408
2/1/2017	Background	0.03	53	7	< 0.083 U	7.4	19	220
2/21/2017	Background	0.05	81.5	12	< 0.083 U	7.6	76	340
5/2/2017	Background	0.04375	77.3	6	0.37 J	7.6	27	328
6/29/2017	Background	0.05282	95.6	6	0.3475 J	7.6	32	332
7/19/2017	Background	0.09178	122	15	< 0.083 U	7.2	95	510
8/10/2017	Detection	0.09788	160	23	0.438 J	7.5	190	716
4/26/2018	Detection	0.03713	61.3	4	< 0.083 U	7.4	28	278
9/5/2018	Detection	0.073	160	58	< 0.083 U	7.3	554	1,234
1/22/2019	Detection	--	--	7.3	--	--	--	--
4/17/2019	Detection	0.035	81.1	3.70	0.21	7.5	13.7	364
9/19/2019	Detection	0.074	143	27.3	0.22	7.9	148	612
5/27/2020	Detection	0.053	82.0	11.3	0.22	8.2	11.7	370
7/14/2020	Detection	--	--	--	--	7.9	--	--
11/9/2020	Detection	0.056	85.6	28.8	0.29	8.1	12.9	402
12/22/2020	Detection	-	--	--	--	7.3	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

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

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

--: Not analyzed

**Table 1 - Groundwater Data Summary: MW-3**

**Turk - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
6/1/2016	Background	< 0.93 U	< 1.05 U	73	0.194411 J	< 0.07 U	1	0.664792 J	--	0.3926 J	0.940276 J	0.01	0.01506 J	0.949404 J	< 0.99 U	< 0.86 U
7/25/2016	Background	< 0.93 U	< 1.05 U	238	0.137503 J	< 0.07 U	0.493284 J	0.785774 J	--	0.4403 J	< 0.68 U	0.075	< 0.005 U	1.16782 J	< 0.99 U	< 0.86 U
9/1/2016	Background	1.90159 J	< 1.05 U	81	0.185901 J	< 0.07 U	0.955367 J	0.803817 J	3.55	0.4288 J	< 0.68 U	0.014	< 0.005 U	1.14299 J	1.25976 J	< 0.86 U
11/2/2016	Background	1.9135 J	2.32209 J	160	0.0958 J	< 0.07 U	0.571016 J	1.33502 J	2.83	0.5852 J	1.51713 J	0.03	< 0.005 U	1.68622 J	< 0.99 U	< 0.86 U
12/15/2016	Background	1.36647 J	1.8418 J	55	0.261831 J	< 0.07 U	0.471105 J	0.395502 J	1.92	0.6047 J	< 0.68 U	0.009	< 0.005 U	0.30882 J	< 0.99 U	< 0.86 U
2/1/2017	Background	1.38687 J	< 1.05 U	55	0.157528 J	< 0.07 U	0.906786 J	0.761635 J	0.942	< 0.083 U	< 0.68 U	0.003	0.00701 J	1.02923 J	< 0.99 U	< 0.86 U
2/21/2017	Background	1.75888 J	< 1.05 U	66	0.239409 J	< 0.07 U	4	1.21066 J	1.156	< 0.083 U	2.18988 J	0.008	0.00692 J	0.551231 J	< 0.99 U	0.918887 J
5/2/2017	Background	< 0.93 U	2.37 J	47.28	0.1 J	< 0.07 U	0.31 J	0.35 J	2.8	0.37 J	< 0.68 U	0.00679	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
6/29/2017	Background	< 0.93 U	< 1.05 U	63.01	0.13 J	< 0.07 U	1.64	0.89 J	1.894	0.3475 J	1.12 J	0.00836	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
7/19/2017	Background	< 0.93 U	< 1.05 U	79.28	0.15 J	< 0.07 U	0.58 J	0.72 J	3.43	< 0.083 U	< 0.68 U	0.01353	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 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**

**Turk - 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
6/1/2016	Background	0.36	391	653	0.6203 J	7.2	190	2,352
7/25/2016	Background	0.455	729	1,055	< 0.083 U	7.4	694	4,084
9/1/2016	Background	0.402	569	1,065	0.5614 J	7.1	671	3,500
11/2/2016	Background	0.393	513	993	0.374 J	7.4	538	3,450
12/15/2016	Background	0.305	280	930	0.3995 J	7.3	434	2,980
2/1/2017	Background	0.445	669	1,159	< 0.083 U	6.8	747	3,720
2/21/2017	Background	0.365	439	730	< 0.083 U	7.2	186	2,404
5/2/2017	Background	0.376	496	1,024	0.44 J	6.9	572	3,370
6/29/2017	Background	0.264	264	659	0.4605 J	7.0	157	2,276
7/19/2017	Background	0.296	306	1,052	< 0.083 U	6.9	557	3,120
8/10/2017	Detection	0.429	648	1,105	0.512 J	7.0	692	3,788
4/26/2018	Detection	0.347	383	1,140	< 0.083 U	7.0	557	3,654
9/5/2018	Detection	0.255	516	1,241	< 0.083 U	6.8	748	5,442
12/20/2018	Detection	--	--	110	--	--	--	2,792
4/17/2019	Detection	0.261	452	1,000	0.38	7.0	164	2,798
9/19/2019	Detection	0.330	573	895	0.34	7.0	157	2,780
5/27/2020	Detection	0.206	328	831	0.27	7.5	246	2,390
11/9/2020	Detection	0.384	664	1,150	0.26	7.5	634	3,150
12/22/2020	Detection	--	--	--	--	6.4	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

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

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

--: Not analyzed

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

**Turk - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
6/1/2016	Background	< 0.93 U	1.83781 J	69	0.23746 J	< 0.07 U	7	3.34813 J	--	0.6203 J	1.47143 J	0.131	0.01634 J	2.98754 J	6	< 0.86 U
7/25/2016	Background	< 0.93 U	< 1.05 U	110	0.454281 J	< 0.07 U	19	8	--	< 0.083 U	4.81995 J	0.162	0.01917 J	1.38966 J	3.81662 J	< 0.86 U
9/1/2016	Background	1.44388 J	1.75655 J	144	0.506995 J	< 0.07 U	23	9	1.909	0.5614 J	6	0.098	0.028	3.08827 J	13	< 0.86 U
11/2/2016	Background	2.65159 J	1.40633 J	56	0.0976 J	< 0.07 U	4	2.56138 J	1.195	0.374 J	2.26641 J	0.105	< 0.005 U	1.80188 J	13	< 0.86 U
12/15/2016	Background	< 0.93 U	2.20107 J	63	0.0334569 J	< 0.07 U	0.630135 J	0.943538 J	2.64	0.3995 J	< 0.68 U	0.125	< 0.005 U	3.76575 J	< 0.99 U	< 0.86 U
2/1/2017	Background	1.15118 J	< 1.05 U	29	< 0.02 U	< 0.07 U	0.266332 J	0.771837 J	0.913	< 0.083 U	< 0.68 U	0.072	0.00591 J	0.342891 J	11	< 0.86 U
2/21/2017	Background	0.987123 J	< 1.05 U	78	0.170596 J	< 0.07 U	9	4.18392 J	4.46	< 0.083 U	2.76588 J	0.104	0.01482 J	2.52827 J	7	< 0.86 U
5/2/2017	Background	2.26 J	< 1.05 U	41.07	0.03 J	< 0.07 U	0.33 J	1.02 J	4.274	0.44 J	< 0.68 U	0.09813	0.006 J	1.41 J	4.09 J	< 0.86 U
6/29/2017	Background	< 0.93 U	< 1.05 U	65.4	0.05 J	< 0.07 U	1.05	1.64 J	13.21	0.4605 J	< 0.68 U	0.116	< 0.005 U	2.65 J	< 0.99 U	< 0.86 U
7/19/2017	Background	< 0.93 U	2.44 J	64.91	0.07 J	< 0.07 U	1.4	1.64 J	3.521	< 0.083 U	1.34 J	0.133	0.013 J	3.06 J	1.18 J	< 0.86 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**

**Turk - 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
6/1/2016	Background	0.06	284	100	0.4866 J	7.7	329	1,272
7/25/2016	Background	0.04	491	188	0.4938 J	7.7	465	1,694
9/1/2016	Background	0.05	251	96	0.408 J	7.5	319	1,250
11/2/2016	Background	0.06	234	80	0.5023 J	7.6	281	1,034
12/15/2016	Background	0.03	217	55	0.2941 J	7.7	220	1,036
2/1/2017	Background	0.05	272	78	0.7224 J	6.8	265	1,092
2/21/2017	Background	0.06	270	80	< 0.083 U	7.7	273	1,156
5/2/2017	Background	0.06152	275	91	0.54 J	7.1	287	1,192
6/29/2017	Background	0.04842	248	73	< 0.083 U	7.0	228	1,104
7/19/2017	Background	0.04983	208	66	< 0.083 U	6.6	216	932
8/10/2017	Detection	0.06474	267	70	< 0.083 U	6.8	233	1,052
4/26/2018	Detection	0.08795	310	105	< 0.083 U	7.0	303	1,408
9/5/2018	Detection	0.086	380	134	< 0.083 U	6.4	273	1,502
4/17/2019	Detection	0.082	290	138	0.30	7.2	343	1,292
9/19/2019	Detection	0.075	306	110	0.27	6.8	275	1,326
5/27/2020	Detection	0.078	301	114	0.28	7.4	319	1,320
11/9/2020	Detection	0.060	240	75.2	0.30	7.5	273	1,080
12/22/2020	Detection	--	--	--	--	6.5	--	--

Notes:

mg/L: milligrams per liter

SU: standard unit

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

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

--: Not analyzed

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

**Turk - LF**

**Appendix IV Constituents**

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
6/1/2016	Background	< 0.93 U	< 1.05 U	40	0.0620377 J	< 0.07 U	0.662999 J	0.611001 J	--	0.4866 J	< 0.68 U	0.049	0.02124 J	1.45446 J	2.29756 J	< 0.86 U
7/25/2016	Background	4.2029 J	< 1.05 U	42	0.165141 J	< 0.07 U	2	1.38215 J	--	0.4938 J	1.36311 J	0.164	0.01234 J	4.13266 J	8	< 0.86 U
9/1/2016	Background	0.948881 J	< 1.05 U	41	0.141298 J	< 0.07 U	0.560473 J	0.970337 J	1.411	0.408 J	< 0.68 U	0.024	0.01038 J	3.3054 J	1.06126 J	< 0.86 U
11/2/2016	Background	< 0.93 U	< 1.05 U	38	< 0.02 U	< 0.07 U	0.37232 J	0.68278 J	3.11	0.5023 J	< 0.68 U	0.024	< 0.005 U	0.760667 J	1.57137 J	< 0.86 U
12/15/2016	Background	< 0.93 U	< 1.05 U	35	< 0.02 U	< 0.07 U	0.558695 J	0.494922 J	1.159	0.2941 J	< 0.68 U	0.015	< 0.005 U	< 0.29 U	< 0.99 U	< 0.86 U
2/1/2017	Background	< 0.93 U	< 1.05 U	43	< 0.02 U	< 0.07 U	0.86197 J	0.547445 J	0.632	0.7224 J	< 0.68 U	0.018	0.01495 J	0.862299 J	< 0.99 U	< 0.86 U
2/21/2017	Background	< 0.93 U	< 1.05 U	43	< 0.02 U	< 0.07 U	1	0.733647 J	0.747	< 0.083 U	< 0.68 U	0.021	0.00912 J	0.957474 J	< 0.99 U	< 0.86 U
5/2/2017	Background	1.2 J	< 1.05 U	38.42	< 0.02 U	< 0.07 U	0.42 J	0.6 J	4.45	0.54 J	< 0.68 U	0.02349	0.016 J	1.11 J	< 0.99 U	< 0.86 U
6/29/2017	Background	< 0.93 U	< 1.05 U	35.21	< 0.02 U	< 0.07 U	< 0.23 U	0.68 J	5.057	< 0.083 U	< 0.68 U	0.01696	0.011 J	2.2 J	< 0.99 U	< 0.86 U
7/19/2017	Background	< 0.93 U	< 1.05 U	35.22	< 0.02 U	< 0.07 U	0.46 J	0.81 J	1.381	< 0.083 U	0.95 J	0.01583	0.026	0.97 J	< 0.99 U	< 0.86 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-10****Turk - 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
6/1/2016	Background	0.07	245	509	0.5264 J	7.8	582	2,252
7/25/2016	Background	0.07	348	680	0.4623 J	6.7	960	2,936
9/1/2016	Background	0.08	349	400	0.5157 J	6.6	444	1,896
11/2/2016	Background	0.09	407	378	0.373 J	6.8	499	1,916
12/15/2016	Background	0.05	363	514	0.3419 J	6.3	559	2,298
2/1/2017	Background	0.05	369	53	1.2456	6.0	62	2,280
2/21/2017	Background	0.177	673	762	< 0.083 U	7.8	1,452	3,814
5/2/2017	Background	0.08024	213	305	0.52 J	5.8	371	1,618
6/29/2017	Background	0.08018	256	277	1.1688	5.8	389	1,666
7/19/2017	Background	0.0858	454	470	3.17	6.3	560	2,146
8/10/2017	Detection	0.07623	392	544	0.37 J	6.2	619	2,252
4/26/2018	Detection	0.06224	298	326	0.9038 J	7.3	452	1,826
9/5/2018	Detection	0.074	410	405	< 0.083 U	7.5	484	1,872
4/17/2019	Detection	0.046	313	431	0.21	7.4	554	2,002
9/19/2019	Detection	0.05 J	339	365	0.21	6.6	481	1,900
5/27/2020	Detection	0.04 J	389	378	0.19	7.6	487	1,780
11/9/2020	Detection	0.04 J	264	282	0.24	6.4	366	1,610

## Notes:

mg/L: milligrams per liter

SU: standard unit

&lt;: 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

Turk - LF

Appendix IV Constituents

Collection Date	Monitoring Program	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Combined Radium	Fluoride	Lead	Lithium	Mercury	Molybdenum	Selenium	Thallium
		µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	pCi/L	mg/L	µg/L	mg/L	µg/L	µg/L	µg/L
6/1/2016	Background	< 0.93 U	< 1.05 U	68	0.0420664 J	< 0.07 U	2	0.608593 J	--	0.5264 J	< 0.68 U	0.039	0.01929 J	0.808299 J	1.28039 J	< 0.86 U
7/25/2016	Background	< 0.93 U	< 1.05 U	57	0.0790461 J	< 0.07 U	0.841449 J	0.890358 J	--	0.4623 J	< 0.68 U	0.073	0.00766 J	1.38895 J	1.70224 J	0.912736 J
9/1/2016	Background	< 0.93 U	< 1.05 U	55	0.0599978 J	< 0.07 U	1	0.876633 J	0.525	0.5157 J	< 0.68 U	0.029	0.00756 J	1.18242 J	< 0.99 U	< 0.86 U
11/2/2016	Background	1.07709 J	< 1.05 U	51	< 0.02 U	< 0.07 U	0.843928 J	0.995858 J	0.658	0.373 J	0.773158 J	0.042	< 0.005 U	1.02999 J	< 0.99 U	< 0.86 U
12/15/2016	Background	< 0.93 U	< 1.05 U	51	< 0.02 U	< 0.07 U	1	0.642068 J	0.951	0.3419 J	< 0.68 U	0.017	< 0.005 U	0.729956 J	< 0.99 U	< 0.86 U
2/1/2017	Background	< 0.93 U	< 1.05 U	60	< 0.02 U	< 0.07 U	1	0.67122 J	0.344	1.2456	< 0.68 U	0.02	0.00911 J	0.7751 J	< 0.99 U	< 0.86 U
2/21/2017	Background	< 0.93 U	< 1.05 U	47	< 0.02 U	< 0.07 U	2	0.951093 J	0.63	< 0.083 U	0.870989 J	0.095	0.01349 J	2.06399 J	< 0.99 U	< 0.86 U
5/2/2017	Background	< 0.93 U	< 1.05 U	58.09	< 0.02 U	< 0.07 U	1.43	0.74 J	1.4731	0.52 J	< 0.68 U	0.01559	< 0.005 U	0.59 J	< 0.99 U	< 0.86 U
6/29/2017	Background	< 0.93 U	< 1.05 U	52.23	< 0.02 U	< 0.07 U	1.24	0.61 J	2.112	1.1688	0.83 J	0.01916	< 0.005 U	0.59 J	< 0.99 U	< 0.86 U
7/19/2017	Background	< 0.93 U	< 1.05 U	48.43	< 0.02 U	< 0.07 U	1.9	0.77 J	3.154	3.17	1.1 J	0.0401	0.007 J	0.87 J	< 0.99 U	< 0.86 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  
Turk Landfill**

*Geosyntec Consultants, Inc.*

CCR Management Unit	Monitoring Well	Well Diameter (inches)	2020-05		2020-07 <sup>[3]</sup>		2020-11		2020-12 <sup>[3]</sup>	
			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 <sup>[1]</sup>	2.0	12.1	5.0	NC	NC	18.6	3.3	17.9	3.4
	MW-2 <sup>[2]</sup>	2.0	57.2	1.1	13.4	4.5	50.5	1.2	13.7	4.4
	MW-3 <sup>[2]</sup>	2.0	16.4	3.7	12.6	4.8	12.2	5.0	14.9	4.1
	MW-4 <sup>[2]</sup>	2.0	18.5	3.3	NC	NC	11.5	5.3	14.0	4.3
	MW-5 <sup>[2]</sup>	2.0	28.2	2.2	NC	NC	18.5	3.3	19.2	3.2
	MW-10 <sup>[2]</sup>	2.0	84.1	0.7	NC	NC	14.2	4.3	NC	NC

Notes:

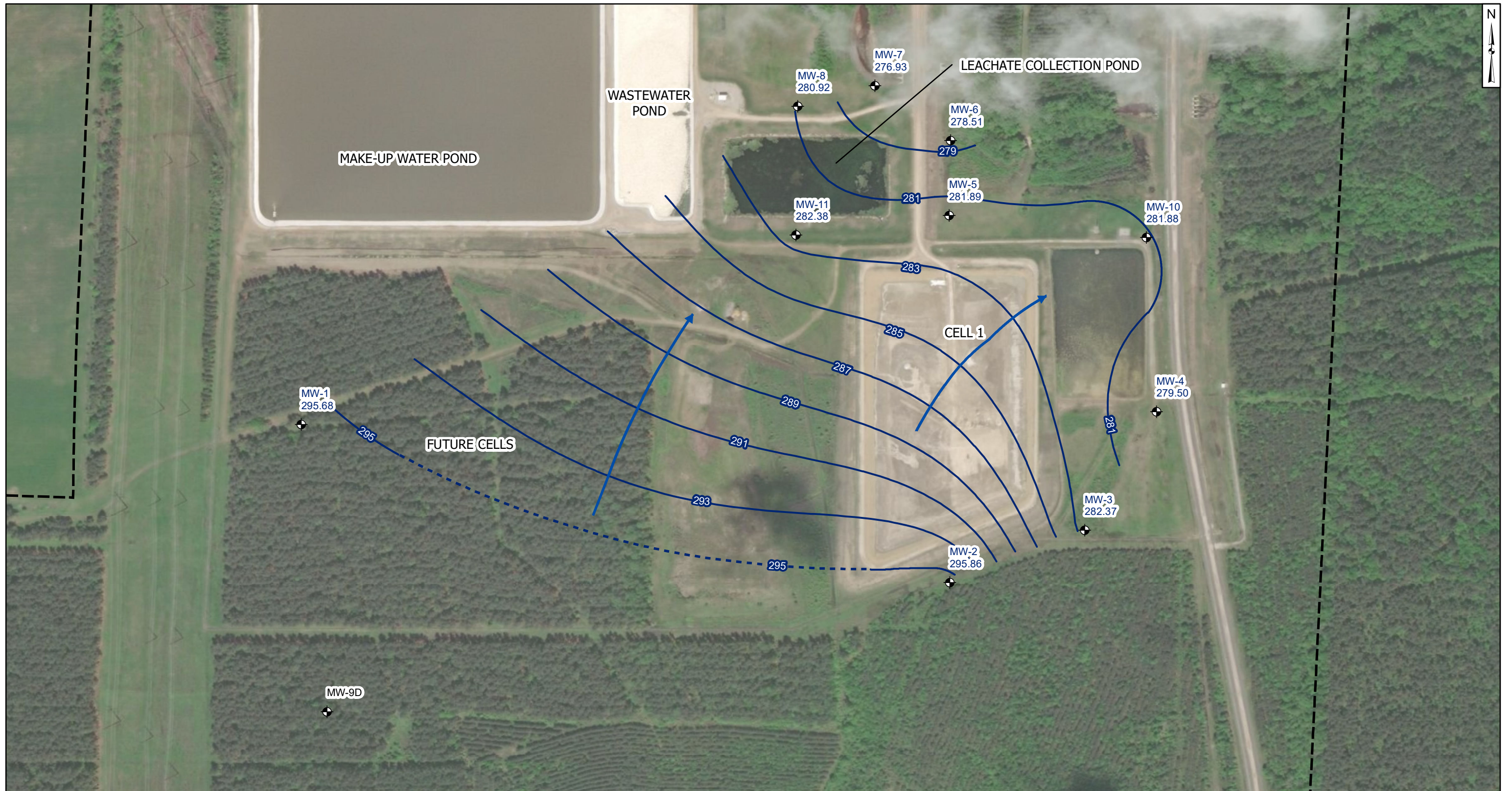
[1] - Background Well






[2] - Downgradient Well

[3] - Only select wells were gauged as part of two-of-two verification sampling

NC - Not Calculated

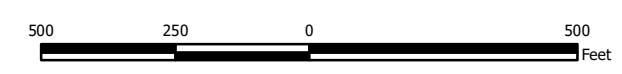




- Legend**
-  Groundwater Monitoring Well
  -  Groundwater Flow Direction
  -  Groundwater Elevation Contour
  -  Groundwater Elevation Contour (Inferred)
  -  Property Boundary

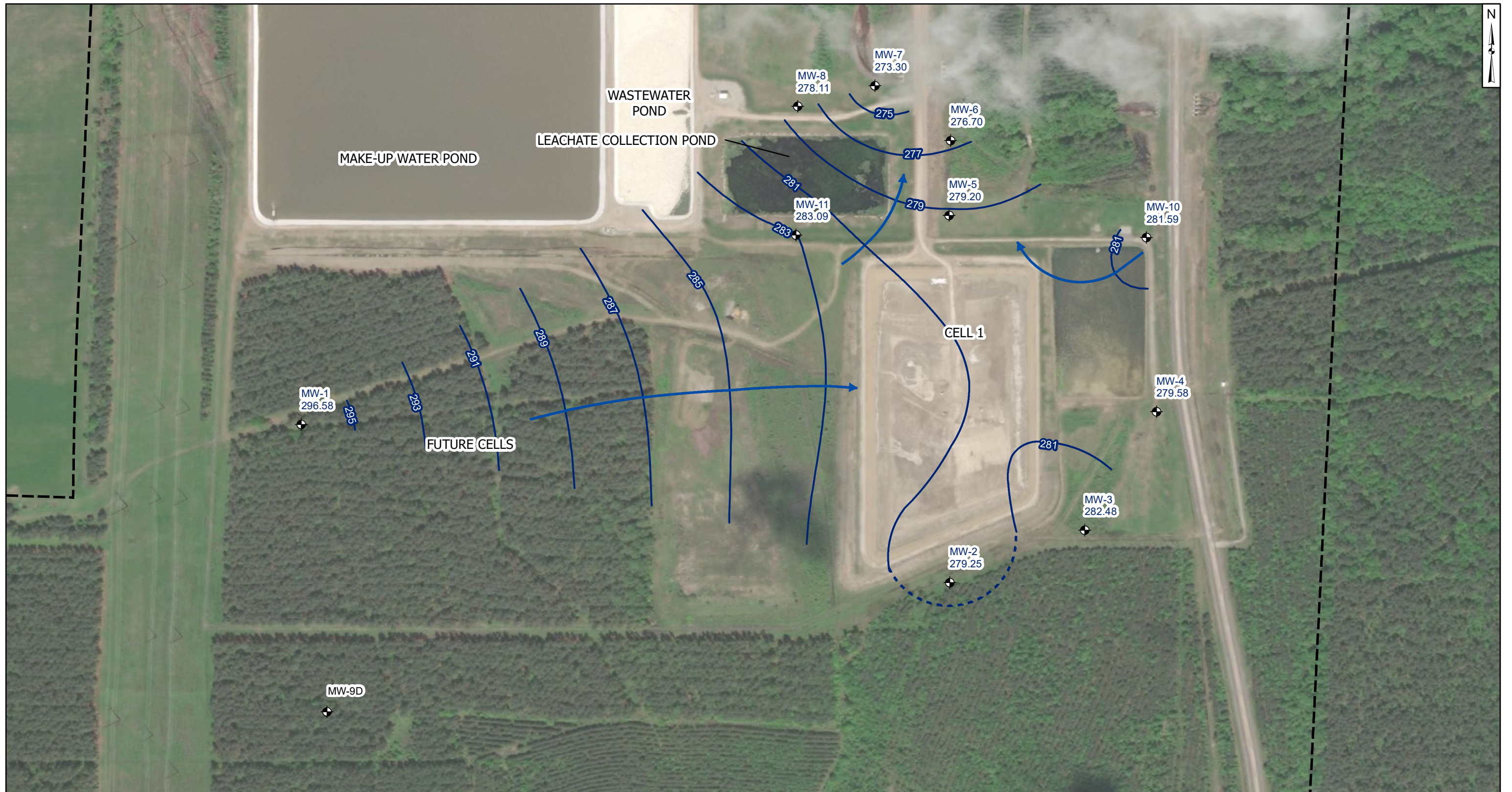
**Notes**

- Monitoring well coordinates and water level data (collected on May 27, 2020) provided by AEP.
- Site features based on information available in Report 1 - Groundwater Monitoring Network for CCR Compliance - John W. Turk, Jr. Power Plant Class 3N Landfill (Terracon, October 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- MW-9D is screened within the lower aquifer and excluded from the potentiometric surface calculations.



<b>Groundwater Elevation Contour Map May 2020</b>		<b>Figure 1</b>
AEP Turk Power Plant - Landfill Fulton, Arkansas		
		
Columbus, Ohio	2020/06/10	

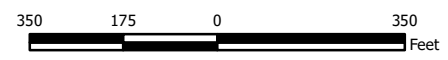




- Legend**
- Groundwater Monitoring Well
  - Groundwater Flow Direction
  - Groundwater Elevation Contour
  - Groundwater Elevation Contour (Inferred)
  - Property Boundary

**Notes**

- Monitoring well coordinates and water level data (collected on November 9, 2020) provided by AEP.
- Site features based on information available in Report 1 - Groundwater Monitoring Network for CCR Compliance - John W. Turk, Jr. Power Plant Class 3N Landfill (Terracon, October 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- MW-9D (Elevation = 256.11 ft amsl) is screened within the lower aquifer and excluded from the potentiometric surface calculations.



**Groundwater Elevation Contour Map  
November 2020**

AEP Turk Power Plant - Landfill  
Fulton, Arkansas

**Geosyntec**  
consultants

Figure

**2**

Columbus, Ohio

2021/01/06



## **APPENDIX II**

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

**STATISTICAL ANALYSIS SUMMARY-**  
**Background Update Calculations**  
**Landfill – John W. Turk, Jr. Plant**  
**Fulton, Arkansas**

*Submitted to*



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January 7, 2020

CHA8473

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Table 1	Detection Monitoring Groundwater Data Summary
Table 2	Background Level Summary

## LIST OF ATTACHMENTS

Attachment A	Certification by a Qualified Professional Engineer
Attachment B	Statistical Analysis Output

## 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 lined landfill (LF), an existing CCR unit at the John W. Turk, Jr. Power Plant located in Fulton, Arkansas.

Ten monitoring events were completed prior to July 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Four semiannual detection monitoring events were conducted between August 2017 and April 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, 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. 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

Ten background monitoring events were completed from May 2016 through June 2017 to establish background concentrations for Appendix III and Appendix IV parameters under the CCR rule. Additional data were collected prior to background monitoring for the CCR Rule at the Turk Landfill. Portions of these data were collected prior to the start of operations at the Turk Plant in December 2012 and prior to the placement of CCR at the Turk Landfill. The historical data collected for boron, chloride, fluoride, pH, sulfate, and total dissolved solids (TDS) were also included in the previous background calculation. 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 plan. The statistical analyses to establish background levels were previously documented in the December 2017 *Statistical Analysis Summary* report (Geosyntec, 2017).

#### 2.2 Data Validation & QA/QC

Since August 2017, four semiannual detection monitoring events have been conducted at the LF. If the initial results for each detection monitoring event identified possible exceedances, verification sampling was completed on an individual well/parameter basis. 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.

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

The analytical data were imported into a Microsoft Access database, where checks were completed to assess the accuracy of sample location identification and analyte identification. Where necessary, unit conversions were applied to standardize reported units across all sampling events. Exported data files were created for use with the Sanitas™ v.9.6.23 statistics software. The export 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. Box plots were also compiled to provide visual representation of variations between wells and within individual wells (Attachment B).

### 2.3.1 Background 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:

$$\begin{aligned} x_i &= \text{individual data point} \\ \tilde{x}_{0.25} &= \text{first quartile} \\ \tilde{x}_{0.75} &= \text{third quartile} \\ IQR &= \text{the interquartile range} = \tilde{x}_{0.75} - \tilde{x}_{0.25} \end{aligned}$$

No potential outliers were identified within the new dataset.

### 2.3.2 Establishment of Updated Background Dataset

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 (September 2011 - July 2017) to the new compliance samples (August 2017 – April 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. No significant increases were found between the two groups. Significant decreases with an  $\alpha=0.01$  were found for boron, chloride, TDS, and sulfate at MW-1; boron and sulfate at MW-2; and boron only at MW-4 and MW-10. However, because the earlier (higher) values represent conditions before placement of waste in the unit, the entire dataset was included as background.

### **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-Francia 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 April 2019 to represent background values. Intrawell LPLs were also generated for pH. 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. The background datasets were updated, and UPLs and LPLs were recalculated. Intra-well tests using a one-of-two retesting procedure were selected for Appendix III parameters.

### **SECTION 3**

#### **REFERENCES**

American Electric Power (AEP). 2017. Statistical Analysis Plan – John W. Turk Plant. January 2017.

Geosyntec Consultants, 2017. Statistical Analysis Summary. Landfill – John W. Turk Power Plant. December 2017.

United States Environmental Protection Agency (USEPA). 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09-007. March 2009.

