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ALTERNATE SOURCE DEMONSTRATION – ECONOMIZER ASH AND PYRITE POND SYSTEM

**Big Bend Power Station
13031 Wyandotte Road
Gibsonton, FL 33572**

Prepared for

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Tampa, Florida

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1. PURPOSE OF ALTERNATE SOURCE DEMONSTRATION REPORT

On behalf of the Tampa Electric Company (TEC), Geosyntec Consultants, Inc. (Geosyntec) has prepared this alternate source demonstration (ASD) for the economizer ash and pyrite pond system (EAPPS) at the TEC's Big Bend Power Station (BBS) in Gibsonton, Florida. This ASD has been prepared to meet the requirements of the U. S. Environmental Protection Agency's (USEPA) coal combustion residual (CCR) Rule 40 CFR Part 257.94(e)(2) which states:

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

1.1 Regulatory Background

In June 2016, TEC implemented baseline groundwater sampling as part of closure requirements for the EAPPS. The monitoring well network consists of two background locations (BBS-CCR-BW1 and BBS-CCR-BW2) and three downgradient locations (BBS-CCR-1, BBS-CCR-2, and BBS-CCR-3) installed within the surficial aquifer at the EAPPS (**Figure 1**). Data from the 10 baseline monitoring events and the first detection monitoring events presented in **Table 1**.

In accordance with the provisions established in 40 CFR 257.93, background concentrations were established for each of the constituents listed in 40 CFR 257 Appendix III by analyzing the data from the two background wells present at EAPPS. A 95% upper prediction limit (UPL) was established for each constituent from the results of 10 baseline sampling events occurring between June 2016 and August 2017. For pH a lower prediction limit (LPL) was also determined since acidic water could potentially be an indicator of a release. The first detection monitoring event occurred in October 2017 and resulted in a statistically significant increase (SSI) in pH above the established UPL of 6.70 standard units (SU) in two of the three downgradient monitoring wells, namely 6.83 and 6.87 SU in BBS-CCR-1, and BBS-CCR-2, respectively. The pH SSIs were documented in a summary memorandum entitled "*Summary of Statistical Analyses of Baseline Groundwater Samples*" dated 15 January 2018 (**Appendix A**).

1.2 Objective of ASD

The purpose of this ASD is to document that the SSIs for pH are not associated with a release from the EAPPS. Although 40 CFR 257 does not contain requirements for an ASD beyond the requirements in 257.94(e)(2), the EPA document *Solid Waste Disposal Facility Criteria Technical Manual EPA 530-R-93-017*, November 1993, Subpart E provides guidance on what would be included in an ASD for a municipal solid waste landfill. Geosyntec's approach has been modeled after Section 5.10 of Subpart E (excerpt provided in **Appendix B**) and the analytical techniques and methods presented in *Guidelines for Development of Alternative Source Demonstrations at*

Coal Combustion Residual Sites (EPRI, 2017). This ASD is based on the following three lines of evidence:

- There is inherent error present in the equipment used to measure pH in the field;
- There is natural variation within pH ranges from both BBS background wells and regional monitoring wells;
- A change in local groundwater flow direction will result in the influence from higher pH waters within the immediate vicinity of the EAPPS.

The approaches developed to evaluate the evidence is provided in Section 2 of this report. The justification and support for each approach is provided in Section 3 of this report.

2. ALTERNATE SOURCE DEMONSTRATION APPROACH

2.1 Evaluation of Inherent Error

Given that pH is a parameter that is collected in the field during groundwater sampling, a possible source of error exists in both the calibration of the measurement instrument and the inherent error present due to the accuracy limits of the instrument. Due to this possibility, a thorough investigation of the instrument calibration forms and groundwater sampling forms was conducted to verify that calibration and sampling were accomplished in accordance with standard operating procedures established by the Florida Department of Environmental Protection (FDEP) in FS 2200. A review of pertinent field logs was performed to identify if the pH probe used to collect the detection monitoring samples from wells BBS-CCR-1 and BBS-CCR-2 was properly calibrated, if the calibration drifted throughout the course of the sampling event, if an adequate amount of groundwater was withdrawn to obtain a representative sample from each monitoring well, and if pH readings were allowed to stabilize prior to sample collection. Additionally, the accuracy limitations of the instrument used to measure pH was assessed and compared to the baseline UPL to ascertain if the margin of error for the two pH measurements in question is below the UPL.

2.2 Evaluation of Natural Variation

Because no other Appendix III constituent exhibited a SSI in the October 2017 detection monitoring event, pH results in BBS-CCR-1 and BBS-CCR-2 are not believed to be the result of a release from the EAPPS, but are rather indicative of background levels in the surficial aquifer. To evaluate background pH, data collected from the TEC industrial wastewater (IWW) and remedial action plan (RAP) monitoring well network (**Figure 2**) were obtained for the period of August 2008 to November 2017 (**Table 2**). Three RAP wells within approximately 100 feet from the northwest, southwest, and southeast corners of the EAPPS (B-36, B-35, and B-17R, respectively) were selected for evaluation based on their upgradient proximity to the EAPPS monitoring well network as determined from groundwater elevations measured at the EAPPS (**Figure 3 to Figure 7**).

For comparison, monitoring wells B-4R, B-39, B-40, and B-41 have historically been designated as surficial aquifer background wells by TEC due to their locations upgradient of any TEC development along the perimeter of the property (**Figure 2**). Additionally, four surficial monitoring wells within the Southwest Florida Water Management District (SWFWMD) Regional Observation and Monitoring Program (ROMP) in the Tampa Bay, FL vicinity were identified for a regional background analysis based on available pH data (**Figure 8**). Historical ROMP data obtained by Geosyntec ranged from September 1985 to March 2003.

ProUCL version 5.1 (EPA, 2016) was utilized to generate a 95% upper confidence limit (UCL) of the arithmetic mean for pH values within each individual monitoring well and each dataset in general accordance with guidelines of Chapter 62-780.680 of the Florida Administrative Code (FAC). The most applicable data distribution provided by ProUCL was utilized. The 95% UCLs provide conservative estimates for the true arithmetic mean of each data set. These values were

compared to the October 2017 pH SSIs in BBS-CCR-1 and BBS-CCR-2 to determine if surficial groundwater pH in the vicinity of the EAPPS is exhibiting typical ranges of background variability.

2.3 Evaluation of Groundwater Flow Direction

Should the observed SSIs be the result of influence from background groundwater, a change in the flow direction of groundwater within the EAPPS would likely be observed. Potentiometric surface maps were generated from the baseline and detection monitoring events to compare the observed flow directions and determine if the SSIs could be the result of a change in flow direction.

3. DEMONSTRATION OF OTHER REASONS FOR STATISTICAL INCREASE

This section presents the results of the approaches discussed in Section 2 and provides support that the lines of evidence identified are plausible sources of the pH SSI.

3.1 Findings from Evaluation of Inherent Error

The sampling team used a YSI® multimeter for pH data collection (as well as temperature, specific conductivity, and dissolved oxygen) during monitoring well purging and sampling. Field forms from the October 2017 detection monitoring sampling event are provided in **Appendix C**. A review of the instrument calibration log recorded at 7:02 AM on 13 October 2017 reveals that a 3-point calibration for the pH probe was conducted in accordance with FDEP FS2200. Initial calibration verification (ICV) was conducted for a pH 7.0 SU buffer solution resulting in an acceptable reading of 7.03 SU at 7:06 AM. The continued calibration verification (CCV) performed at 2:29 PM upon the completion of the sampling activities resulted in an acceptable reading of 7.11 SU. Groundwater sampling forms documenting field parameter stabilization for BBS-CCR-1 and BBS-CCR-2 indicate that an adequate amount of water was withdrawn from each well prior to sampling to obtain a representative sample. Additionally, three consecutive pH readings were collected within ± 0.2 SU of each other signifying pH stabilization in each well.

A 0.08 SU drift in pH was observed in the post calibration verification but is not enough to explain why the pH concentrations of BBS-CCR-1 and BBS-CCR-2 (6.83 and 6.87 SU respectively) are outside of the background level of 6.70 SU. However, the error inherent to the instrument itself is accurate within ± 0.2 SU (YSI, 2009). As a result, the October 2017 pH values at BBS-CCR-1 and BBS-CCR-2 are more correctly stated as 6.83 ± 0.2 SU and 6.87 ± 0.2 SU, indicating that the 6.70 SU background level is within the accuracy limits of the instrument.

3.2 Findings from Evaluation of Natural Variation

Statistics for pH data from TEC surficial monitoring wells immediately upgradient of the EAPPS, BBS surficial background monitoring wells, and regional SWFWMD ROMP surficial monitoring wells are included in **Table 2**. Results from 95% UCL calculations are summarized below.

3.2.1 Anthropogenic Background Data – Surficial Aquifer

The pH data from the Economizer Ash and Long-Term Fly Ash Pond monitoring wells (B-17R, B-35, and B-36) indicates the following:

- pH values ranged between 6.60 and 6.96 SU between May 2011 and May 2017;
- 95% UCL values for individual monitoring wells ranged between 6.78 and 6.89 SU and
- The 95% UCL for pH within all three monitoring wells was calculated as 6.82 SU based on 35 total observations.

3.2.2 Natural Background Data – Surficial Aquifer

The pH data from TEC Big Bend IWW/RAP Background Monitoring Wells (B-4R, B-39, B-40, and B-41) indicates the following:

- pH values within the surficial TEC property background wells ranged from 5.81 to 7.31 SU between May 2011 to May 2017;
- 95% UCL values for individual monitoring wells ranged between 6.21 and 7.21 SU; and
- The 95% UCL for pH within all four monitoring wells calculated using 51 total observations is 6.85 SU.

The pH data from the SWFWMD ROMP Monitoring Wells indicates the following:

- pH values ranged between 5.59 and 7.42 SU between September 1985 and March 2003;
- Three of the four monitoring wells had an insufficient number of data points (< 8) to calculate a 95% UCL. Arithmetic mean values are reported for these wells instead. Arithmetic mean and 95% UCL values ranged between 5.77 and 7.25 SU within the individual ROMP wells; and
- The 95% UCL for pH within all four ROMP wells calculated using 34 total observations is 7.13 SU

A 95% UCL of 6.93 SU was also calculated using the combined TEC background and ROMP background well data (85 total observations) over an average range from 5.59 to 7.42 SU.

3.3 Findings from Evaluation of Groundwater Flow Direction

Seasonal variations (e.g., wet and dry seasons) in groundwater flow direction from June 2016 to October 2017 (wet to dry seasons) are presented in **Figure 3** (June 2016), **Figure 4** (August 2015), **Figure 5** (November 2016), **Figure 6** (April 2017), and **Figure 7** (October 2017). Since the installation of the EAPPS monitoring well network in May 2016, little variability in groundwater flow direction was observed during the baseline monitoring events with a predominately north-northeast flow direction observed from background wells BBS-CCR-BW1 and BBS-CCR-BW2 towards the three upgradient monitoring wells located along the northern and eastern borders of the EAPPS. **Figures 3-6** illustrate that surficial groundwater was flowing towards the EAPPS monitoring wells from RAP monitoring well B-35 consistently and that B-36 has been cross to upgradient of BBS-CCR-1 periodically. Similarly, the location of B-17R is typically upgradient of the EAPPS and BBS-CCR-3 based on the northward flow direction observed at BBS-CCR-BW-1 throughout baseline sampling events.

However, noticeable change in groundwater elevations was observed during the October 2017 detection monitoring event, resulting in a more pronounced east-west component across the EAPPS (**Figure 7**). Additionally, a south-southwesterly component appears to be present based on the reversal of gradients observed between monitoring wells BBS-CCR-3 and BBS-CCR-BW-1. These westerly flow components are more aligned with the regional flow across BBS which follows a general east to west flow pattern towards Tampa Bay (**Figure 9**).

4. CONCLUSIONS AND RECOMMENDATIONS

Based on the data review and analysis presented in this ASD, Geosyntec concludes the following regarding the pH SSIs observed in October 2017:

- The margin of error in the pH instrument of ± 0.2 SU means that the background pH level of 6.70 SU is also between 6.50 and 6.90 SU. As a result, the pH values at BBS-CCR-1 and BBS-CCR-2 of 6.83 and 6.87 SU, respectively, are within the margin of error of the instrument and should not be considered SSIs.
- The range of pHs in background adjacent to the EAPPS (6.78 SU to 6.89 SU with a total 95% UCL of 6.82 SU) and BBS to regional background (5.59 to 7.42 SU with a total 95% UCL of 6.93 SU) encompasses the range of pH values (6.30 and 6.70 SU) observed at the EAPPS.
- Subtle changes in groundwater flow direction at the EAPPS (observed in October 2017 during the detection monitoring event) indicates that groundwater originating from the southeast and northwest migrates towards the EAPPS, thus providing for mixing of background groundwater (both anthropogenic and natural) with local groundwater.

This ASD documents that the statistically significant increase in pH at two downgradient monitoring wells is from a source other than the EAPPS. Therefore, the EAPPS will remain in the detection monitoring program.

5. REFERENCES

Electric Power Research Institute (EPRI). 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Sites.

Geosyntec Consultants, Inc. 2018. Technical Memorandum: *Summary of Statistical Analyses of Baseline Groundwater Samples Economizer Ash and Pyrite Pond System.*

Southwest Florida Water Management District (SWFWMD). 2018. Water Management Information System: <https://www.swfwmd.state.fl.us/data/hydrologic>

United States Environmental Protection Agency (EPA). 2002. 40 CFR Part 257 – Criteria for Classification of Solid Waste Disposal Facilities and Practices.

United States Environmental Protection Agency (EPA). 1993. Solid Waste Disposal Facility Criteria. *Technical Manual 530R-93-017 Subpart E.*

United States Environmental Protection Agency (EPA). 2016. ProUCL Version 5.1. Statistical Support Software for Site Investigation and Evaluation.

YSI Environmental. 2009. YSI 556 MPS Operations Manual.

