

Prepared for:



Tampa, Florida

GROUNDWATER MONITORING SYSTEM DESIGN AND CONSTRUCTION REPORT

**Big Bend Power Station
Economizer Ash and Pyrite Pond System
13031 Wyandotte Road
Gibsonton, FL 33572**

Prepared by:

Geosyntec 
consultants

13101 Telecom Drive
Suite 120
Temple Terrace, FL 33637

Project Number: FR2814
October 2017

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LIST OF ACRONYMS

BBS	Big Bend Power Station
bls	below land surface
CCR	Coal Combustion Residual
cm/s	centimeters per second
CFR	Code of Federal Regulations
cy	cubic yards
EAPPS	Economizer Ash and Pyrite Pond System
ft	feet
FGD	Flue gas desulfurization
ICU	Intermediate confining unit
msl	Mean sea level
NAVD88	North Atlantic Vertical Datum of 1988
TEC	Tampa Electric Company
SAS	Surficial aquifer system
UFAS	Upper Floridan Aquifer System

1. PURPOSE

The following report was prepared to meet requirements of 40 CFR 257.91(a)(b)(c) or (d) as applicable, and (e). This report documents that the groundwater monitoring system for the Coal Combustion Residual (CCR) Economizer Ash and Pyrite Pond System (EAPPS) within the scope of 40 CFR 257.50 at Tampa Electric Company's (TEC) Big Bend Power Station (BBS) in Gibsonton, Florida complies with these requirements.

2. SITE DESCRIPTION

2.1 Site

The BBS (or “Site”) is a coal-fired electrical power generation facility owned and operated by TEC. The Site is located on the eastern shore of Tampa Bay in Gibsonton, Florida in Sections 9, 10, 15, and 16, Township 31, Range 19 East in the Gibsonton Quadrangle, with the center of the facility at approximately 27°47’36” north latitude and 82°24’16” west longitude. Topography at the Site ranges from approximately sea level (along the western portion of the BBS) to approximately 10.5 feet (ft) relative to the North Atlantic Vertical Datum of 1988 (NAVD88) near the eastern portions of the property along U.S. Highway 41.

Construction of BBS began in the late 1960s on two dredge/fill peninsulas. The four coal-fired power generating units present at the BBS were placed in service in 1970, 1973, 1976, and 1985. Units 1, 2, and 3 are wet-bottom slag-tap type units that originally used saltwater slag-handling systems and electrostatic precipitators for stack gas emissions control. However, these units are now operating as freshwater systems, subsequently allowing more internal water recycling. Unit 4 is a dry-bottom unit with a closed-loop freshwater bottom ash-slucie system. All units are equipped with electrostatic precipitators, and stack gasses are treated with a limestone flue gas desulfurization (FGD) system.

The Economizer Ash and Pyrite Pond System (EAPPS) was built in the early 1980s to support the operation of Big Bend Unit 4 and consists of three lined ponds, as described in Section 2.2. The location of the Site and the components of the EAPPS, including the north and south economizer ash ponds and the suction pond, are shown on **Figure 1** and **Figure 2**.

2.2 CCR Units

The EAPPS comprises three ponds that are considered one CCR unit by 40 CFR 257.53 and are located approximately 1,000 feet southeast of the active power generating units (**Figure 1**). The north economizer ash pond and economizer ash suction pond are still in operation. The south economizer ash pond has been converted to dry storage of material excavated from the south recycle pond when it was reconstructed and lined in 2010.

The pond bottom and dike crest elevations for each pond are reportedly 5.5 ft and 31 ft, respectively; however, the elevation datum is unknown (Geosyntec, 2016). The South Economizer Ash Pond contains an estimated 337,400 cubic yards (cy) of CCR material over a surface area of 7.2 acres. The north pond contains an estimated 90,000 cy of CCR material (Geosyntec, 2016) over a surface area of 5.4 acres. The suction pond has a surface area of 1.6 acres, receives decant water from the north and south economizer ash ponds, and contains no CCR material.

3. SITE CONCEPTUAL HYDROGEOLOGIC MODEL

3.1 Regional Geology and Hydrogeology

The general hydrogeologic units that form the hydrogeologic framework in the region include the surficial aquifer system (SAS), the intermediate confining unit (ICU) and the upper Floridan aquifer system (UFAS). Based on Site-specific data as well as hydrogeologic studies of west-central Florida (Tihanksy and Knochenmus, 2001), the intermediate aquifer system has not been identified as being present at this location.

The SAS sediments comprise Pleistocene shell deposits and terrace sands. Thicknesses of the SAS deposits vary considerably due to the irregular surface of the underlying limestone, but typically range between 20 to 30 ft thick near the Site (SWFWMD, 2010). The shell deposits are typically overlain by surface sands.

The ICU resides within the undifferentiated Hawthorn Group. Due to the absence of the intermediate aquifer system, the permeable strata are absent and consequently the less permeable, fine grained clastic clay units are generally more prevalent. These clay units with varying silt, sand content, and marls make up the semi-confining unit that separates the surficial and Floridan Aquifer systems. The occurrence and composition of these clay and marl units vary laterally and vertically (ECT, 2007).