# TABLES

**Table 1: Groundwater Data Summary  
Turk - Landfill**

Parameter	Unit	MW-1				MW-2				MW-3				
		8/10/2017	4/26/2018	9/5/2018	4/17/2019	8/10/2017	4/26/2018	9/5/2018	4/17/2019	8/10/2017	4/26/2018	9/5/2018	1/22/2019	4/17/2019
		2017-D1	2018-D1	2018-D2	2019-D1	2017-D1	2018-D1	2018-D2	2019-D1	2017-D1	2018-D1	2018-D2	2018-D2-R2	2019-D1
Boron	mg/L	0.181	0.126	0.098	0.120	0.075	0.043	0.098	0.037	0.098	0.037	0.073	-	0.035
Calcium	mg/L	207	153	198	160	62.9	51.8	111	76.8	160	61.3	160	-	81.1
Chloride	mg/L	243	166	216	197	10.0	6.00	13.0	5.86	23.0	4.00	58.0	7.30	3.70
Fluoride	mg/L	0.959 J	1.66	1.00 U	1.51	0.451 J	1.00 U	1.00 U	0.340	0.438 J	1.00 U	1.00 U	-	0.210
Total Dissolved Solids (TDS)	mg/L	1600	1220	1220	1190	304	264	348	310	716	278	1230	-	364
Sulfate	mg/L	417	294	280	317	25.0	22.0	66.0	18.6	190	28.0	554	-	13.7
pH	SU	7.0	7.3	7.1	7.5	7.5	7.6	7.4	7.9	7.5	7.4	7.3	-	7.5

Parameter	Unit	MW-4					MW-5				MW-10			
		8/10/2017	4/26/2018	9/5/2018	12/20/2018	4/17/2019	8/10/2017	4/26/2018	9/5/2018	4/17/2019	8/10/2017	9/5/2018	4/26/2018	4/17/2019
		2017-D1	2018-D1	2018-D2	2018-D2-R1	2019-D1	2017-D1	2018-D1	2018-D2	2019-D1	2017-D1	2018-D2	2018-D1	2019-D1
Boron	mg/L	0.429	0.347	0.255	-	0.261	0.065	0.088	0.086	0.082	0.076	0.074	0.062	0.046
Calcium	mg/L	648	383	516	-	452	267	310	380	290	392	410	298	313
Chloride	mg/L	1110	1140	1240	110	1000	70.0	105	134	138	544	405	326	431
Fluoride	mg/L	0.512 J	1.00 U	1.00 U	-	0.380	1.00 U	1.00 U	1.00 U	0.300	0.370 J	1.00 U	0.904 J	0.210
Total Dissolved Solids (TDS)	mg/L	3790	3650	5440	2790	2800	1050	1410	1500	1290	2250	1870	1830	2000
Sulfate	mg/L	692	557	748	-	164	233	303	273	343	619	484	452	554
pH	SU	7.0	7.0	6.8	-	7.0	6.8	7.0	6.4	7.2	6.2	7.5	7.3	7.4

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: Verification event associated with detection monitoring round

All samples were collected as part of the detection monitoring program in accordance with 40 CFR 257.90(e)(3)

**Table 2: Background Level Summary  
Turk Plant - Landfill**

Parameter	Unit	Description	MW-2	MW-3	MW-4	MW-5	MW-10
Boron	mg/L	Intrawell Background Value (UPL)	1.40	1.30	0.609	0.504	0.430
Calcium	mg/L	Intrawell Background Value (UPL)	135	246	799	451	615
Chloride	mg/L	Intrawell Background Value (UPL)	140	660	1240	708	1180
Fluoride	mg/L	Intrawell Background Value (UPL)	1.40	1.03	0.620	0.584	0.908
pH	SU	Intrawell Background Value (UPL)	8.1	7.9	7.5	7.8	7.7
		Intrawell Background Value (LPL)	6.3	6.4	6.4	6.1	5.7
Sulfate	mg/L	Intrawell Background Value (UPL)	1900	2300	971	1180	1800
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	3800	4800	4880	3360	5240

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 W. Turk, Jr. 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

15296  
License Number

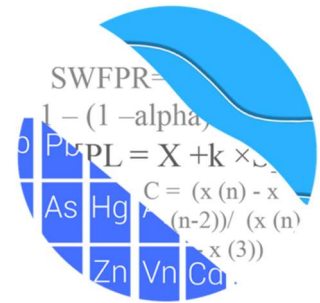
ARKANSAS  
Licensing State

01.13.2020  
Date



**ATTACHMENT B**  
**Statistical Analysis Output**

## GROUNDWATER STATS CONSULTING



December 20, 2019

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

RE: Background Update – Turk Landfill

Dear Ms. Kreinberg,

Groundwater Stats Consulting, formerly the statistical consulting division of Sanitas Technologies, is pleased to provide the proposed background update of prediction limits with data through April 2019 for American Electric Power's Turk 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).

The Turk Landfill is a lined landfill that has been sampling groundwater at each well for the CCR program since June 2016. Prior to regulation under this program, groundwater data collection began in 2011 before waste was placed at the Landfill in 2013. Groundwater sampling continued through March 2016 and prior to the start of sampling under the CCR regulations. All data collected through March 2016 are, reportedly, considered background data due downgradient well placement of approximately 300 feet away from the Landfill and transport times of groundwater estimated at 30 ft./year. Additionally, the landfill is lined and pre-waste data are available to characterize natural conditions of groundwater.

The monitoring well network, as provided by Geosyntec Consultants, consists of the following: upgradient well MW-1; and downgradient wells MW-2, MW-3, MW-4, MW-5, and MW-10.

Data were sent electronically to Groundwater Stats Consulting, and the statistical analysis was reviewed by Dr. Kirk Cameron, PhD Statistician with MacStat Consulting, primary author of the USEPA Unified Guidance, and Senior Advisor to Groundwater Stats Consulting. The statistical analysis was prepared according to the background screening conducted in December 2017 that was approved by Dr. Kirk Cameron.

The following CCR Detection Monitoring constituents were evaluated:

●**Appendix III Parameters:** boron, calcium, chloride, fluoride, pH, sulfate, and TDS

Time series plots for these parameters are provided for all wells and constituents; and are used to evaluate concentrations over time as well as for the purpose of updating statistical limits (Figure A). Additionally, box plots are included for all constituents at upgradient and downgradient wells (Figure B). Values in background which have been flagged as outliers may be seen in a lighter font and as a disconnected symbol on the graph. A summary of these values follows this letter. 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.

During the background screening conducted in December 2017 data at all wells were evaluated for the following: 1) outliers; 2) trends; 3) most appropriate statistical method for Appendix III parameters based on site characteristics of groundwater data upgradient of the facility; and 4) eligibility of downgradient wells when intrawell statistical methods are recommended. Power curves were provided to demonstrate that the selected statistical methods for Appendix III parameters comply with the USEPA Unified Guidance recommendations as discussed below.

**Summary of Statistical Method:**

- 1) Intrawell prediction limits, combined with a 1-of-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. While the false positive rate associated with the parametric limits is based on an annual 10% as recommended by the EPA Unified Guidance (2009), the false positive rate associated with the nonparametric limits is dependent upon the available background sample size, number of future comparisons, and verification resample plan. 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 Background Screening – December 2017**

### Outlier Evaluation

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

Tukey's outlier test noted an outlier for sulfate in well MW-4, and this value was flagged as such in the database. A substitution of the most recent reporting limit was applied when varying detection limits existed in data. The results were submitted with the background screening report.

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 several statistically significant decreasing trends and a handful of statistically significant increasing trends. The majority of these trends were relatively low in magnitude when compared to average concentrations. Therefore, no adjustments were made to the data sets with a few exceptions as described below.

While the test identified an increasing trend for fluoride at well MW-10, the trend was also relatively low in magnitude compared to average concentrations at this well; however, the most recent measurement reported in July 2017 was higher than all other historic measurements. Therefore, the background period used in the statistical analysis included all historical data through June 2017.

A few well/constituent pairs utilize a truncated background period to establish statistical limits due to decreasing trends. Distinct concentration differences were apparent in background data, with the more recent concentrations considerably lower than historical measurements. Selecting the more recent measurements for construction of statistical limits will result in lower limits that are considered more conservative from a regulatory perspective. The well/constituent pairs include: chloride in wells MW-2 and MW-3; sulfate in wells MW-2 and MW-3; and total dissolved solids in well MW-3. A list of the specific background periods used follows this letter.

### Appendix III – Determination of Spatial Variation

The Analysis of Variance (ANOVA) is typically used to statistically evaluate differences in average concentrations among upgradient wells, which assists in identifying whether the interwell or intrawell methods are the most appropriate statistical approach for a given parameter. However, this evaluation was not possible at the Turk Landfill because only one upgradient well currently exists in the monitoring well network. Since pre-waste data

are available for all wells at the Turk Landfill, the ANOVA was used to evaluate whether natural spatial variation exists in groundwater among the entire well network at the site using all pre-CCR data through March 2016 to determine whether interwell or intrawell statistical limits are recommended. In all cases except pH, variation was identified by the ANOVA. Because pre-waste data are available and groundwater downgradient of the facility is not suspected to be affected from practices at the site, the intrawell method was recommended for each of the Appendix III parameters.

Interwell tests, which compare downgradient well data to statistical limits constructed from pooled upgradient well data, are appropriate when multiple upgradient wells are available and 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 limited upgradient well data are available; when upgradient wells exhibit spatial variation; or when statistical limits constructed from upgradient wells would not be conservative from a regulatory perspective. Additionally, downgradient water quality must be considered to be unimpacted from the facility.

All Appendix III parameters were evaluated during the background screening and the results of those findings were submitted with that report. All available data through July 2017, with the exceptions noted above for truncated background periods, at each well were used to establish intrawell background limits based on a 1-of-2 resample plan that are used for future comparisons of compliance data at each well during subsequent semi-annual sample events.

Natural systems continuously evolve due to physical changes made to the environment. Examples include capping a landfill, paving areas near a well, or lining a drainage channel to prevent erosion. Periodic updating of background statistical limits is necessary to accommodate these types of changes. In the intrawell case, data for all wells and constituents are re-evaluated when a minimum of 4 new data points for each well are available to determine whether earlier concentrations are representative of present-day groundwater quality. In some cases, the earlier portion of data are deselected prior to construction of limits in order to provide sensitive limits that will rapidly detect changes in groundwater quality. Even though the data are excluded from the calculation, the values will continue to be reported and shown in tables and graphs.

In the event of an initial exceedance of compliance well data, the 1-of-2 resample plan allows for collection of an additional sample to determine whether the initial exceedance is confirmed. When the resample confirms the initial exceedance, a statistically significant increase (SSI) is identified and further research would be required to identify the cause of



the exceedance (i.e. impact from the site, natural variation, or an off-site source). If the resample falls within the statistical limit, the initial exceedance is considered to be a false positive result and, therefore, no further action is necessary.

### **September 2019 - Background Update**

The Appendix III parameters at all wells were screened for outliers using Tukey's outlier test. The test identified the highest value of sulfate in well MW-4 which was flagged. The test did not identify calcium in wells MW-2 and MW-3; fluoride in well MW-10, and TDS in well MW-1; however, the highest value in each of these records was flagged and deselected prior to construction of statistical limits as these values were considerably higher than remaining measurements in each respective well. The resulting statistical limit is lower and more conservative from a regulatory perspective.

The Mann-Whitney (Wilcoxon Rank Sum) test was used to compare the medians of historical data through July 2017 to the new compliance samples at each well through April 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). No statistically significant increases were found between the two groups for any of the well/constituent pairs. Several well/constituent pairs, however, have statistically significant decreases; however, all earlier measurements represent pre-waste data and are, therefore, used to construct statistical limits. Trend tests accompany the prediction limits and will continue to be performed on all data since 2017 for these pairs to ensure identification of increasing concentrations should they begin to occur. All records were updated to include more recent data through April 2019 (Figure E). A summary of these results follows this letter and the test results are included with the Mann-Whitney test section at the end of this report.

Intrawell prediction limits using all historical data through April 2019, combined with a 1-of-2 resample plan, were constructed and a summary of the updated limits follows this letter (Figure F).

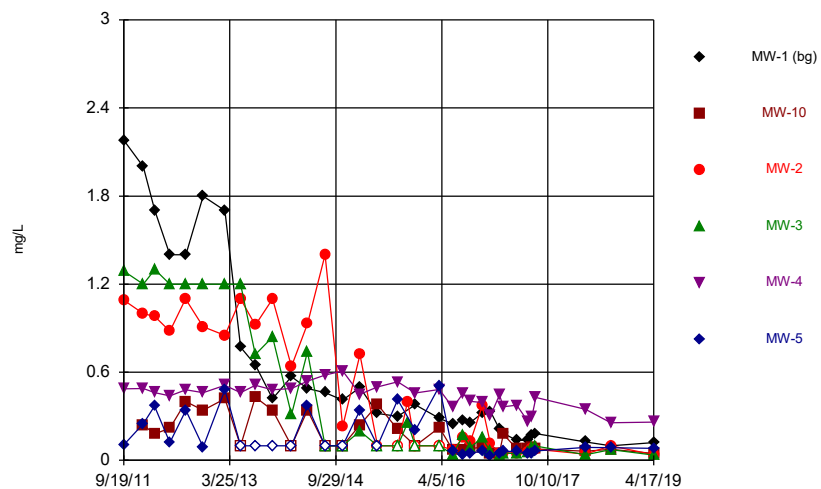
Thank you for the opportunity to assist you in the statistical analysis of groundwater quality for the Turk Landfill. If you have any questions or comments, please feel free to contact me.

For Groundwater Stats Consulting,

A handwritten signature in black ink that reads "Kristina Rayner". The signature is written in a cursive, flowing style.

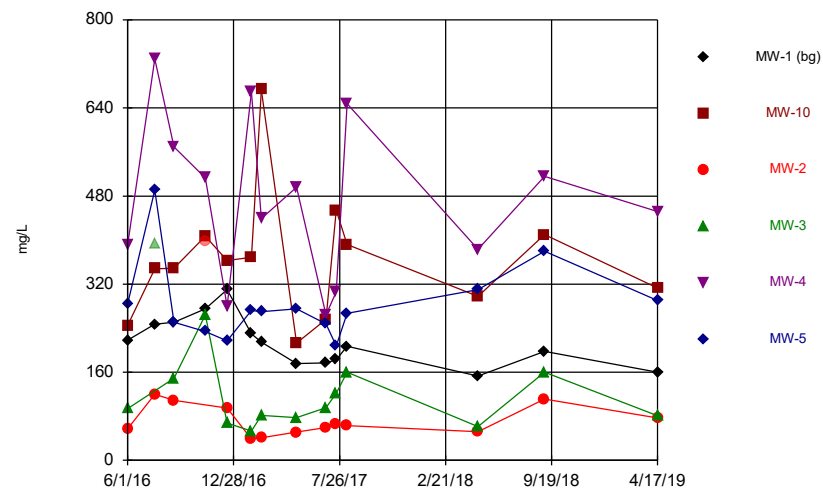
Kristina L. Rayner  
Groundwater Statistician

Time Series



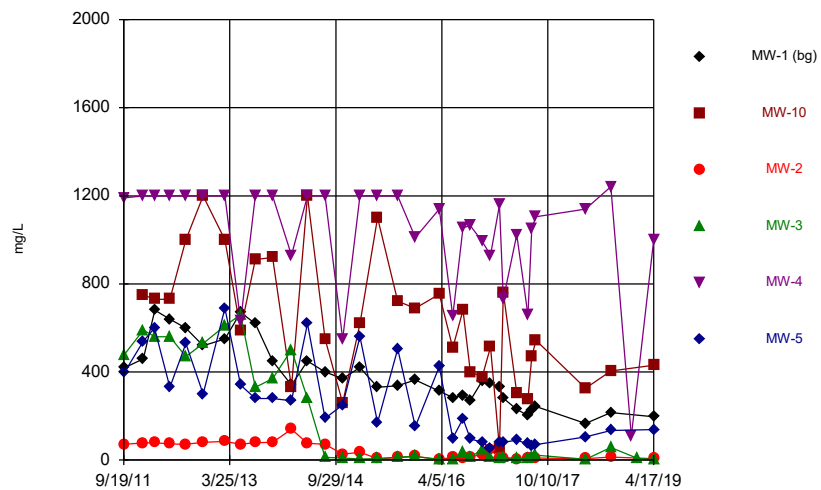
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 Turk Landfill Client: Geosyntec Data: Turk Landfill

Time Series



Constituent: Calcium Analysis Run 11/10/2019 7:31 PM View: Descriptive - Appendix III  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

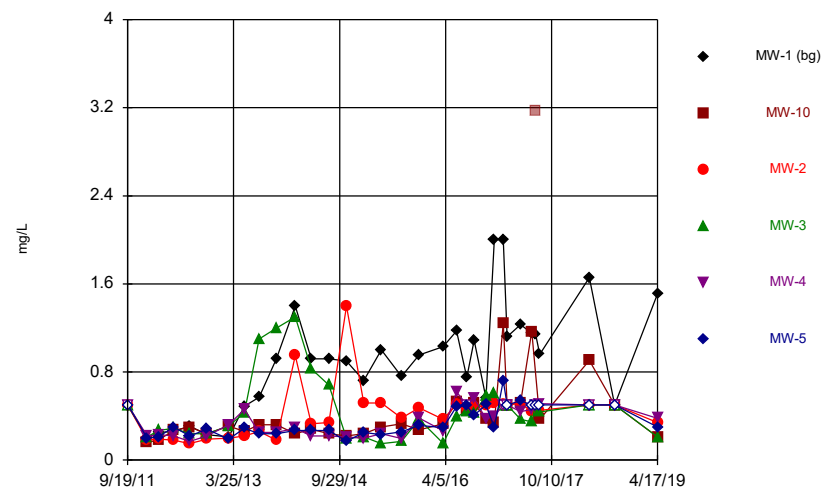
Time Series



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 Turk Landfill Client: Geosyntec Data: Turk Landfill

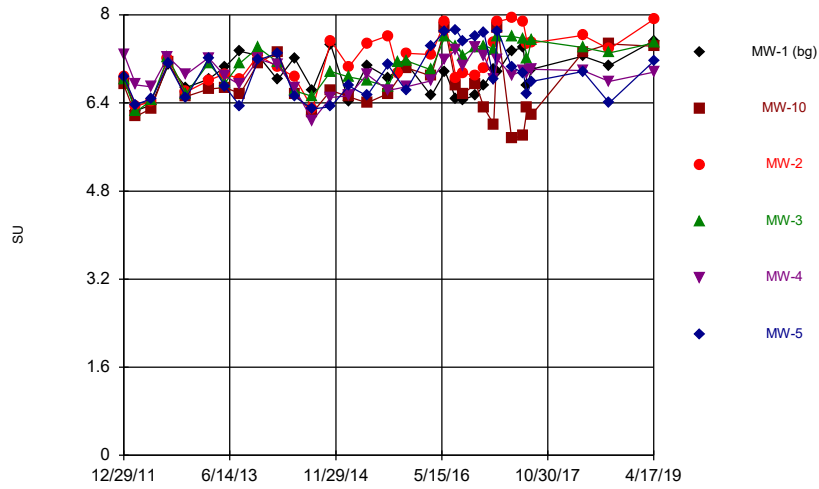
Hollow symbols indicate censored values.

Time Series



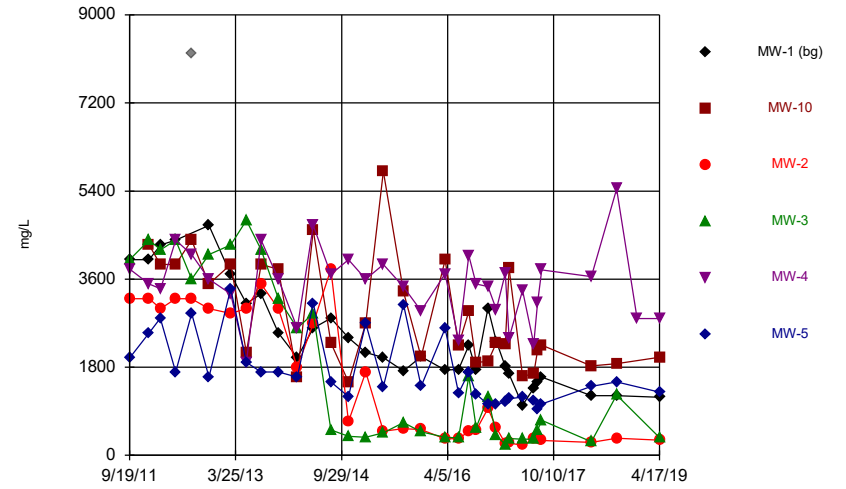
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### Time Series



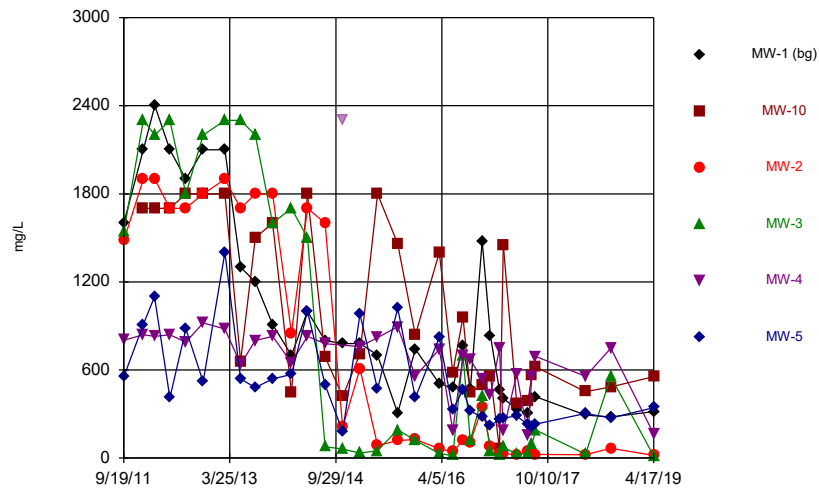
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### Time Series



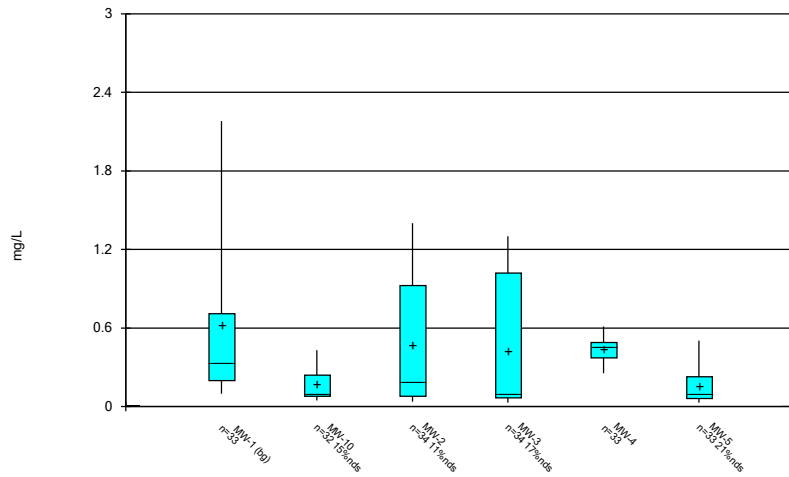
Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/10/2019 7:32 PM View: Descriptive - Appendix  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Time Series



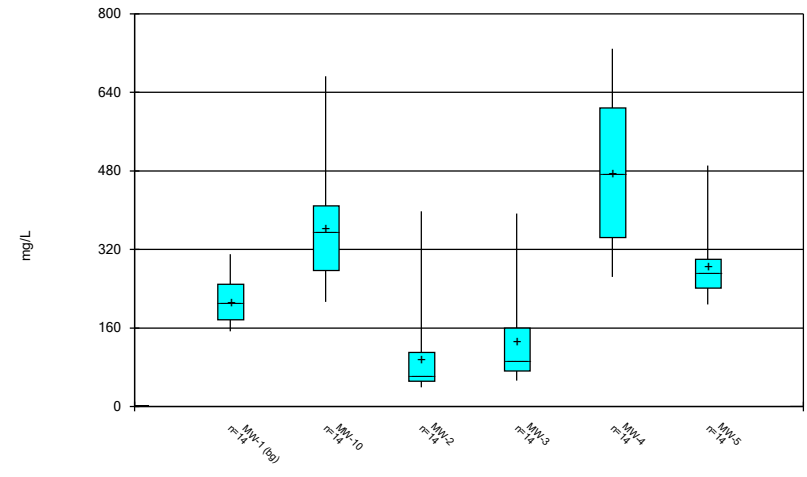
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Box & Whiskers Plot



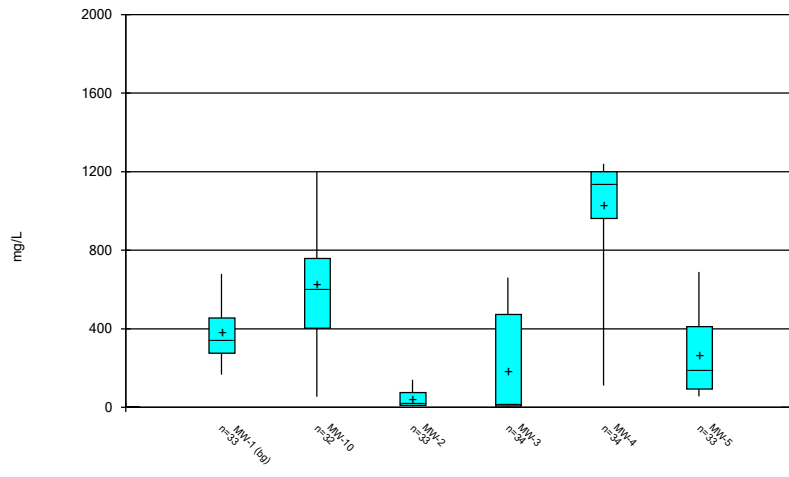
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Box & Whiskers Plot



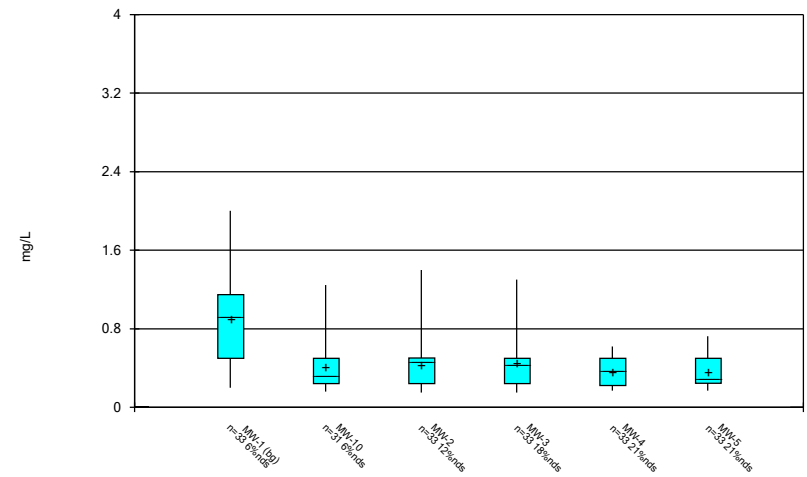
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Box & Whiskers Plot



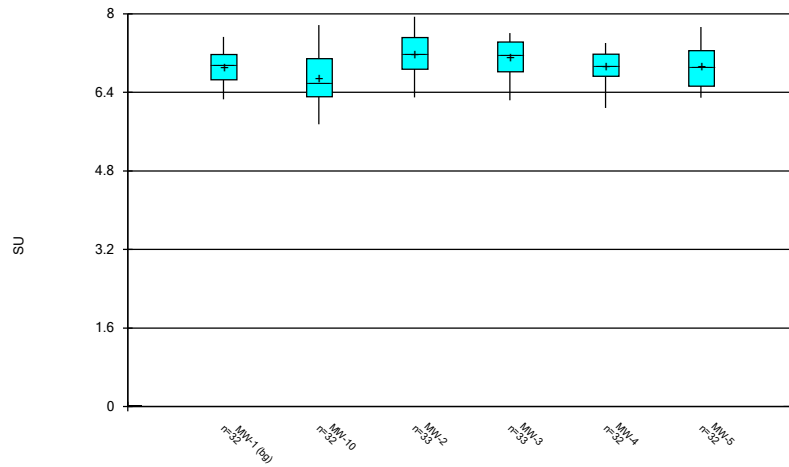
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Box & Whiskers Plot



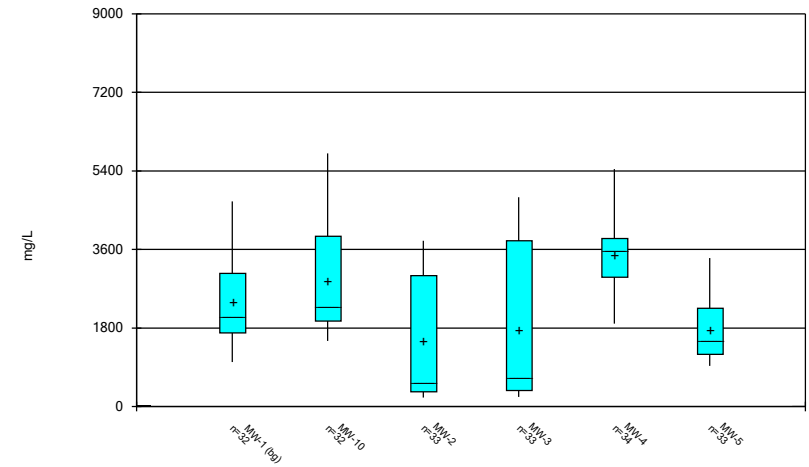
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Box & Whiskers Plot



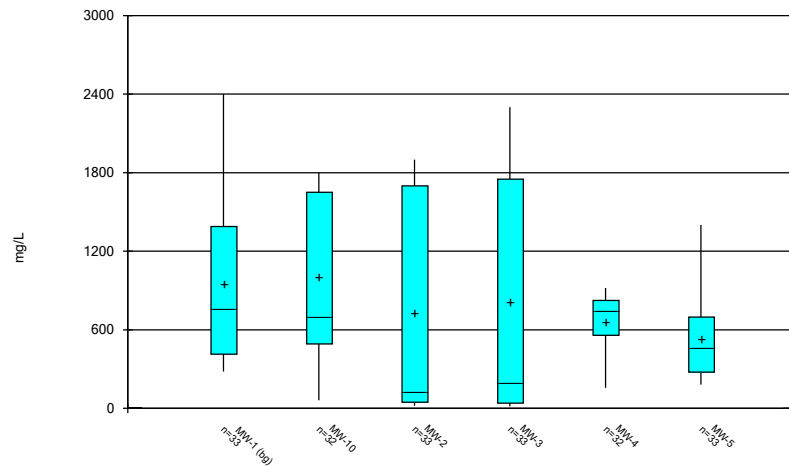
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Box & Whiskers Plot



Constituent: Solids, Total Dissolved [TDS] Analysis Run 9/30/2019 4:09 PM View: Descriptive - Appendix I  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Box & Whiskers Plot



Constituent: Sulfate Analysis Run 9/30/2019 4:09 PM View: Descriptive - Appendix III  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

# Outlier Summary

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 11/10/2019, 7:35 PM

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	MW-2 Calcium (mg/L)	MW-3 Calcium (mg/L)	MW-10 Fluoride (mg/L)	MW-1 Solids, Total Dissolved [TDS] (mg/L)	MW-4 Sulfate (mg/L)
8/8/2012				8200 (o)	
11/5/2014					2300 (o)
7/25/2016		393 (o)			
11/2/2016	398 (o)				
7/19/2017			3.17 (o)		