TABLES



Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

TECO, Big Bend Facility
Apollo Beach, Florida

Well ID				BBS-CCR-BW1											
Sample Date				6/24/2016	7/27/2016	8/26/2016	10/28/2016	11/10/2016	1/26/2017	4/13/2017	6/28/2017	7/20/2017	8/16/2017	10/13/2017	
Parameter	Units	MCL	Bkgd*	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	
Top of Casing Elevation	ft NAVD 88	--	--	30.13	30.13	30.13	30.13	30.13	30.13	30.13	30.13	30.13	30.13	30.13	
Depth to Water	ft BTOC	--	--	25.37	26.19	25.78	29.42	29.84	30.49	30.71	29.92	28.89	28.74	29.60	
Groundwater Elevation	ft NAVD 88	--	--	4.76	3.94	4.35	0.71	0.29	-0.36	-0.58	0.21	1.24	1.39	0.53	
Temperature	C	NA	--	27.84	28.25	28.11	27.46	27.50	26.98	27.20	27.72	27.89	28.08	28.16	
Specific Conductivity (field)	umhos/cm	NA	--	5620	5420	5140	4860	5000	4940	1580	5010	4960	5000	4570	
pH (field)	SU	6.5 - 8.5	--	6.51	6.38	6.41	6.50	6.52	6.46	6.49	6.47	6.49	6.52	6.55	
Dissolved Oxygen	mg/L	NA	--	0.180	0.170	0.120	0.130	0.130	0.200	0.140	0.420	0.600	0.450	0.400	
Redox Potential	mV	NA	--	-8.60	-7.30	-22.80	-76.20	-71.1	-20.2	-114.00	-11.4	-23.00	3.60	-18.40	
Turbidity (field)	NTU	NA	--	5.14	7.10	6.47	4.08	1.77	2.04	4.22	0.69	2.38	6.03	2.51	
Appendix III Parameters															
Boron	mg/L	1.4**	54.6	59.1	56.9	53.7 V	51.4	49.7	45.9	49.0	51.7	47.00	48.00	44.20	
Calcium	mg/L	NA	997.5	781	737	729	675 V	692	728	693	781	744 V	743	691	
Chloride	mg/L	250	1088	1140 J-	1120	1030	939 V	993 V	942 V	934	995	915 V	793	809	
Fluoride	mg/L	4***	0.664	0.199	0.110	0.180	0.194	0.261	0.315	0.256	0.298	0.255 J	0.0100 U	0.334	
Sulfate	mg/L	250	1677	1440 J-	1510	1420	1400	1440	1520	1550	1510	1470	1320	217	
Total Dissolved Solids	mg/L	500	5418	5050 J-	4190 I(-)	4290	4120 J-	4170 J-	4510 J	4060 J	4430	4160 J	4340	3890	
Appendix IV Parameters															
Antimony	ug/L	6	1.47	0.600 U	0.600 U	1.77 I	6.00 U	0.600 U	0.600 U	0.600 U	0.600 U	6.00 U	0.600 U	0.600 U	
Arsenic	ug/L	10	8.89	10.2	8.10	8.89	3.20 U	8.49	0.320 U	8.61	7.68	8.48 I	6.60	9.06	
Barium	ug/L	2000	106	72.9	68.2	61.4	60.0	61.2	54.6	53.6	55.4	51.7	55.6	55.8	
Beryllium	ug/L	4	0.215	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	
Cadmium	ug/L	5	0.235	0.100 U	0.100 U	0.100 U	1.00 U	0.100 U	0.100 U	0.108 I	0.124 I	1.00 U	0.100 U	0.100 U	
Chromium	ug/L	100	2.45	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	3.23 I	2.29 I	2.16 I	2.48 J	1.6 U	
Cobalt	ug/L	140**	1.61	1.40 I	1.33 I	1.52 I	0.963 I	1.45 I	1.50 I	2.0 U	1.71 I	1.97 I	1.66 J	1.86 J	
Lead	ug/L	15	0.265	0.0800 U	0.200 I	0.111 I	0.800 U	0.102 I	0.113 I	0.129 I	0.0800 U	0.800 U	0.291 J	0.103 J	
Lithium	ug/L	140**	19	8.9 I	20 I	7.4 I	11 I	10 I	18 I	39.7	15 U	17 I	0.050 U	17 I,V	
Mercury	ug/L	2	0.0500	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	
Molybdenum	ug/L	35**	12.8	4.46 I	2.88 I	11.1 I	6.00 I	6.58 I	7.16 I	15.6 I	16.3 U	13.6 I	1.43 J	4.27 J	
Radium 226/228	pCi/L	1	38.2	38	35	31	32.3	29.9	32.5	39.7	37.8	37.2	30.1	22.1	
Selenium	ug/L	50	2.08	2.09	1.92 I	1.73 I	2.00 U	2.51	0.200 U	1.62 I	1.81 I	2.00 U	1.76 J	2.14 J	
Thallium	ug/L	2	0.229	0.118 I	0.100 U	0.100 U	1.00 U	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	0.100 U	0.100 U	

Notes and Abbreviations provided on Page 6.

Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

TECO, Big Bend Facility
Apollo Beach, Florida

Well ID				BBS-CCR-BW2											
Sample Date				6/24/2016	7/27/2016	8/26/2016	10/28/2016	11/10/2016	1/26/2017	4/13/2017	6/28/2017	7/20/2017	8/16/2017	10/13/2017	
Parameter	Units	MCL	Bkgd*	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Results Q	Results Q	Results Q	Result Q	
Top of Casing Elevation	ft NAVD 88	--	--	9.81	9.81	9.81	9.81	9.81	9.81	9.81	9.81	9.81	9.81	30.13	
Depth to Water	ft BTOC	--	--	4.72	5.52	5.22	8.06	8.45	9.13	9.24	8.53	7.45	7.33	7.38	
Groundwater Elevation	ft NAVD 88	--	--	5.09	4.29	4.59	1.75	1.36	0.68	0.57	1.28	2.36	2.48	22.75	
Temperature	C	NA	--	26.42	27.56	27.74	27.22	27.10	25.25	30.71	26.69	27.20	27.69	27.95	
Specific Conductivity (field)	umhos/cm	NA	--	1640	1500	1380	1340	1400	1460	1480	1538	1540	1580	1700	
pH (field)	SU	6.5 - 8.5	--	6.53	6.48	6.48	6.67	6.68	6.62	6.67	6.64	6.66	6.68	6.70	
Dissolved Oxygen	mg/L	NA	--	0.370	0.150	0.100 U	0.370	0.200	0.300	1.32	0.190	0.330	0.430	0.280	
Redox Potential	mV	NA	--	-59.4	-84.1	-59.5	-91.5	-73.8	-74.1	-42.0	-82.4	-94.0	-53.3	-72.10	
Turbidity (field)	NTU	NA	--	6.70	4.86	1.73	3.99	5.86	16.4	19.0	6.1	5.3	3.66	3.96	
Appendix III Parameters															
Boron	mg/L	1.4**	54.6	3.89	4.25	3.70 V	3.90	3.75	3.27	4.08	4.54 J-	4.57	4.39	4.08	
Calcium	mg/L	NA	997.5	313	271	237	238 J-,V	243	240	260	290 J-	278 V	287	321	
Chloride	mg/L	250	1088	123	116	116	125 V	129 V	145 V	140	135	123 V	117	84.9	
Fluoride	mg/L	4***	0.664	0.409	0.432	0.455	0.440	0.464	0.472	0.478	0.559	0.319 J	0.352	0.513	
Sulfate	mg/L	250	1677	414	341	276	246	255	255	323	402	41.7	462	632	
Total Dissolved Solids	mg/L	500	5418	1230	1060	980	1010	966 J-	1140	1120	1170	1200	1180 J	1330	
Appendix IV Parameters															
Antimony	ug/L	6	1.47	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	6.000 U	0.600 U	0.600 U
Arsenic	ug/L	10	8.89	2.65	1.75 I	2.03	1.62 I	2.59	0.709 I	1.45 I	1.68 I	3.20 U	1.80 J	2.01	
Barium	ug/L	2000	106	51.3	49.8	43.2	46.3	45.8	38.8	42.7	48.8	47.7	49.9	56.2	
Beryllium	ug/L	4	0.215	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.220 U	0.200 U	0.254 J	
Cadmium	ug/L	5	0.235	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	0.100 U	0.100 U	
Chromium	ug/L	100	2.45	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.68 I	2.26 I	1.60 U	1.60 U	
Cobalt	ug/L	140**	1.61	1.00 U	0.14 I	0.153 I	0.151 I	0.157 I	0.136 I	2.0 U	0.0959 I	0.400 U	0.110 J	0.129 J	
Lead	ug/L	15	0.265	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.800 U	0.101 J	0.800 U	
Lithium	ug/L	140**	19	3.8 I	9.1 I	2.0 I	3.8 I	1.7 I	5.2 I	3.4	5.2 I	5.9 I	0.050 U	8.2 I,V	
Mercury	ug/L	2	0.0500	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	
Molybdenum	ug/L	35**	12.8	2.40 I	1.00 U	7.57	1.42 I	1.00 U	2.56 I	9.65 I	10.2 U	8.9 I	4.08 J	2.51 J	
Radium 226/228	pCi/L	1	38.2	4.8	5.1 J	4.0	4.8	8.0	4.8 J	4.5	4.8	4.4	4.9	4.9	
Selenium	ug/L	50	2.08	0.722 I	0.760 I	0.577 I	0.489 I	0.485 I	0.260 I	0.539 I	0.386 I	2.00 U	0.420 J	0.523 J	
Thallium	ug/L	2	0.229	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	1.00 U	0.100 U	0.100 U	

Notes and Abbreviations provided on Page 6.

Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

TECO, Big Bend Facility
Apollo Beach, Florida

Well ID				BBS-CCR-1											
Sample Date				6/24/2016	7/27/2016	8/26/2016	10/28/2016	11/10/2016	1/26/2017	4/13/2017	6/28/2017	7/20/2017	8/16/2017	10/13/2017	
Parameter	Units	MCL	Bkgd*	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Results Q	Results Q	Result Q	
Top of Casing Elevation	ft NAVD 88	--	--	7.79	7.79	7.79	7.79	7.79	7.79	7.79	7.79	7.79	7.79	7.79	
Depth to Water	ft BTOC	--	--	3.51	5.00	5.06	6.78	7.38	7.46	7.64	7.41	5.86	7.03	7.32	
Groundwater Elevation	ft NAVD 88	--	--	4.28	2.79	2.73	1.01	0.41	0.33	0.15	0.38	1.93	0.76	0.47	
Temperature	C	NA	--	25.48	26.41	27.05	25.78	25.70	24.03	23.70	25.54	25.81	25.80	26.57	
Specific Conductivity (field)	umhos/cm	NA	--	3940	4180	4000	4060	4290	4320	4170	4063	3960	4110	4260	
pH (field)	SU	6.5 - 8.5	--	6.80	6.67	6.71	6.83	6.82	6.79	6.84	6.78	6.81	6.82	6.83	
Dissolved Oxygen	mg/L	NA	--	0.100	0.220	0.140	0.10 U	0.100 U	0.100 U	0.100 U	0.270	0.100	0.280	0.240	
Redox Potential	mV	NA	--	-49.1	-74.1	-34.8	-107.0	-136	-110	-80.40	-80.60	-122.00	-109.00	-83.30	
Turbidity (field)	NTU	NA	--	8.01	3.88	2.08	3.22	0.890	1.99	4.12	3.63	1.58	1.88	0.89	
Appendix III Parameters															
Boron	mg/L	1.4**	54.6	14.4	0.306	11.4	15.7	16.2	15.5 J-	16.4	16.5	16	17	19.90	
Calcium	mg/L	NA	997.5	541	227	556	556 V	606	579 J-	555	569	576 V	572	596.00	
Chloride	mg/L	250	1088	619	742 J-	695	743 J-	817 V	820 V	124	720	694 J-, V	710	716	
Fluoride	mg/L	4***	0.664	0.211	0.128	0.454	0.104	0.0871	0.184	0.170	0.208	0.157 J	0.200	0.201	
Sulfate	mg/L	250	1677	1240	1320 J-	1240	1230 J-	1290	1350	443	1120	1390	1240	1230	
Total Dissolved Solids	mg/L	500	5418	3060 J	3140	2980	3170 J-	3470 J-	3670 J	3110 J	3140	3400 J	2960 J	3470	
Appendix IV Parameters															
Antimony	ug/L	6	1.47	0.600 U	1.03 I	0.600 U	0.600 U	0.600 U	0.602 I	0.600 U	0.600 U	3.00 U	0.600 U	0.600 U	
Arsenic	ug/L	10	8.89	8.74	7.38	7.94	8.30	8.93	9.04	10.5	9.76	10.3	9.33	9.03	
Barium	ug/L	2000	106	122	30.8	115	122	129	115	116 I	113	112	122	129	
Beryllium	ug/L	4	0.215	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	2.00 U	0.200 U	0.200 U	0.200 U	0.200 U	
Cadmium	ug/L	5	0.235	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.500 U	0.100 U	0.100 U	
Chromium	ug/L	100	2.45	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.93 I	1.62 I	1.60 U	1.60 U	
Cobalt	ug/L	140**	1.61	1.00 U	0.450 I	0.485	0.507 I	0.519 I	0.489 I	2.0 U	0.484 I	0.495 I	0.473 J	0.453 J	
Lead	ug/L	15	0.265	0.0800 U	0.110 I	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.0979 I	0.0800 U	0.400 U	0.080 U	0.080 U	
Lithium	ug/L	140**	19	8.3 I	15 I	7.4 I	12 I	8.4 I	14 I	10 I	13 I	14 I, J3	0.050 U	15 I, V	
Mercury	ug/L	2	0.0500	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	
Molybdenum	ug/L	35**	12.8	106	105	80.3	95.5	98.4	92.4	124 I	96.5 I	99.6	86.4	82.5	
Radium 226/228	pCi/L	1	38.2	39	33	15	42.6	37.3	32.5	35.8 I	41.4	34.7	33.4	35.6	
Selenium	ug/L	50	2.08	0.696 I	0.960 I	0.385	0.690 I	1.04 I	0.653 I	0.937 I	0.756 I	2.25 I	0.918 J	0.99 J	
Thallium	ug/L	2	0.229	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.500 U	0.100 U	0.100 U	

Notes and Abbreviations provided on Page 6.

Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

TECO, Big Bend Facility
Apollo Beach, Florida

Well ID				BBS-CCR-2											
Sample Date				6/24/2016	7/27/2016	8/26/2016	10/28/2016	11/10/2016	1/26/2017	4/13/2017	6/28/2017	7/20/2017	8/16/2017	10/13/2017	
Parameter	Units	MCL	Bkgd*	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Results Q	Results Q	Result Q	
Top of Casing Elevation	ft NAVD 88	--	--	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	8.14	
Depth to Water	ft BTOC	--	--	3.45	5.30	5.35	6.78	6.88	6.93	7.15	6.97	5.06	6.53	6.88	
Groundwater Elevation	ft NAVD 88	--	--	4.69	2.84	2.79	1.36	1.26	1.21	0.99	1.17	3.08	1.61	1.26	
Temperature	C	NA	--	25.62	26.42	27.35	25.64	25.66	24.27	23.95	25.12	25.74	26.43	26.46	
Specific Conductivity (field)	umhos/cm	NA	--	1580	1700	1570	1500	1540	1560	1540	1485	1630	1560	1350	
pH (field)	SU	6.5 - 8.5	--	6.80	6.68	6.74	6.87	6.89	6.89	6.93	6.87	6.97	6.92	6.87	
Dissolved Oxygen	mg/L	NA	--	0.100	0.130	0.100 U	0.100	0.130	0.100 U	0.100 U	0.240	0.100 U	0.250	0.200	
Redox Potential	mV	NA	--	-71.0	-67.4	-27.3	-183	-186	-182	-138	-131	-154.0	-233.0	-188	
Turbidity (field)	NTU	NA	--	4.90	7.16	3.31	3.73	7.10	4.93	3.43	4.71	4.56	3.22	3.03	
Appendix III Parameters															
Boron	mg/L	1.4**	54.6	1.55	2.81	2.86	2.08	2.28	3.86	5.01	3.20	4.94	4.32	0.888	
Calcium	mg/L	NA	997.5	198	193	192	181 V	181	172	163	173	178 V	171	169	
Chloride	mg/L	250	1088	118	140	124	112 V	111 V	115 J+	119	105	114 V	113	70.9	
Fluoride	mg/L	4***	0.664	0.148	0.183	0.150	0.171	0.168	0.248 J+	0.237	0.214	0.166 J	0.155	0.182	
Sulfate	mg/L	250	1677	471	542	484	468	468	490 J-	485 J-	415 J-	481	459	432	
Total Dissolved Solids	mg/L	500	5418	1170 J-	1170	1120	1130	1110	1140	1150	1080	1140	1080	1030	
Appendix IV Parameters															
Antimony	ug/L	6	1.47	0.600 U	0.830 I	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	1.20 U	0.600 U	
Arsenic	ug/L	10	8.89	1.83 I	0.990 I	1.25	1.16 I	1.37 I	1.09 I	2.64	1.01 I	0.974 I	1.02 J	1.14	
Barium	ug/L	2000	106	65.0	64.8	61.4	60.6	62.4	54.6	55.8	54.6	54.6	56.8	53.3	
Beryllium	ug/L	4	0.215	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.423 U	0.200 U	0.200 U	
Cadmium	ug/L	5	0.235	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.200 U	0.200 U	
Chromium	ug/L	100	2.45	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	2.29 I	1.96 I	3.11 I	1.60 U	1.60 U	
Cobalt	ug/L	140**	1.61	1.00 U	0.0900 I	0.0776	0.107 I	0.105 I	0.0902 I	2.0 U	0.0875 I	0.0857 I	0.150 J	0.115 J	
Lead	ug/L	15	0.265	0.0800 U	0.110 I	0.0800 U	0.129 I	0.0955 I	0.0800 U	0.176 I	0.144 I	0.127 I	0.244 J	0.15 J	
Lithium	ug/L	140**	19	10 I	17 I	11 I	14 I	11 I	13 I	13 I	14 I	16 I	0.050 U	16 I,V	
Mercury	ug/L	2	0.0500	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	
Molybdenum	ug/L	35**	12.8	1.73 I	1.00 U	7.78	1.00 U	1.43 I	2.52 I	9.82 I	9.59 U	9.88 I	3.02 J	1.99 J	
Radium 226/228	pCi/L	1	38.2	15.0	13.2	32	14.9	14.8	13.9	14.2	14.7	14.4	12.1	13.5	
Selenium	ug/L	50	2.08	0.376 I	0.280 I	0.200 U	0.333 I	0.259 I	0.200 U	0.200 U	0.200 U	0.474 I	0.662 J	0.474 J	
Thallium	ug/L	2	0.229	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.200 U	0.200 U	

Notes and Abbreviations provided on Page 6.

Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

TECO, Big Bend Facility
Apollo Beach, Florida

Well ID				BBS-CCR-3											
Sample Date				6/24/2016	7/27/2016	8/26/2016	10/28/2016	11/10/2016	1/26/2017	4/13/2017	6/28/2017	7/20/2017	8/16/2017	10/13/2017	
Parameter	Units	MCL	Bkgd*	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	Result Q	
Top of Casing Elevation	ft NAVD 88	--	--	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78	6.78	
Depth to Water	ft BTOC	--	--	1.51	3.60	3.48	6.54	6.77	6.81	7.13	6.64	4.77	6.04	6.52	
Groundwater Elevation	ft NAVD 88	--	--	5.27	3.18	3.30	0.24	0.01	-0.03	-0.35	0.14	2.01	0.74	0.26	
Temperature	C	NA	--	26.62	27.28	27.07	26.20	26.10	24.25	24.27	26.15	26.73	26.86	27.18	
Specific Conductivity (field)	umhos/cm	NA	--	1580	1740	1690	1640	1650	1510	1580	1755	1750	1790	1750	
pH (field)	SU	6.5 - 8.5	--	6.42	6.19	6.29	6.42	6.46	6.42	6.49	6.38	6.36	6.42	6.44	
Dissolved Oxygen	mg/L	NA	--	0.540	0.100 U	0.150	0.100 U	0.100 U	0.110	0.140	0.280	0.170	0.290	0.370	
Redox Potential	mV	NA	--	-145	-74.4	-155.0	-266	-239	-168	-114	-125	-122	-206	-249	
Turbidity (field)	NTU	NA	--	11.5	8.04	6.35	3.26	1.18	1.79	4.22	0.94	0.51	0.47	2.39	
Appendix III Parameters															
Boron	mg/L	1.4**	54.6	0.662	13.2	0.540 V	0.532	0.502	0.381	0.385	0.184	0.211	0.266	0.373	
Calcium	mg/L	NA	997.5	187	196	200	201 V	200	176	176	192	205 J-, V	187	190	
Chloride	mg/L	250	1088	88.9	140	136	140 V	129 V	129 V	124	168	158 V	156	153	
Fluoride	mg/L	4***	0.664	0.313	0.262	0.286	0.299	0.331	0.391	0.415	0.338	0.230 J	0.338	0.333	
Sulfate	mg/L	250	1677	474	516	517	541	492	454	443	493	506	484	503	
Total Dissolved Solids	mg/L	500	5418	1200	1220	1210	1220	1220	1200	1120	1280	1310	1290	1310	
Appendix IV Parameters															
Antimony	ug/L	6	1.47	0.600 U	0.770 I	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	0.600 U	3.00 U	0.600 U	0.600 U	
Arsenic	ug/L	10	8.89	1.23 I	0.540 I	0.603 I	0.623 I	0.765 I	0.320 U	0.320 U	0.525 I	1.60 U	0.536 J	0.665 J	
Barium	ug/L	2000	106	65.3	67.6	63.6	66.3	63.0	56.2	58.6	61.8	63.4	59.8	59.3	
Beryllium	ug/L	4	0.215	0.200 U	0.200 U	0.272 I	0.200 U	0.200 U	0.200 U	0.200 U	0.200 U	0.356 U	0.200 U	0.200 U	
Cadmium	ug/L	5	0.235	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.500 U	0.100 U	0.100 U	
Chromium	ug/L	100	2.45	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	1.60 U	3.12 I	3.43 I	2.02 J	1.60 U	
Cobalt	ug/L	140**	1.61	1.00 U	0.0900 I	0.125 I	0.124 I	0.117 I	0.0989 I	2.0 U	0.119 I	0.200 U	0.123 J	0.115 J	
Lead	ug/L	15	0.265	0.125 I	0.0800 I	0.0800 U	0.107 I	0.0800 U	0.0800 U	0.0800 U	0.0800 U	0.400 U	0.0800 U	0.0800 U	
Lithium	ug/L	140**	19	3.7 I	11 I	6.1 I	8.2 I	6.1 I	7.7 I	6.3 I	5.2 I	10 I	0.050 U	11 I, V	
Mercury	ug/L	2	0.0500	0.0580 I	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	0.0500 U	
Molybdenum	ug/L	35**	12.8	4.09 I	2.23 I	8.10	3.63 I	3.90 I	5.42 I	11.7 I	11.9 U	10.6 I	3.14 J	3.82 J	
Radium 226/228	pCi/L	1	38.2	10.3	12.3	15	18.1	17.5	15	14.4	17.7	20.3	19.6	20.0	
Selenium	ug/L	50	2.08	0.262 I	0.270 I	0.200 U	0.200 U	0.253 I	0.200 U	0.200 U	0.200 U	1.00 U	0.200 U	0.285 J	
Thallium	ug/L	2	0.229	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.100 U	0.500 U	0.100 U	0.100 U	

Notes and Abbreviations provided on Page 6.

Table 1: TECO Big Bend EAPPS Analytical Groundwater Results

TECO, Big Bend Facility

Apollo Beach, Florida

Notes:

1. U: Laboratory qualifier - Indicates that the compound was not detected above the reporting limit.
2. I: Laboratory qualifier - The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit; estimated value
3. J(-): Laboratory qualifier - The reported value is an estimated value.
4. J: Data validation qualifier - The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
5. UJ: Data validation qualifier - The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.
6. J- : Data validation qualifier - The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.
7. V: Analyte detected in the method blank.
8. Q: Laboratory qualifier- Re-analysis of sample beyond the accepted holding time.
9. J3: Laboratory qualifier - Estimated value; value may not be accurate. Spike recovery or RPD outside of criteria.
9. MCLs - EPA Maximum Contaminant Levels; primary enforceable standards shown unless otherwise noted. Secondary (non-enforceable) standards shown in italics.
10. Detections shown in bold text and highlighted yellow when above background levels or enforceable federal MCLs or Florida Groundwater Cleanup Target Levels (GCTL) if background is less.
11. * Background concentration determined as two times the mean from BBS-CCR-BW1 and BBS-CCR-BW2 in accordance with FDEP Guidance Document "Guidance for Comparing Background and Site Chemical Concentrations in Groundwater" (July 2013). Non - detects taken as 1/2 the reporting limit. Yellow shading indicates above background.
12. ** Florida GCTLs per FDEP Chapter 62-777 of the Florida Administrative Code.
13. *** Secondary MCL for fluoride is 2 mg/L but not enforceable.
14. Background / Upgradient Well shaded green.
15. Concentrations in red considered anomalous (July 2016).

Abbreviations:

Q - Data qualifier

C - Celsius

ft BTOC - feet below top of well casing

mg/L - milligrams per liter

SU - Standard units

ft NAVD 88 - feet elevation in North American Vertical Datum 1988

ug/L - micrograms per liter

umhos/cm - micromhos per centimeter

Table 2: Statistical Comparison of Background Groundwater pH in the Surficial Aquifer

TECO Big Bend Station
13031 Wyandotte Road, Gibsonton, FL 33572

Monitoring Well Units Adjacent to EAPPS

TECO Big Bend Unit Name	Monitoring Wells	Period of Record	Number of Observations	pH ¹ Minimum	pH ¹ Maximum	95% UCL ²	Statistic ³
Unit 20 (Economizer and Long Term Fly Ash Pond)	B-17R	5/11 - 11/13	11	6.70	6.89	6.89	95% Student's-t UCL
	B-35	5/11 - 5/17	12	6.60	6.92	6.78	95% Student's-t UCL
	B-36	5/11 - 5/17	12	6.70	6.96	6.85	95% Student's-t UCL
	TOTAL	5/11 - 5/17	35	6.60	6.96	6.82	95% Adjusted Gamma UCL

TECO Big Bend and Regional Surficial Aquifer Background Monitoring Wells

Background Source	Monitoring Wells	Period of Record	Number of Observations	pH ¹ Minimum	pH ¹ Maximum	95% UCL ²	Statistic ³
TECO Big Bend IWW/RAP ⁴ Background Wells	B-4R	5/11 - 5/17	15	5.81	6.5	6.21	95% Student's-t UCL
	B-39	5/11 - 5/17	12	6.87	7.31	7.21	95% Student's-t UCL
	B-40	5/11 - 5/17	12	6.70	7.10	7.00	95% Student's-t UCL
	B-41	5/11 - 5/17	12	6.60	7.10	6.97	95% Student's-t UCL
	TOTAL	5/11 - 5/17	51	5.81	7.31	6.85	95% Student's-t UCL

SWFWMD ⁵ Regional Observation and Monitoring Program	TR 9-2	9/93 - 3/03	4	5.59	5.96	5.77*	Arithmetic Mean
	TR 9-3	9/85 - 3/03	19	6.75	7.42	7.25	95% Student's-t UCL
	TR 10-2	9/85 - 3/03	7	6.71	7.16	7.00*	Arithmetic Mean
	TR12-1	8/93 - 3/03	4	7.15	7.33	7.24*	Arithmetic Mean
	TOTAL	9/85 - 3/03	34	5.59	7.42	7.13	95% Student's-t UCL

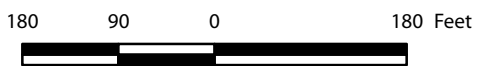
COMBINED⁶	9/85 - 5/17	85	5.59	7.42	6.93	95% Student's-t UCL
-----------------------------	-------------	----	------	------	-------------	---------------------

Notes:

- All results are reported for pH in standard units (SU).
 - 95% UCL = 95% of the Upper Confidence Limit of the arithmetic mean of the data set.
 - Statistics reported are the most appropriate based on the underlying distribution of each data set.
 - IWW and RAP refer to TECO's Industrial Wastewater and Remedial Action Plan monitoring well networks respectively.
 - SWFWMD = Southwest Florida Water Management District
 - Combined statistic represents the combination of both SWFWMD Regional Observation and Monitoring (ROMP) monitoring wells and TECO Big Bend background monitoring wells.
- * Insufficient number of observations to calculate a 95% UCL; arithmetic mean reported instead.

FIGURES





**CCR Monitoring Well Locations
Economizer Ash and Pyrite Pond System**

TEC Big Bend Station
Gibsonton, FL





Figure
1

Tampa, FL

March 2018

Path: [I:\usville-01\DATA\1\OGIS\FR2814_2017_Annual_CCR_GW_Report\FWDX\CCR_MW_Loc.mxd 18 January 2018 -JRB

Legend

-  Background Well Location
-  CCR Monitoring Well Location

Note:
2014 Aerial Imagery source, Florida Department of Transportation
Surveying and Mapping Office APLUS website.

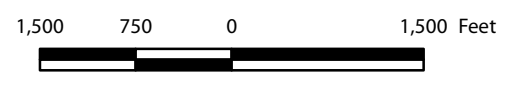


- Legend**
- Industrial Wastewater Well Location
 - Remedial Action Plan Well Location
 - Upper Floridan Industrial Wastewater Well Location
 - Upper Floridan Remedial Action Plan Well Location
 - Well Location Abandoned in 2015
 - Approximate Site Boundary

1. Long Term Fly Ash Pond/Reclaimed Water Pond (lined) (#22)
2. South Economizer Ash Pond (lined) (#20)
3. North Economizer Ash Pond (lined) (#20)
4. Economizer Ash Suction Pond (lined) (#20)
5. South Bottom Ash Pond (lined) (#19)
6. North Bottom Ash Pond (lined) (#19)
7. Bottom Ash Suction Pond (lined) (#19)
8. Settling Basins (concrete) (#17/18)
9. Settling Pond (lined) (#17/18)
10. South Recycle Pond (lined) (#17/18)
11. North Recycle Pond (lined) (#17/18)
12. Storm Water Pond
13. Coal Field
14. BB Aero Unit CT4
15. Rail Car Unloading
16. Gypsum Storage Area (#21)
17. Slag Dewatering Bins
18. Long Term Bottom Ash Area (#23)
19. Dredge Disposal Area DA-2 (#1/2)
20. Former Spray Field (#16)
21. Limestone and FGD Area (#13/14)

Notes:

1. Site boundary as provided by Tampa Electric Company.
2. * indicates background monitoring well.
3. R indicates replacement monitoring well.
4. UF indicates monitoring well screen interval located in Upper Floridan Aquifer system.
5. Prior to abandonment, MWC-19 was converted to an intermediate well and the designation changed to MWI-19.
6. Source of 2011 Aerials: Florida Department of Transportation, Surveying and Mapping Office.