# Outlier Analysis - Significant Results

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 11/10/2019, 7:03 PM

<u>Constituent</u>	<u>Well</u>	<u>Outlier</u>	<u>Value(s)</u>	<u>Date(s)</u>	<u>Method</u>	<u>N</u>	<u>Mean</u>	<u>Std. Dev.</u>	<u>Distribution</u>	<u>Normality Test</u>
Sulfate (mg/L)	MW-4	Yes	2300	11/5/2014	NP	33	709.5	358.5	x^(1/3)	ShapiroWilk

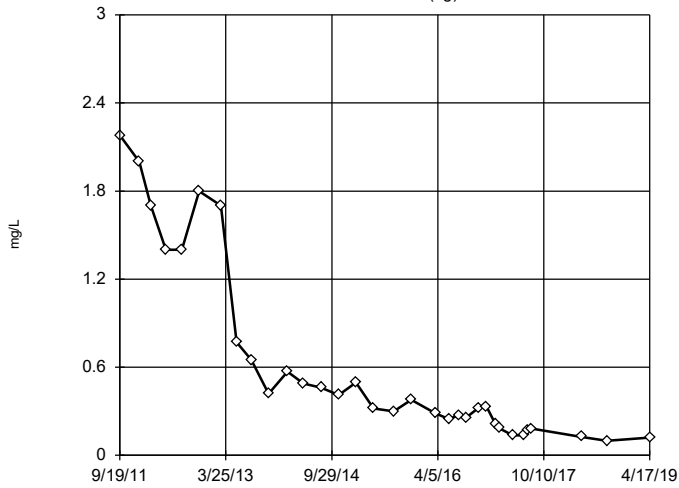


# Outlier Analysis - All Results

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 11/10/2019, 7:03 PM

Constituent	Well	Outlier	Value(s)	Date(s)	Method	N	Mean	Std. Dev.	Distribution	Normality Test
Boron (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	33	0.622	0.6215	ln(x)	ShapiroWilk
Boron (mg/L)	MW-10	No	n/a	n/a	NP	32	0.1736	0.1252	ln(x)	ShapiroWilk
Boron (mg/L)	MW-2	No	n/a	n/a	NP	34	0.4711	0.4485	ln(x)	ShapiroWilk
Boron (mg/L)	MW-3	No	n/a	n/a	NP	34	0.4258	0.4912	ln(x)	ShapiroWilk
Boron (mg/L)	MW-4	No	n/a	n/a	NP	33	0.4356	0.08994	x^2	ShapiroWilk
Boron (mg/L)	MW-5	No	n/a	n/a	NP	33	0.1551	0.14	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	14	214.3	45.05	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-10	No	n/a	n/a	NP	14	363.6	112.5	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-2	No	n/a	n/a	NP	14	95.58	91	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-3	No	n/a	n/a	NP	14	132.8	93.55	ln(x)	ShapiroWilk
Calcium (mg/L)	MW-4	No	n/a	n/a	NP	14	475.4	144.9	sqrt(x)	ShapiroWilk
Calcium (mg/L)	MW-5	No	n/a	n/a	NP	14	285.5	72.65	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	33	381.4	144.9	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-10	No	n/a	n/a	NP	32	628.4	286.6	sqrt(x)	ShapiroWilk
Chloride (mg/L)	MW-2	No	n/a	n/a	NP	33	40.68	36.22	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-3	No	n/a	n/a	NP	34	184.2	242.6	ln(x)	ShapiroWilk
Chloride (mg/L)	MW-4	No	n/a	n/a	NP	34	1028	253.7	x^6	ShapiroWilk
Chloride (mg/L)	MW-5	No	n/a	n/a	NP	33	266.1	194	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	33	0.8907	0.4815	sqrt(x)	ShapiroWilk
Fluoride (mg/L)	MW-10	No	n/a	n/a	NP	32	0.4882	0.5521	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-2	No	n/a	n/a	NP	33	0.4318	0.239	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-3	No	n/a	n/a	NP	33	0.4597	0.2875	ln(x)	ShapiroWilk
Fluoride (mg/L)	MW-4	No	n/a	n/a	NP	33	0.358	0.1343	x^(1/3)	ShapiroWilk
Fluoride (mg/L)	MW-5	No	n/a	n/a	NP	33	0.3558	0.1383	ln(x)	ShapiroWilk
pH (SU)	MW-1 (bg)	No	n/a	n/a	NP	32	6.918	0.3431	x^2	ShapiroWilk
pH (SU)	MW-10	No	n/a	n/a	NP	32	6.694	0.5196	ln(x)	ShapiroWilk
pH (SU)	MW-2	No	n/a	n/a	NP	33	7.193	0.461	normal	ShapiroWilk
pH (SU)	MW-3	No	n/a	n/a	NP	33	7.12	0.3777	x^6	ShapiroWilk
pH (SU)	MW-4	No	n/a	n/a	NP	32	6.928	0.2871	x^6	ShapiroWilk
pH (SU)	MW-5	No	n/a	n/a	NP	32	6.945	0.4629	ln(x)	ShapiroWilk
Solids, Total Dissolved [TDS] (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	33	2583	1436	ln(x)	ShapiroWilk
Solids, Total Dissolved [TDS] (mg/L)	MW-10	No	n/a	n/a	NP	32	2885	1117	ln(x)	ShapiroWilk
Solids, Total Dissolved [TDS] (mg/L)	MW-2	No	n/a	n/a	NP	33	1492	1323	ln(x)	ShapiroWilk
Solids, Total Dissolved [TDS] (mg/L)	MW-3	No	n/a	n/a	NP	33	1770	1699	ln(x)	ShapiroWilk
Solids, Total Dissolved [TDS] (mg/L)	MW-4	No	n/a	n/a	NP	34	3480	727.4	normal	ShapiroWilk
Solids, Total Dissolved [TDS] (mg/L)	MW-5	No	n/a	n/a	NP	33	1751	711.8	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-1 (bg)	No	n/a	n/a	NP	33	947.5	655.3	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-10	No	n/a	n/a	NP	32	994.2	582	x^(1/3)	ShapiroWilk
Sulfate (mg/L)	MW-2	No	n/a	n/a	NP	33	728.7	804	ln(x)	ShapiroWilk
Sulfate (mg/L)	MW-3	No	n/a	n/a	NP	33	813.5	939.8	ln(x)	ShapiroWilk
<b>Sulfate (mg/L)</b>	<b>MW-4</b>	<b>Yes</b>	<b>2300</b>	<b>11/5/2014</b>	<b>NP</b>	<b>33</b>	<b>709.5</b>	<b>358.5</b>	<b>x^(1/3)</b>	<b>ShapiroWilk</b>
Sulfate (mg/L)	MW-5	No	n/a	n/a	NP	33	525	312.8	ln(x)	ShapiroWilk

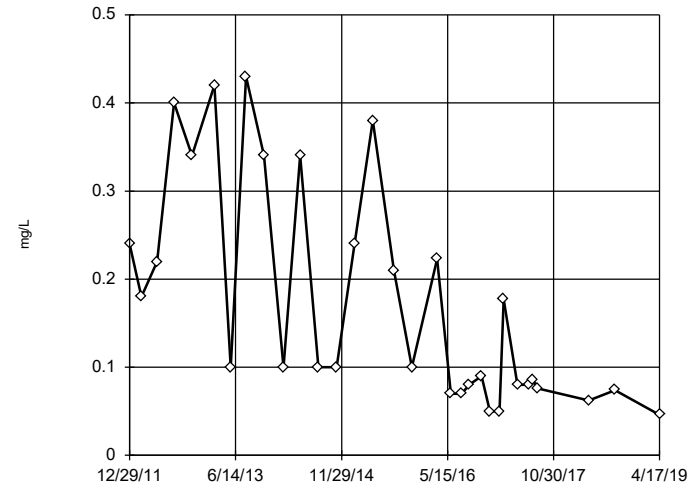
### Tukey's Outlier Screening MW-1 (bg)



n = 33  
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 = 32.51, low cutoff = 0.004297, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

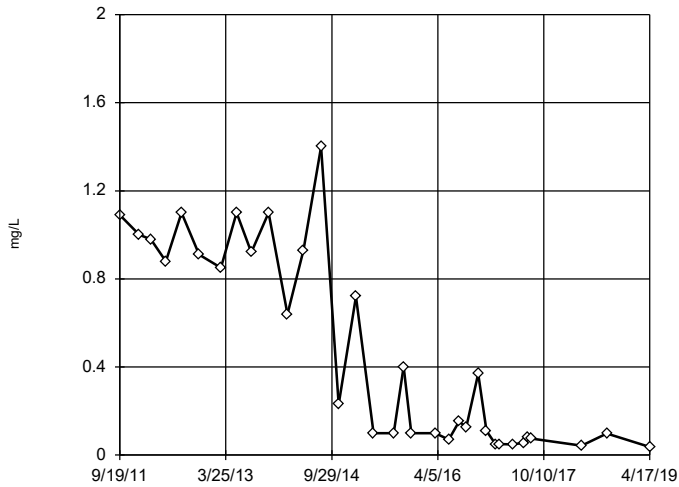
### Tukey's Outlier Screening MW-10



n = 32  
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 = 6.967, low cutoff = 0.00269, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

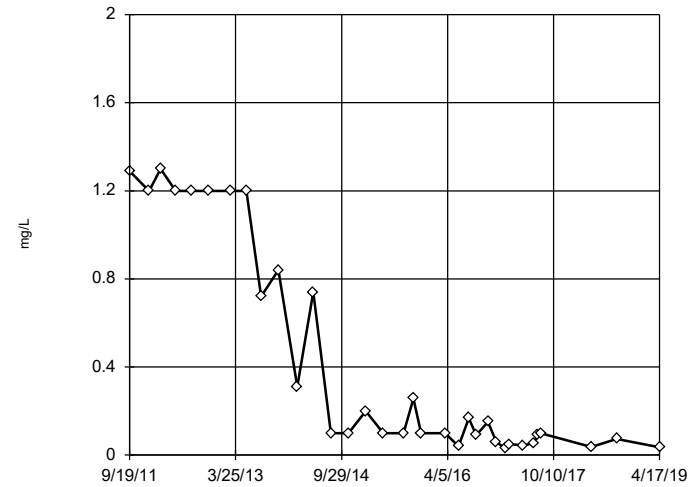
### Tukey's Outlier Screening MW-2



n = 34  
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 = 1493, low cutoff = 0.00004887, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

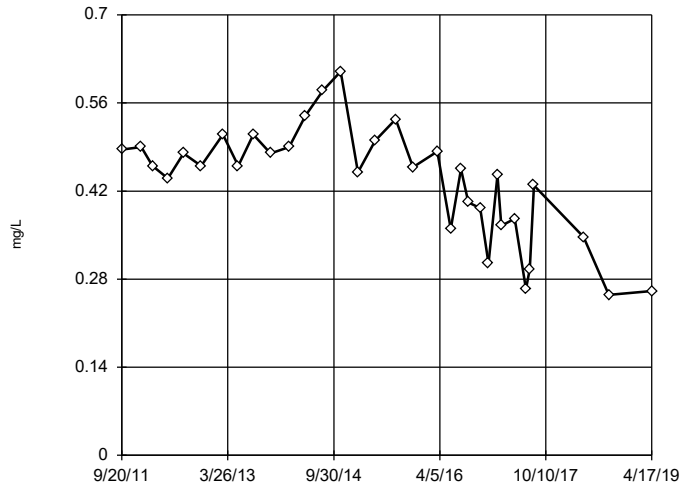
### Tukey's Outlier Screening MW-3



n = 34  
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 = 3505, low cutoff = 0.00001896, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

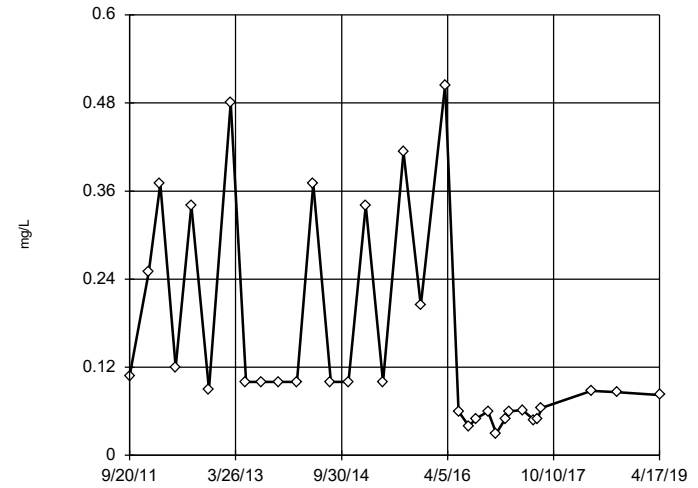
### Tukey's Outlier Screening MW-4



n = 33  
 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 = 0.7406, low cutoff = -0.4136, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

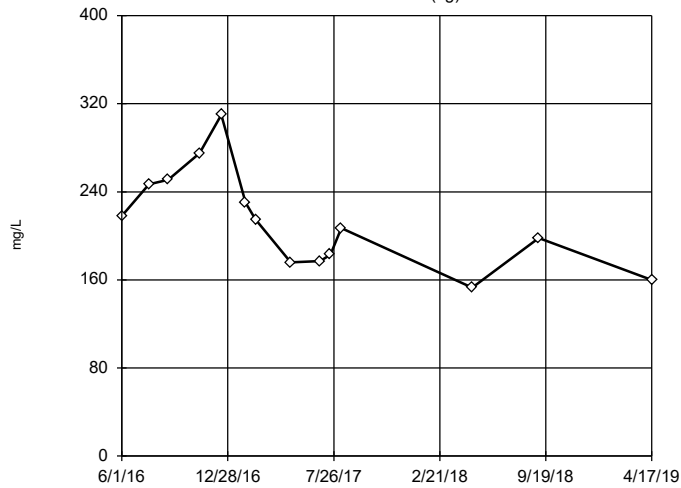
### Tukey's Outlier Screening MW-5



n = 33  
 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 = 12.04, low cutoff = 0.001125, based on IQR multiplier of 3.

Constituent: Boron Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

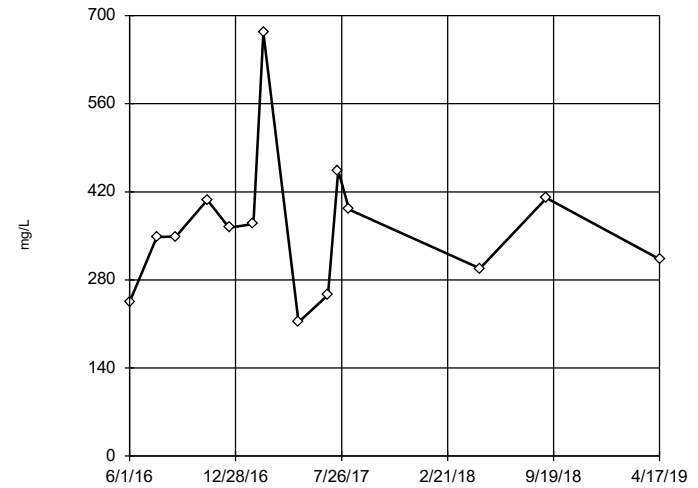
### Tukey's Outlier Screening MW-1 (bg)



n = 14  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 699.1, low cutoff = 62.87, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening MW-10

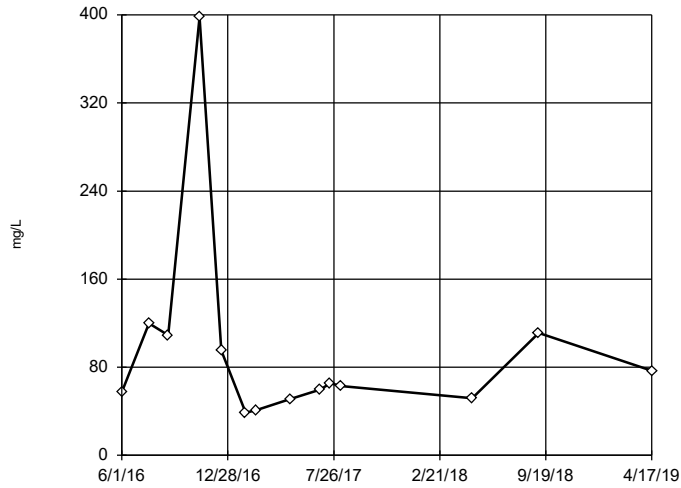


n = 14  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 1322, low cutoff = 85.38, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-2



n = 14

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

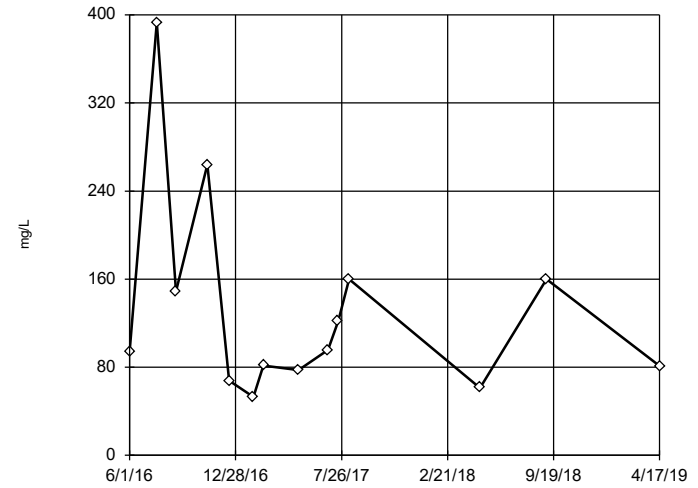
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1072, low cutoff = 5.285, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-3



n = 14

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

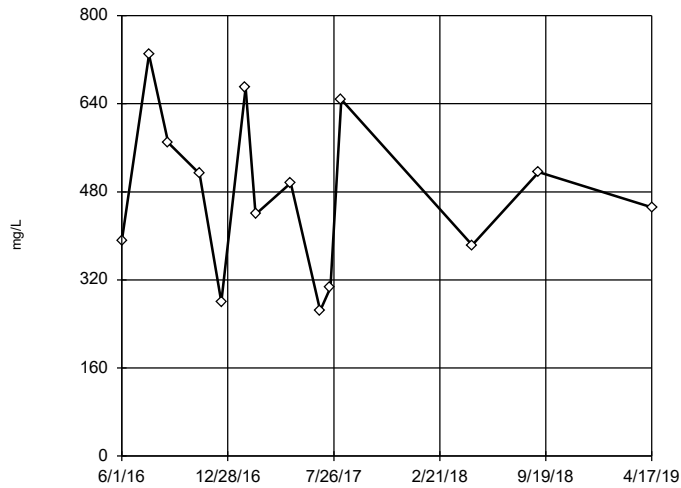
Data were natural log transformed to achieve best W statistic (graph shown in original units).

High cutoff = 1727, low cutoff = 6.706, based on IQR multiplier of 3.

Constituent: Calcium Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

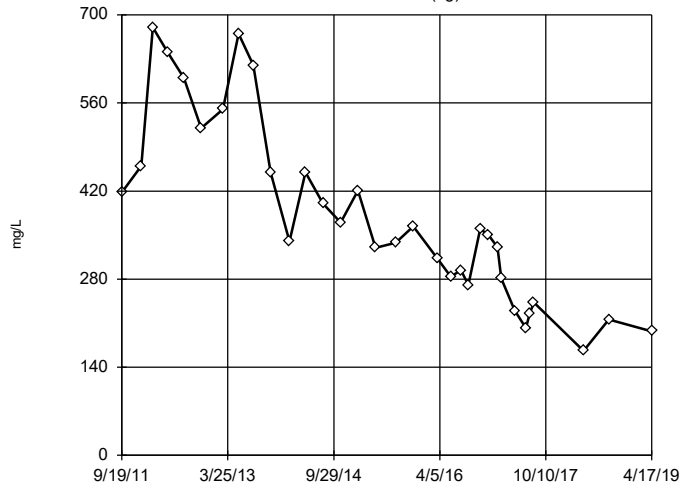
### Tukey's Outlier Screening

MW-4



### Tukey's Outlier Screening

MW-1 (bg)

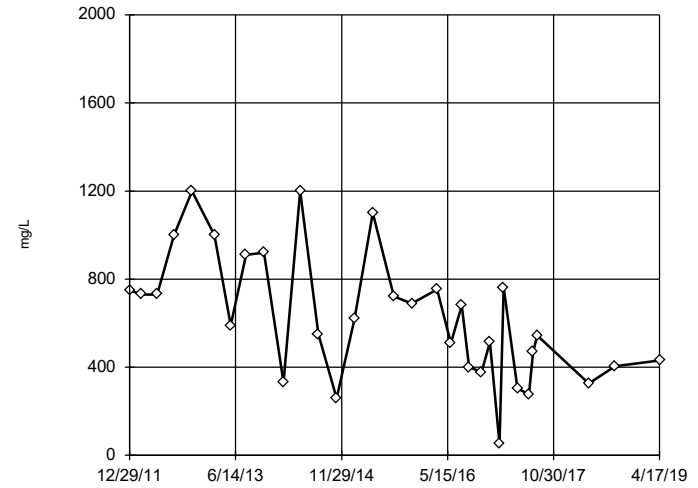


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 2039, low cutoff = 61.57, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-10

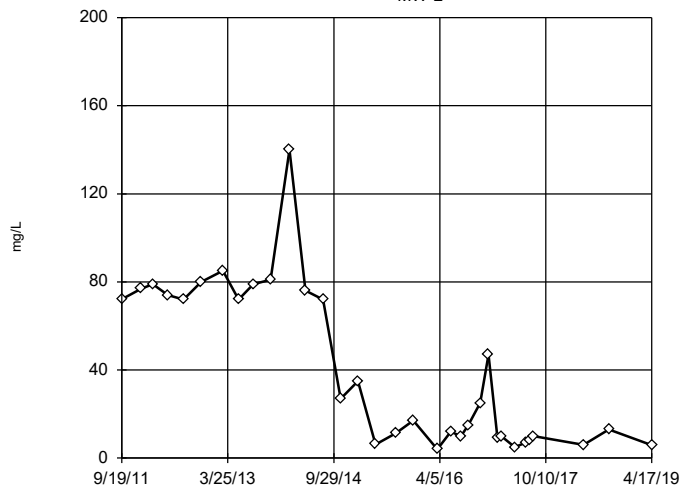


n = 32  
 No outliers found.  
 Tukey's method selected by user.  
 Data were square root transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 2490, low cutoff = -5.376, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-2

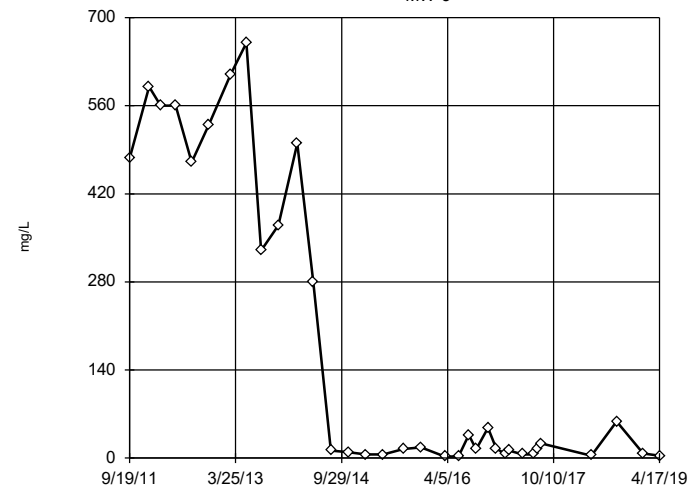


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 37045, low cutoff = 0.01921, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

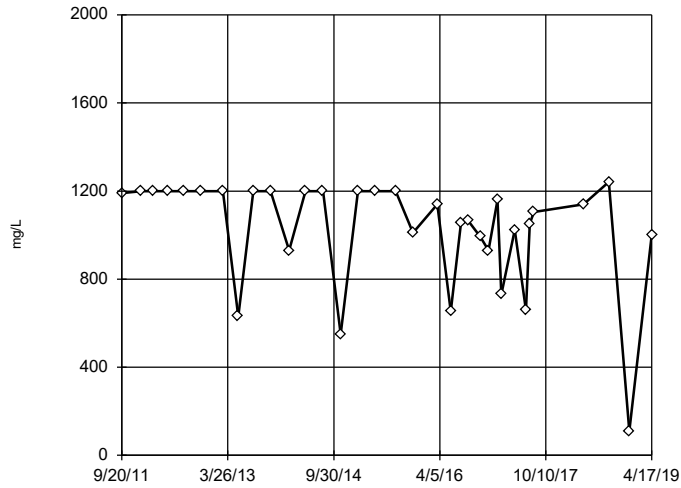
MW-3



n = 34  
 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 = 1.8e8, low cutoff = 0.00001667, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

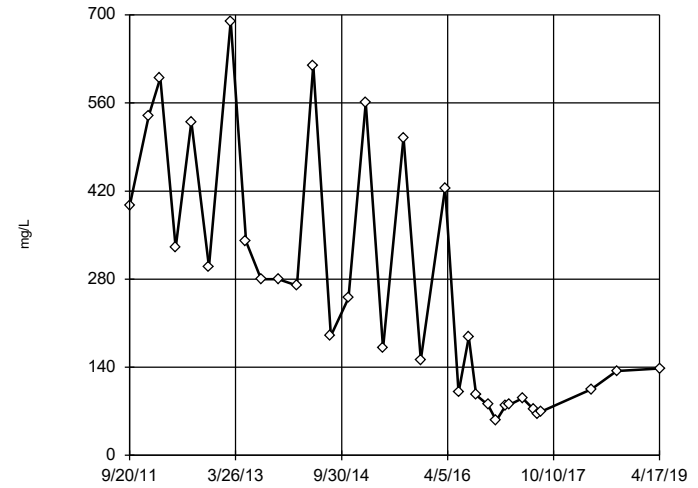
Tukey's Outlier Screening  
MW-4



n = 34  
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 = 1456, low cutoff = -1338, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

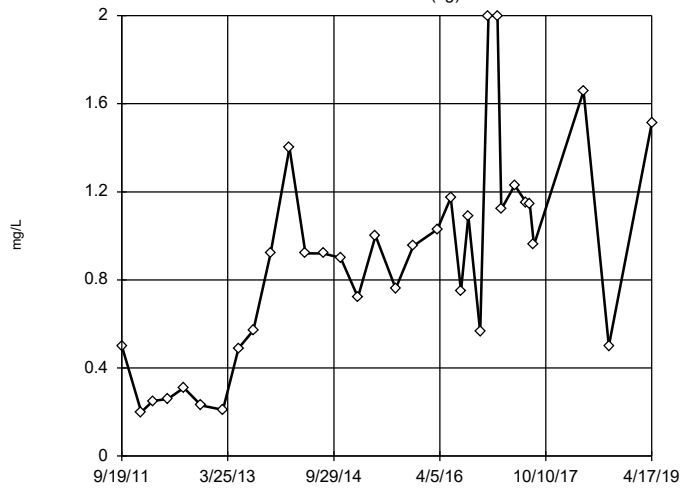
Tukey's Outlier Screening  
MW-5



n = 33  
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 = 34690, low cutoff = 1.105, based on IQR multiplier of 3.

Constituent: Chloride Analysis Run 11/10/2019 7:01 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

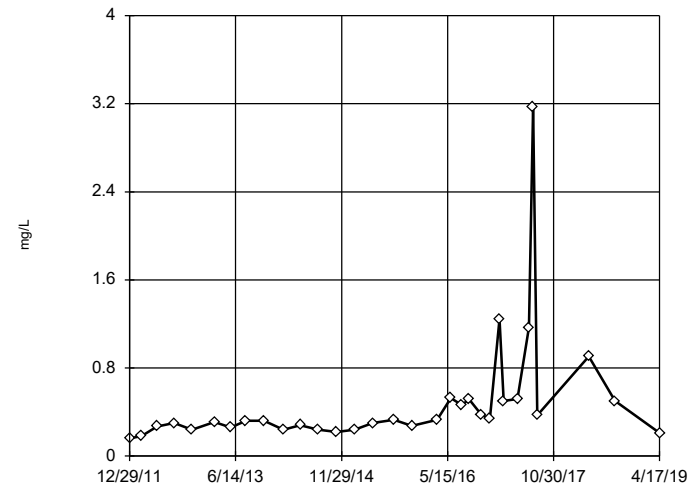
Tukey's Outlier Screening  
MW-1 (bg)



n = 33  
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 = 4.687, low cutoff = -0.1491, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

Tukey's Outlier Screening  
MW-10

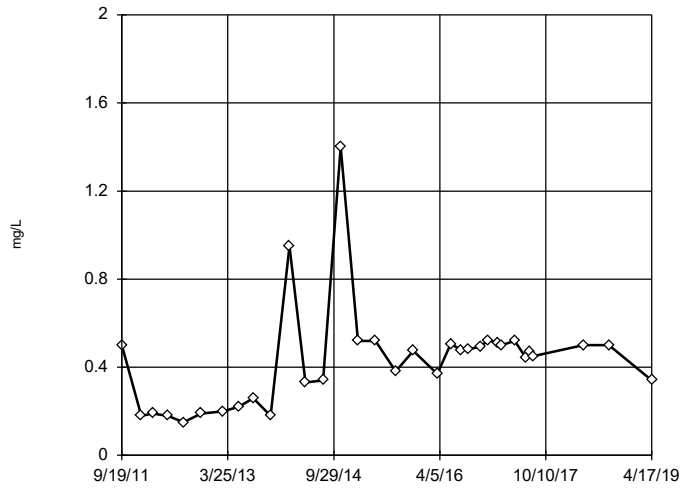


n = 32  
No outliers found. Tukey's method selected by user.  
Data were natural log transformed to achieve best W statistic (graph shown in original units).  
High cutoff = 4.01, low cutoff = 0.03115, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-2

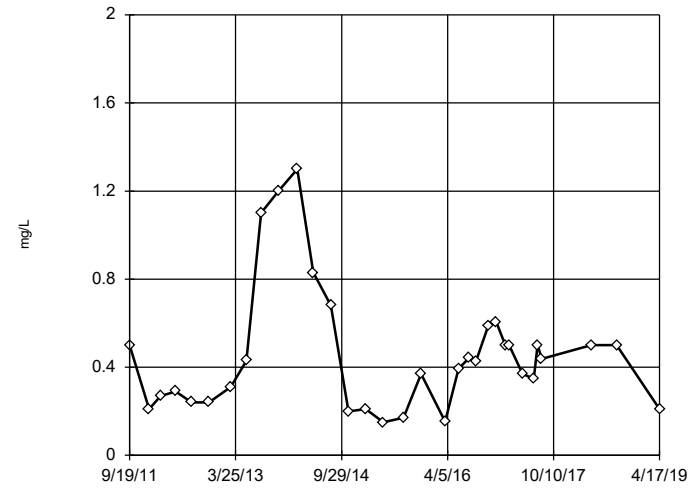


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 4.686, low cutoff = 0.02568, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-3

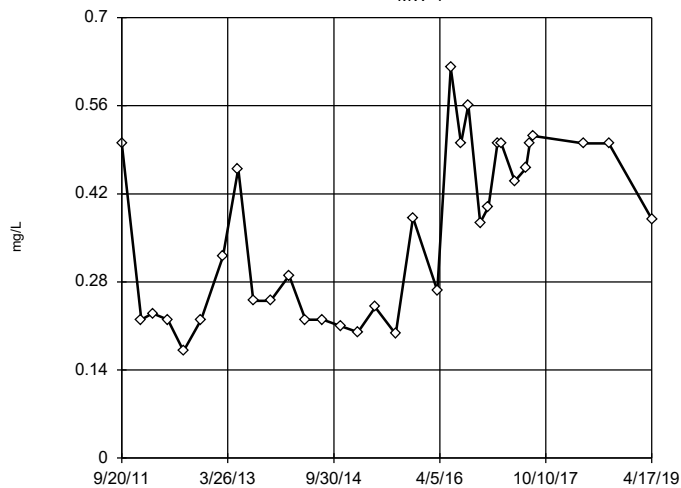


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 4.521, low cutoff = 0.02654, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-4

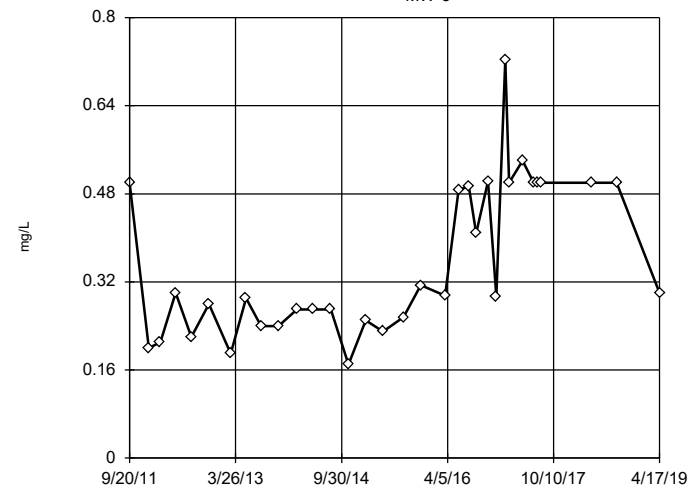


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were cube root transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 2.536, low cutoff = 0.00003801, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-5

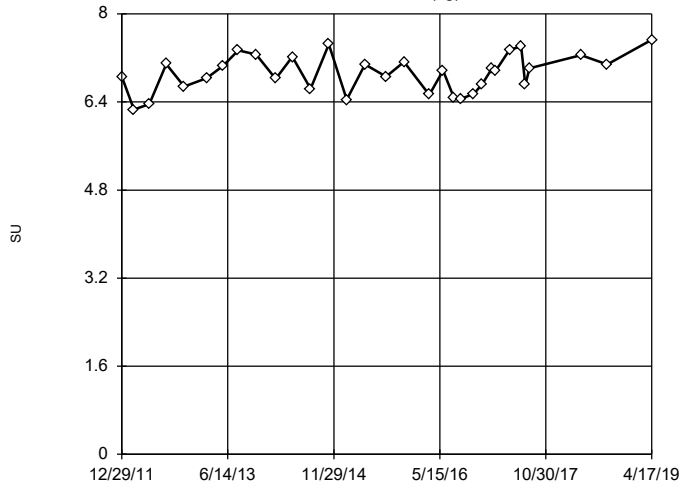


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 4.253, low cutoff = 0.0288, based on IQR multiplier of 3.