Monitoring Well Network

TEC Big Bend Station
Gibsonton, FL

Geosyntec
consultants

Tampa, FL March 2018

Figure
2

Path: I:\Users\jho1\Documents\GIS\Map\TECO_BB\Bend\MXD\MAR2018\MW_Network_MAR2018.mxd, 31 Mar 2018 10:48 AM



Legend

- Existing Monitoring Well Locations
- CCR Compliance Piezometer Locations
- Surface Water Staff Gauge Locations
- Potentiometric Surface Elevation (ft NAVD)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:

1. NAVD88 indicatea North American Vertical Datum of 1988.
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.



Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - June 2016
 TEC Big Bend Station
 Gibsonton, FL

Geosyntec
 consultants

Figure
3

Tampa, FL March 2018

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Legend

- Existing Monitoring Well Locations
- Background Well Location
- CCR Monitoring Well Location
- Potentiometric Surface Elevation (ft NAVD88)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:

1. NAVD88 indicatea North American Vertical Datum of 1988.
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.



Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - August 2016
 TEC Big Bend Station
 Gibsonton, FL

Geosyntec
 consultants

Tampa, FL March 2018

Figure
4

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Legend

- Existing Monitoring Well Locations
- Background Well Location
- CCR Monitoring Well Location
- Potentiometric Surface Elevation (ft NAVD88)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:

1. NAVD88 indicatea North American Vertical Datum of 1988.
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

**Long Term
Fly Ash
Pond (Lined)**

180 90 0 180 Feet

Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - November 2016
 TEC Big Bend Station
 Gibsonton, FL

		Figure 5
Tampa, FL	March 2018	

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Legend

- Existing Monitoring Well Locations
- Background Well Location
- CCR Monitoring Well Location
- Potentiometric Surface Elevation (ft NAVD88)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:

1. NAVD88 indicatea North American Vertical Datum of 1988.
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

**Long Term
Fly Ash
Pond (Lined)**

180 90 0 180 Feet

**Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - April 2017**

TEC Big Bend Station
Gibsonston, FL

Geosyntec
consultants

Figure
6

Tampa, FL March 2018

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Legend

- Existing Monitoring Well Locations
- Background Well Location
- CCR Monitoring Well Location
- Potentiometric Surface Elevation (ft NAVD88)
- Groundwater Flow Direction
- Groundwater Elevation (ft NAVD)

Notes:

1. NAVD88 indicatea North American Vertical Datum of 1988.
2. NM indicates not measured.
3. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

**Long Term
Fly Ash
Pond (Lined)**

180 90 0 90 180 Feet

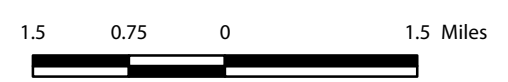
Economizer Ash and Pyrite Pond System
Surficial Aquifer Potentiometric Surface - October 2017
 TEC Big Bend Station
 Gibsonton, FL

Geosyntec
 consultants

Figure
7

Tampa, FL March 2018

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Regional Surficial Aquifer Monitoring Well Locations

TEC Big Bend Station
Gibsonton, FL





Figure

8

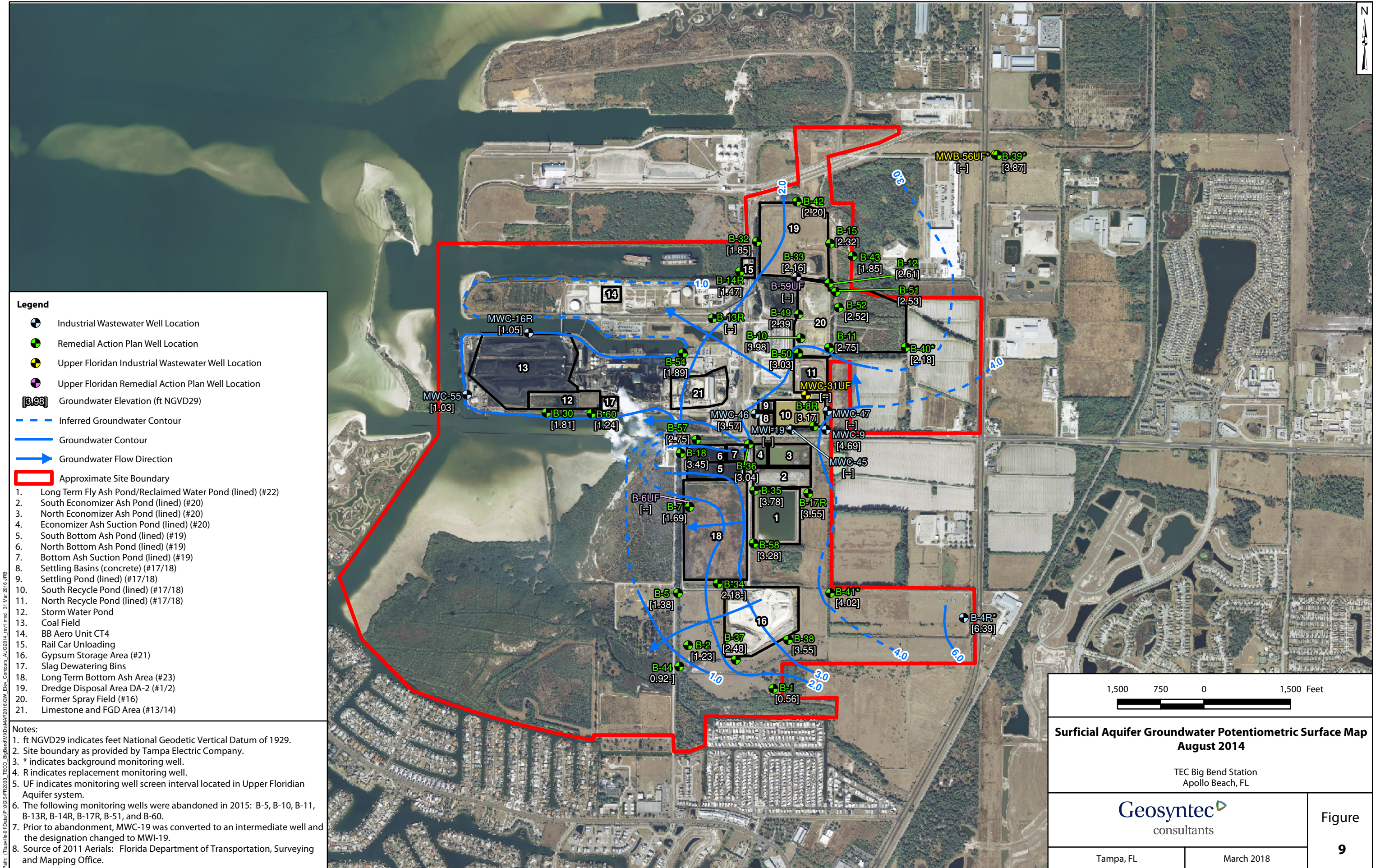
Tampa, FL

March 2018

- Legend**
-  ROMP Well Location
 -  Approximate Site Boundary

Notes:

1. ROMP locations were obtained from the Southwest Florida Water Management District (SWFWMD) Regional Observation and Monitoring Program (ROMP): <https://www.swfwmd.state.fl.us/data/hydrologic/>.
2. 2017 World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community.



- Legend**
- Industrial Wastewater Well Location
 - Remedial Action Plan Well Location
 - Upper Floridan Industrial Wastewater Well Location
 - Upper Floridan Remedial Action Plan Well Location
 - Groundwater Elevation (ft NGVD29)
 - Inferred Groundwater Contour
 - Groundwater Contour
 - Groundwater Flow Direction
 - Approximate Site Boundary

1. Long Term Fly Ash Pond/Reclaimed Water Pond (lined) (#22)
2. South Economizer Ash Pond (lined) (#20)
3. North Economizer Ash Pond (lined) (#20)
4. Economizer Ash Suction Pond (lined) (#20)
5. South Bottom Ash Pond (lined) (#19)
6. North Bottom Ash Pond (lined) (#19)
7. Bottom Ash Suction Pond (lined) (#19)
8. Settling Basins (concrete) (#17/18)
9. Settling Pond (lined) (#17/18)
10. South Recycle Pond (lined) (#17/18)
11. North Recycle Pond (lined) (#17/18)
12. Storm Water Pond
13. Coal Field
14. BB Aero Unit CT4
15. Rail Car Unloading
16. Gypsum Storage Area (#21)
17. Slag Dewatering Bins
18. Long Term Bottom Ash Area (#23)
19. Dredge Disposal Area DA-2 (#1/2)
20. Former Spray Field (#16)
21. Limestone and FGD Area (#13/14)

Notes:

1. ft NGVD29 indicates feet National Geodetic Vertical Datum of 1929.
2. Site boundary as provided by Tampa Electric Company.
3. * indicates background monitoring well.
4. R indicates replacement monitoring well.
5. UF indicates monitoring well screen interval located in Upper Floridan Aquifer system.
6. The following monitoring wells were abandoned in 2015: B-5, B-10, B-11, B-13R, B-14R, B-17R, B-51, and B-60.
7. Prior to abandonment, MWC-19 was converted to an intermediate well and the designation changed to MWI-19.
8. Source of 2011 Aerials: Florida Department of Transportation, Surveying and Mapping Office.

1,500 750 0 1,500 Feet

Surficial Aquifer Groundwater Potentiometric Surface Map
August 2014

TEC Big Bend Station
Apollo Beach, FL

Geosyntec
consultants

Tampa, FL March 2018

Figure
9

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APPENDIX A
SUMMARY OF STATISTICAL ANALYSES OF
BASELINE GROUNDWATER SAMPLES

Memorandum

Date: 15 January 2018

To: Randy Melton

Copies to: Terry Eastley
Zel Jones

From: Cathy Crea, M.Sc.
Todd Kafka, PG

Subject: Summary of Statistical Analyses of Baseline Groundwater Samples
Economizer Ash and Pyrite Pond System
Tampa Electric Company - Big Bend Station
13031 Wyandotte Road
Gibsonton, FL 33572

On April 17, 2015, the United States Environmental Protection Agency (USEPA) published 40 Code of Federal Regulations (CFR) Parts 257 and 261: Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule (USEPA, 2015). This regulation addresses the safe disposal of coal combustion residuals (CCR) as solid waste under Subtitle D of the Resource Conservation and Recovery Act (RCRA) and is referred to herein as the CCR Rule. The CCR Rule became effective on October 14, 2015. The rule provides national minimum criteria for “the safe disposal of CCR in new and existing CCR landfills, surface impoundments, and lateral expansions, design and operating criteria, groundwater monitoring and corrective action, closure requirements and post closure care, and recordkeeping, notification, and internet posting requirements.” The groundwater monitoring requirements of the CCR Rule apply to the economizer ash and pyrite pond system (EAPPS) at Tampa Electric Company’s (TEC) Big Bend Power Station (BBS) in southeast Hillsborough County in Gibsonton, Florida.

Geosyntec Consultants (Geosyntec) has prepared this technical memorandum to summarize the statistical analyses performed on the baseline groundwater samples collected from the groundwater monitoring system (GMS) established at the EAPPS. These activities have been undertaken by TEC to comply with the requirements set forth in 40 CFR 257.50 “Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments” pertaining to the EAPPS. TEC installed

a groundwater monitoring system at the EAPPs that complies with 40 CFR 257.91 and performed baseline groundwater sampling events in accordance with 40 CFR 257.93. Geosyntec's statistical analyses were performed in accordance with the *Statistical Analysis Plan* dated 15 October 2017.

BACKGROUND

The groundwater monitoring system (GMS) was installed at the EAPPs in May 2016 and consists to two background monitoring wells, BBS-CCR-BW1 and BBS-CCR-BW2, and three downgradient monitoring wells, BBS-CCR-1, BBS-CCR-2, and BBS-CCR-3. TEC conducted eleven baseline groundwater sampling events from the GMS between June 2016 and October 2017 and analyzed the samples for Appendix III and Appendix IV constituents as required in 40 CFR 257.93. The inorganic data were reviewed based on the following: *CCR Groundwater Monitoring Program Plan*, Big Bend Power Station, Apollo Beach, Florida, September 2016, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, August 2014 (OSWER 9355.0-131, EPA 540-R-013-001), as well as by the pertinent methods referenced by the data package and professional and technical judgment.

Geosyntec prepared a *Statistical Analysis Plan* to provide details on the selection of statistical methods in accordance with the provisions set forth in 40 CFR 257.93 "Groundwater sampling and analysis requirements." These statistical methods were used to establish background conditions and to evaluate groundwater monitoring data collected during detection monitoring (40 CFR 257.94) to evaluate if the CCR units at the BBS are adversely impacting groundwater quality.

METHODOLOGY AND APPROACH

The statistical approach used to evaluate groundwater monitoring data was selected from a suite of methods provided in 40 CFR 257.93(f) (1 through 5) and performed in accordance with a set of performance standards provided in 40 CFR 257.93(g), when applicable.

The approach included the following steps for each Appendix III constituent:

1. Graphical display of data and assessment of equal variance;
2. Evaluate trends and seasonality in the background dataset for each constituent.
3. Identify potential outliers;
4. Evaluate the population distribution of the background dataset for each constituent;
5. Calculate the frequency of non-detects (NDs), and summary statistics (e.g., minimum, maximum, and mean) of the background dataset for each constituent;

6. Calculate appropriate upper limits (95%-95% upper tolerance limit [UTL] and a 95% upper prediction limit [UPL]); and
7. Compare upper limits to the most recent concentrations in the compliance (or downgradient) wells to determine if a statistically significant increase (SSI) above background has occurred.

Assumptions:

- The laboratory reporting limit was substituted for non-detects in all datasets.
- The laboratory reported value for estimated (J-flagged) concentrations were retained in all datasets.
- When a duplicate sample was collected at a background monitoring well, only the higher of the primary and duplicate sample concentrations were included in the aggregated dataset.

BACKGROUND GROUNDWATER QUALITY STATISTICS

The results of the Appendix III constituents (e.g., boron, calcium, chloride, fluoride, pH, sulfate, and total dissolved solids) detected in groundwater samples from the two background monitoring wells were used to establish background concentrations for these constituents (**Table 1**). Based on professional judgment, the sulfate concentration of 41.7 milligrams per liter (mg/L) detected in BBS-CCR-BW2 on 7/20/17 was deemed an analytical error and was removed from the dataset.

Potential outliers:

- A sulfate concentration of 217 mg/L at BBS-CCR-BW1 was identified as a potential low concentration outlier but was retained in the dataset.
- The TDS concentration of 5,050 mg/L at BBS-CCR-BW1 was identified as a potential high concentration outlier but was retained in the dataset.

Increasing trends:

- An increasing pH trend is statistically present at BBS-CCR-BW2 based on the non-parametric Mann Kendall analysis.

Each of the Appendix III constituents exhibited a non-parametric distribution among the two background wells. The two background wells did show spatial variability for all the Appendix III constituents. An intra-well comparison is often used in these circumstances; however, this approach is not appropriate for the EAPPS since there is no groundwater data representative of pre-operational conditions (e.g., prior to

EAPPS) and therefore no information if the background wells may have already been impacted prior to their construction. Consequently, the data from the two background monitoring wells were aggregated for each constituent to create a single pooled background dataset, consisting of 22 observations (11 events x 2 monitoring wells). Two non-parametric upper limits were calculated for each constituent: a 95%-95% upper tolerance limit (UTL) and a 95% upper prediction limit (UPL), both of which result in the maximum detected concentration among both background wells. However, the 95%-95% UTL could not achieve a confidence level above 67%, but the UPL did achieve 95% confidence. As such, the 95% UPL was used to evaluate SSI for each constituent.

DETECTION MONITORING

Groundwater samples were collected from the GMS in October 2017 to serve as the first detection monitoring event. The comparison of the detection monitoring results to the background values for the Appendix III constituents is shown in **Table 2**. A statistically significant increase (SSI) over background was observed for pH in two compliance monitoring wells (BBS-CCR-1 and BBS-CCR-2).

CONCLUSIONS

As specified in 40 CFR 257.94(3) (e), TEC will either provide (i) a demonstration that the SSI is due to sampling or analysis error, another source, or natural variability or (ii) commence with assessment monitoring within 90 days of this SSI (e.g., by 15 April 2018). The pH values of 6.83 and 6.87 identified as SSIs are within the natural range of groundwater at BBS based on historical values which have been measured across BBS. In the absence of SSIs for other Appendix III constituents, the SSIs for pH do not appear to be attributable to a release from the EAPPS, but are instead attributable to natural variability. Therefore, TEC will continue with detection monitoring as applicable for the EAPPS.