Constituent: Fluoride Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-1 (bg)

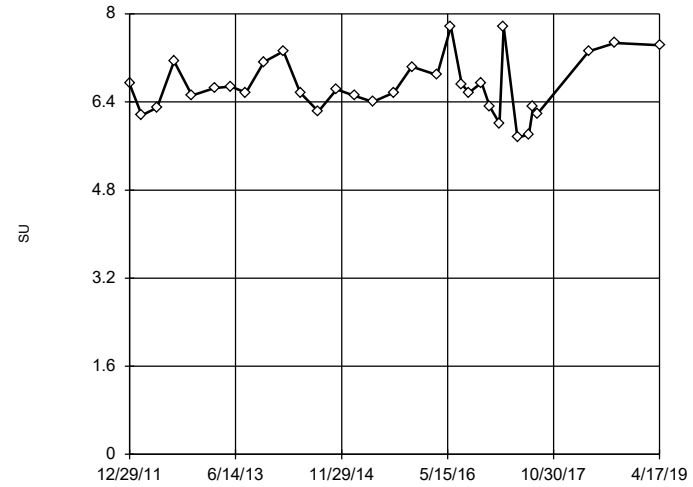


n = 32  
 No outliers found.  
 Tukey's method selected by user.  
 Data were square transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 8.536, low cutoff = 4.793, based on IQR multiplier of 3.

Constituent: pH Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-10

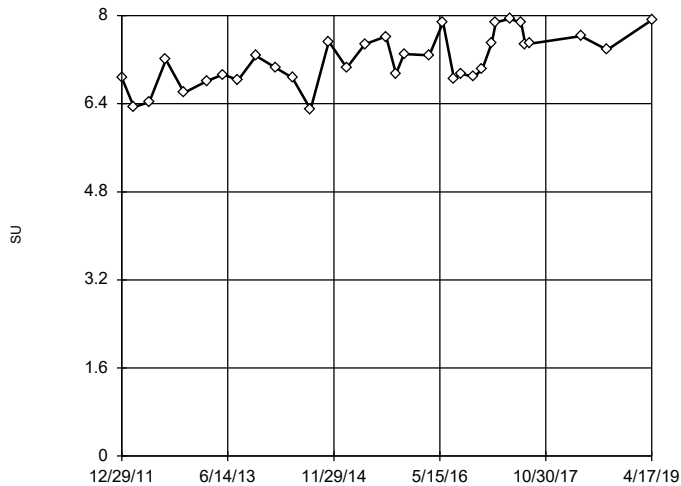


n = 32  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 10.03, low cutoff = 4.458, based on IQR multiplier of 3.

Constituent: pH Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-2

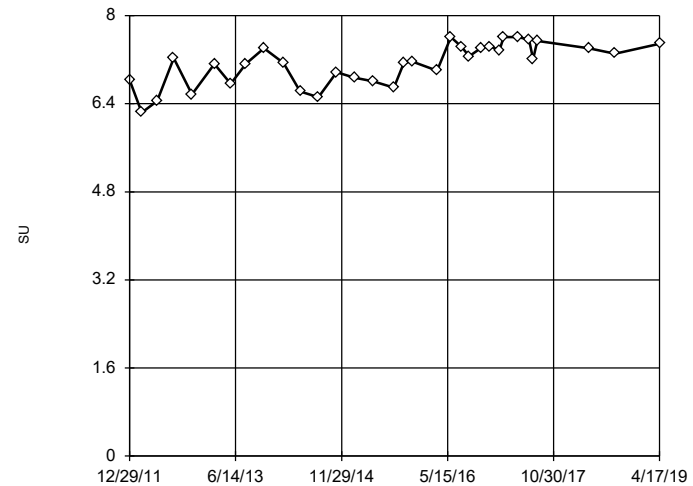


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Ladder of Powers transformations did not improve normality, analysis run on raw data.  
 High cutoff = 9.45, low cutoff = 4.935, based on IQR multiplier of 3.

Constituent: pH Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-3



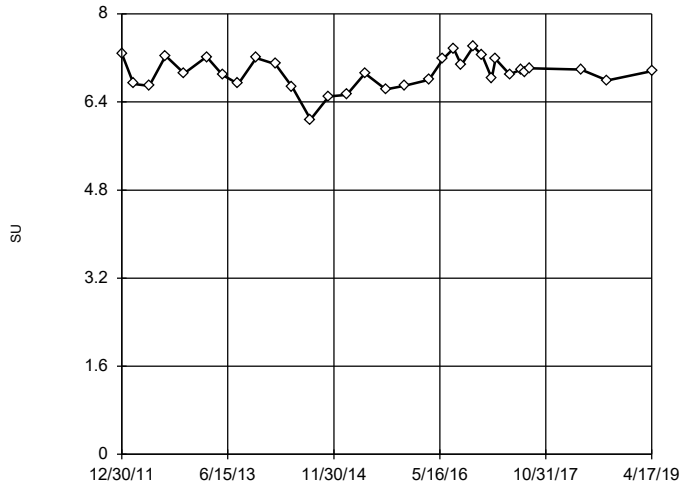
n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were x^6 transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 8.467, low cutoff = -6.815, based on IQR multiplier of 3.

Constituent: pH Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill



### Tukey's Outlier Screening

MW-4

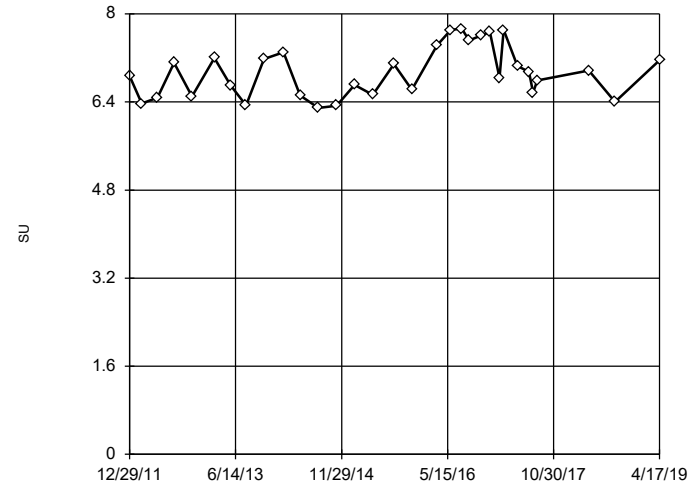


n = 32  
 No outliers found.  
 Tukey's method selected by user.  
 Data were  $x^6$  transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 8.036, low cutoff = -5.832, based on IQR multiplier of 3.

Constituent: pH Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-5

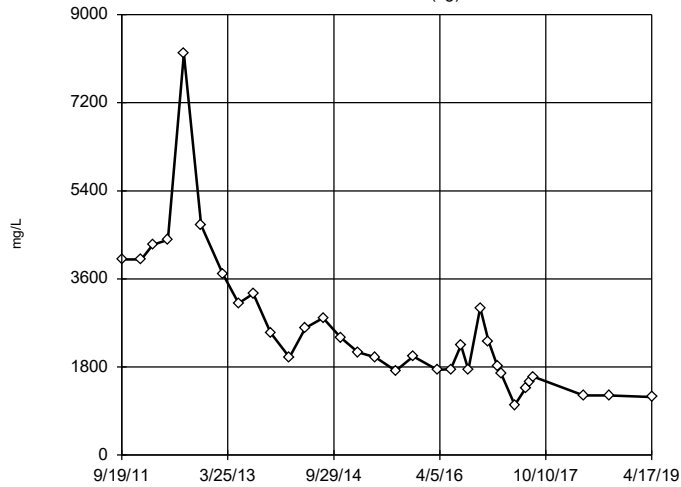


n = 32  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 9.944, low cutoff = 4.757, based on IQR multiplier of 3.

Constituent: pH Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-1 (bg)

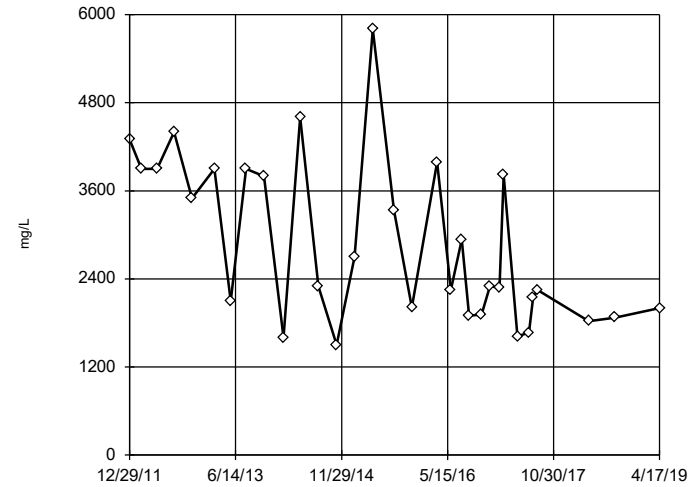


n = 33  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 21692, low cutoff = 249.1, based on IQR multiplier of 3.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-10

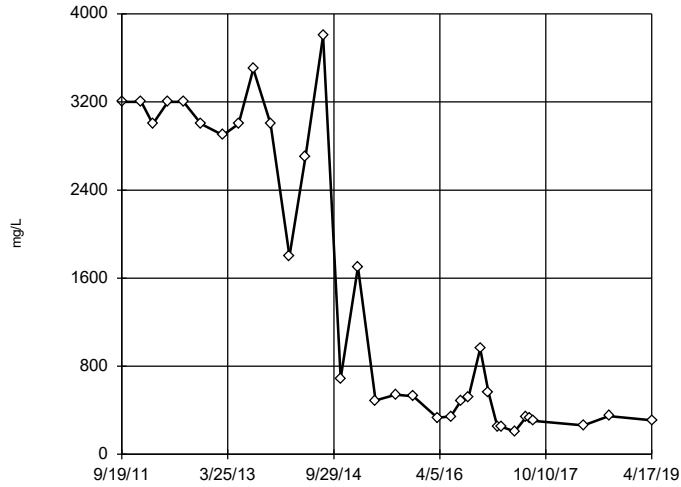


n = 32  
 No outliers found.  
 Tukey's method selected by user.  
 Data were natural log transformed to achieve best W statistic (graph shown in original units).  
 High cutoff = 30794, low cutoff = 248, based on IQR multiplier of 3.

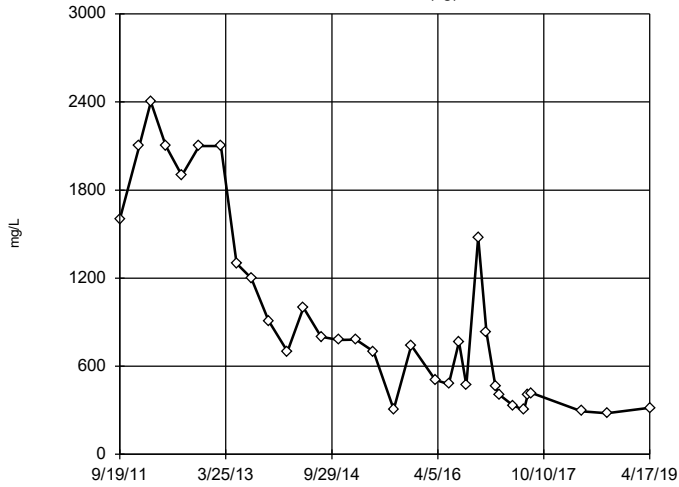
Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening

MW-2



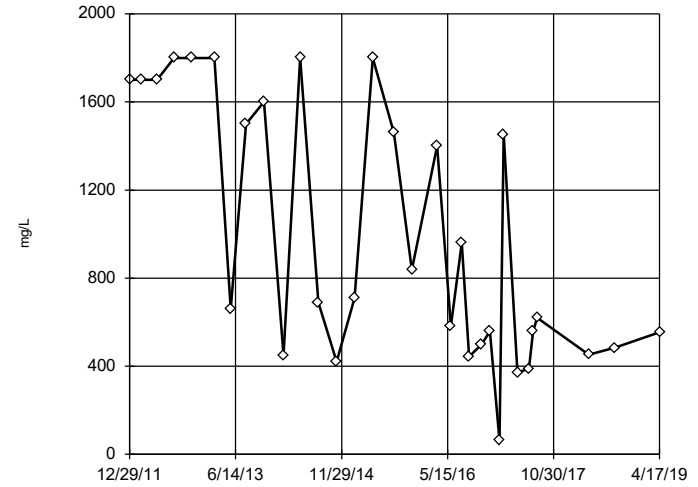
### Tukey's Outlier Screening MW-1 (bg)



n = 33  
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 = 52872, low cutoff = 10.8, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

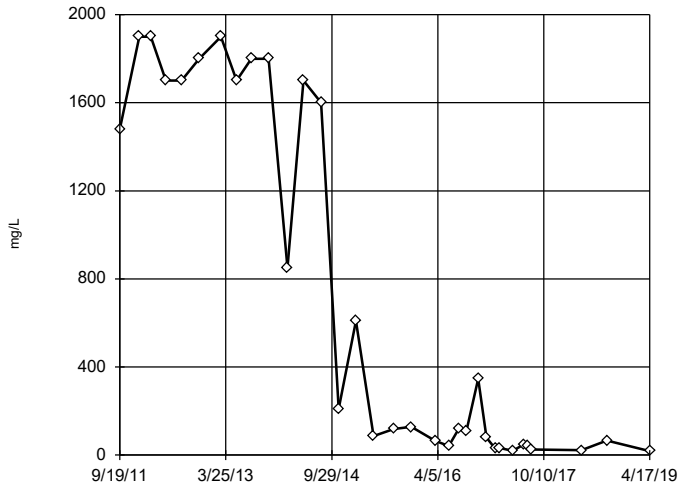
### Tukey's Outlier Screening MW-10



n = 32  
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 = 13123, low cutoff = -58.41, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

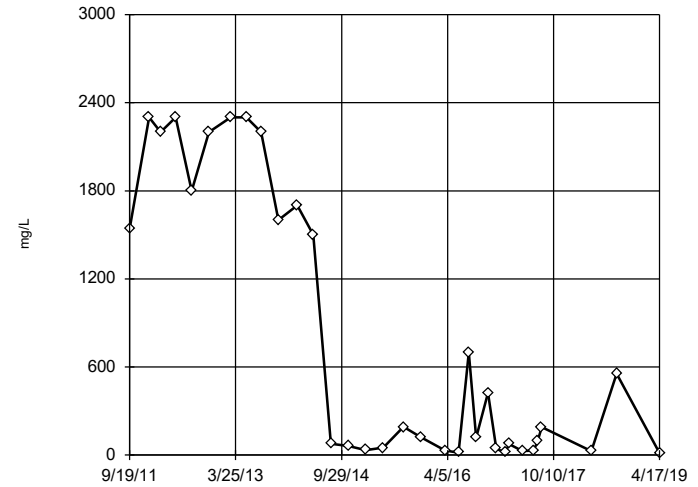
### Tukey's Outlier Screening MW-2



n = 33  
No outliers found.  
Tukey's method selected by user.  
Data were natural log transformed to achieve best W statistic (graph shown in original units).  
High cutoff = 8.6e7, low cutoff = 0.0009079, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

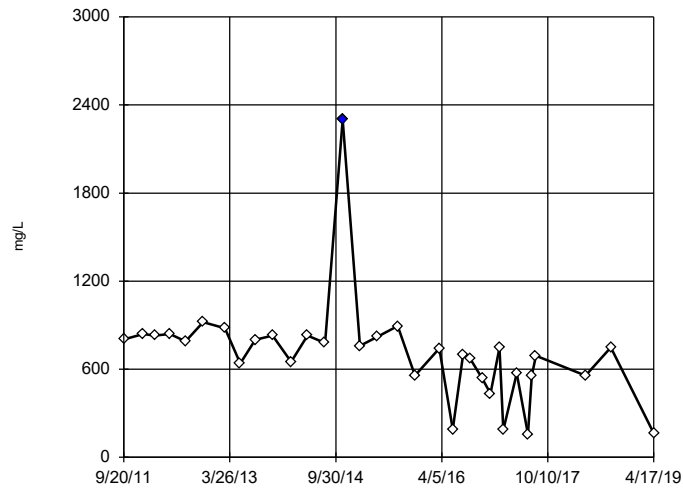
### Tukey's Outlier Screening MW-3



n = 33  
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 = 1.7e8, low cutoff = 0.0003993, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

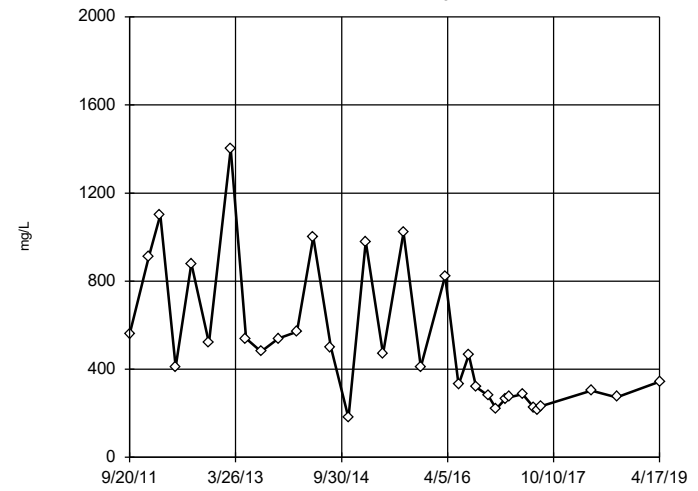
### Tukey's Outlier Screening MW-4



n = 33  
Outlier is drawn as solid.  
Tukey's method selected by user.  
Data were cube root transformed to achieve best W statistic (graph shown in original units).  
High cutoff = 2151, low cutoff = 105, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Tukey's Outlier Screening MW-5



n = 33  
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 = 10357, low cutoff = 18.32, based on IQR multiplier of 3.

Constituent: Sulfate Analysis Run 11/10/2019 7:02 PM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

# Mann-Whitney - Significant Results

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 11/12/2019, 1:34 PM

<u>Constituent</u>	<u>Well</u>	<u>Calc.</u>	<u>0.01</u>	<u>Sig.</u>	<u>Method</u>
Boron (mg/L)	MW-1 (bg)	-3.062	Yes	Yes	Mann-W
Boron (mg/L)	MW-10	-2.656	Yes	Yes	Mann-W
Boron (mg/L)	MW-2	-2.649	Yes	Yes	Mann-W
Boron (mg/L)	MW-4	-2.622	Yes	Yes	Mann-W
Chloride (mg/L)	MW-1 (bg)	-3.006	Yes	Yes	Mann-W
Solids, Total Dissolved [TDS] (mg/L)	MW-1 (bg)	-2.878	Yes	Yes	Mann-W
Sulfate (mg/L)	MW-1 (bg)	-2.844	Yes	Yes	Mann-W
Sulfate (mg/L)	MW-2	-2.735	Yes	Yes	Mann-W

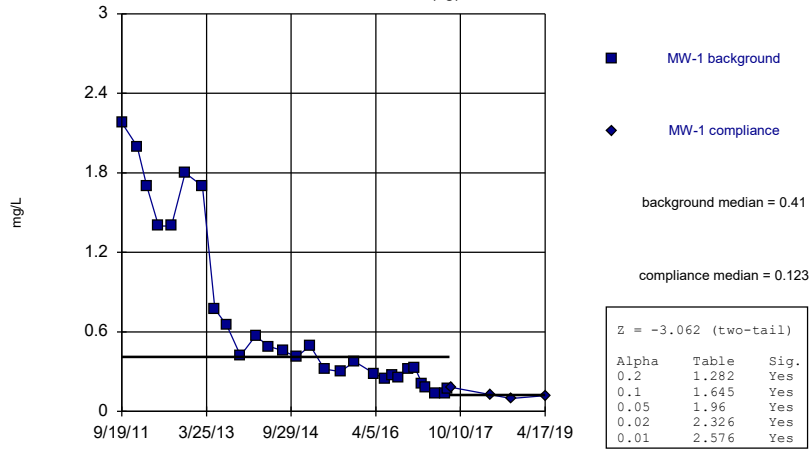
# Mann-Whitney - All Results

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 11/12/2019, 1:34 PM

<u>Constituent</u>	<u>Well</u>	<u>Calc.</u>	<u>0.01</u>	<u>Sig.</u>	<u>Method</u>
<b>Boron (mg/L)</b>	<b>MW-1 (bg)</b>	<b>-3.062</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
<b>Boron (mg/L)</b>	<b>MW-10</b>	<b>-2.656</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
<b>Boron (mg/L)</b>	<b>MW-2</b>	<b>-2.649</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
Boron (mg/L)	MW-3	-2.391	No	No	Mann-W
<b>Boron (mg/L)</b>	<b>MW-4</b>	<b>-2.622</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
Boron (mg/L)	MW-5	-1.026	No	No	Mann-W
Calcium (mg/L)	MW-1 (bg)	-2.051	No	No	Mann-W
Calcium (mg/L)	MW-10	0.07071	No	No	Mann-W
Calcium (mg/L)	MW-2	0.5401	No	No	Mann-W
Calcium (mg/L)	MW-3	0.2318	No	No	Mann-W
Calcium (mg/L)	MW-4	0.3536	No	No	Mann-W
Calcium (mg/L)	MW-5	1.626	No	No	Mann-W
<b>Chloride (mg/L)</b>	<b>MW-1 (bg)</b>	<b>-3.006</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
Chloride (mg/L)	MW-10	-1.624	No	No	Mann-W
Chloride (mg/L)	MW-2	-2.07	No	No	Mann-W
Chloride (mg/L)	MW-3	-1.459	No	No	Mann-W
Chloride (mg/L)	MW-4	-0.4754	No	No	Mann-W
Chloride (mg/L)	MW-5	-1.627	No	No	Mann-W
Fluoride (mg/L)	MW-1 (bg)	1.159	No	No	Mann-W
Fluoride (mg/L)	MW-10	0.767	No	No	Mann-W
Fluoride (mg/L)	MW-2	0.3315	No	No	Mann-W
Fluoride (mg/L)	MW-3	0.1937	No	No	Mann-W
Fluoride (mg/L)	MW-4	1.915	No	No	Mann-W
Fluoride (mg/L)	MW-5	1.719	No	No	Mann-W
pH (SU)	MW-1 (bg)	1.824	No	No	Mann-W
pH (SU)	MW-10	1.426	No	No	Mann-W
pH (SU)	MW-2	2.014	No	No	Mann-W
pH (SU)	MW-3	1.821	No	No	Mann-W
pH (SU)	MW-4	0.114	No	No	Mann-W
pH (SU)	MW-5	-0.4274	No	No	Mann-W
<b>Solids, Total Dissolved [TDS] (mg/L)</b>	<b>MW-1 (bg)</b>	<b>-2.878</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
Solids, Total Dissolved [TDS] (mg/L)	MW-10	-1.882	No	No	Mann-W
Solids, Total Dissolved [TDS] (mg/L)	MW-2	-2.348	No	No	Mann-W
Solids, Total Dissolved [TDS] (mg/L)	MW-3	-1.186	No	No	Mann-W
Solids, Total Dissolved [TDS] (mg/L)	MW-4	0.2432	No	No	Mann-W
Solids, Total Dissolved [TDS] (mg/L)	MW-5	-1.186	No	No	Mann-W
<b>Sulfate (mg/L)</b>	<b>MW-1 (bg)</b>	<b>-2.844</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
Sulfate (mg/L)	MW-10	-1.57	No	No	Mann-W
<b>Sulfate (mg/L)</b>	<b>MW-2</b>	<b>-2.735</b>	<b>Yes</b>	<b>Yes</b>	<b>Mann-W</b>
Sulfate (mg/L)	MW-3	-1.408	No	No	Mann-W
Sulfate (mg/L)	MW-4	-1.397	No	No	Mann-W
Sulfate (mg/L)	MW-5	-1.71	No	No	Mann-W

### Mann-Whitney (Wilcoxon Rank Sum)

MW-1 (bg)

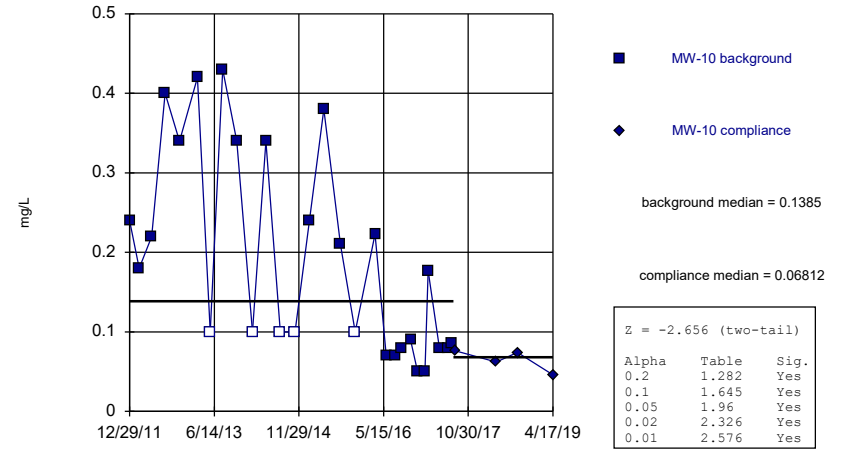


Constituent: Boron Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Hollow symbols indicate censored values.

### Mann-Whitney (Wilcoxon Rank Sum)

MW-10

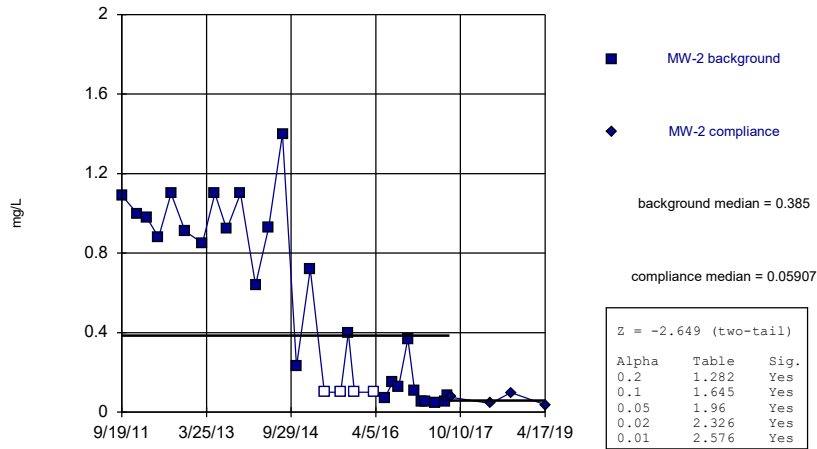


Constituent: Boron Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Hollow symbols indicate censored values.

### Mann-Whitney (Wilcoxon Rank Sum)

MW-2

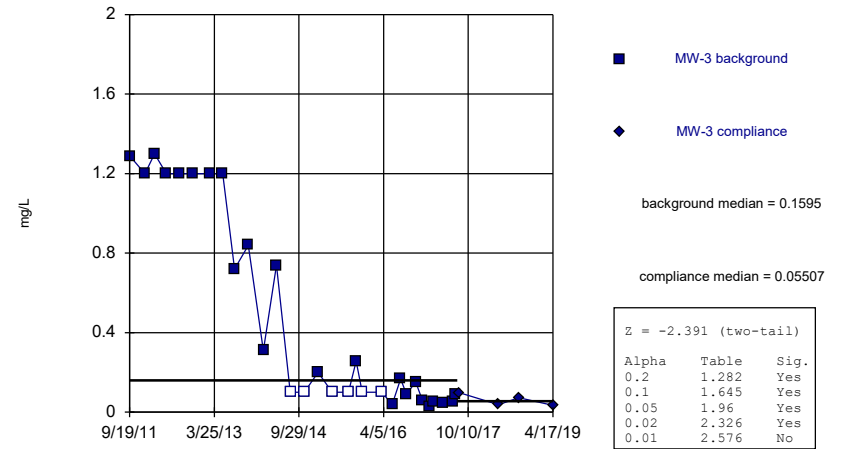


Constituent: Boron Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Hollow symbols indicate censored values.