* * * * *

TABLE 1 - BACKGROUND STATISTICS, TEC BIG BEND STATION ECONOMIZER ASH AND PYRITE POND SYSTEM, APOLLO BEACH, FL

Parameter	Units	Number of Samples	Number of NDs	Percent NDs	Minimum Result	Average Result	Maximum Result	Potential Outlier?	Trend?	Background Concentration		
										Distribution	95% UPL ²	Comment
Boron	mg/L	22	0	0	3.27	27.32	59.1	None	No	NP	59.1	Confidence for UTL = 67.6%
Calcium	mg/L	22	0	0	237	499	781	None	No	NP	781	Confidence for UTL = 67.6%
Chloride	mg/L	22	0	0	84.9	543.8	1140	None	No	NP	1140	Confidence for UTL = 67.6%
Fluoride	mg/L	22	1	5	<0.01	0.332	0.559	None	No	NP	0.559	Confidence for UTL = 67.6%
pH (field)	STD	22	0	0	6.38	6.55	6.70	None	Yes (BBS-CCR-BW2)	NP	(6.38, 6.70)	Confidence for UTL = 30.18%
Sulfate	mg/L	21 ¹	0	0	217	876	1550	217 (BBS-CCR-BW1)	No	NP	1547	Confidence for UTL = 65.9%
Total Dissolved Solids	mg/L	22	0	0	966	2709	5050	5050 (BBS-CCR-BW1)	No	NP	5050	Confidence for UTL = 67.6%

Notes:

< - concentration not detected at or above the adjusted reporting limit

mg/L - milligrams per litre

ND - non-detect

NP - non-parametric

STD - standard units

UTL - upper tolerance limit

UPL - upper prediction limit

1 - A concentration of 41.7 mg/L detected at BBS-CCR-BW2 on 7/20/17 was removed from the data set as a laboratory error based on professional judgment.

2 - The 95% UPL was calculated based on either a normal, lognormal, or Gamma distribution. If data did not follow a discernible distribution, then a non-parametric 95% UPL was calculated. A two-sided prediction interval was calculated for pH.

TABLE 2 - DETECTION MONITORING RESULTS, TEC BIG BEND STATION ECONOMIZER ASH AND PYRITE POND SYSTEM, APOLLO BEACH, FL

Analytical Parameter		Boron, total	Calcium, total	Chloride, total	Fluoride, total	pH (field)	Sulfate, total	Total Dissolved Solids
Units		mg/L	mg/L	mg/L	mg/L	STD	mg/L	mg/L
Background Concentration Value		59.1	781	1140	0.559	(6.38, 6.70)	1550	5050
Well ID	Sample Collection Date	October 2017 Detection Monitoring Results						
BBS-CCR-1	10/13/2017	19.9	596	716	0.201	6.83	1230	3470
BBS-CCR-2	10/13/2017	0.888	169	70.9	0.182	6.87	432	1030
BBS-CCR-3	10/13/2017	0.373	190	153	0.333	6.44	503	1310

Notes:

- Bold, highlighted text indicates statistically significant increase above background concentration values.

< - concentration not detected at or above the adjusted reporting limit.

mg/L - milligrams per liter

STD - standard units

APPENDIX B
EPA530-R-93-017 SUBPART E SECTION 5.10

Individual Well Comparisons

When only two wells (e.g., a single background and a single compliance point well) are being compared, owners or operators should not perform the parametric or nonparametric ANOVA. Instead, a parametric t-test, such as Cochran's Approximation to the Behrens-Fisher Students' t-test, or a nonparametric test should be performed. When a single compliance well group is being compared to background data and a nonparametric test is needed, the Wilcoxin Rank-Sum test should be performed. These tests are discussed in more detail in standard statistical references and in USEPA (1992b).

Intra-Well Comparisons

Intra-well comparisons, where data of one well are evaluated over time, are useful in evaluating trends in individual wells and for identifying seasonal effects in the data. The intra-well comparison methods do not compare background data to compliance data. Where some existing facilities may not have valid background data, however, intra-well comparisons may represent the only valid comparison available. In the absence of a true background well, several monitoring events may be required to determine trends and seasonal fluctuations in ground-water quality.

Control charts may be used for intra-well comparisons but are only appropriate for uncontaminated wells. If a well is intercepting a release, then it is already in an "out-of-control" state, which violates the principal assumption underlying control chart procedures. Time series analysis (i.e., plotting concentrations over time) is extremely useful for identifying trends in

monitoring data. Such data may be adjusted for seasonal effects to aid in assessing the degree of change over time. Guidance for and limitations of intra-well comparison techniques are provided in USEPA (1989) and USEPA (1992b).

Treatment of Non-Detects

The treatment of data below the detection limit of the analytical method (non-detects) used depends on the number or percentage of non-detects and the statistical method employed. Guidance on how to treat non-detects is provided in USEPA (1992b).

5.10 DETECTION MONITORING PROGRAM 40 CFR §258.54

5.10.1 Statement of Regulation

(a) Detection monitoring is required at MSWLF units at all ground-water monitoring wells defined under §§258.51(a)(1) and (a)(2) of this part. At a minimum, a detection monitoring program must include the monitoring for the constituents listed in Appendix I of this part.

- 1) The Director of an approved State may delete any of the Appendix I monitoring parameters for a MSWLF unit if it can be shown that the removed constituents are not reasonably expected to be in or derived from the waste contained in the unit.**
- 2) The Director of an approved State may establish an alternative list of inorganic indicator parameters for a MSWLF unit, in lieu of some or all of**

the heavy metals (constituents 1-15 in Appendix I), if the alternative parameters provide a reliable indication of inorganic releases from the MSWLF unit to the ground water. In determining alternative parameters, the Director shall consider the following factors:

- (i) The types, quantities, and concentrations of constituents in wastes managed at the MSWLF unit;
- (ii) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the MSWLF unit;
- (iii) The detectability of indicator parameters, waste constituents, and reaction products in the ground water; and
- (iv) The concentration or values and coefficients of variation of monitoring parameters or constituents in the background ground-water.

(b) The monitoring frequency for all constituents listed in Appendix I, or the alternative list approved in accordance with paragraph (a)(2), shall be at least semiannual during the active life of the facility (including closure) and the post-closure period. A minimum of four independent samples from each well (background and downgradient) must be collected and analyzed for the Appendix I constituents, or the alternative list approved in accordance with paragraph (a)(2), during the first semiannual sampling event. At least one sample from each well(background and downgradient)

must be collected and analyzed during subsequent semiannual sampling events. The Director of an approved State may specify an appropriate alternative frequency for repeated sampling and analysis for Appendix I constituents, or the alternative list approved in accordance with paragraph (a)(2), during the active life (including closure) and the post-closure care period. The alternative frequency during the active life (including closure) shall be no less than annual. The alternative frequency shall be based on consideration of the following factors:

- 1) Lithology of the aquifer and unsaturated zone;
- 2) Hydraulic conductivity of the aquifer and unsaturated zone;
- 3) Ground-water flow rates;
- 4) Minimum distance between upgradient edge of the MSWLF unit and downgradient monitoring well screen (minimum distance of travel); and
- 5) Resource value of the aquifer.

(c) If the owner or operator determines, pursuant to §258.53(g) of this part, that there is a statistically significant increase over background for one or more of the constituents listed in Appendix I or the alternative list approved in accordance with paragraph (a)(2), at any monitoring well at the boundary specified under §258.51(a)(2), the owner or operator:

- (1) Must, within 14 days of this finding, place a notice in the operating record indicating which constituents have shown statistically significant changes from

background levels, and notify the State Director that this notice was placed in the operating record; and

(2) Must establish an assessment monitoring program meeting the requirements of §258.55 of this part within 90 days, except as provided for in paragraph (3) below.

(3) The owner/operator may demonstrate that a source other than a MSWLF unit caused the contamination or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in ground-water quality. A report documenting this demonstration must be certified by a qualified ground-water scientist or approved by the Director of an approved State and be placed in the operating record. If a successful demonstration is made and documented, the owner or operator may continue detection monitoring as specified in this section. If after 90 days, a successful demonstration is not made, the owner or operator must initiate an assessment monitoring program as required in §258.55.

5.10.2 Applicability

Except for the small landfill exemption and the no migration demonstration, detection monitoring is required at existing MSWLF units, lateral expansions of units, and new MSWLF units. Monitoring must occur at least semiannually at both background wells and downgradient well locations. The Director of an approved State may specify an alternative sampling frequency. Monitoring parameters must include all Appendix I constituents unless an alternative

list has been established by the Director of an approved State.

During the first semiannual monitoring event, the owner or operator must collect at least four independent ground-water samples from each well and analyze the samples for all constituents in the Appendix I or alternative list. Each subsequent semiannual event must include, at a minimum, the collection and analysis of one sample from all wells. The monitoring requirement continues throughout the active life of the landfill and the post-closure care period.

If an owner or operator determines that a statistically significant increase over background has occurred for one or more Appendix I constituents (or constituents on an alternative list), a notice must be placed in the facility operating record (see Table 5-2). The owner or operator must notify the State Director within 14 days of the finding. Within 90 days, the owner or operator must establish an assessment monitoring program conforming to the requirements of §258.55.

If evidence exists that a statistically significant increase is due to factors unrelated to the unit, the owner or operator may make a demonstration to this effect to the Director of an approved State or place a certified demonstration in the operating record. The potential reasons for an apparent statistical increase may include:

- A contaminant source other than the landfill unit
- A natural variation in ground-water quality
- An analytical error

- A statistical error
- A sampling error.

The demonstration that one of these reasons is responsible for the statistically significant increase over background must be certified by a qualified ground-water scientist or approved by the Director of an approved State. If a successful demonstration is made and documented, the owner or operator may continue detection monitoring.

If a successful demonstration is not made within 90 days, the owner or operator must initiate an assessment monitoring program. A flow chart for a detection monitoring program in a State whose program has not been approved by EPA is provided in Figure 5-5.

5.10.3 Technical Considerations

If there is a statistically significant increase over background during detection monitoring for one or more constituents listed in Appendix I of Part 258 (or an alternative list of parameters in an approved State), the owner or operator is required to begin assessment monitoring. The requirement to conduct assessment monitoring will not change, even if the Director of an approved State allows the monitoring of geochemical parameters in lieu of some or all of the metals listed in Appendix I. If an owner or operator suspects that a statistically significant increase in a geochemical parameter is caused by natural variation in ground-water quality or a source other than a MSWLF unit, a demonstration to this effect must be documented in a report to avoid proceeding to assessment monitoring.

Independent Sampling for Background

The ground-water monitoring requirements specify that four independent samples be collected from each well to establish background during the first semiannual monitoring event. This is because almost all statistical procedures are based on the assumption that samples are independent of each other. In other words, independent samples more accurately reflect the true range of natural variability in the ground water, and statistical analyses based on independent samples are more accurate. Replicate samples, whether field replicates or lab splits, are not statistically independent measurements.

It may be necessary to gather the independent samples over a range of time sufficient to account for seasonal differences. If seasonal differences are not taken into account, the chance for false positives increases (monitoring results indicate a release, when a release has not occurred). The sampling interval chosen must ensure that sampling is being done on different volumes of ground water. To determine the appropriate interval between sample collection events that will ensure independence, the owner or operator can determine the site's effective porosity, hydraulic conductivity, and hydraulic gradient and use this information to calculate ground-water velocity (USEPA, 1989). Knowing the velocity of the ground water should enable an owner/operator to establish an interval that ensures the four samples are being collected from four different volumes of water. For additional information on establishing sampling interval, see *Statistical Analysis of Groundwater Monitoring Data at RCRA*

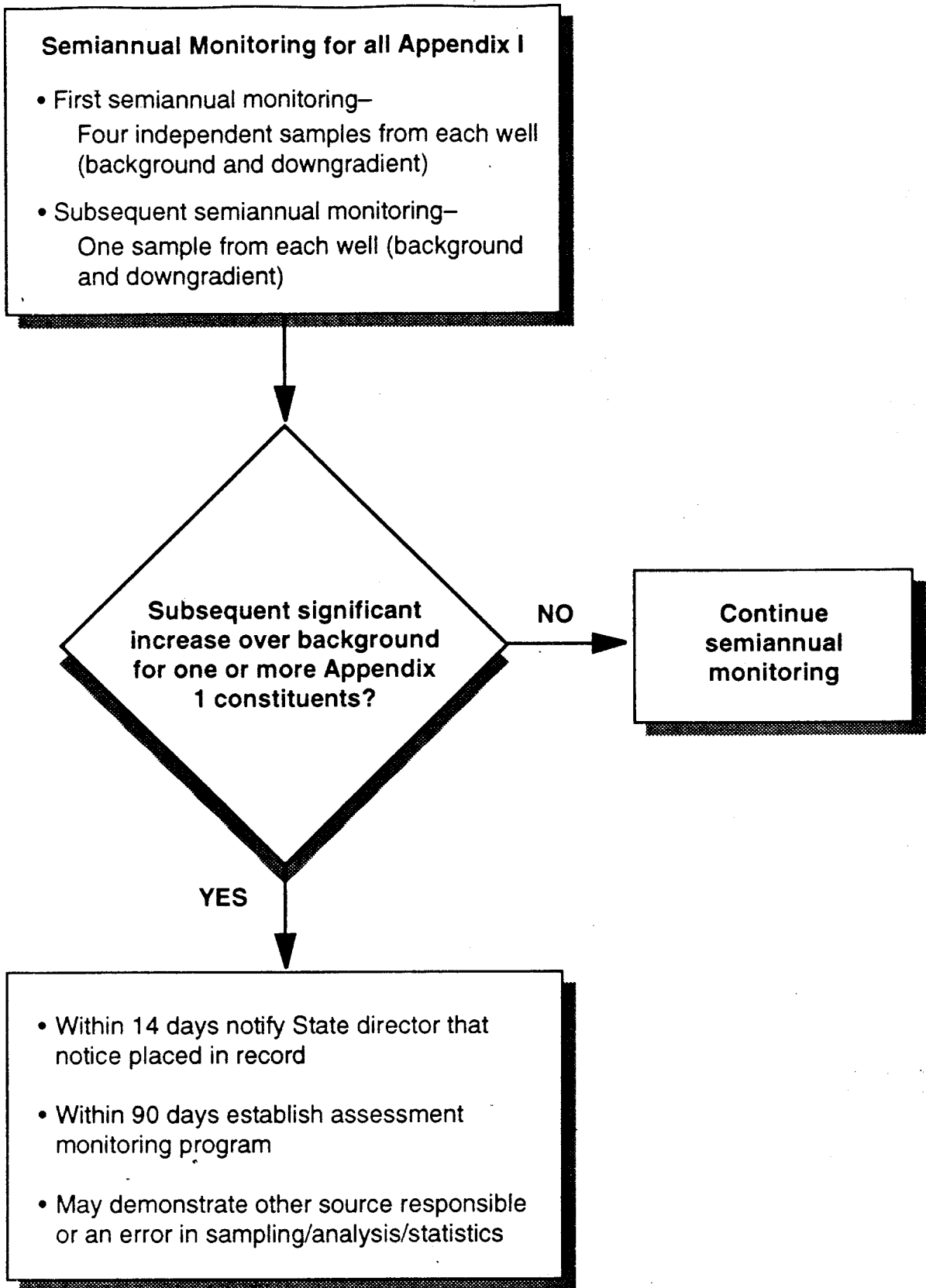


Figure 5-5. Detection Monitoring Program

Facilities - Interim Final Guidance, (USEPA, 1989).

Alternative List/Removal of Parameters

An alternative list of Appendix I constituents may be allowed by the Director of an approved State. The alternative list may use geochemical parameters, such as pH and specific conductance, in place of some or all of the metals (Parameters 1 through 15) in Appendix I. These alternative parameters must provide a reliable indication of inorganic releases from the MSWLF unit to ground water. The option of establishing an alternative list applies only to Parameters 1 through 15 of Appendix I. The list of ground-water monitoring parameters must include all of the volatile organic compounds (Appendix I, Parameters 16 through 62).

A potential problem in substituting geochemical parameters for metals on the alternative list is that many of the geochemical parameters are naturally occurring. However, these parameters have been used to indicate releases from MSWLF units. Using alternative geochemical parameters is reasonable in cases where natural background levels are not high enough to mask the detection of a release from a MSWLF unit. The decision to use alternative parameters also should consider natural spatial and temporal variability in the geochemical parameters.

The types, quantities, and concentrations of wastes managed at the MSWLF unit play an important role in determining whether removal of parameters from Appendix I is appropriate. If an owner or operator has definite knowledge of the nature of wastes accepted at the facility, then removal of

constituents from Appendix I may be acceptable. Usually, a waste would have to be homogeneous to allow for this kind of determination. The owner or operator may submit a demonstration that documents the presence or absence of certain constituents in the waste. The owner or operator also would have to demonstrate that constituents proposed for deletion from Appendix I are not degradation or reaction products of constituents potentially present in the waste.

Alternative Frequency

In approved States, 40 CFR §258.54(b) allows the Director to specify an alternative frequency for ground-water monitoring. The alternative frequency is applicable during the active life, including the closure and the post-closure periods. The alternative frequency can be no less than annual.

The need to vary monitoring frequency must be evaluated on a site-specific basis. For example, for MSWLF units located in areas with low ground-water flow rates, it may be acceptable to monitor ground water less frequently. The sampling frequency chosen must be sufficient to protect human health and the environment. Depending on the ground-water flow rate and the resource value of the aquifer, less frequent monitoring may be allowable or more frequent monitoring may be necessary. An approved State may specify an alternative frequency for repeated sampling and analysis of Appendix I constituents based on the following factors:

- 1) Lithology of the aquifer and the unsaturated zone

- 2) Hydraulic conductivity of the aquifer and the unsaturated zone
- 3) Ground-water flow rates
- 4) Minimum distance between the upgradient edge of the MSWLF unit and the downgradient well screen
- 5) The resource value of the aquifer.

Approved States also can set alternative frequencies for monitoring during the post-closure care period based on the same factors.

Notification

The notification requirement under 40 CFR §258.54(c) requires an owner or operator to 1) place a notice in the operating record that indicates which constituents have shown statistically significant increases and 2) notify the State Director that the notice was placed in the operating record. The constituents can be from either Appendix I or from an alternative list.

Demonstrations of Other Reasons For Statistical Increase

An owner or operator is allowed 90 days to demonstrate that the statistically significant increase of a contaminant/constituent was caused by statistical, sampling, or analytical errors or by a source other than the landfill unit. The demonstration allowed in §258.54(c)(3) may include:

- 1) A demonstration that the increase resulted from another contaminant source

- 2) A comprehensive audit of sampling, laboratory, and data evaluation procedures
- 3) Resampling and analysis to verify the presence and concentration of the constituents for which the increase was reported.

A demonstration that the increase in constituent concentration is the result of a source other than the MSWLF unit should document that:

- An alternative source exists.
- Hydraulic connection exists between the alternative source and the well with the significant increase.
- Constituent(s) (or precursor constituents) are present at the alternative source or along the flow path from the alternative source prior to possible release from the MSWLF unit.
- The relative concentration and distribution of constituents in the zone of contamination are more strongly linked to the alternative source than to the MSWLF unit when the fate and transport characteristics of the constituents are considered.
- The concentration observed in ground water could not have resulted from the MSWLF unit given the waste constituents and concentrations in the MSWLF unit leachate and wastes, and site hydrogeologic conditions.
- The data supporting conclusions regarding the alternative source are historically consistent with hydrogeologic

conditions and findings of the monitoring program.

The demonstration must be documented, certified by a qualified ground-water scientist, and placed in the operating record of the facility.

Demonstrations of Other Sources of Error

A successful demonstration that the statistically significant change is the result of an error in sampling, analysis, or data evaluation may include the following:

- Clear indication of a transcription or calculation error
- Clear indication of a systematic error in analysis or data reduction
- Resampling, analysis, and evaluation of results
- Corrective measures to prevent the recurrence of the error and incorporation of these measures into the ground-water monitoring program.

If resampling is necessary, the sample(s) taken must be independent of the previous sample. More than one sample may be required to substantiate the contention that the original sample was not representative of the ground-water quality in the affected well(s).

5.11 ASSESSMENT MONITORING PROGRAM

40 CFR §258.55(a)-(f)

5.11.1 Statement of Regulation

(a) Assessment monitoring is required whenever a statistically significant increase over background has been detected for one or more of the constituents listed in Appendix I or in the alternate list approved in accordance with § 258.54(a)(2).

(b) Within 90 days of triggering an assessment monitoring program, and annually thereafter, the owner or operator must sample and analyze the ground water for all constituents identified in Appendix II of this part. A minimum of one sample from each downgradient well must be collected and analyzed during each sampling event. For any new constituent detected in the downgradient wells as a result of the complete Appendix II analysis, a minimum of four independent samples from each well (background and downgradient) must be collected and analyzed to establish background for the new constituents. The Director of an approved State may specify an appropriate subset of wells to be sampled and analyzed for Appendix II constituents during assessment monitoring. The Director of an approved State may delete any of the Appendix II monitoring parameters for a MSWLF unit if it can be shown that the removed constituents are not reasonably expected to be contained in or derived from the waste contained in the unit.

APPENDIX C

**GROUNDWATER SAMPLING AND
CALIBRATION FORMS - OCTOBER 13, 2017**

DEP-SOP-001/01
FS 2200 Groundwater Sampling
Form FD 9000-24
GROUNDWATER SAMPLING LOG

FACILITY NAME: Big Bend	SITE LOCATION: Apollo Beach, FL.
WELL NO: BBS-CCR-1	SAMPLE ID: L17J115-01 A DATE: 10/13/17

PURGING DATA

WELL DIAMETER (inches)	TUBING DIAMETER (inches) 1/4	WELL SCREEN INTERVAL (NGVD) DEPTH 12.32 feet to 22.32 (feet)	STATIC DEPTH TO WATER (feet): 7.32	PURGE PUMP TYPE OR BAILER: PP							
WELL VOLUME PURGE: (only fillout if applicable) $1 \text{ WELL VOLUME} = (\text{TOTAL WELL DEPTH} - \text{STATIC DEPTH TO WATER}) \times \text{WELL CAPACITY}$ = (feet - feet) x gallons/foot = gallons											
EQUIPMENT VOLUME PURGE: (only fillout if applicable) $1 \text{ EQUIPMENT VOL.} = \text{PUMP VOLUME} + (\text{TUBING CAPACITY} \times \text{TUBING LENGTH}) + \text{FLOW CELL VOLUME}$ = (0 gallons + (0.0026 gallons/foot x 23.3 feet) + 0.06 gallons = 0.12 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 17.32	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 17.32	PURGING INITIATED AT: 11:17	PURGING ENDED AT: 11:32	TOTAL VOLUME PURGED (gallons): 1.51							
TIME	VOLUME PURGED (GALLONS)	CUMUL. VOLUME PURGED (GALLONS)	PURGE RATE (GPM)	DEPTH TO WATER (FEET)	pH (standard units)	TEMP. (°C)	COND. (µmhos/cm OR µS/cm)	DISSOLVED OXYGEN (circle mg/l or % saturation)	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)
11:28	1.10	1.10	0.10	7.41	6.83	26.47	4268	0.20	1.86	Clear	None
11:30	0.21	1.31	0.11	7.40	6.83	26.53	4261	0.24	0.97	Clear	None
11:32	0.20	1.51	0.10	7.41	6.83	26.57	4258	0.24	0.89	Clear	None
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88											
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.00006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: RAB TECO				SAMPLER (S) SIGNATURES:				SAMPLING INITIATED AT: 11:32		SAMPLING ENDED AT: 11:50	
PUMP OR TUBING DEPTH IN WELL (feet): 17.3				SAMPLE PUMP FLOW RATE (mL per minute): 383				TUBING MATERIAL CODE: PE/S			
FIELD DECONTAMINATION: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>				FIELD-FILTERED: Y <input type="checkbox"/> N <input checked="" type="checkbox"/> FILTER SIZE: µm				DUPLICATE: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION				INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL. ADDED IN FIELD (ml) (1)	FINAL pH					
@Ino-500	1	PE	500ml	NONE	NONE	N/A	Inorganics		PP		
@Met-250	2	PE	250ml	HNO3	1ml	<2	Metals		PP		
@Rad-1L	2	PE	1L	HNO3	5ml	<2	Radiologicals		PP		

REMARKS:
 (1) Sample bottles pre-preserved at laboratory prior to sample collection.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)
 SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

NOTES: 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
 2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
 pH: ± 0.2 units Temperature: ± 0.2 °C Specific Conductance: ± 5% Dissolved Oxygen: all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) Turbidity: all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

DEP-SOP-001/01
FS 2200 Groundwater Sampling
Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: Big Bend	SITE LOCATION: Apollo Beach, FL.
WELL NO: BBS-CCR-2	SAMPLE ID: L17J115-02 A DATE: 10/13/17

PURGING DATA

WELL DIAMETER (inches)	TUBING DIAMETER (inches) 1/4	WELL SCREEN INTERVAL DEPTH 11.84 feet to 21.84 (feet)	STATIC DEPTH TO WATER (feet): 6.88	PURGE PUMP TYPE OR BAILER: PP							
WELL VOLUME PURGE: (only fillout if applicable) 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY = (feet - feet) x gallons/foot = gallons											
EQUIPMENT VOLUME PURGE: (only fillout if applicable) 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME = (0 gallons + (0.0026 gallons/foot X 22.84 feet) + 0.06 gallons = 0.12 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 16.84	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 16.84	PURGING INITIATED AT: 10:48	PURGING ENDED AT: 11:00	TOTAL VOLUME PURGED (gallons): 1.20							
TIME	VOLUME PURGED (GALLONS)	CUMUL. VOLUME PURGED (GALLONS)	PURGE RATE (GPM)	DEPTH TO WATER (FEET)	pH (standard units)	TEMP. (°C)	COND. (µmhos/cm OR µS/cm)	DISSOLVED OXYGEN (circle mg/l or % saturation)	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)
10:56	0.80	0.80	0.10	6.94	6.87	26.44	1348	0.19	3.18	Lt. Yellow	None
10:58	0.20	1.00	0.10	6.94	6.86	26.45	1350	0.16	2.80	Lt. Yellow	None
11:00	0.20	1.20	0.10	6.95	6.87	26.46	1350	0.20	3.03	Lt. Yellow	None
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.00006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: RAB TECO				SAMPLER (S) SIGNATURES:				SAMPLING INITIATED AT: 11:00		SAMPLING ENDED AT: 11:10	
PUMP OR TUBING DEPTH IN WELL (feet): 16.8				SAMPLE PUMP FLOW RATE (mL per minute): 380				TUBING MATERIAL CODE: PE/S			
FIELD DECONTAMINATION: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>				FIELD-FILTERED: Y <input type="checkbox"/> N <input checked="" type="checkbox"/> FILTER SIZE: µm				DUPLICATE: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION			INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE		
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL. ADDED IN FIELD (ml) (1)	FINAL pH					
@Ino-500	1	PE	500ml	NONE	NONE	N/A	Inorganics		PP		
@Met-250	2	PE	250ml	HNO3	1ml	<2	Metals		PP		
@Rad-1L	2	PE	1L	HNO3	5ml	<2	Radiologicals		PP		

REMARKS:
 (1) Sample bottles pre-preserved at laboratory prior to sample collection.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPF = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

NOTES:
 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
 2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

DEP-SOP-001/01
FS 2200 Groundwater Sampling
Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: Big Bend	SITE LOCATION: Apollo Beach, FL.
WELL NO: BBS-CCR-3	SAMPLE ID: L17J115-03 A
DATE: 10/13/17	

PURGING DATA

WELL DIAMETER (inches)	TUBING DIAMETER (inches) 1/4	WELL SCREEN INTERVAL DEPTH 13.23 feet to 23.23 (feet)	STATIC DEPTH TO WATER (feet): 6.52	PURGE PUMP TYPE OR BAILER: PP							
WELL VOLUME PURGE: (only fillout if applicable)											
$1 \text{ WELL VOLUME} = (\text{TOTAL WELL DEPTH} - \text{STATIC DEPTH TO WATER}) \times \text{WELL CAPACITY}$ = (feet - feet) x gallons/foot = gallons											
EQUIPMENT VOLUME PURGE: (only fillout if applicable)											
$1 \text{ EQUIPMENT VOL.} = \text{PUMP VOLUME} + (\text{TUBING CAPACITY} \times \text{TUBING LENGTH}) + \text{FLOW CELL VOLUME}$ = (0 gallons + (0.0026 gallons/foot X 24.23 feet) + 0.06 gallons = 0.12 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 18.23	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 18.23		PURGING INITIATED AT: 10:13	PURGING ENDED AT: 10:26							
TOTAL VOLUME PURGED (gallons): 0.63											
TIME	VOLUME PURGED (GALLONS)	CUMUL. VOLUME PURGED (GALLONS)	PURGE RATE (GPM)	DEPTH TO WATER (FEET)	pH (standard units)	TEMP. (°C)	COND. (µmhos/cm OR µS/cm)	DISSOLVED OXYGEN (circle mg/L or % saturation)	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)
10:22	0.43	0.43	0.05	6.72	6.47	27.31	1785	0.36	1.59	Yellow	Mild
10:24	0.10	0.53	0.05	6.72	6.45	27.20	1763	0.50	1.13	Yellow	Mild
10:26	0.10	0.63	0.05	6.71	6.44	27.18	1747	0.37	2.39	Yellow	Mild
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88											
TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.00006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: RAB TECO				SAMPLER (S) SIGNATURES:				SAMPLING INITIATED AT: 10:26		SAMPLING ENDED AT: 10:42	
PUMP OR TUBING DEPTH IN WELL (feet): 18.2				SAMPLE PUMP FLOW RATE (mL per minute): 187				TUBING MATERIAL CODE: PE/S			
FIELD DECONTAMINATION: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>				FIELD-FILTERED: Filtration Equipment Type: Y <input type="checkbox"/> N <input checked="" type="checkbox"/> FILTER SIZE: µm				DUPLICATE: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION				INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL. ADDED IN FIELD (ml) (1)	FINAL pH					
@Ino-500	1	PE	500ml	NONE	NONE	N/A	Inorganics		PP		
@Met-250	2	PE	250ml	HNO3	1ml	<2	Metals		PP		
@Rad-1L	2	PE	1L	HNO3	5ml	<2	Radiologicals		PP		

REMARKS: **(1) Sample bottles pre-preserved at laboratory prior to sample collection.**

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)

SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailer; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

NOTES:

1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.