### Mann-Whitney (Wilcoxon Rank Sum)

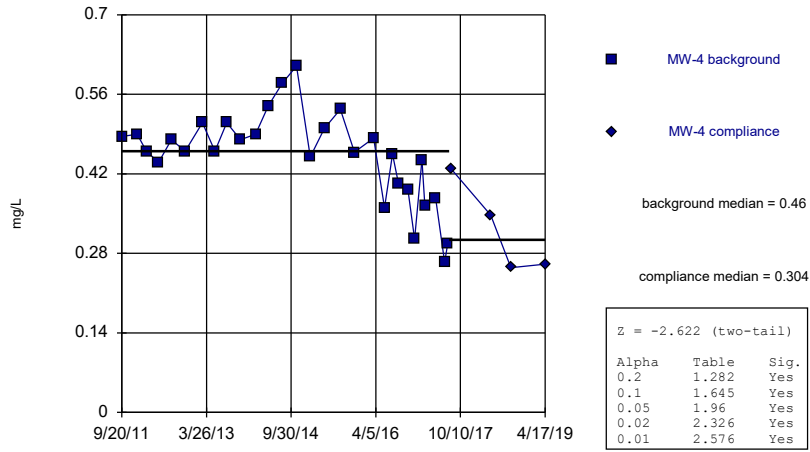
MW-3



Constituent: Boron Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

MW-4

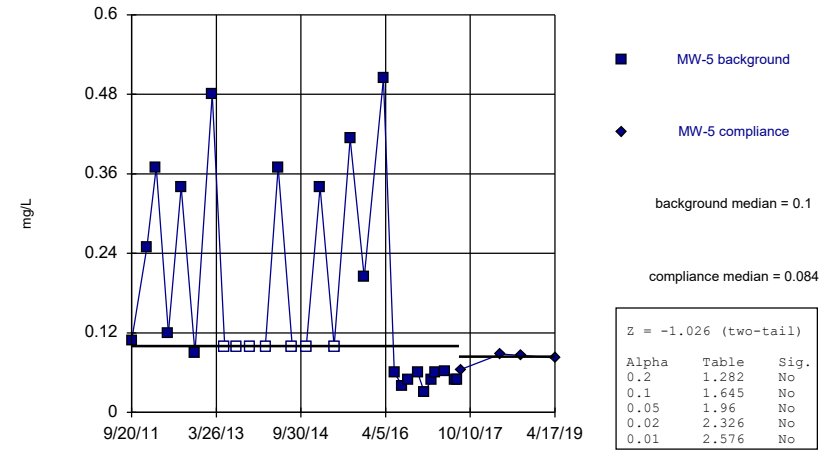


Constituent: Boron Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Hollow symbols indicate censored values.

### Mann-Whitney (Wilcoxon Rank Sum)

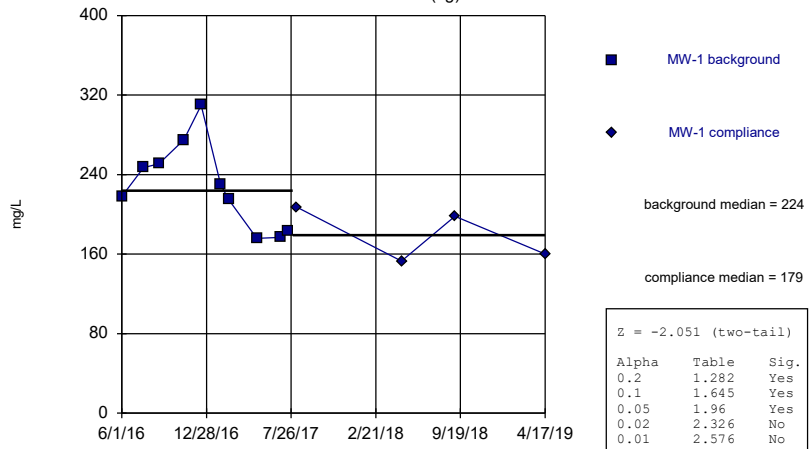
MW-5



Constituent: Boron Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

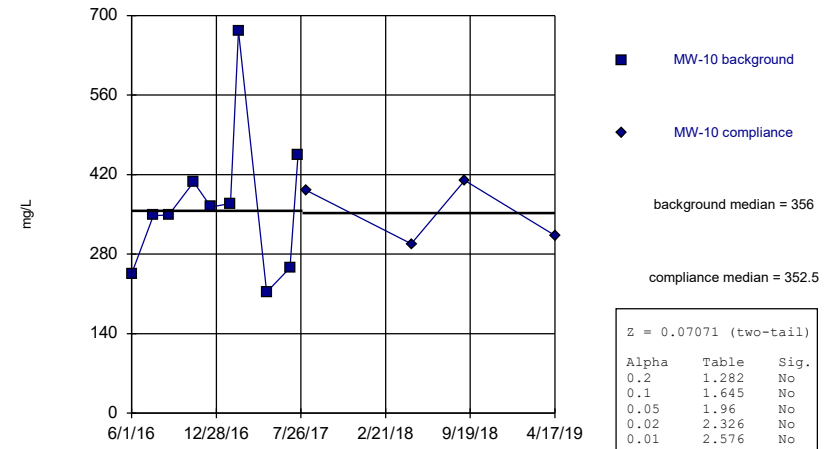
MW-1 (bg)



Constituent: Calcium Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

MW-10

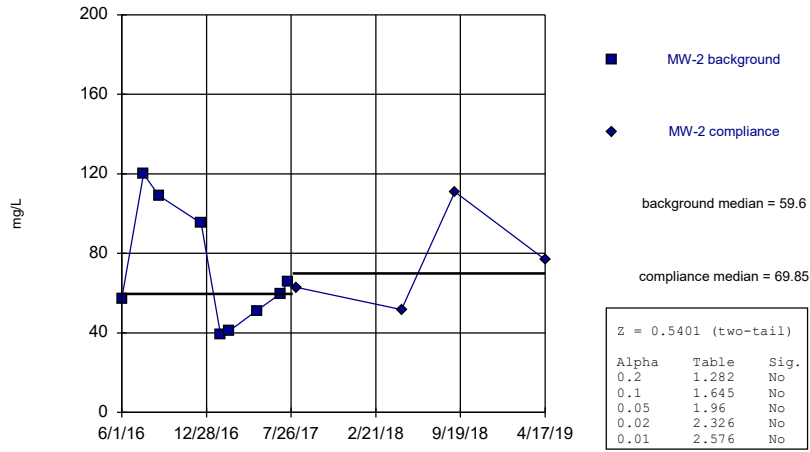


Constituent: Calcium Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill



### Mann-Whitney (Wilcoxon Rank Sum)

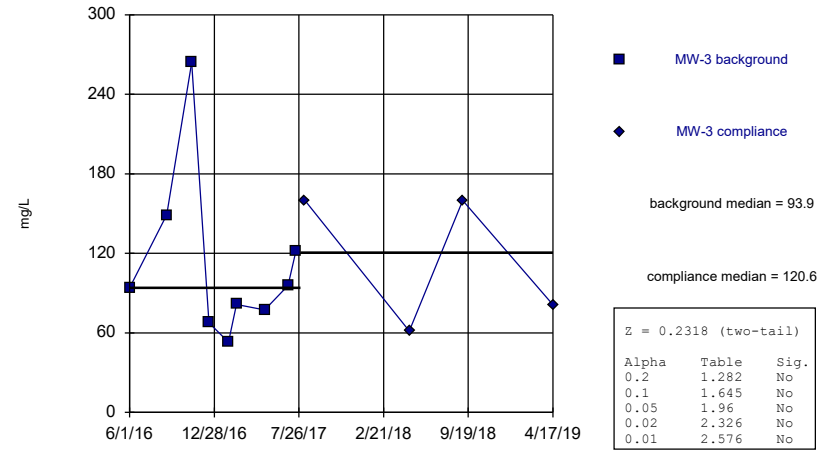
MW-2



Constituent: Calcium Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

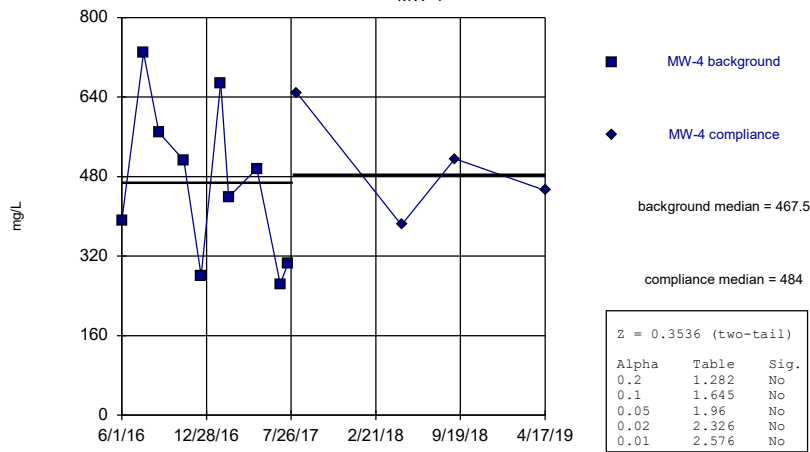
MW-3



Constituent: Calcium Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

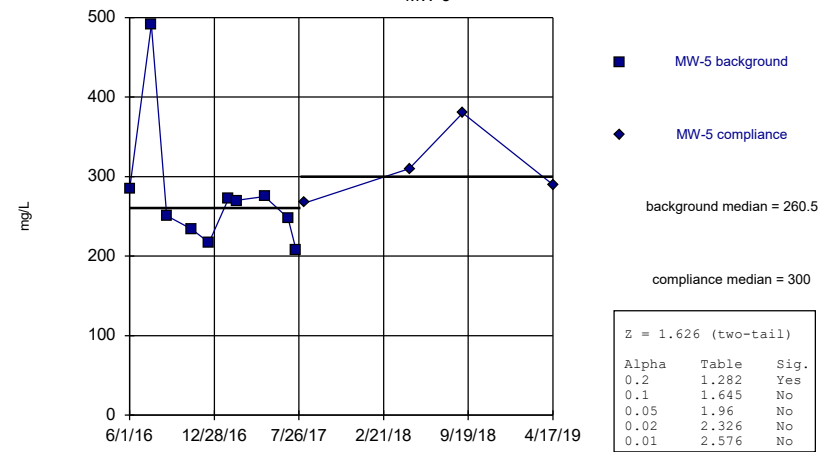
MW-4



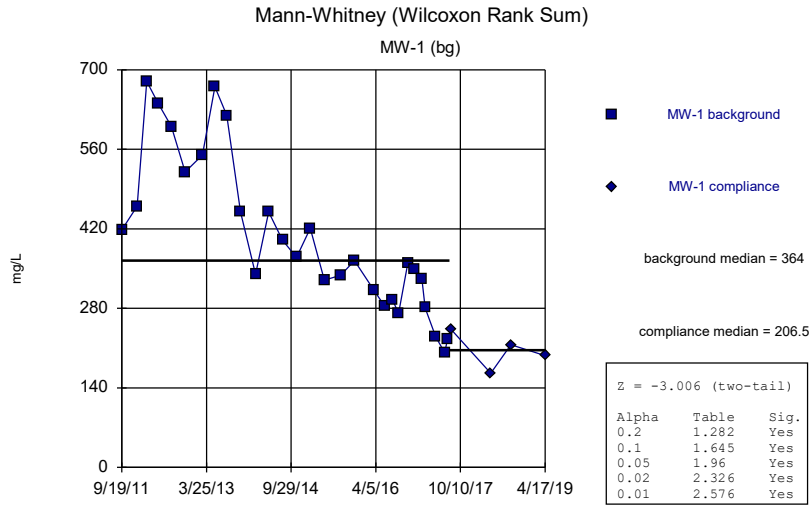
Constituent: Calcium Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

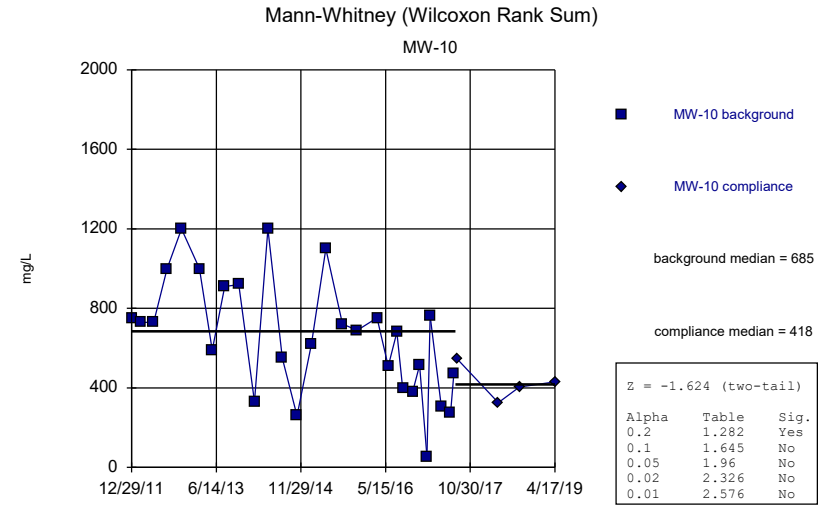
MW-5



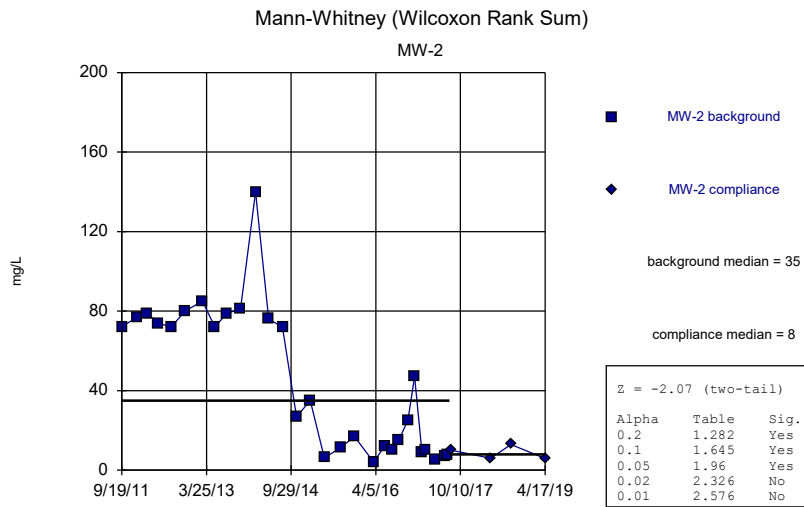
Constituent: Calcium Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill



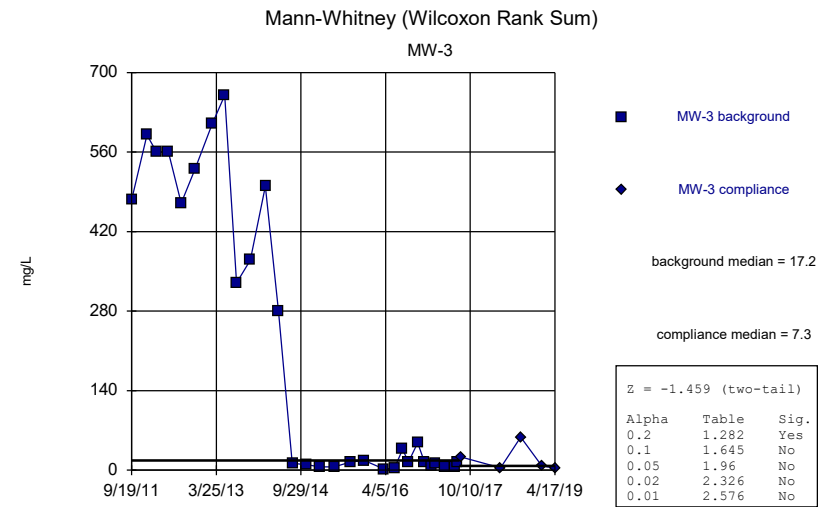
Constituent: Chloride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill



Constituent: Chloride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill



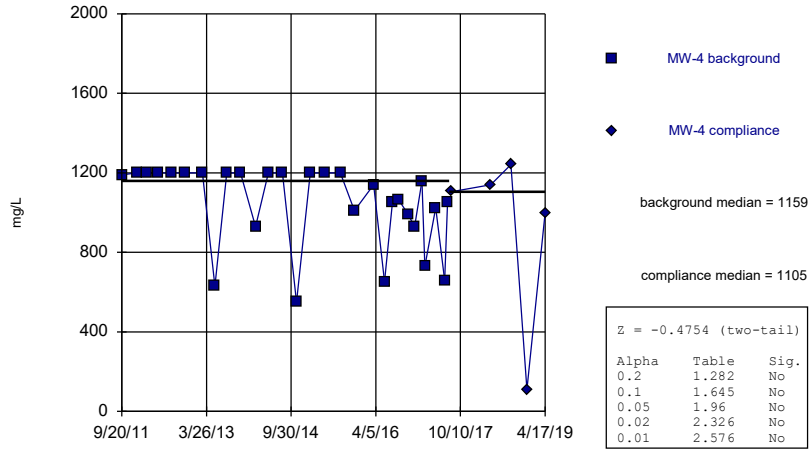
Constituent: Chloride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill



Constituent: Chloride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

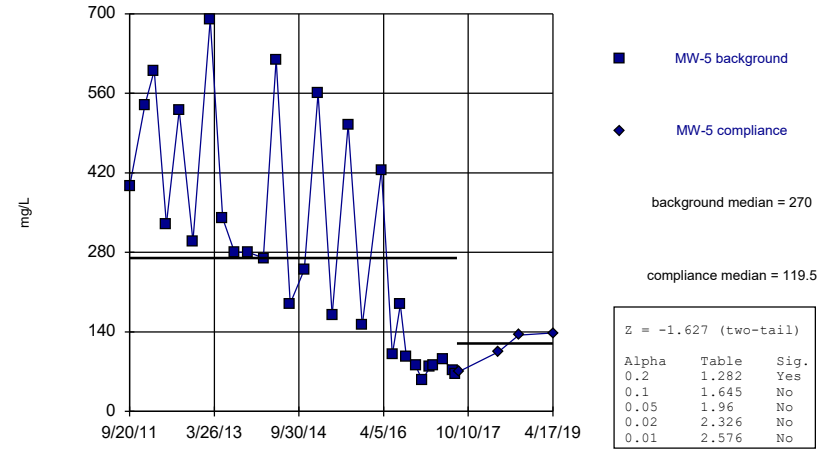
MW-4



Constituent: Chloride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

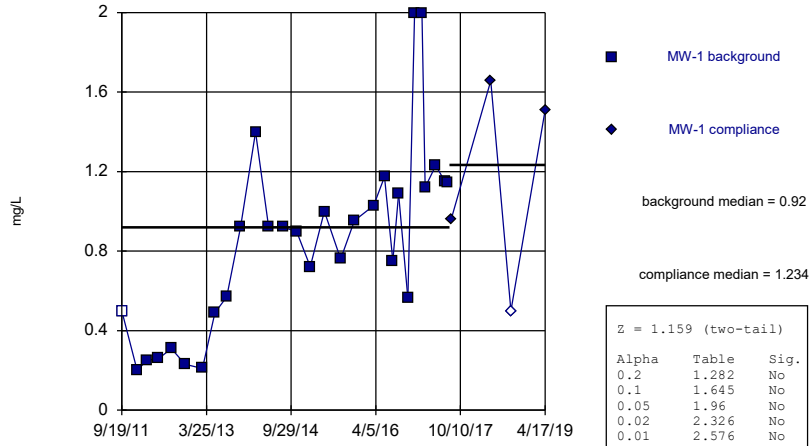
MW-5



Constituent: Chloride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

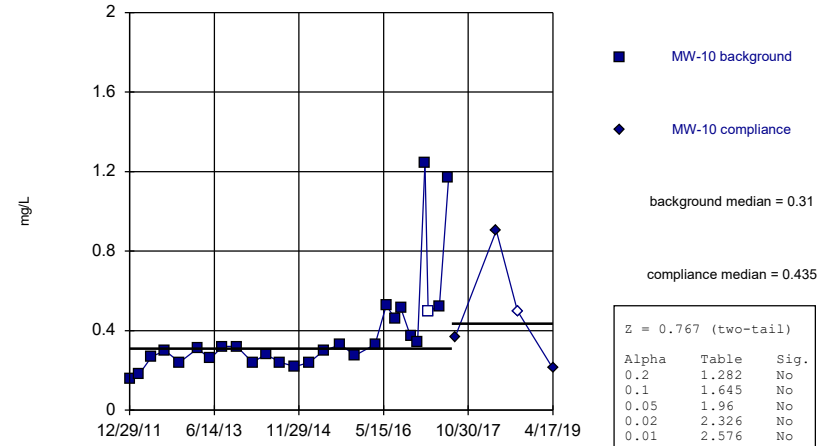
MW-1 (bg)



Constituent: Fluoride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

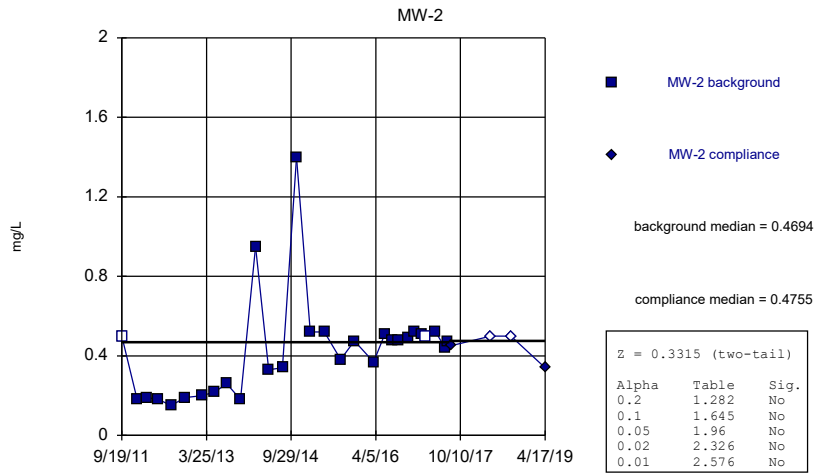
### Mann-Whitney (Wilcoxon Rank Sum)

MW-10



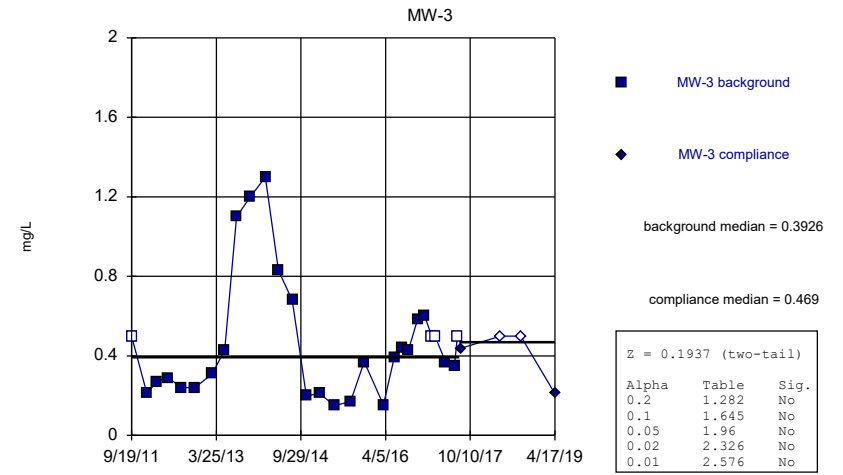
Constituent: Fluoride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)



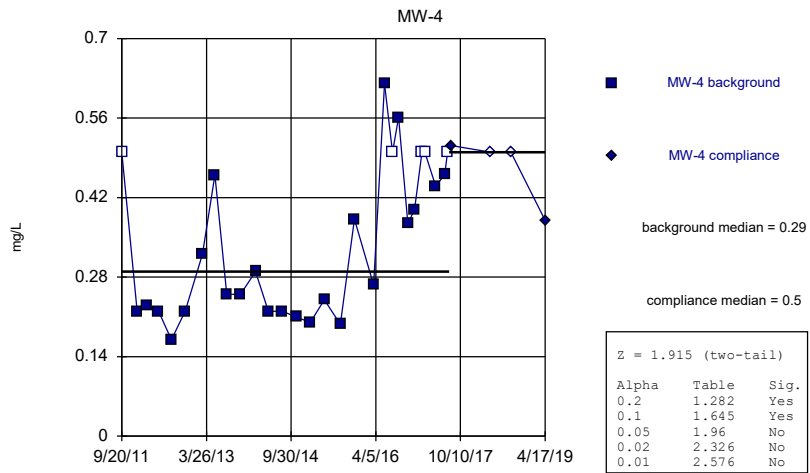
Constituent: Fluoride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)



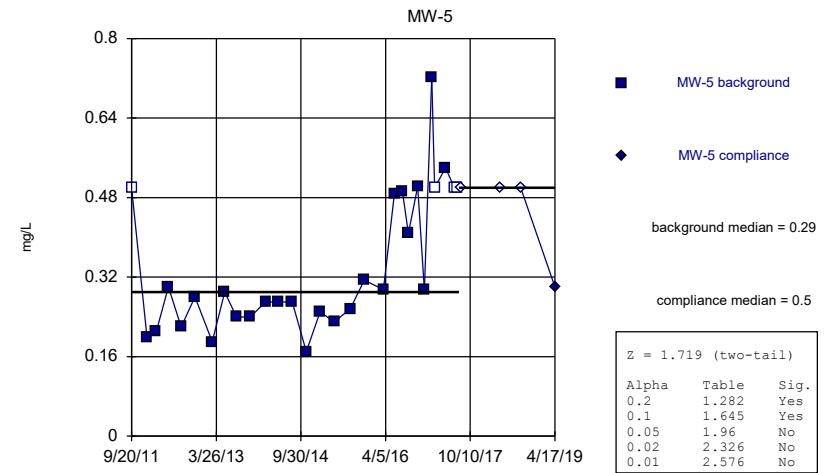
Constituent: Fluoride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)



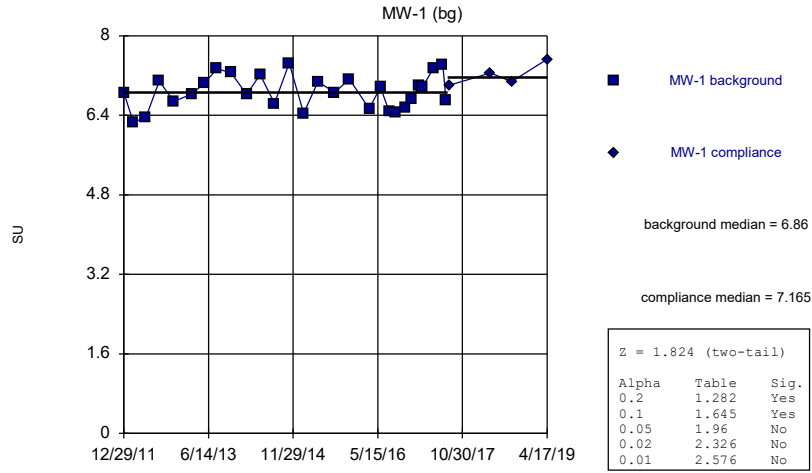
Constituent: Fluoride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)



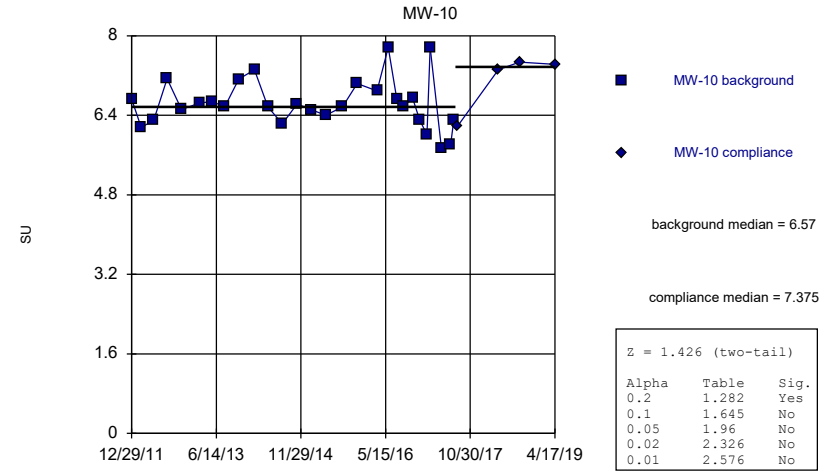
Constituent: Fluoride Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)



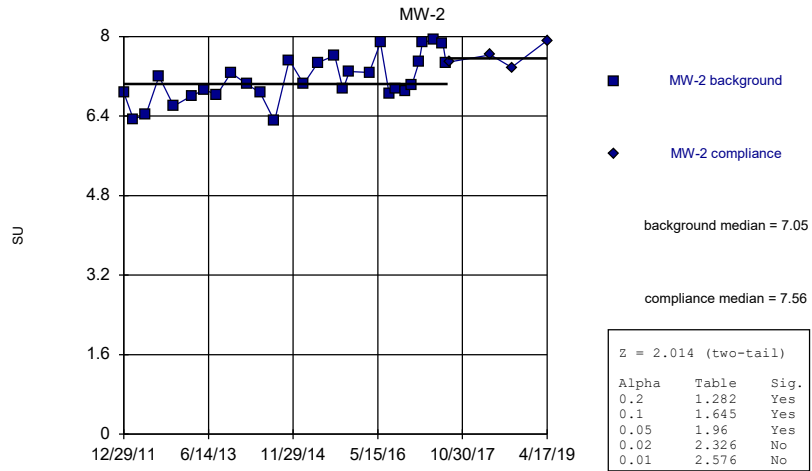
Constituent: pH Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)



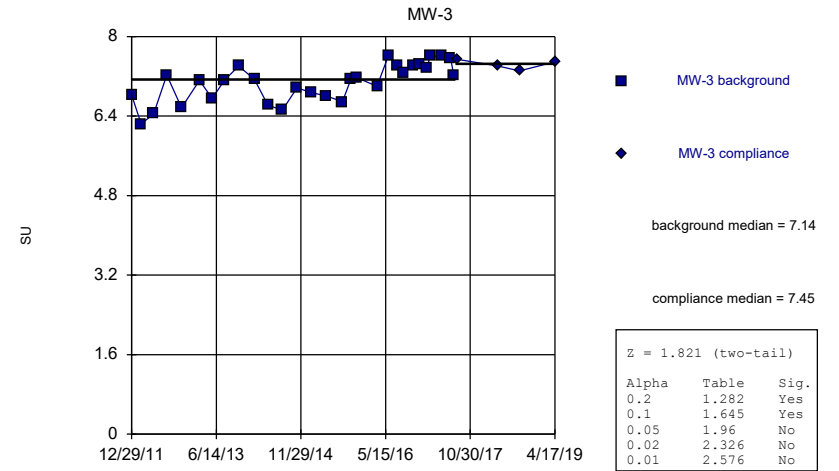
Constituent: pH Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)