2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)

pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

DEP-SOP-001/01
FS 2200 Groundwater Sampling
Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: Big Bend	SITE LOCATION: Apollo Beach, FL.
WELL NO: BBS-CCR-BW-1	SAMPLE ID: L17J115-04 A DATE: 10/13/17

PURGING DATA

WELL DIAMETER (inches)	TUBING DIAMETER (inches) 1/4	WELL SCREEN INTERVAL DEPTH 34.30 (feet) to 44.30 (feet)	STATIC DEPTH TO WATER (feet): 29.60	PURGE PUMP TYPE OR BAILER: ESP							
WELL VOLUME PURGE: (only fillout if applicable) 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY = (feet - feet) x gallons/foot = gallons											
EQUIPMENT VOLUME PURGE: (only fillout if applicable) 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME = (0 gallons + (0.0026 gallons/foot X 100 feet) + 0.06 gallons = 0.32 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 39.30	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 39.30	PURGING INITIATED AT: 9:49	PURGING ENDED AT: 10:01	TOTAL VOLUME PURGED (gallons): 8.23							
TIME	VOLUME PURGED (GALLONS)	COMPL. VOLUME PURGED (GALLONS)	PURGE RATE (GPM)	DEPTH TO WATER (FEET)	pH (standard units)	TEMP. (°C)	COND. (µmhos/cm OR µS/cm)	DISSOLVED OXYGEN (circle (mg/l) or % saturation)	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)
9:57	5.49	5.49	0.69	30.43	6.55	27.81	4384	0.87	7.30	Clear	None
9:59	1.37	6.86	0.69	30.42	6.55	27.81	4499	0.57	4.40	Clear	None
10:01	1.37	8.23	0.69	30.41	6.55	27.86	4570	0.40	2.51	Clear	None
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.00006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: RAB TECO				SAMPLER (S) SIGNATURES:				SAMPLING INITIATED AT: 10:01		SAMPLING ENDED AT: 10:04	
PUMP OR TUBING DEPTH IN WELL (feet): 39.3				SAMPLE PUMP FLOW RATE (mL per minute): 2600				TUBING MATERIAL CODE: PE			
FIELD DECONTAMINATION: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>				FIELD-FILTERED: Y <input type="checkbox"/> N <input checked="" type="checkbox"/> FILTER SIZE: µm				DUPLICATE: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION				INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL. ADDED IN FIELD (ml) (1)	FINAL pH					
@Ino-500	1	PE	500ml	NONE	NONE	N/A	Inorganics		ESP		
@Met-250	2	PE	250ml	HNO3	1ml	<2	Metals		ESP		
@Rad-1L	2	PE	1L	HNO3	5ml	<2	Radiologicals		ESP		

REMARKS:
 (1) Sample bottles pre-preserved at laboratory prior to sample collection.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

NOTES:
 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
 2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

DEP-SOP-001/01
FS 2200 Groundwater Sampling
Form FD 9000-24
GROUNDWATER SAMPLING LOG

SITE NAME: Big Bend	SITE LOCATION: Apollo Beach, FL.
WELL NO: BBS-CCR-BW-2	SAMPLE ID: L17J115-05 A DATE: 10/13/17

PURGING DATA

WELL DIAMETER (inches)	TUBING DIAMETER (inches) 1/4	WELL SCREEN INTERVAL DEPTH 13.64 feet to 23.34 (feet)	STATIC DEPTH TO WATER (feet): 7.38	PURGE PUMP TYPE OR BAILER: PP							
WELL VOLUME PURGE: (only fillout if applicable) 1 WELL VOLUME = (TOTAL WELL DEPTH - STATIC DEPTH TO WATER) X WELL CAPACITY = (feet - feet) x gallons/foot = gallons											
EQUIPMENT VOLUME PURGE: (only fillout if applicable) 1 EQUIPMENT VOL. = PUMP VOLUME + (TUBING CAPACITY X TUBING LENGTH) + FLOW CELL VOLUME = (0 gallons + (0.0026 gallons/foot X 24.64 feet) + 0.06 gallons = 0.12 gallons											
INITIAL PUMP OR TUBING DEPTH IN WELL (feet): 18.49	FINAL PUMP OR TUBING DEPTH IN WELL (feet): 18.49	PURGING INITIATED AT: 9:15	PURGING ENDED AT: 9:32	TOTAL VOLUME PURGED (gallons): 2.27							
TIME	VOLUME PURGED (GALLONS)	COMPL. VOLUME PURGED (GALLONS)	PURGE RATE (GPM)	DEPTH TO WATER (FEET)	pH (standard units)	TEMP. (°C)	COND. (µmhos/cm OR µS/cm)	DISSOLVED OXYGEN (circle (mg/l) or % saturation)	TURBIDITY (NTUs)	COLOR (describe)	ODOR (describe)
9:28	1.75	1.75	0.13	7.61	6.68	27.92	1706	0.39	4.98	Lt. Yellow	None
9:30	0.26	2.01	0.13	7.62	6.69	27.95	1702	0.31	6.12	Lt. Yellow	None
9:32	0.26	2.27	0.13	7.62	6.70	27.98	1699	0.28	3.96	Lt. Yellow	None
WELL CAPACITY (Gallons Per Foot): 0.75" = 0.02; 1" = 0.04; 1.25" = 0.06; 2" = 0.16; 3" = 0.37; 4" = 0.65; 5" = 1.02; 6" = 1.47; 12" = 5.88 TUBING INSIDE DIA. CAPACITY (Gal./Ft.): 1/8" = 0.00006; 3/16" = 0.0014; 1/4" = 0.0026; 5/16" = 0.004; 3/8" = 0.006; 1/2" = 0.010; 5/8" = 0.016											

SAMPLING DATA

SAMPLED BY (PRINT) / AFFILIATION: RAB TECO				SAMPLER (S) SIGNATURES:				SAMPLING INITIATED AT: 9:32		SAMPLING ENDED AT: 9:40	
PUMP OR TUBING DEPTH IN WELL (feet): 18.5				SAMPLE PUMP FLOW RATE (mL per minute): 503				TUBING MATERIAL CODE: PE/S			
FIELD DECONTAMINATION: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>				FIELD-FILTERED: Y <input type="checkbox"/> N <input checked="" type="checkbox"/> FILTER SIZE: µm				DUPLICATE: Y <input type="checkbox"/> N <input checked="" type="checkbox"/>			
SAMPLE CONTAINER SPECIFICATION				SAMPLE PRESERVATION				INTENDED ANALYSIS AND/OR METHOD		SAMPLING EQUIPMENT CODE	
SAMPLE ID CODE	# CONTAINERS	MATERIAL CODE	VOLUME	PRESERVATIVE USED	TOTAL VOL. ADDED IN FIELD (ml) (1)	FINAL pH					
@Ino-500	1	PE	500ml	NONE	NONE	N/A	Inorganics		PP		
@Met-250	2	PE	250ml	HNO3	1ml	<2	Metals		PP		
@Rad-1L	2	PE	1L	HNO3	5ml	<2	Radiologicals		PP		

REMARKS:
 (1) Sample bottles pre-preserved at laboratory prior to sample collection.

MATERIAL CODES: AG = Amber Glass; CG = Clear Glass; PE = Polyethylene; PP = Polypropylene; S = Silicone; T = Teflon; O = Other (Specify)
SAMPLING/PURGING EQUIPMENT CODES: APP = After Peristaltic Pump; B = Bailor; BP = Bladder Pump; ESP = Electric Submersible Pump; PP = Peristaltic Pump; RFPP = Reverse Flow Peristaltic Pump; SM = Straw Method (tubing Gravity Drain); VT = Vacuum Trap; O = Other (Specify)

NOTES:
 1. The above do not constitute all of the information required by Chapter 62-160, F.A.C.
 2. STABILIZATION CRITERIA FOR RANGE OF VARIATION OF LAST THREE CONSECUTIVE READINGS (SEE FS 2212, SECTION 3)
pH: ± 0.2 units **Temperature:** ± 0.2 °C **Specific Conductance:** ± 5% **Dissolved Oxygen:** all readings ≤ 20% saturation (see Table FS 2200-2); optionally, ± 0.2 mg/L or ± 10% (whichever is greater) **Turbidity:** all readings ≤ 20 NTU; optionally ± 5 NTU or 10% (whichever is greater)

Site: **Big Bend** Date: **10/13/17** File Name: **101317_Wells_RAB** Weather: **Partly Cloudy & Warm** Sampler(s)/Initials: **RAB /TECO** Initials: **RAB**

LIMS #	Loction Code	Time	FE ² mg/l	pH (SU) PH	Temp °C TEMP-C	Cond(uMHOS) COND-F	DO Mg/L DO	Turbidity(NTU) TURB-N-F	Redox (mv) REDOX	Sulfite (mg/L) SO3-TR	Color \$COLOR-W	Odor \$ODOR-W	NGVD Time LEVEL	
L17J115-01 A	BBS-CCR-1	11:50		6.83	26.57	4258	0.24	0.89	-83.3		Clear	None		
L17J115-02 A	BBS-CCR-2	11:10		6.87	26.46	1350	0.20	3.03	-188.5		Lt. Yellow	None		
LIMS #	250ml Cyan (3)	1L Inorg (1)	500ml Inorg (2)	250ml Inorg (3)	1L Mts (1)	250ml Mts (3)	1L Rads (1)	500ml Sulfide (2)	500ml Mts (2)	250ml Nuts (3)	40ml Vial (6)	500 ml Nuts (2)	1L Rads Diss. (1)	Total Containers
L17J115-01 A	<input type="checkbox"/>		1		<input type="checkbox"/>	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 2							10
L17J115-02 A	<input type="checkbox"/>		1		<input type="checkbox"/>	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 2							

(1) 1L plastic (PP) (2) 500ml plastic (PP) (3) 250ml plastic (PP) (4) 100ml coliform bottle (5) 1L amber glass (AG) (6) 40ml VOA vial (CG)

ESS 0107301Y ESS 0218201Y ESS 0307301Y ESS ESS

Samples On Ice Yes No Sample Receipt Time 14:18

Preservation	Pres ID	Preservation	Pres ID	Preservation	Pres ID	Temp
1L bottles (rads): 5 ml HNO3 to pH <2	L 012558	250ml bottles (nuts): 1 ml H2SO4 to pH <2	L	500 ml bottles(Sulfide) 2ml NaOH/Zinc Acet. to pH >12	L	1.4
500 ml bottles (metals): 2 ml HNO3 to pH <2	L	40 ml Vial (TOC): 0.5 ml H2SO4 to pH <2	L	250 ml bottles (Cyan) 1g NaOH to pH >12	L	
250 ml bottles (metal): 1 ml HNO3 to pH <2	L 012558	1L bottles (diss. rads): filtered with 0.45um, 5 ml HNO3 to pH <2	L	A checked box indicates that the sample was verified to a pH of <2		

pH Meter Calibration	Buffer ID	Buffer Value	Cal	Time	ICV	Time	CCV	Time	Redox Cal	Time	Temp °C	Reading mv	Theo Value mv
Meter ID: MPM08	L 019949D	7	7.01	7:02	7.03	7:06	7.11	14:29	Meter ID: MPM08	7:10	21.5	236.0	236.2
FDEP FT 1100	L 019074C	10	10.05	7:02					Meter ID: MPM08	14:33	21.1	233.5	236.2
Units: SU	L 019303D	4	4.00	7:02					Zobell Sol ID:				

Conductivity Meter Calib.	Standard ID	Std Value	Cal	Time	ICV	Time	CCV	Time	DO Meter Cal	Time	Temp °C	Reading mg/l	Theo Value mg/l
Meter ID: MPM08	L 018805E	1000	1000	7:14					Meter ID: MPM08	6:54	21.4	8.90	8.863
FDEP FT 1200, Units: uMHOS	L 019100B	10000			9830	7:18	9791	14:01					

Turbidity Meter Calibration	Standard ID	Std Value	Acceptability Range	ICV	Time	CCV	Time	Therm ID	pH	Conduct. (%)	DO (mg/l)	Redox (mv)	
Meter ID: TMO7	L 019883	5.56	5.00	6.12	5.60	6:43	5.61	13:59	MPM08	14:42	20.8	8.97	8.950
FDEP FT 1600, Units: NTU	L 0								Barom. Pres				
									760				

Sulfite Info (QC Check) (EPA 377.1)	QC Result mg/l	Time	Titrator ID	Na Thio ID	DO 3 Pillow ID	Starch Ind. ID	Iodate/Iodide ID	Therm ID	pH	Conduct. (%)	DO (mg/l)	Redox (mv)
QC Std: 5ml (NaThio)/500ml DI=10mg/L				L	L	L	L	MPM08	0.2	5	0.3	10

Purging Information Well Capacities (gallons/ft): 2" = 0.16 4" =0.65 Tubing Inside Diam. Capacities Gallons/ft): 1/4" =0.0026, 3/8" =0.006

Well #	Diam/ Comp	Screen Interval (ft)	Intake Depth (ft)	Well Depth (ft)	Depth to Water (ft)	Water Column (ft)	Well Capacity (gal)	1 Well Volume (gal)	Tubing Capacity (gal/ft.)	Tubing Length (ft)	Pump Volume (gal)	Cell Volume (gal)	1 Eqpt. Volume (gal)
BBS-CCR-1	2	10	17.32	22.32	7.32	15.00	0.16	2.40	0.0026	23.3	0	0.06	0.12

Purge Meth:	Time	Rate (ml/min)	Volume (gal)	Total Vol. (gal)	Water Depth (ft)	pH (SU)	Temp °C	Cond (uMHOS)	DO (mg/L)	Turbidity (NTU)	Purge Criteria	Status	Equipment ID	Eqpt. Table
1A	11:28	380	1.10	1.10	7.41	6.83	26.47	4268	0.20	1.86	ph: +/- 0.2	STABLE	Level Meter:	WLM08
Purge Start:	11:30	390	0.21	1.31	7.40	6.83	26.53	4261	0.24	0.97	Temp C +/- 0.2	STABLE	Pump:	PP
11:17	11:32	380	0.20	1.51	7.41	6.83	26.57	4258	0.24	0.89	Cond % +/- 5	STABLE	Tubing:	PE/S
Purge End:											DO % Sat. < 20	STABLE	Dedicated <input checked="" type="checkbox"/>	Yes
11:32											Turb. NTU < 20	STABLE	Tubing? <input type="checkbox"/>	No
Purge Complete At	11:18	Gallons to Purge	0.12	Stability Values =	6.83	26.57	4258	0.24	0.89					

Well #	Diam/ Comp	Screen Interval (ft)	Intake Depth (ft)	Well Depth (ft)	Depth to Water (ft)	Water Column (ft)	Well Capacity (gal)	1 Well Volume (gal)	Tubing Capacity (gal/ft.)	Tubing Length (ft)	Pump Volume (gal)	Cell Volume (gal)	1 Eqpt. Volume (gal)
BBS-CCR-2	2	10	16.84	21.84	6.88	14.96	0.16	2.39	0.0026	22.84	0	0.06	0.12

Purge Meth:	Time	Rate (ml/min)	Volume (gal)	Total Vol. (gal)	Water Depth (ft)	pH (SU)	Temp °C	Cond (uMHOS)	DO (mg/L)	Turbidity (NTU)	Purge Criteria	Status	Equipment ID	Eqpt. Table
1A	10:56	380	0.80	0.80	6.94	6.87	26.44	1348	0.19	3.18	ph: +/- 0.2	STABLE	Level Meter:	WLM08
Purge Start:	10:58	380	0.20	1.00	6.94	6.86	26.45	1350	0.16	2.80	Temp C +/- 0.2	STABLE	Pump:	PP
10:48	11:00	380	0.20	1.20	6.95	6.87	26.46	1350	0.20	3.03	Cond % +/- 5	STABLE	Tubing:	PE/S
Purge End:											DO % Sat. < 20	STABLE	Dedicated <input checked="" type="checkbox"/>	Yes
11:00											Turb. NTU < 20	STABLE	Tubing? <input type="checkbox"/>	No
Purge Complete At	10:49	Gallons to Purge	0.12	Stability Values =	6.87	26.46	1350	0.20	3.03					

Comments:

Total Time Total Miles

Site: **Big Bend** Date: **10/13/17** File Name: **101317_Wells_RAB** Weather: **Partly Cloudy & Warm** Sampler(s) / Initials: **RAB /TECO** Initials