Constituent: pH Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

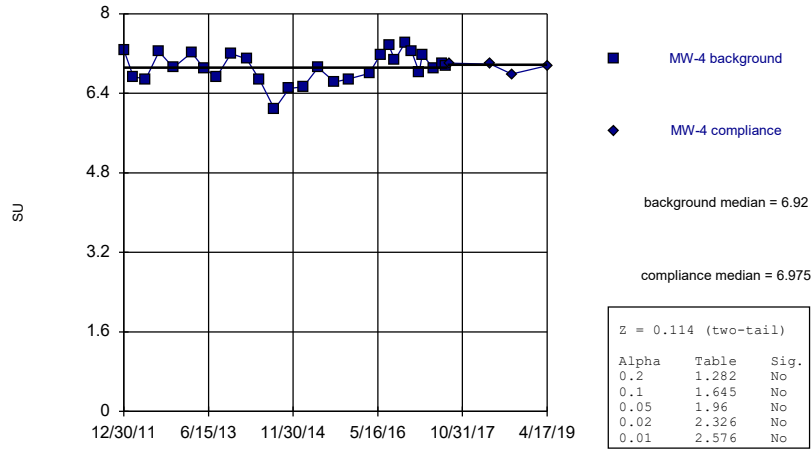
Mann-Whitney (Wilcoxon Rank Sum)



Constituent: pH Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

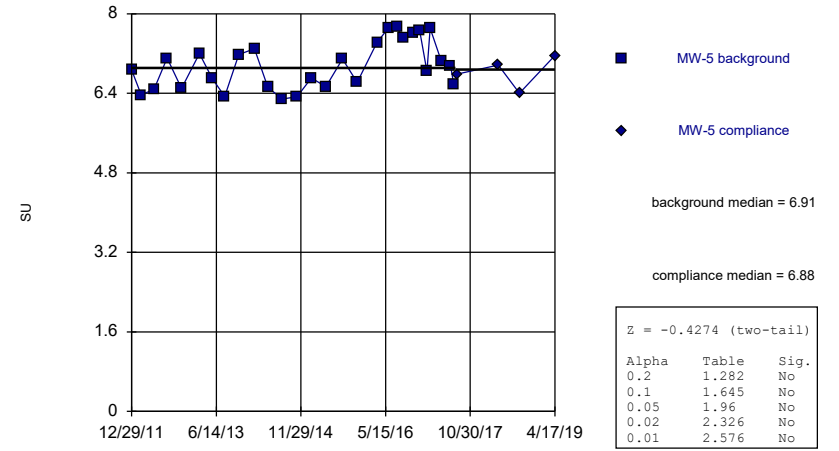
MW-4



Constituent: pH Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

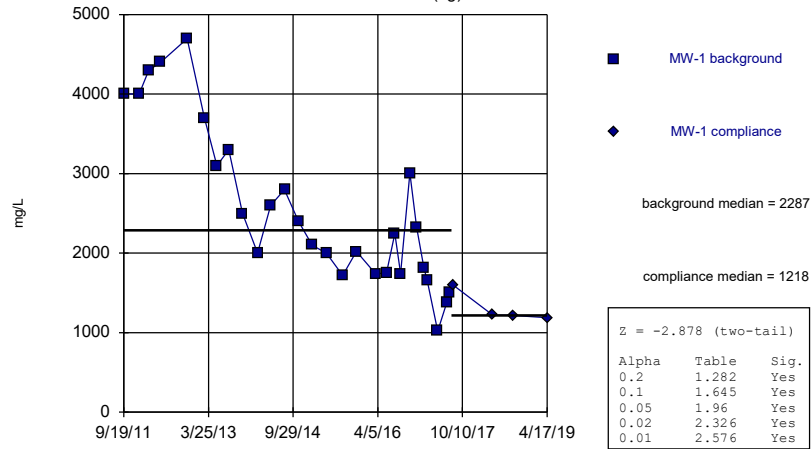
MW-5



Constituent: pH Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

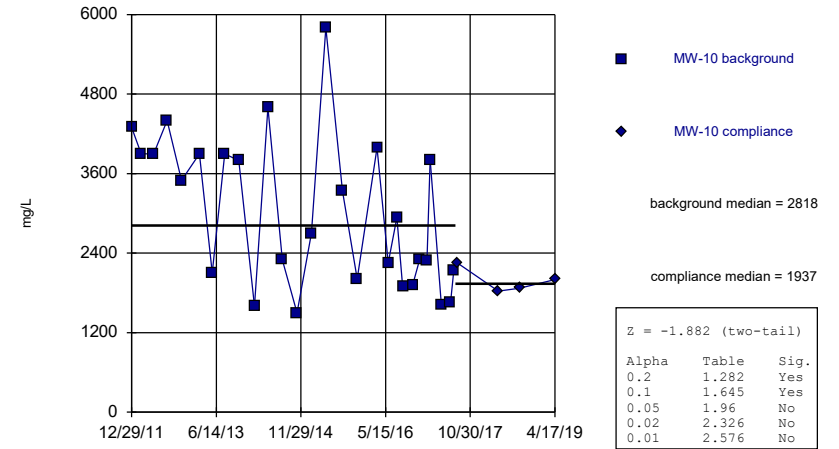
MW-1 (bg)



Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

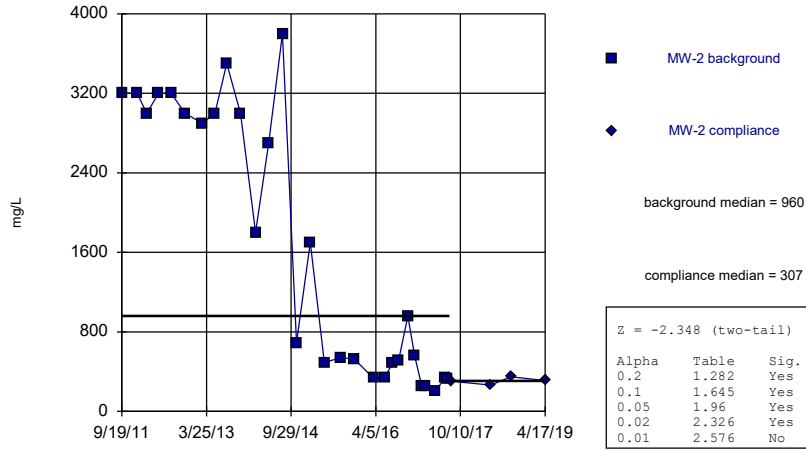
MW-10



Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

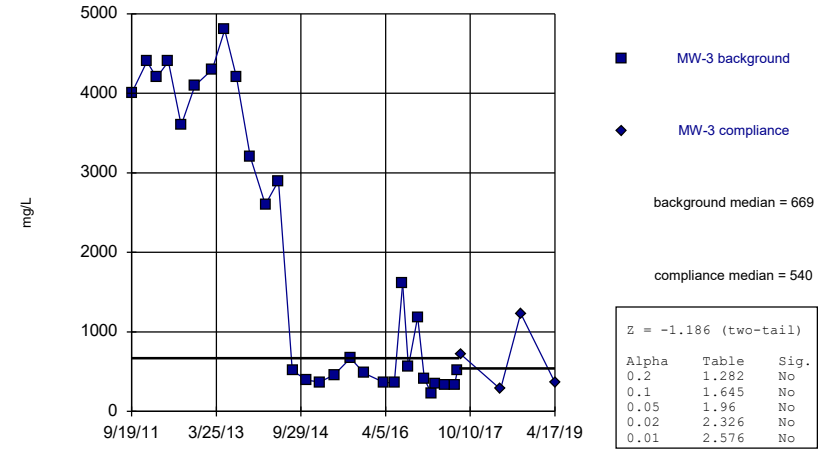
MW-2



Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

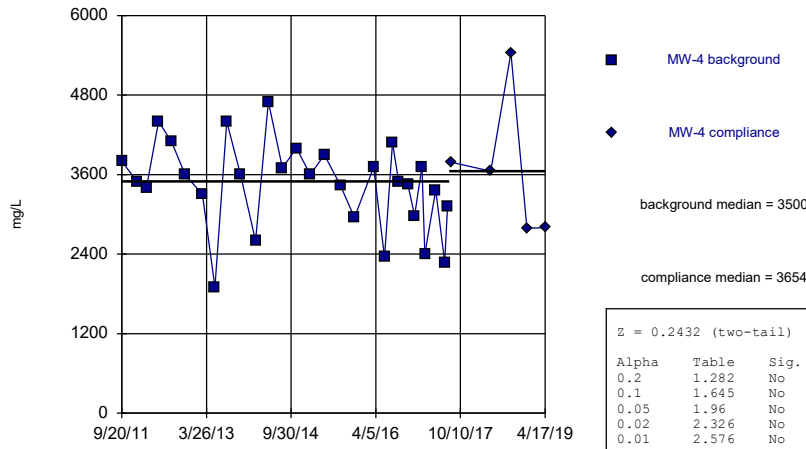
MW-3



Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

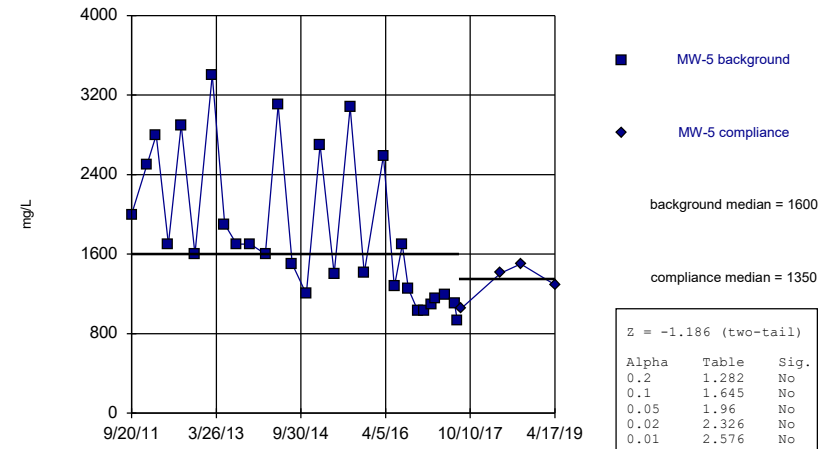
MW-4



Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Mann-Whitney (Wilcoxon Rank Sum)

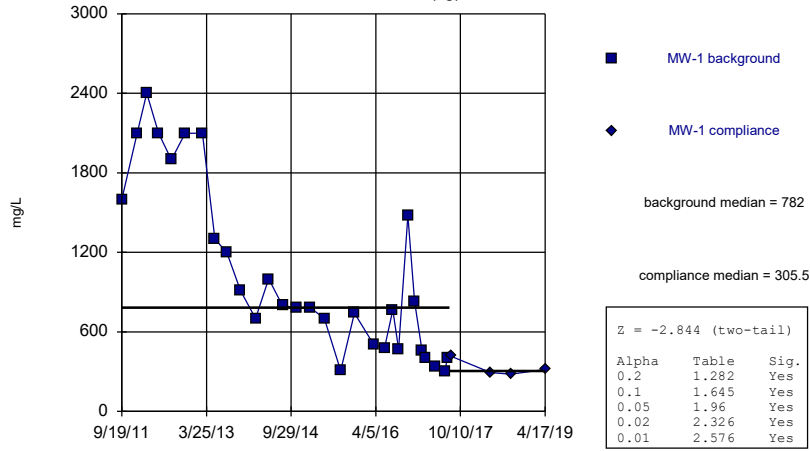
MW-5



Constituent: Solids, Total Dissolved [TDS] Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)

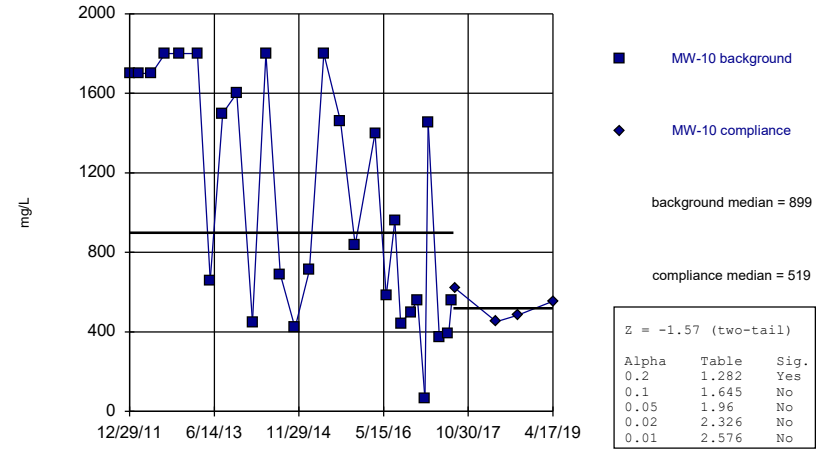
MW-1 (bg)



Constituent: Sulfate Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)

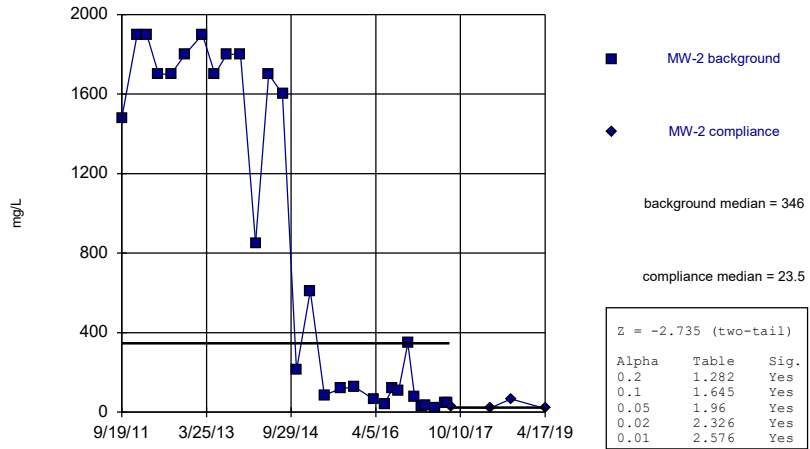
MW-10



Constituent: Sulfate Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)

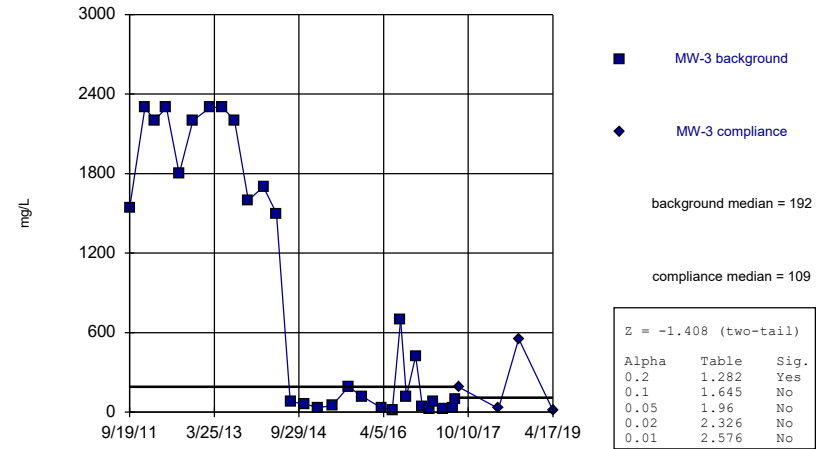
MW-2



Constituent: Sulfate Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)

MW-3

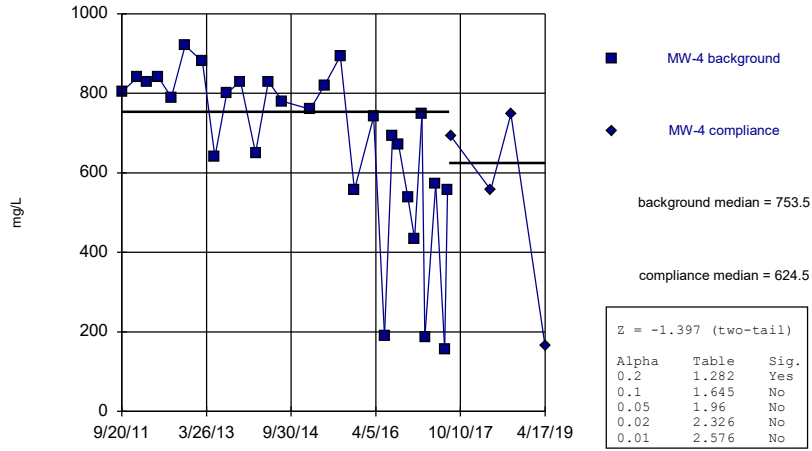


Constituent: Sulfate Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill



Mann-Whitney (Wilcoxon Rank Sum)

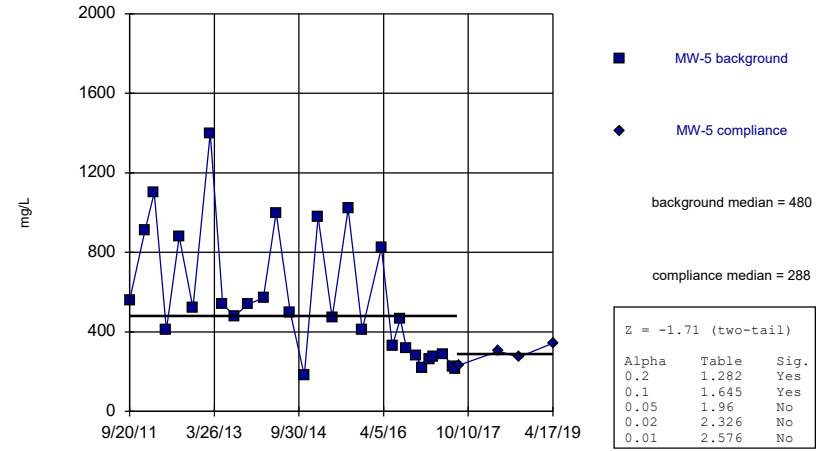
MW-4



Constituent: Sulfate Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

Mann-Whitney (Wilcoxon Rank Sum)

MW-5



Constituent: Sulfate Analysis Run 11/12/2019 1:32 PM View: Mann Whitney  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

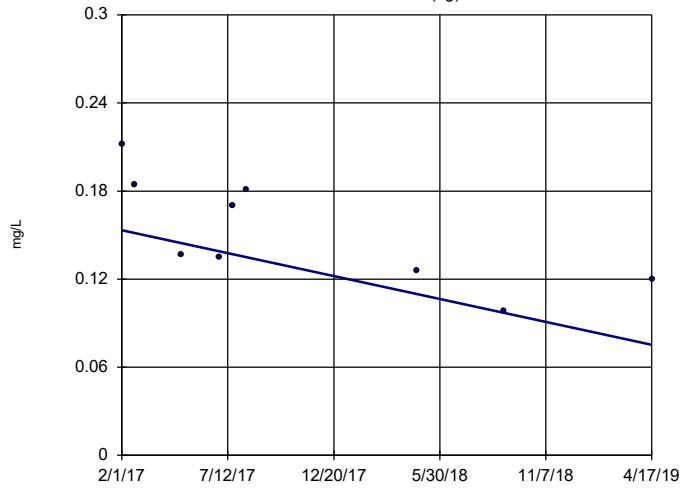
# Trend Test Summary Table - All Results (No Significant)

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 12/20/2019, 11:11 AM

<u>Constituent</u>	<u>Well</u>	<u>Slope</u>	<u>Calc.</u>	<u>Critical</u>	<u>Sig.</u>	<u>N</u>	<u>%NDs</u>	<u>Normality</u>	<u>Xform</u>	<u>Alpha</u>	<u>Method</u>
Boron (mg/L)	MW-1 (bg)	-0.03537	-24	-25	No	9	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-10	-0.01706	-16	-25	No	9	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-2	0.006338	1	25	No	9	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-3	0.0115	6	25	No	9	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-4	-0.06514	-18	-25	No	9	0	n/a	n/a	0.01	NP
Boron (mg/L)	MW-5	0.01832	18	25	No	9	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-1 (bg)	-42.97	-22	-25	No	9	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-2	-0.07177	-1	-25	No	9	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-3	-0.3076	-2	-30	No	10	0	n/a	n/a	0.01	NP
Chloride (mg/L)	MW-5	29.59	14	25	No	9	0	n/a	n/a	0.01	NP
Fluoride (mg/L)	MW-10	-0.2336	-13	-21	No	8	25	n/a	n/a	0.01	NP
Solids, Total Dissolved [TDS] (mg/L)	MW-1 (bg)	-232	-18	-25	No	9	0	n/a	n/a	0.01	NP
Solids, Total Dissolved [TDS] (mg/L)	MW-2	34.59	14	25	No	9	0	n/a	n/a	0.01	NP
Solids, Total Dissolved [TDS] (mg/L)	MW-3	347.7	16	25	No	9	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-1 (bg)	-55.46	-17	-25	No	9	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-10	90.08	10	25	No	9	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-3	32.25	8	25	No	9	0	n/a	n/a	0.01	NP
Sulfate (mg/L)	MW-5	31.72	11	25	No	9	0	n/a	n/a	0.01	NP

### Sen's Slope Estimator

MW-1 (bg)

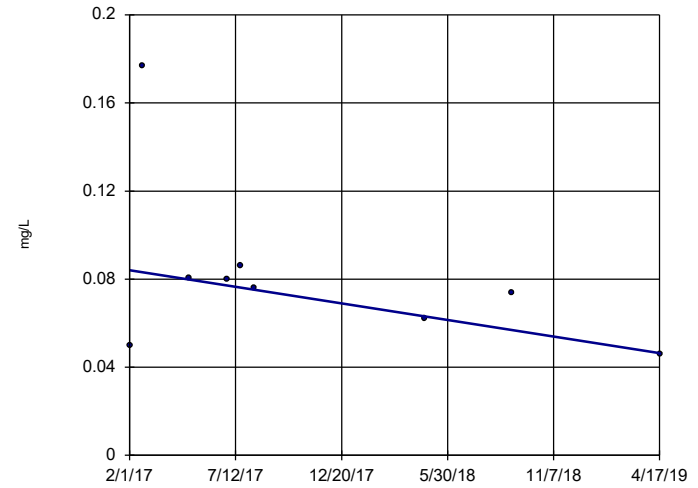


n = 9  
 Slope = -0.03537  
 units per year.  
 Mann-Kendall  
 statistic = -24  
 critical = -25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Boron Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-10

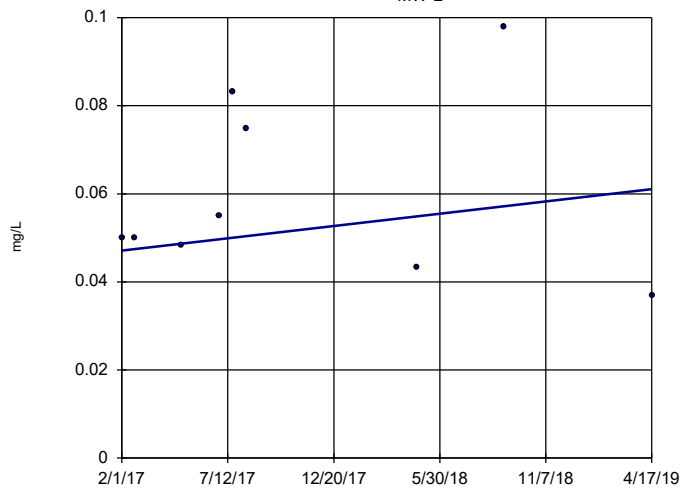


n = 9  
 Slope = -0.01706  
 units per year.  
 Mann-Kendall  
 statistic = -16  
 critical = -25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Boron Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-2

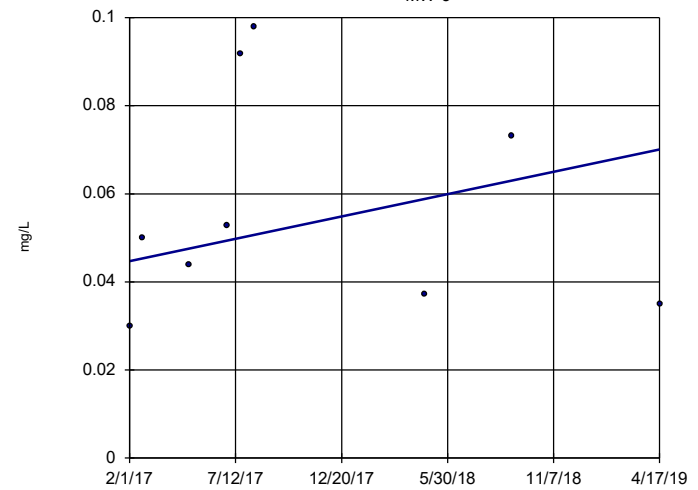


n = 9  
 Slope = 0.006338  
 units per year.  
 Mann-Kendall  
 statistic = 1  
 critical = 25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Boron Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-3

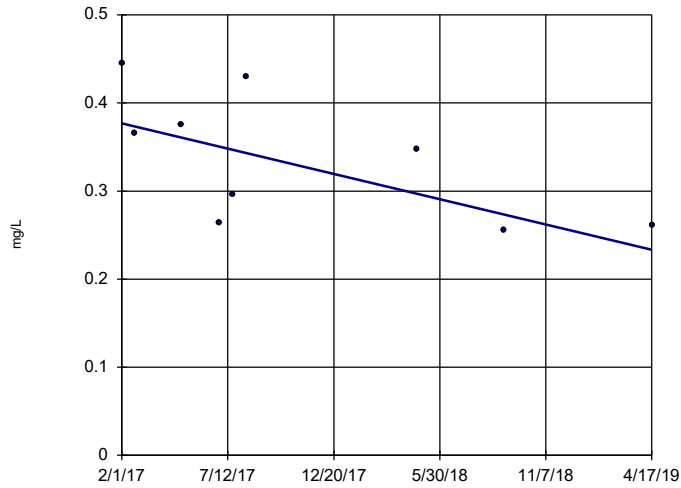


n = 9  
 Slope = 0.0115  
 units per year.  
 Mann-Kendall  
 statistic = 6  
 critical = 25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Boron Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-4

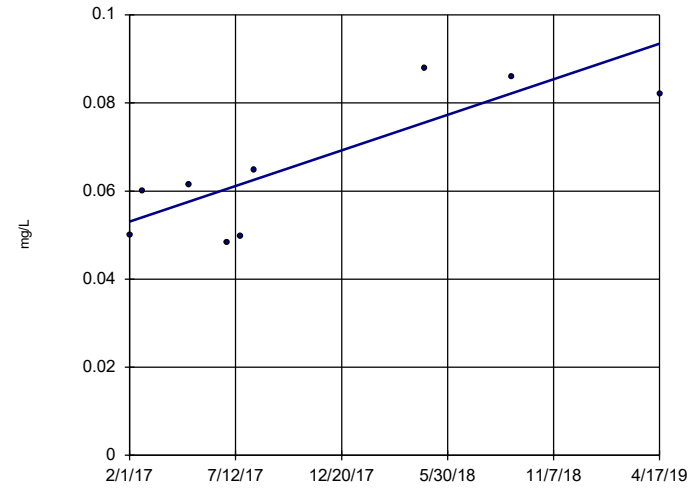


n = 9  
 Slope = -0.06514  
 units per year.  
 Mann-Kendall  
 statistic = -18  
 critical = -25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Boron Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-5

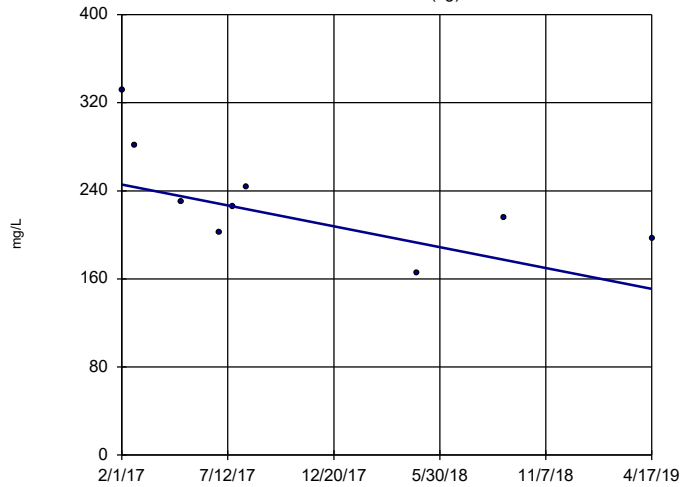


n = 9  
 Slope = 0.01832  
 units per year.  
 Mann-Kendall  
 statistic = 18  
 critical = 25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Boron Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-1 (bg)

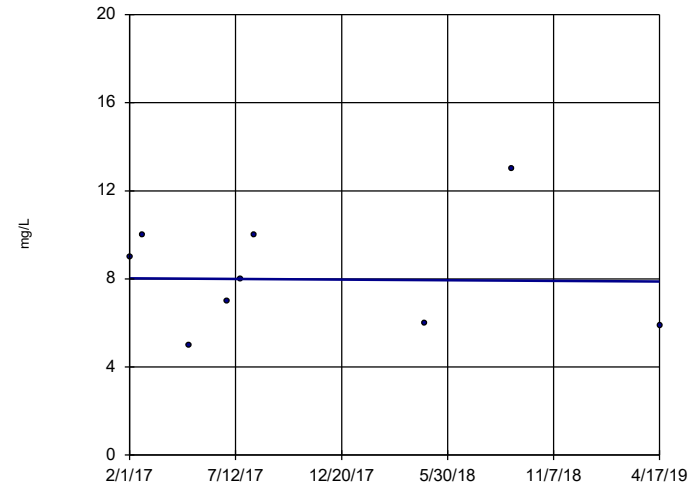


n = 9  
 Slope = -42.97  
 units per year.  
 Mann-Kendall  
 statistic = -22  
 critical = -25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Chloride Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-2

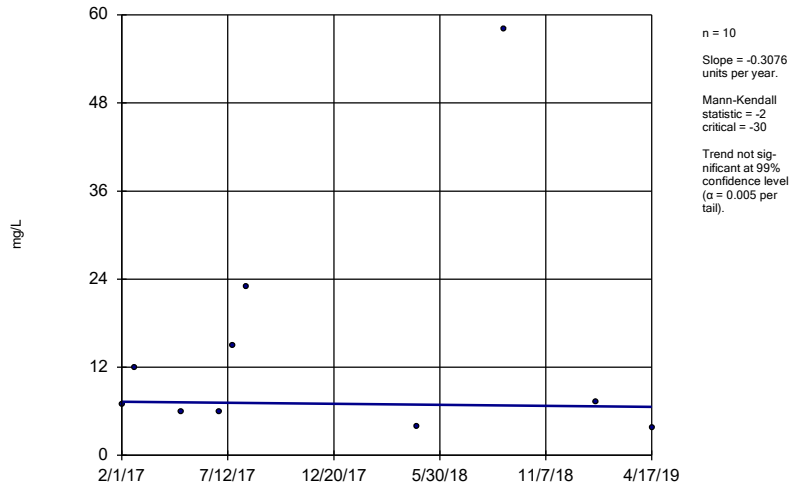


n = 9  
 Slope = -0.07177  
 units per year.  
 Mann-Kendall  
 statistic = -1  
 critical = -25  
 Trend not sig-  
 nificant at 99%  
 confidence level  
 ( $\alpha = 0.005$  per  
 tail).