LIMS #	Loction Code	Time	FE ² mg/l	pH (SU) PH	Temp °C TEMP-C	Cond(µMHOS) COND-F	DO Mg/L DO	Turbidity(NTU) TURB-N-F	Redox (mv) REDOX	Sulfite (mg/L) SO3-TR	Color \$COLOR-W	Odor \$ODOR-W	NGVD Time LEVEL	
L17J115-03 A	BBS-CCR-3 CCR-PZ-4	10:42		6.44	27.18	1747	0.37	2.39	-249.3		Yellow	Mild		
LIMS #	250ml Cyan (3)	1L Inorg (1)	500ml Inorg (2)	250ml Inorg (3)	1L Mts (1)	250ml Mts (3)	1L Rads (1)	500ml Sulfide (2)	500ml Mts (2)	250ml Nuts (3)	40ml Vial (6)	500 ml Nuts (2)	1L Rads Diss. (1)	Total Containers
L17J115-03 A	<input type="checkbox"/>		1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	2	<input checked="" type="checkbox"/>	2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	5

(1) 1L plastic (PP) (2) 500ml plastic (PP) (3) 250ml plastic (PP) (4) 100ml coliform bottle (5) 1L amber glass (AG) (6) 40ml VOA vial (CG)
 ESS 0107301Y ESS 0218201Y ESS 0307301Y ESS ESS
 Yes No Samples On Ice Sample Receipt Time 14:18

Preservation		Pres ID	Preservation		Pres ID	Preservation		Pres ID
1L bottles (rads): 5 ml HNO3 to pH <2	L	012558	250ml bottles (nuts): 1 ml H2SO4 to pH <2	L	<input type="checkbox"/>	500 ml bottles(Sulfide) 2ml NaOH/Zinc Acet. to pH >12	L	<input type="checkbox"/>
500 ml bottles (metals): 2 ml HNO3 to pH <2	L	<input type="checkbox"/>	40 ml Vial (TOC): 0.5 ml H2SO4 to pH <2	L	<input type="checkbox"/>	250 ml bottles (Cyan) 1g NaOH to pH >12	L	<input type="checkbox"/>
250 ml bottles (metal): 1 ml HNO3 to pH <2	L	012558	1L bottles (diss. rads): filtered with 0.45µm, 5 ml HNO3 to pH <2	L	<input type="checkbox"/>	A checked box indicates that the sample was verified to a pH of <2		

pH Meter Calibration		Buffer ID	Buffer Value	Cal	Time	ICV	Time	CCV	Time	Redox Cal	Time	Temp °C	Reading mv	Theo Value mv
Meter ID:	MPM08	L 019949D	7	7	7:02	7.03	7:06	7.11	14:29	Meter ID:	7:10	21.5	236.0	236.2
FDEP FT 1100	L	019074C	10	10	7:02	QC: (pH +/- 0.2) (Cond +/- 5%) (DO +/- 0.3mg/L) (Redox +/- 10mv)				MPM08	14:33	21.1	233.5	236.2
Units: SU	L	019303D	4	4	7:02	A checked box indicates ICV / CCV passed				Zobell Sol ID:				

Conductivity Meter Calib.		Standard ID	Std Value	Cal	Time	ICV	Time	CCV	Time	L	50B	DO Meter Cal	Time	Temp °C	Reading mg/l	Theo Value mg/l
Meter ID:	MPM08	L 018805E	1000	1000	7:14							Meter ID:	6:54	21.4	8.90	8.863
FDEP FT 1200, Units: µMHOS	L	019100B	10000			9830	7:18	9791	14:01							

Turbidity Meter Calibration		Standard ID	Std Value	Acceptability Range	ICV	Time	CCV	Time	Meter ID	Time	Temp °C	Reading mg/l	Theo Value mg/l	
Meter ID:	TM07	L 019883	5.56	5.00	6.12	5.60	6:43	5.61	13:59	MPM08	14:42	20.8	8.97	8.950
FDEP FT 1600, Units: NTU	L	0								Barom. Pres				
										760				

Sulfite Info (QC Check) (EPA 377.1)		QC Result mg/l	Time	Titrator ID	Na Thio ID	DO 3 Pillow ID	Starch Ind. ID	Iodate/Iodide ID	Therm ID	pH	Conduct. (%)	DO (mg/l)	Redox (mv)
QC Std: 5ml (NaThio)/500ml DI=10mg/L	L				L	L	L	L	MPM08	0.2	5	0.3	10

Purging Information Well Capacities (gallons/ft): 2" = 0.16 4" =0.65 Tubing Inside Diam. Capacities Gallons/ft: 1/4" =0.0026 3/8" =0.006

Well #	Diam/ Comp	Screen Interval (ft)	Intake Depth (ft)	Well Depth (ft)	Depth to Water (ft)	Water Column (ft)	Well Capacity (gal)	1 Well Volume (gal)	Tubing Capacity (gal/ft.)	Tubing Length (ft)	Pump Volume (gal)	Cell Volume (gal)	1 Eqpt. Volume (gal)
BBS-CCR-3	2	10	18.23	23.23	6.52	16.71	0.16	2.67	0.0026	24.23	0	0.06	0.12

Purge Meth:	Time	Rate (ml/min)	Volume (gal)	Total Vol. (gal)	Water Depth (ft)	pH (SU)	Temp °C	Cond (µMHOS)	DO (mg/L)	Turbidity (NTU)	Purge Criteria	Status	Equipment ID	Eqpt. Table	
1A	10:22	180	0.43	0.43	6.72	6.47	27.31	1785	0.36	1.59	ph:+/- 0.2	STABLE	Level Meter:	WLM08	
Purge Start:	10:24	190	0.10	0.53	6.72	6.45	27.20	1763	0.50	1.13	Temp°C+/- 0.2	STABLE	Pump:	PP	
	10:13	10:26	190	0.10	0.63	6.71	6.44	27.18	1747	0.37	2.39	Cond % +/- 5	STABLE	Tubing:	PE/S
Purge End:	10:26										DO % Sat. < 20	STABLE	Dedicated	<input checked="" type="checkbox"/> Yes	
											Turb. NTU < 20	STABLE	Tubing?	<input type="checkbox"/> No	
Purge Complete At		10:16	Gallons to Purge	0.12	Stability Values =	6.44	27.18	1747	0.37	2.39					

Well #	Diam/ Comp	Screen Interval (ft)	Intake Depth (ft)	Well Depth (ft)	Depth to Water (ft)	Water Column (ft)	Well Capacity (gal)	1 Well Volume (gal)	Tubing Capacity (gal/ft.)	Tubing Length (ft)	Pump Volume (gal)	Cell Volume (gal)	1 Eqpt. Volume (gal)
	2	10	14	18		18.00	0.16	2.88	0.0026	100	0	0.06	0.32

Purge Meth:	Time	Rate (ml/min)	Volume (gal)	Total Vol. (gal)	Water Depth (ft)	pH (SU)	Temp °C	Cond (µMHOS)	DO (mg/L)	Turbidity (NTU)	Purge Criteria	Status	Equipment ID	Eqpt. Table
											ph:+/- 0.2		Level Meter:	WLM08
Purge Start:											Temp°C+/- 0.2		Pump:	PP
											Cond % +/- 5		Tubing:	PE/S
Purge End:											DO % Sat. < 20		Dedicated	<input type="checkbox"/> Yes
											Turb. NTU < 20		Tubing?	<input type="checkbox"/> No
Purge Complete At			Gallons to Purge	0.32	Stability Values =									

Comments: Total Time Total Miles

Site: **Big Bend** Date: **10/13/17** File Name: **101317_Wells_RAB** Weather: **Partly Cloudy & Warm** Sampler(s) / Initials: **RAB /TECO** Initials

LIMS #	Loction Code	Time	FE ² mg/l	pH (SU) PH	Temp °C TEMP-C	Cond(uMHOS) COND-F	DO Mg/L DO	Turbidity(NTU) TURB-N-F	Redox (mv) REDOX	Sulfite (mg/L) SO3-TR	Color \$COLOR-W	Odor \$ODOR-W	NGVD Time LEVEL	
L17J115-04 A	BBS-CCR-BW-1	10:04		6.6	27.9	4570	0.4	2.5	-18.4		Clear	None		
L17J115-05 A	BBS-CCR-BW-2	9:40		6.7	28.0	1699	0.3	4.0	-72.1		Lt. Yellow	None		

LIMS #	250ml Cyan (3)	1L Inorg (1)	500ml Inorg (2)	250ml Inorg (3)	1L Mts (1)	250ml Mts (3)	1L Rads (1)	500ml Sulfide (2)	500ml Mts (2)	250ml Nuts (3)	40ml Vial (6)	500 ml Nuts (2)	1L Rads Diss. (1)	Total Containers
L17J115-04 A	<input type="checkbox"/>		1		<input type="checkbox"/>	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 2							10
L17J115-05 A	<input type="checkbox"/>		1		<input type="checkbox"/>	<input checked="" type="checkbox"/> 2	<input checked="" type="checkbox"/> 2							

(1) 1L plastic (PP) (2) 500ml plastic (PP) (3) 250ml plastic (PP) (4) 100ml coliform bottle (5) 1L amber glass (AG) (6) 40ml VOA vial (CG)

ESS 0107301Y ESS 0218201Y ESS 0307301Y ESS ESS

Samples On Ice Yes No Time 14:18

Preservation	Pres ID	Preservation	Pres ID	Preservation	Pres ID
1L bottles (rads): 5 ml HNO3 to pH <2	L 012558 <input checked="" type="checkbox"/>	250ml bottles (nuts): 1 ml H2SO4 to pH <2	L <input type="checkbox"/>	500 ml bottles(Sulfide) 2ml NaOH/Zinc Acet. to pH >12	L <input type="checkbox"/>
500 ml bottles (metals): 2 ml HNO3 to pH <2	L <input type="checkbox"/>	40 ml Vial (TOC): 0.5 ml H2SO4 to pH <2	L <input type="checkbox"/>	250 ml bottles (Cyan) 1g NaOH to pH >12	L <input type="checkbox"/>
250 ml bottles (metal): 1 ml HNO3 to pH <2	L 012558 <input checked="" type="checkbox"/>	1L bottles (diss. rads): filtered with 0.45um, 5 ml HNO3 to pH <2	L <input type="checkbox"/>	A checked box indicates that the sample was verified to a pH of <2	

pH Meter Calibration	Buffer ID	Buffer Value	Cal	Time	ICV	Time	CCV	Time	Redox Cal	Time	Temp °C	Reading mv	Theo Value mv
Meter ID: MPM08	L 019949D	7	7	7:02	7.03	7:06	7.11	14:29	Meter ID: MPM08	7:10	21.5	236.0	236.2
FDEP FT 1100	L 019074C	10	10	7:02	QC: (pH +/- 0.2) (Cond +/- 5%) (DO +/- 0.3mg/L) (Redox +/- 10mv)				Meter ID: MPM08	14:33	21.1	233.5	236.2
Units: SU	L 019303D	4	4	7:02	A checked box indicates ICV / CCV passed				Zobell Sol ID:				

Conductivity Meter Calib.	Standard ID	Std Value	Cal	Time	ICV	Time	CCV	Time	L 019150B	DO Meter Cal	Time	Temp °C	Reading mg/l	Theo Value mg/l
Meter ID: MPM08	L 018805E	1000	1000	7:14						Meter ID: MPM08	6:54	21.4	8.90	8.863
FDEP FT 1200, Units: uMHOS	L 019100B	10000			9830	7:18	9791	14:01						

Turbidity Meter Calibration	Standard ID	Std Value	Acceptability Range	ICV	Time	CCV	Time	MPM08	14:42	20.8	8.97	8.950
Meter ID: TM07	L 019883	5.56	5.00	6.12	5.60	6:43	5.61	13:59	Barom. Pres			
FDEP FT 1600, Units: NTU	L 0								760			

Sulfite Info (QC Check) (EPA 377.1)	QC Result mg/l	Time	Titrator ID	Na Thio ID	DO 3 Pillow ID	Starch Ind. ID	Iodate/Iodide ID	Therm ID	pH	Conduct. (%)	DO (mg/l)	Redox (mv)
QC Std: 5ml (NaThio)/500ml DI=10mg/L				L	L	L	L	MPM08	0.2	5	0.3	10

Purging Information Well Capacities (gallons/ft): 2" = 0.16 4" =0.65 Tubing Inside Diam. Capacities Gallons/ft): 1/4" =0.0026 3/8" =0.006

Well #	Diam/ Comp	Screen Interval (ft)	Intake Depth (ft)	Well Depth (ft)	Depth to Water (ft)	Water Column (ft)	Well Capacity (gal)	1 Well Volume (gal)	(Tubing Capacity (gal/ft.) X Tubing Length (ft)) + Pump Volume (gal)	Cell Volume (gal)	1 Eqpt. Volume (gal)			
BBS-CCR-BW-1	2	10	39.3	44.3	29.60	14.70	0.16	2.35	0.0026 100 0	0.06	0.32			
Purge Meth:	Time	Rate (ml/min)	Volume (gal)	Total Vol. (gal)	Water Depth (ft)	pH (SU)	Temp °C	Cond (uMHOS)	DO (mg/L)	Turbidity (NTU)	Purge Criteria	Status	Equipment ID	Eqpt. Table
1A	9:57	2600	5.49	5.49	30.43	6.55	27.81	4384	0.87	7.30	ph: +/- 0.2	STABLE	Level Meter: WLM08	
Purge Start:	9:59	2600	1.37	6.86	30.42	6.55	27.81	4499	0.57	4.40	Temp C +/- 0.2	STABLE	Pump: ESP	
	9:49	10:01	2600	1.37	8.23	30.41	27.86	4570	0.40	2.51	Cond % +/- 5	STABLE	Tubing: PE	
Purge End:	10:01										DO % Sat. < 20	STABLE	Dedicated <input type="checkbox"/> Yes	
											Turb. NTU < 20	STABLE	Tubing? <input checked="" type="checkbox"/> No	
Purge Complete At	9:49	Gallons to Purge 0.32	Stability Values =		6.55	27.86	4570	0.40	2.51					

Well #	Diam/ Comp	Screen Interval (ft)	Intake Depth (ft)	Well Depth (ft)	Depth to Water (ft)	Water Column (ft)	Well Capacity (gal)	1 Well Volume (gal)	(Tubing Capacity (gal/ft.) X Tubing Length (ft)) + Pump Volume (gal)	Cell Volume (gal)	1 Eqpt. Volume (gal)			
BBS-CCR-BW-2	2	10	18.49	23.84	7.38	16.46	0.16	2.63	0.0026 24.64 0	0.06	0.12			
Purge Meth:	Time	Rate (ml/min)	Volume (gal)	Total Vol. (gal)	Water Depth (ft)	pH (SU)	Temp °C	Cond (uMHOS)	DO (mg/L)	Turbidity (NTU)	Purge Criteria	Status	Equipment ID	Eqpt. Table
1A	9:28	510	1.75	1.75	7.61	6.68	27.92	1706	0.39	4.98	ph: +/- 0.2	STABLE	Level Meter: WLM08	
Purge Start:	9:30	500	0.26	2.01	7.62	6.69	27.95	1702	0.31	6.12	Temp C +/- 0.2	STABLE	Pump: PP	
	9:15	9:32	500	0.26	2.27	7.62	27.98	1699	0.28	3.96	Cond % +/- 5	STABLE	Tubing: PE/S	
Purge End:	9:32										DO % Sat. < 20	STABLE	Dedicated <input checked="" type="checkbox"/> Yes	
											Turb. NTU < 20	STABLE	Tubing? <input type="checkbox"/> No	
Purge Complete At	9:16	Gallons to Purge 0.12	Stability Values =		6.70	27.98	1699	0.28	3.96					

Comments:

Total Time Total Miles