Constituent: Chloride Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

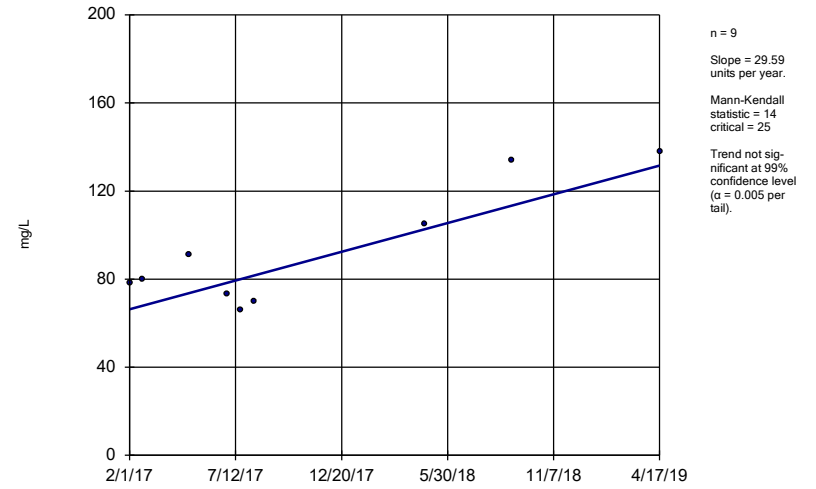
MW-3



Constituent: Chloride Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

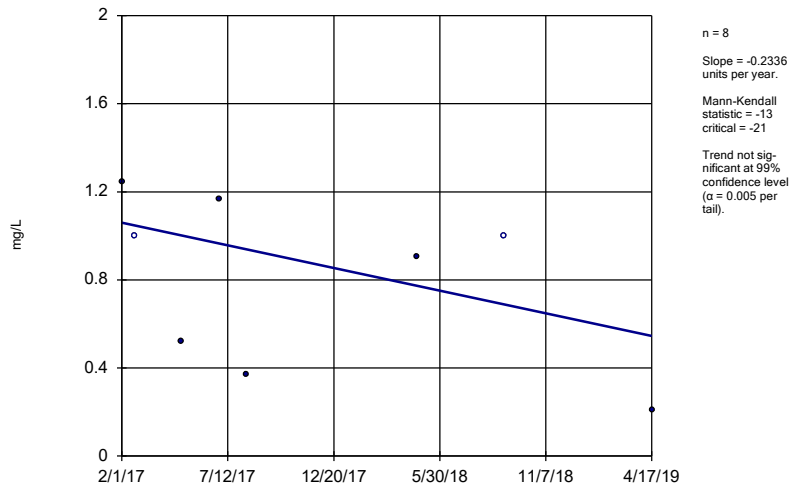
MW-5



Constituent: Chloride Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

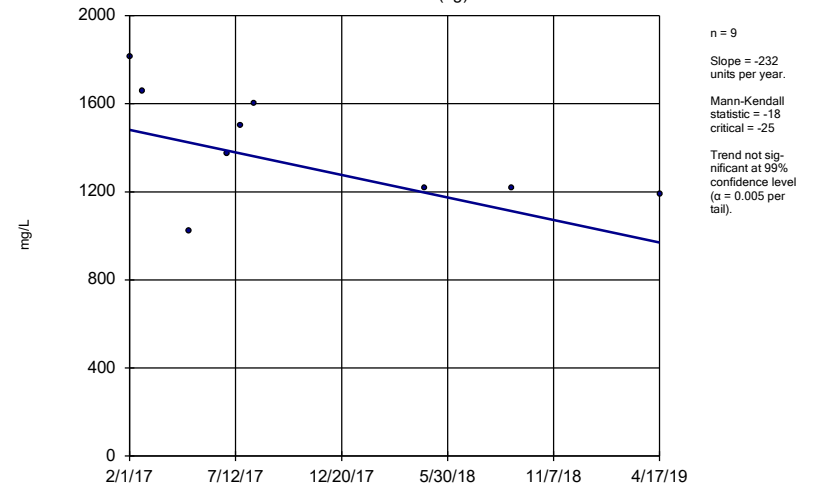
MW-10



Constituent: Fluoride Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

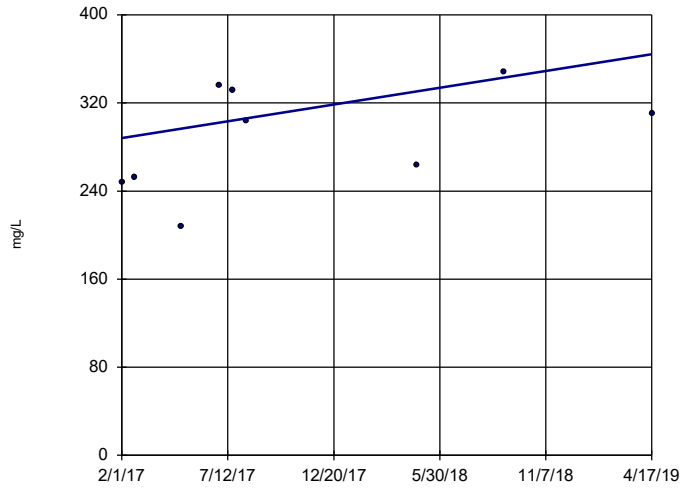
MW-1 (bg)



Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluati  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-2

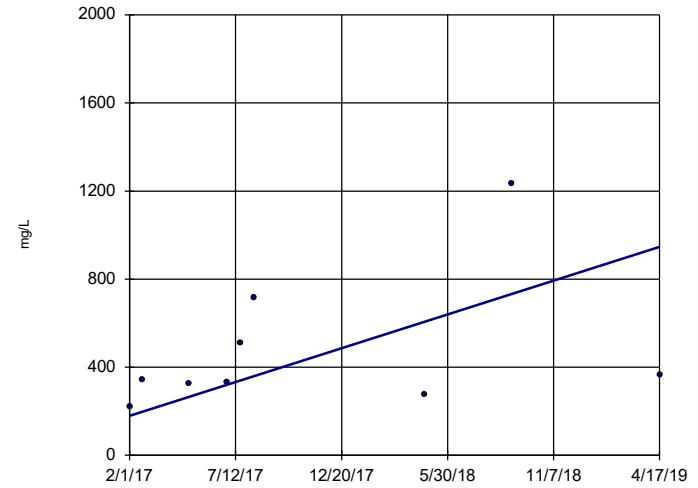


n = 9  
 Slope = 34.59 units per year.  
 Mann-Kendall statistic = 14  
 critical = 25  
 Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-3

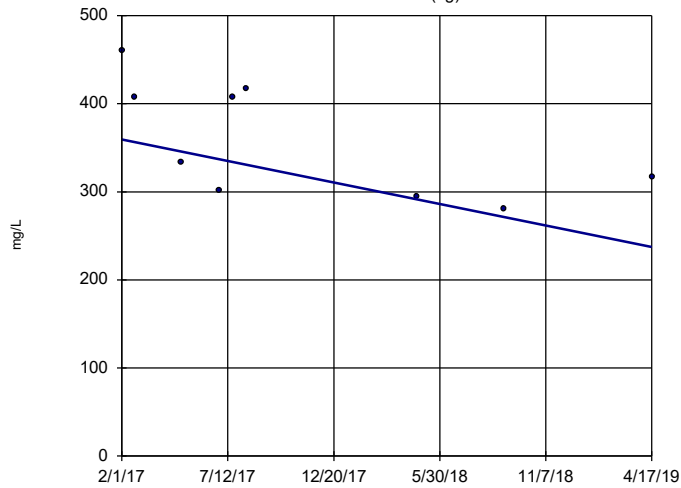


n = 9  
 Slope = 347.7 units per year.  
 Mann-Kendall statistic = 16  
 critical = 25  
 Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-1 (bg)

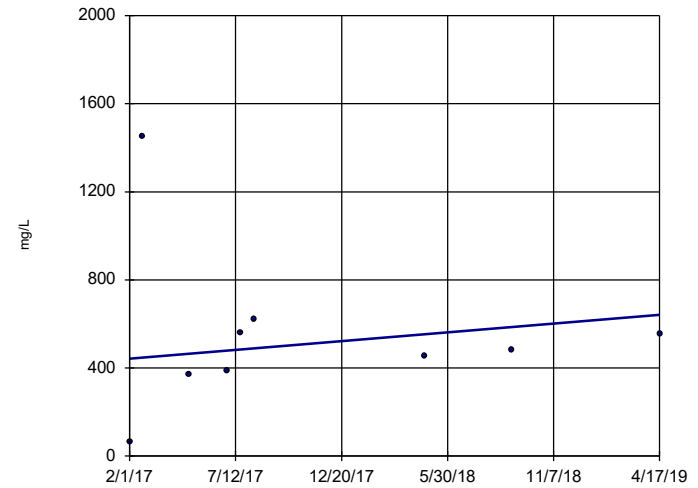


n = 9  
 Slope = -55.46 units per year.  
 Mann-Kendall statistic = -17  
 critical = -25  
 Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-10

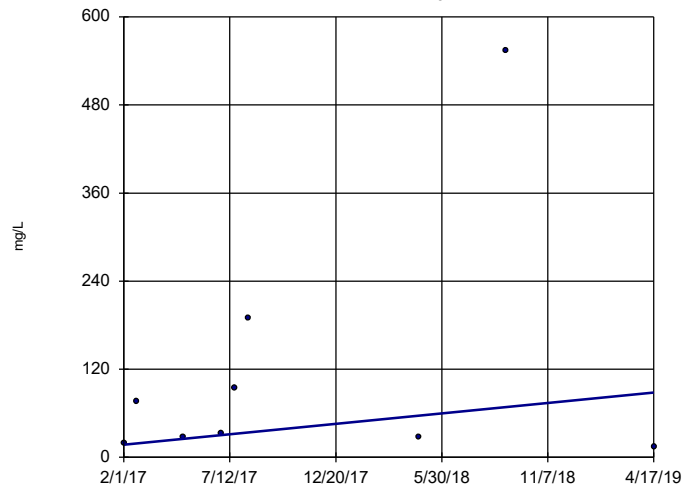


n = 9  
 Slope = 90.08 units per year.  
 Mann-Kendall statistic = 10  
 critical = 25  
 Trend not significant at 99% confidence level (α = 0.005 per tail).

Constituent: Sulfate Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
 Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-3

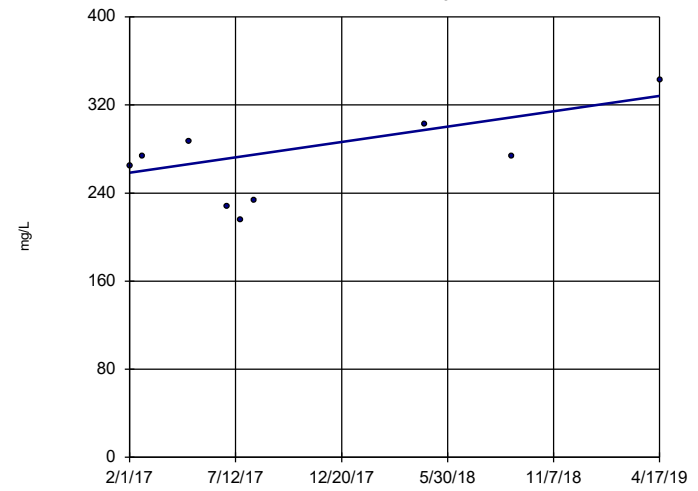


n = 9  
Slope = 32.25  
units per year.  
Mann-Kendall  
statistic = 8  
critical = 25  
Trend not sig-  
nificant at 99%  
confidence level  
( $\alpha = 0.005$  per  
tail).

Constituent: Sulfate Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
Turk Landfill Client: Geosyntec Data: Turk Landfill

### Sen's Slope Estimator

MW-5



n = 9  
Slope = 31.72  
units per year.  
Mann-Kendall  
statistic = 11  
critical = 25  
Trend not sig-  
nificant at 99%  
confidence level  
( $\alpha = 0.005$  per  
tail).

Constituent: Sulfate Analysis Run 12/20/2019 11:10 AM View: Trend Tests Evaluation  
Turk Landfill Client: Geosyntec Data: Turk Landfill

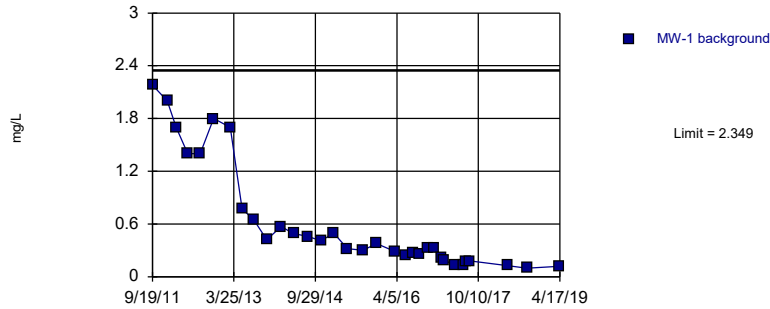
# Intrawell Prediction Limit Summary

Turk Landfill Client: Geosyntec Data: Turk Landfill Printed 12/20/2019, 11:06 AM

Constituent	Well	Upper Lim.	Lower Lim.	Bg N	Bg Mean	Std. Dev.	%NDs	ND Adj.	Transform	Alpha	Method
Boron (mg/L)	MW-1	2.349	n/a	33	-0.8937	0.9064	0	None	ln(x)	0.001504	Param Intra 1 of 2
Boron (mg/L)	MW-10	0.43	n/a	32	n/a	n/a	15.63	n/a	n/a	0.001803	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-2	1.4	n/a	34	n/a	n/a	11.76	n/a	n/a	0.001599	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-3	1.3	n/a	34	n/a	n/a	17.65	n/a	n/a	0.001599	NP Intra (normality) 1 of 2
Boron (mg/L)	MW-4	0.609	n/a	33	0.4356	0.08994	0	None	No	0.001504	Param Intra 1 of 2
Boron (mg/L)	MW-5	0.504	n/a	33	n/a	n/a	21.21	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Calcium (mg/L)	MW-1	315	n/a	14	214.3	45.05	0	None	No	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-10	615	n/a	14	363.6	112.5	0	None	No	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-2	135.3	n/a	13	72.32	27.62	0	None	No	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-3	245.8	n/a	13	112.8	58.35	0	None	No	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-4	799.3	n/a	14	475.4	144.9	0	None	No	0.001504	Param Intra 1 of 2
Calcium (mg/L)	MW-5	450.8	n/a	14	16.79	1.988	0	None	sqrt(x)	0.001504	Param Intra 1 of 2
Chloride (mg/L)	MW-1	660.6	n/a	33	381.4	144.9	0	None	No	0.001504	Param Intra 1 of 2
Chloride (mg/L)	MW-10	1183	n/a	32	628.4	286.6	0	None	No	0.001504	Param Intra 1 of 2
Chloride (mg/L)	MW-2	140	n/a	33	n/a	n/a	0	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Chloride (mg/L)	MW-3	660	n/a	34	n/a	n/a	0	n/a	n/a	0.001599	NP Intra (normality) 1 of 2
Chloride (mg/L)	MW-4	1241	n/a	34	n/a	n/a	0	n/a	n/a	0.001599	NP Intra (normality) 1 of 2
Chloride (mg/L)	MW-5	707.8	n/a	33	15.25	5.891	0	None	sqrt(x)	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-1	1.819	n/a	33	0.8907	0.4815	6.061	None	No	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-10	0.9077	n/a	31	-1.049	0.4909	6.452	None	ln(x)	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-2	1.4	n/a	33	n/a	n/a	12.12	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Fluoride (mg/L)	MW-3	1.03	n/a	33	0.6161	0.2067	18.18	Kaplan-Meier	sqrt(x)	0.001504	Param Intra 1 of 2
Fluoride (mg/L)	MW-4	0.6203	n/a	33	n/a	n/a	21.21	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Fluoride (mg/L)	MW-5	0.584	n/a	33	-1.249	0.3687	21.21	Kaplan-Meier	ln(x)	0.001504	Param Intra 1 of 2
pH (SU)	MW-1	7.582	6.255	32	6.918	0.3431	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-10	7.699	5.689	32	6.694	0.5196	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-2	8.082	6.305	33	7.193	0.461	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-3	7.848	6.392	33	7.12	0.3777	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-4	7.483	6.372	32	6.928	0.2871	0	None	No	0.000752	Param Intra 1 of 2
pH (SU)	MW-5	7.841	6.05	32	6.945	0.4629	0	None	No	0.000752	Param Intra 1 of 2
Solids, Total Dissolved [TDS] (mg/L)	MW-1	4418	n/a	32	2408	1039	0	None	No	0.001504	Param Intra 1 of 2
Solids, Total Dissolved [TDS] (mg/L)	MW-10	5243	n/a	32	52.77	10.15	0	None	sqrt(x)	0.001504	Param Intra 1 of 2
Solids, Total Dissolved [TDS] (mg/L)	MW-2	3800	n/a	33	n/a	n/a	0	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Solids, Total Dissolved [TDS] (mg/L)	MW-3	4800	n/a	33	n/a	n/a	0	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Solids, Total Dissolved [TDS] (mg/L)	MW-4	4878	n/a	34	3480	727.4	0	None	No	0.001504	Param Intra 1 of 2
Solids, Total Dissolved [TDS] (mg/L)	MW-5	3362	n/a	33	7.396	0.3755	0	None	ln(x)	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-1	2823	n/a	33	6.628	0.6834	0	None	ln(x)	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-10	1800	n/a	32	n/a	n/a	0	n/a	n/a	0.001803	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-2	1900	n/a	33	n/a	n/a	0	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-3	2300	n/a	33	n/a	n/a	0	n/a	n/a	0.001701	NP Intra (normality) 1 of 2
Sulfate (mg/L)	MW-4	971	n/a	32	482321	238140	0	None	x^2	0.001504	Param Intra 1 of 2
Sulfate (mg/L)	MW-5	1181	n/a	33	22.03	6.396	0	None	sqrt(x)	0.001504	Param Intra 1 of 2



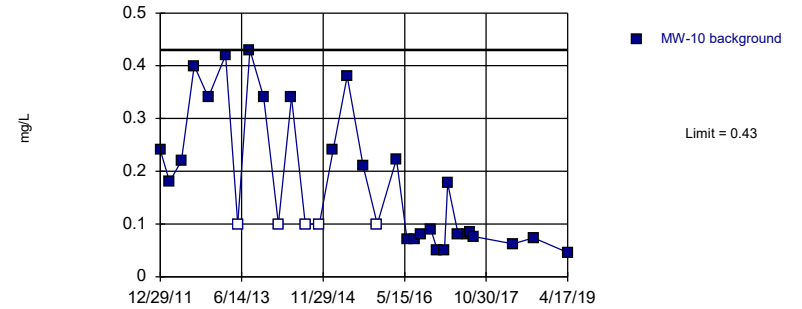
Prediction Limit  
Intrawell Parametric, MW-1 (bg)



Background Data Summary (based on natural log transformation): Mean=-0.8937, Std. Dev.=0.9064, n=33.  
Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9291, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Boron Analysis Run 12/20/2019 11:03 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

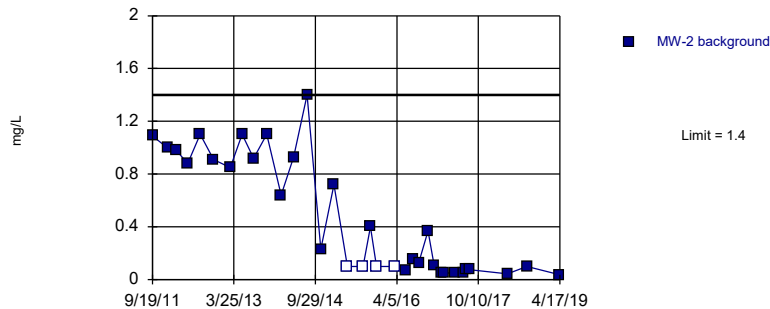
Prediction Limit  
Intrawell Non-parametric, MW-10



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 32 background values. 15.63% NDs. Well-constituent pair annual alpha = 0.003603. Individual comparison alpha = 0.001803 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

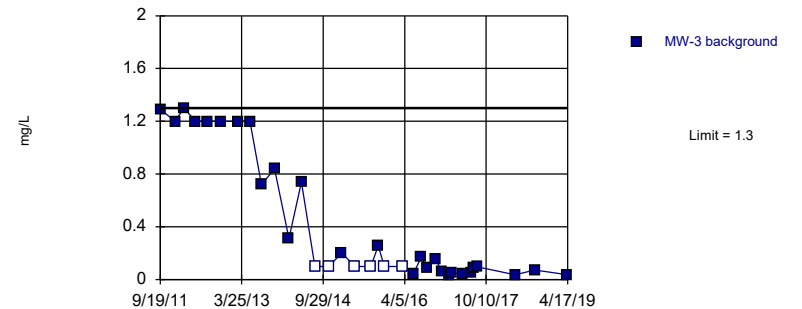
Prediction Limit  
Intrawell Non-parametric, MW-2



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 34 background values. 11.76% NDs. Well-constituent pair annual alpha = 0.003195. Individual comparison alpha = 0.001599 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

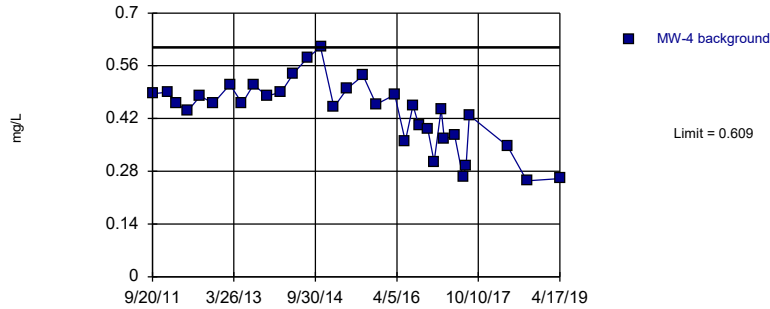
Prediction Limit  
Intrawell Non-parametric, MW-3



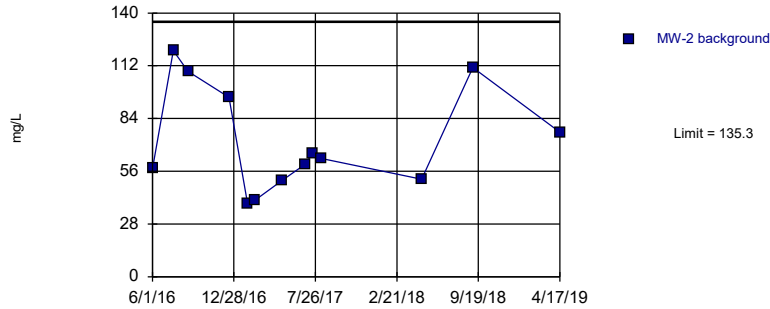
Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 34 background values. 17.65% NDs. Well-constituent pair annual alpha = 0.003195. Individual comparison alpha = 0.001599 (1 of 2). Assumes 1 future value.

Constituent: Boron Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

Prediction Limit  
Intrawell Parametric, MW-4



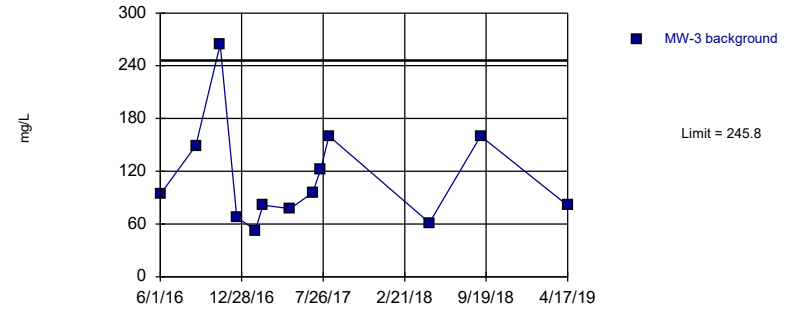
Prediction Limit  
Intrawell Parametric, MW-2



Background Data Summary: Mean=72.32, Std. Dev.=27.62, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8966, critical = 0.814. Kappa = 2.279 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

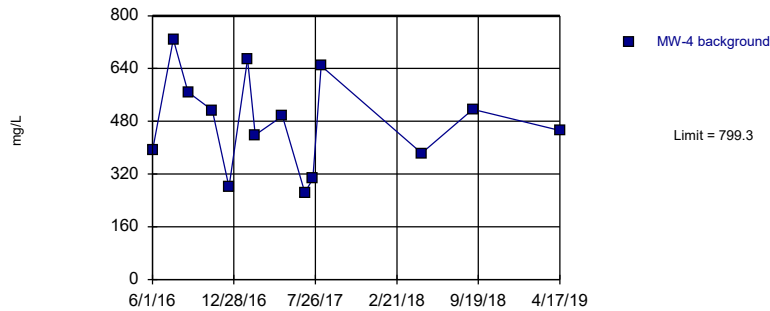
Prediction Limit  
Intrawell Parametric, MW-3



Background Data Summary: Mean=112.8, Std. Dev.=58.35, n=13. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8432, critical = 0.814. Kappa = 2.279 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

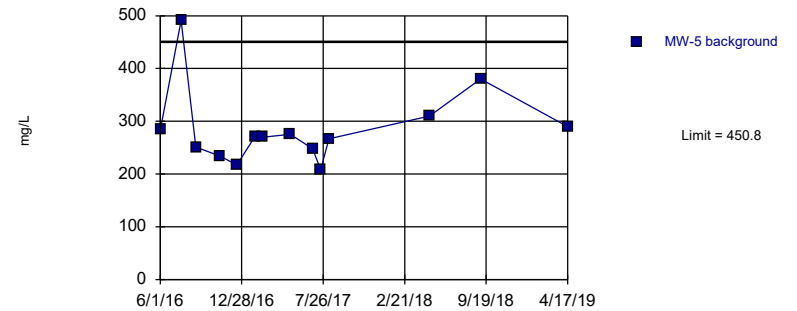
Prediction Limit  
Intrawell Parametric, MW-4



Background Data Summary: Mean=475.4, Std. Dev.=144.9, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9636, critical = 0.825. Kappa = 2.236 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

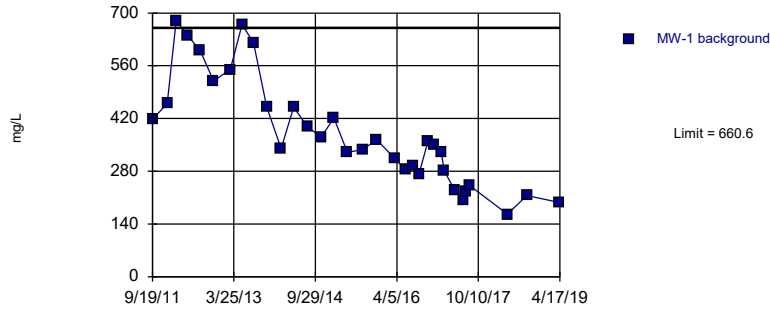
Prediction Limit  
Intrawell Parametric, MW-5



Background Data Summary (based on square root transformation): Mean=16.79, Std. Dev.=1.988, n=14. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.8442, critical = 0.825. Kappa = 2.236 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Calcium Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

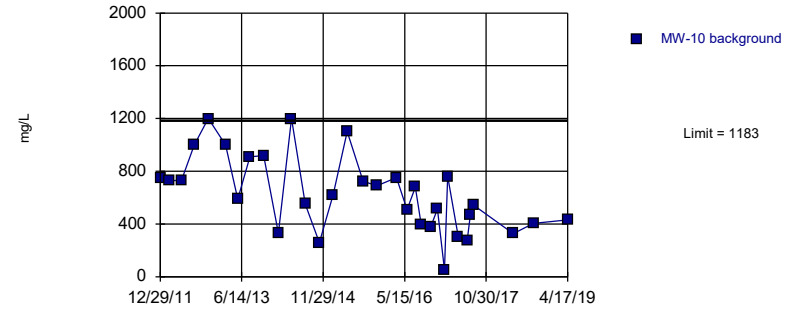
Prediction Limit  
Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=381.4, Std. Dev.=144.9, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9293, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

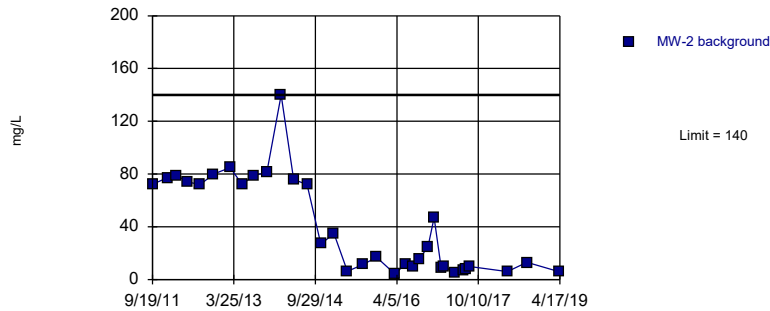
Prediction Limit  
Intrawell Parametric, MW-10



Background Data Summary: Mean=628.4, Std. Dev.=286.6, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.969, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

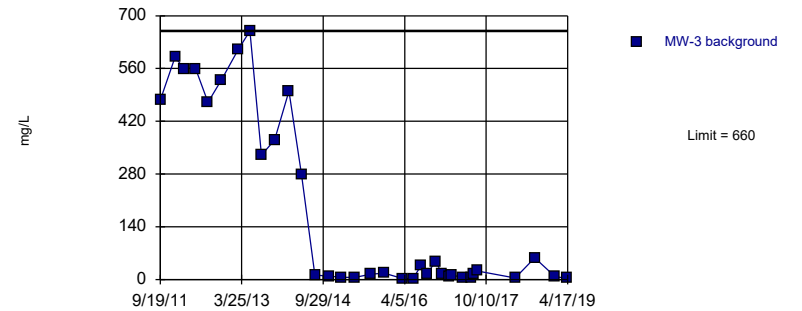
Prediction Limit  
Intrawell Non-parametric, MW-2



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Chloride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

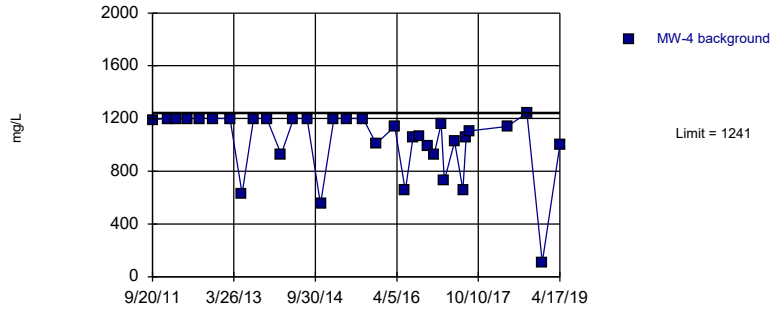
Prediction Limit  
Intrawell Non-parametric, MW-3



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 34 background values. Well-constituent pair annual alpha = 0.003195. Individual comparison alpha = 0.001599 (1 of 2). Assumes 1 future value.

Constituent: Chloride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

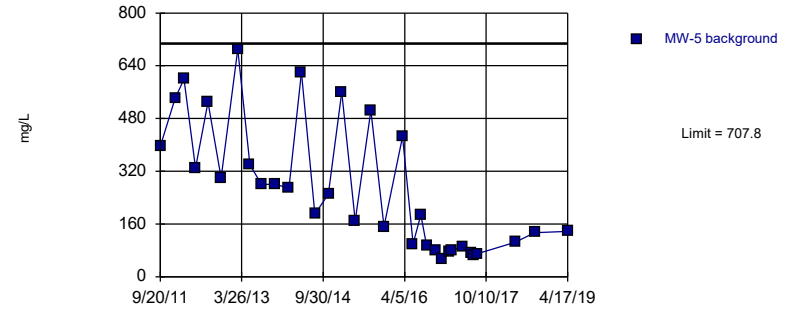
Prediction Limit  
Intrawell Non-parametric, MW-4



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 34 background values. Well-constituent pair annual alpha = 0.003195. Individual comparison alpha = 0.001599 (1 of 2). Assumes 1 future value.

Constituent: Chloride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

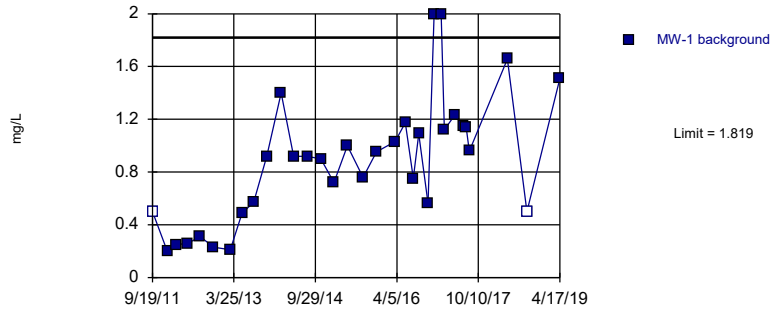
Prediction Limit  
Intrawell Parametric, MW-5



Background Data Summary (based on square root transformation): Mean=15.25, Std. Dev.=5.891, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9112, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Chloride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

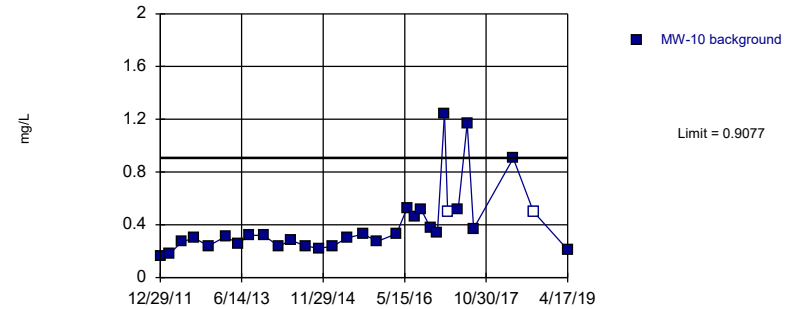
Prediction Limit  
Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=0.8907, Std. Dev.=0.4815, n=33, 6.061% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.942, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Fluoride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

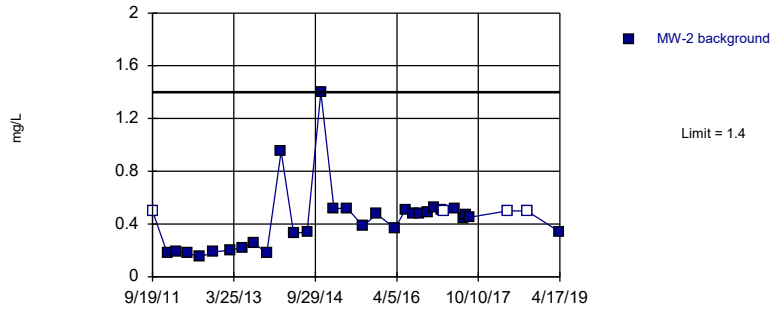
Prediction Limit  
Intrawell Parametric, MW-10



Background Data Summary (based on natural log transformation): Mean=-1.049, Std. Dev.=0.4909, n=31, 6.452% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.906, critical = 0.902. Kappa = 1.94 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Fluoride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

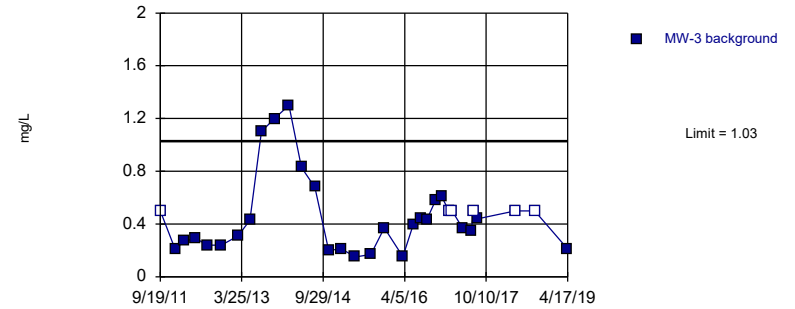
Prediction Limit  
Intrawell Non-parametric, MW-2



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. 12.12% NDs. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

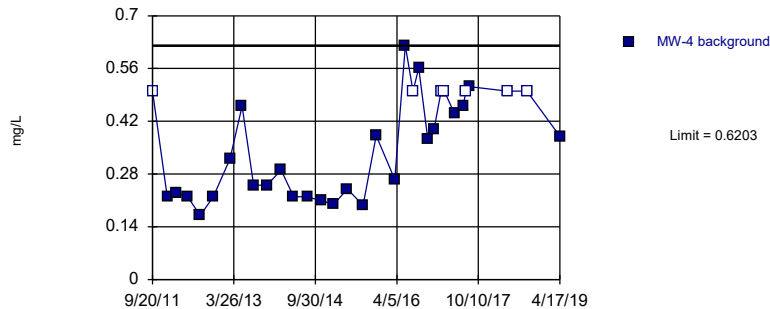
Prediction Limit  
Intrawell Parametric, MW-3



Background Data Summary (based on square root transformation) (after Kaplan-Meier Adjustment): Mean=0.6161, Std. Dev.=0.2067, n=33, 18.18% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9139, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Fluoride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

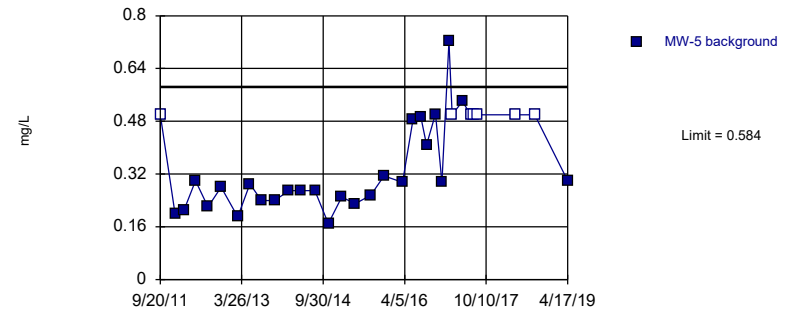
Prediction Limit  
Intrawell Non-parametric, MW-4



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. 21.21% NDs. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Fluoride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

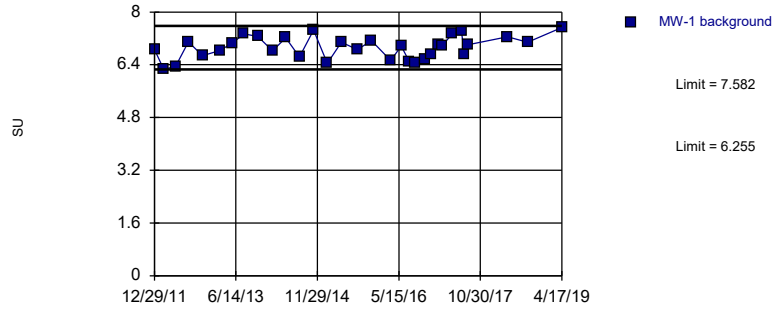
Prediction Limit  
Intrawell Parametric, MW-5



Background Data Summary (based on natural log transformation) (after Kaplan-Meier Adjustment): Mean=-1.249, Std. Dev.=0.3687, n=33, 21.21% NDs. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9087, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Fluoride Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

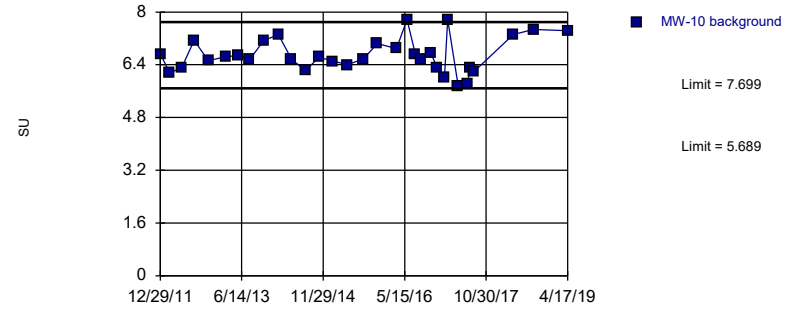
Prediction Limit  
Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=6.918, Std. Dev.=0.3431, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9703, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

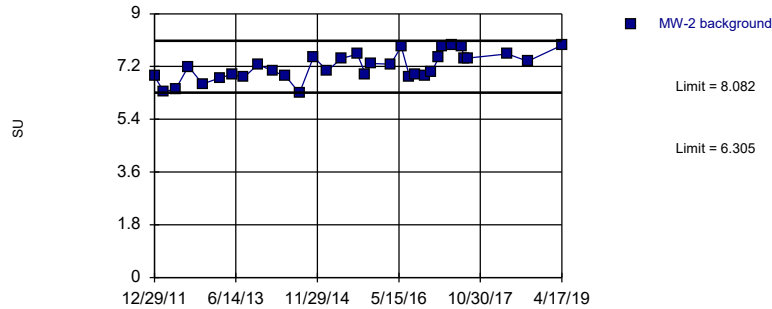
Prediction Limit  
Intrawell Parametric, MW-10



Background Data Summary: Mean=6.694, Std. Dev.=0.5196, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9605, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

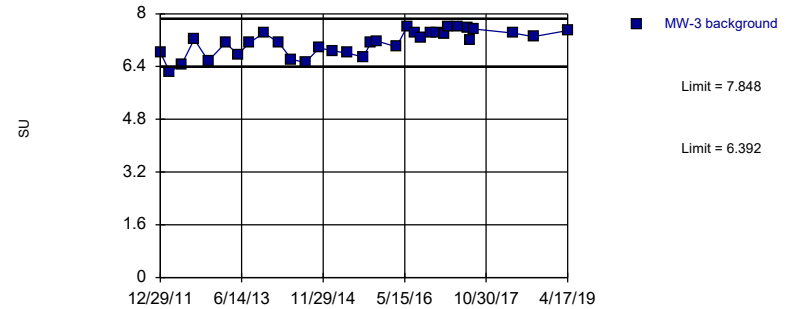
Prediction Limit  
Intrawell Parametric, MW-2



Background Data Summary: Mean=7.193, Std. Dev.=0.461, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9526, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

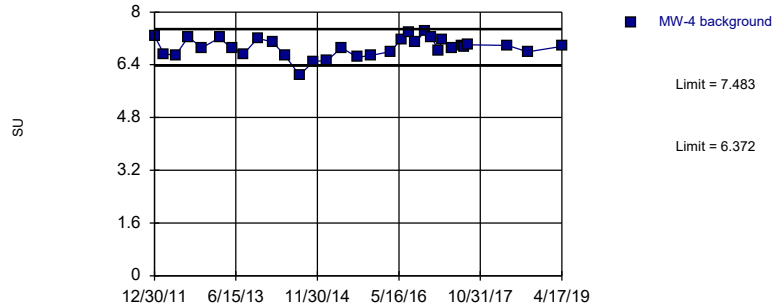
Prediction Limit  
Intrawell Parametric, MW-3



Background Data Summary: Mean=7.12, Std. Dev.=0.3777, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9346, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

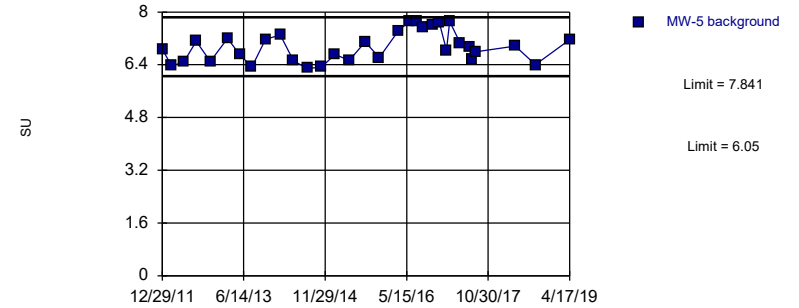
Prediction Limit  
Intrawell Parametric, MW-4



Background Data Summary: Mean=6.928, Std. Dev.=0.2871, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9646, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

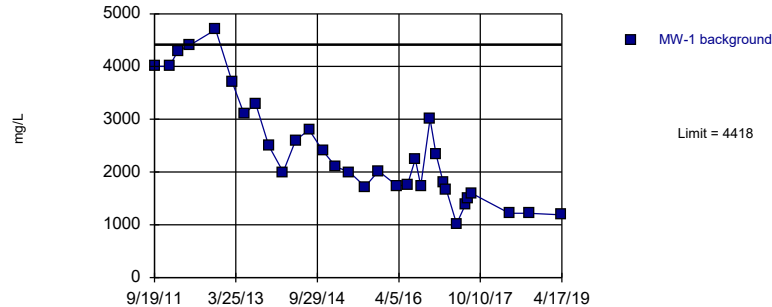
Prediction Limit  
Intrawell Parametric, MW-5



Background Data Summary: Mean=6.945, Std. Dev.=0.4629, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9254, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: pH Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

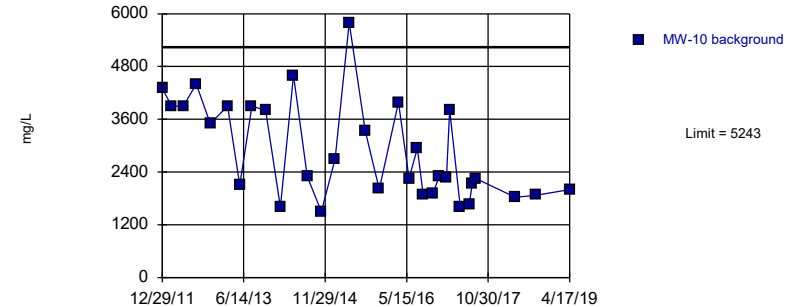
Prediction Limit  
Intrawell Parametric, MW-1 (bg)



Background Data Summary: Mean=2408, Std. Dev.=1039, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9066, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

Prediction Limit  
Intrawell Parametric, MW-10

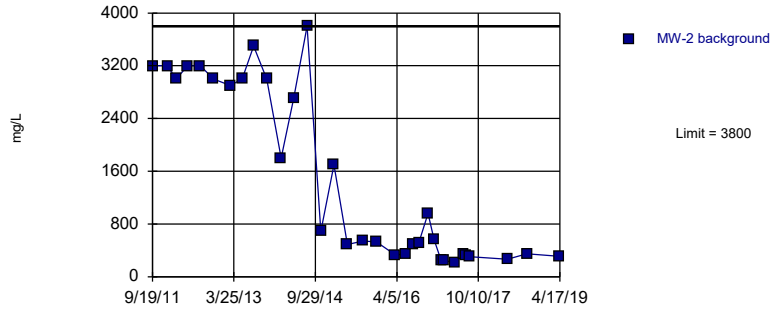


Background Data Summary (based on square root transformation): Mean=52.77, Std. Dev.=10.15, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9105, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill



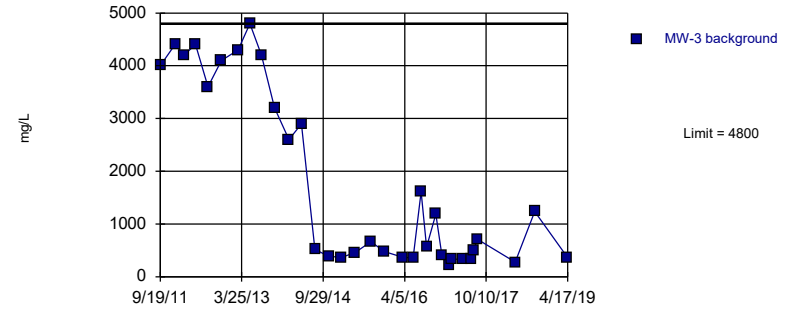
Prediction Limit  
Intrawell Non-parametric, MW-2



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

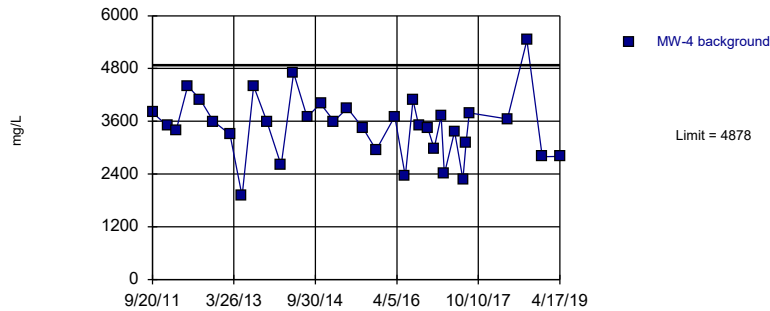
Prediction Limit  
Intrawell Non-parametric, MW-3



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

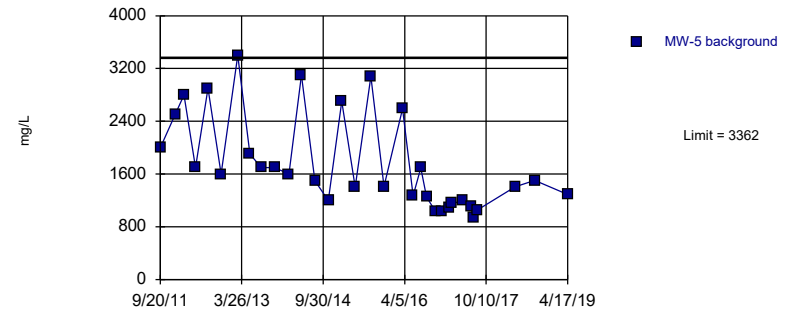
Prediction Limit  
Intrawell Parametric, MW-4



Background Data Summary: Mean=3480, Std. Dev.=727.4, n=34. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9769, critical = 0.908. Kappa = 1.922 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

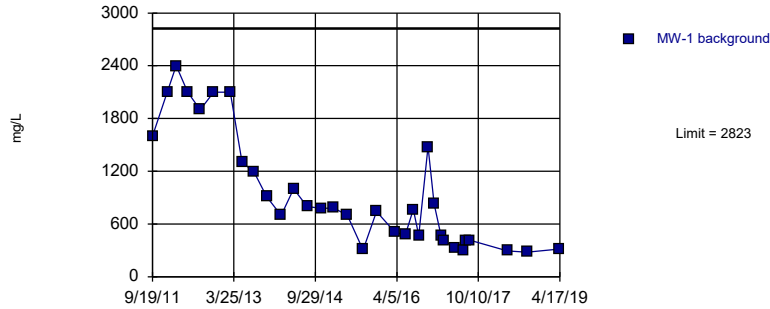
Prediction Limit  
Intrawell Parametric, MW-5



Background Data Summary (based on natural log transformation): Mean=7.396, Std. Dev.=0.3755, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9195, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Solids, Total Dissolved [TDS] Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

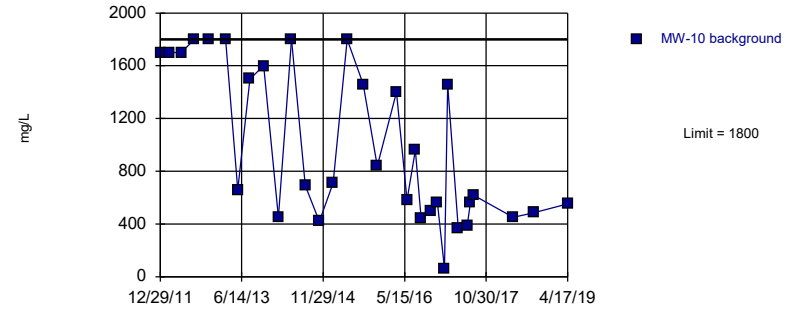
Prediction Limit  
Intrawell Parametric, MW-1 (bg)



Background Data Summary (based on natural log transformation): Mean=6.628, Std. Dev.=0.6834, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9229, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Sulfate Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

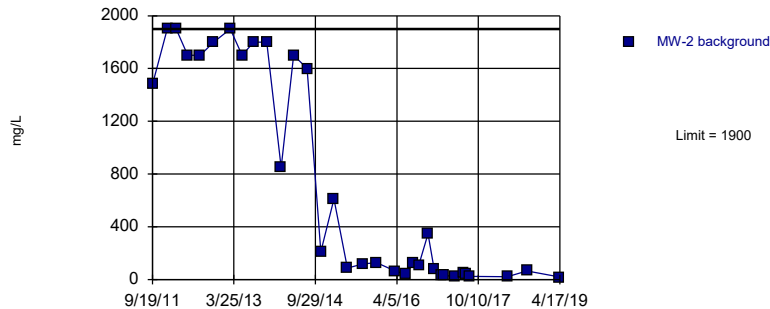
Prediction Limit  
Intrawell Non-parametric, MW-10



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 32 background values. Well-constituent pair annual alpha = 0.003603. Individual comparison alpha = 0.001803 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

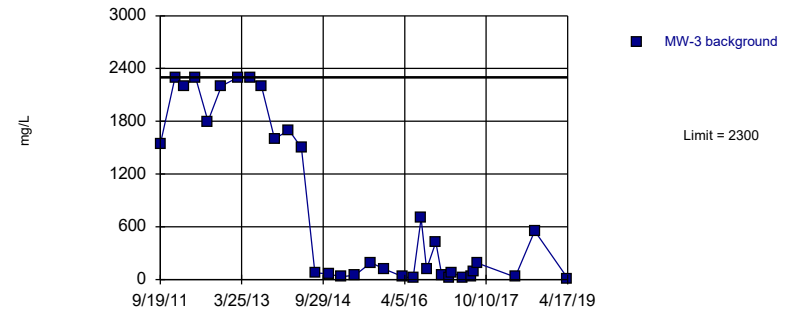
Prediction Limit  
Intrawell Non-parametric, MW-2



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

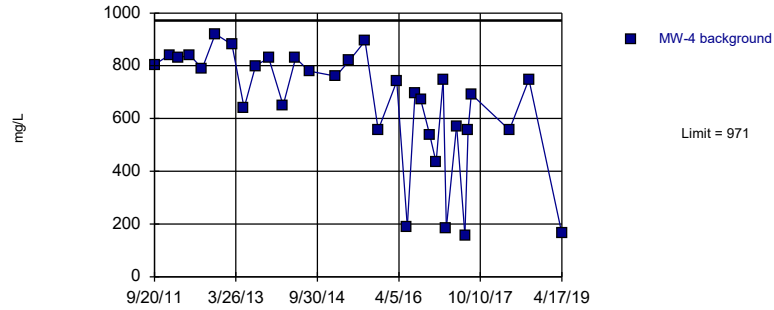
Prediction Limit  
Intrawell Non-parametric, MW-3



Non-parametric test used in lieu of parametric prediction limit because the Shapiro Wilk normality test showed the data to be non-normal at the 0.01 alpha level. Limit is highest of 33 background values. Well-constituent pair annual alpha = 0.003399. Individual comparison alpha = 0.001701 (1 of 2). Assumes 1 future value.

Constituent: Sulfate Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

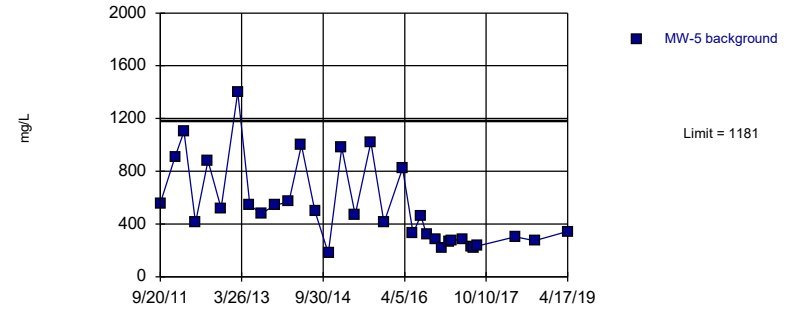
Prediction Limit  
Intrawell Parametric, MW-4



Background Data Summary (based on square transformation): Mean=482321, Std. Dev.=238140, n=32. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9202, critical = 0.904. Kappa = 1.934 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Sulfate Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

Prediction Limit  
Intrawell Parametric, MW-5



Background Data Summary (based on square root transformation): Mean=22.03, Std. Dev.=6.396, n=33. Normality test: Shapiro Wilk @alpha = 0.01, calculated = 0.9115, critical = 0.906. Kappa = 1.928 (c=7, w=5, 1 of 2, event alpha = 0.05132). Report alpha = 0.001504. Assumes 1 future value.

Constituent: Sulfate Analysis Run 12/20/2019 11:04 AM View: PL's - Intrawell  
Turk Landfill Client: Geosyntec Data: Turk Landfill

## Memorandum

Date: August 20, 2020

To: David Miller (AEP)

Copies to: Leslie Fuershbach (AEP)

From: Allison Kreinberg (Geosyntec)

Subject: Evaluation of Detection Monitoring Data at Turk Plant's Landfill (LF)

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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 Landfill (LF), an existing CCR unit at the Turk Power Plant located in Fulton, Arkansas, was completed on May 27, 2020. Based on the results, verification sampling was completed on July 14, 2020.

Background values for the Turk LF were previously calculated in December 2017. 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 January 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 only concluded if both samples in a series of two exceeds the UPL (or are below the LPL for pH).

Detection monitoring results and the relevant background values are summarized in Table 1. No SSIs were observed at the Turk LF CCR unit, and as a result the Turk 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  
Turk Plant - Landfill**

*Geosyntec Consultants, Inc.*

Parameter	Unit	Description	MW-2		MW-3		MW-4	MW-5	MW-10
			5/27/2020	7/14/2020	5/27/2020	7/14/2020	5/27/2020	5/27/2020	5/27/2020
Boron	mg/L	Intrawell Background Value (UPL)	1.40		1.30		0.609	0.504	0.430
		Analytical Result	0.051	--	0.053	--	0.206	0.078	0.03
Calcium	mg/L	Intrawell Background Value (UPL)	135		246		799	451	615
		Analytical Result	75.7	--	82.0	--	328	301	244
Chloride	mg/L	Intrawell Background Value (UPL)	140		660		1240	708	1180
		Analytical Result	6.17	--	11.3	--	831	114	327
Fluoride	mg/L	Intrawell Background Value (UPL)	1.40		1.03		0.620	0.584	0.908
		Analytical Result	0.28	--	0.22	--	0.27	0.28	0.19
pH	SU	Intrawell Background Value (UPL)	8.1		7.9		7.5	7.8	7.7
		Intrawell Background Value (LPL)	6.3		6.4		6.4	6.1	5.7
		Analytical Result	<b>8.5</b>	7.9	<b>8.2</b>	7.9	7.5	7.4	7.6
Sulfate	mg/L	Intrawell Background Value (UPL)	1900		2300		971	1180	1800
		Analytical Result	17.2	--	11.7	--	246	319	414
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	3800		4800		4880	3360	5240
		Analytical Result	311		370		2390	1320	1680

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 January 8, 2020 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Turk 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

15296

License Number

ARKANSAS

Licensing State

08.20.2020

Date

## Memorandum

Date: January 18, 2021  
To: David Miller (AEP)  
Copies to: Leslie Fuershbach (AEP)  
From: Allison Kreinberg (Geosyntec)  
Subject: Evaluation of Detection Monitoring Data at Turk Plant's Landfill (LF)

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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 2020 at the Landfill (LF), an existing CCR unit at the Turk Power Plant located in Fulton, Arkansas, was completed on November 9, 2020. Based on the results, verification sampling was completed on December 22, 2020.

Background values for the Turk LF were previously calculated in December 2017. 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 January 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 only concluded if both samples in a series of two exceeds the UPL (or are below the LPL for pH).

Detection monitoring results and the relevant background values are summarized in Table 1. No SSIs were observed at the Turk LF CCR unit, and as a result the Turk 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  
Turk - Landfill**

*Geosyntec Consultants, Inc.*

Parameter	Unit	Description	MW-2		MW-3		MW-4	MW-5	MW-10
			11/9/2020	12/22/2020	11/9/2020	12/22/2020	11/9/2020	11/9/2020	11/9/2020
Boron	mg/L	Intrawell Background Value (UPL)	1.40		1.30		0.609	0.504	0.430
		Detection Monitoring Result	0.059	--	0.056	--	0.384	0.060	0.04
Calcium	mg/L	Intrawell Background Value (UPL)	135		246		799	451	615
		Detection Monitoring Result	89.9	--	85.6	--	664	240	264
Chloride	mg/L	Intrawell Background Value (UPL)	140		660		1,240	708	1,180
		Detection Monitoring Result	7.55	--	28.8	--	1,150	75.2	282
Fluoride	mg/L	Intrawell Background Value (UPL)	1.40		1.03		0.620	0.584	0.908
		Detection Monitoring Result	0.34	--	0.29	--	0.26	0.30	0.24
pH	SU	Intrawell Background Value (UPL)	8.1		7.8		7.5	7.8	7.7
		Intrawell Background Value (LPL)	6.3		6.4		6.4	6.1	5.7
		Detection Monitoring Result	<b>8.5</b>	7.2	<b>8.1</b>	7.3	7.5	7.5	6.4
Sulfate	mg/L	Intrawell Background Value (UPL)	1,900		2,300		971	1,180	1,800
		Detection Monitoring Result	52.9	--	12.9	--	634	273	366
Total Dissolved Solids	mg/L	Intrawell Background Value (UPL)	3,800		4,800		4,880	3,360	5,240
		Detection Monitoring Result	332	--	402	--	3,150	1,080	1,610

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 January 8, 2020 *Statistical Analysis Summary* report, is appropriate for evaluating the groundwater monitoring data for the Turk 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

15296  
License Number

ARKANSAS  
Licensing State

01.27.2021  
Date