The UFAS consists of a continuous series of carbonate units. The UFAS is composed of the limestone sequences that occur in the Tampa Member of the Arcadia Formation of the Hawthorn Group as well as the underlying Suwannee Limestone and other carbonate strata. The Tampa Member encompasses sandy limestone containing varying amounts of clays and marls. The upper portion of the Suwannee Limestone is a finely crystalline limestone that consists of minor amounts of quartz sand and shell fragments. **Figure 3** shows regional groundwater elevations of the UFAS in the vicinity of the BBS in September 2014 based on data obtained from the Southwest Florida Water Management District. Groundwater in the UFAS generally flows regionally from east to west toward Tampa Bay.

3.2 Site Geology and Hydrogeology

The water table across the Site exists within the SAS where the groundwater flow direction is influenced by ponds, drainage ditches, canals, and small creeks. Historical trends from data collected on Site (ECT, 2003) identified an upward vertical flow gradient from the UFAS to the SAS, with certain wells occasionally exhibiting artesian conditions (ECT, 2007) with a potentiometric surface ranging from 0 to 10 ft above msl. This elevated potentiometric pressure inhibits downward seepage of groundwater from the SAS to the UFAS. Seasonal fluctuations in the water levels and potentiometric surface may allow for temporary, localized downward

flow gradients (ECT, 2007). Hydraulic flow gradients and local hydrogeologic conditions identify Tampa Bay as the discharge point for flow within the SAS.

The 2002 Revised Groundwater Monitoring Plan reported horizontal hydraulic conductivity values at the Site ranging from 1.7×10^{-3} to 1.1×10^{-5} centimeters per second (cm/s) for tests completed in the upper 25 feet of the SAS (Schreuder, Inc. 2002). Additional data from a previous study referenced within Schreuder (2002) reported an average field horizontal hydraulic conductivity of 1.2×10^{-3} cm/s in the upper 16 ft. of the SAS and a field vertical hydraulic conductivity of 3.9×10^{-5} cm/s at a depth of 25 ft. bls. Laboratory hydraulic conductivity tests were performed for the least permeable aquifer materials including silty sands and lower clay layers above the limestone. These low permeability materials comprise the Tampa Member of the Arcadia Formation of the Hawthorn Group. Hydraulic conductivity values from the clay layers ranged from 3×10^{-7} to 6×10^{-8} cm/s.

Hydraulic conductivity values for the SAS and ICU are presented in **Table 1**.

3.3 Aquifer System Description

3.3.1 Identification of Uppermost Aquifer

The uppermost aquifer is defined by 40 CFR 257.53 as the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. The upper limit is measured at a point closest to the natural ground surface to which the aquifer rises during the wet season. As described in Section 3.2, the uppermost aquifer at the Site is the SAS.

3.3.2 Groundwater Flow Direction

A surface water feature, Jackson Branch, to the north/northeast of the EAPPS appears to influence local groundwater flow toward the stream in contrast to the general groundwater flow direction at the BBS, which is east to west. The groundwater flow direction near the EAPPS is generally north/northeast.

3.3.3 Groundwater Flow Rates

On 24 and 28 June 2016, Geosyntec collected groundwater elevation data from Site monitoring wells during high and low tide events, respectively, to evaluate groundwater flow conditions in the SAS. Groundwater elevation contours were developed using the water level measurements and indicated an average horizontal hydraulic gradient near the EAPPS of 2.0×10^{-3} ft/ft during both low and high tides (**Figure 5 and Figure 6**). The primary sediments of the SAS are fine sand to silty sand. Assuming an effective porosity of 20% and the measured hydraulic conductivity values for the SAS (**Table 1**), it is possible to calculate the average linear velocity of groundwater using the equation below:

$$q = K \left(\frac{i}{n_e} \right)$$

where q is the average groundwater linear velocity, K is the hydraulic conductivity (**Table 1**), i is the hydraulic gradient, and n_e is the effective porosity. Using the average K value from Seaburn and Robertson (1.2×10^{-3} cm/s) and values described above, the average linear velocity of groundwater ranges from 0.2 to 0.6 ft/day, which corresponds to a potential range of flow velocities from approximately 7 to 22 feet per year toward Jackson Branch.

4. BACKGROUND WELLS

The CCR Rule requires a minimum of one background well where water quality has not been affected by CCR constituents. Background wells for CCR monitoring at the EAPPS include BBS-CCR-BW-1 and BBS-CCR-BW-2, as shown on **Figure 4** and were designed to monitor the water quality of the upper SAS upgradient of the EAPPS. These upgradient wells are intended to be used for statistical comparison to groundwater data from downgradient monitoring wells. The documentation for the design, installation, and development of these wells is found in *Groundwater Monitoring Well Design, Installation, Development, and Decommissioning Report, October 2017*. A well construction summary is provided in **Table 2**.

5. DETECTION MONITORING SYSTEM

The detection monitoring network was designed to monitor the water quality of the upper SAS downgradient of the EAPPS (BBS-CCR1, BBS-CCR-2, and BBS-CCR-3). The detection monitoring wells at the waste boundary are located at the “hydraulically downgradient perimeter (i.e., the edge) of the CCR unit or at the closest practical distance from this location” [80 FR 21400]. The screen intervals are at or below the actual depth of CCR material in the upper portion of the SAS and therefore meet the performance standards specified in 257.91(a) through (d). Monitoring well locations are shown on **Figure 4**.

During the initial groundwater sampling phase of Detection Monitoring, wells listed in **Table 2** and depicted on **Figure 4** are to be sampled for Appendix III and Appendix IV constituents a minimum of eight times prior to 17 October 2017 [40 CFR 257.94(b)] (USEPA, April 2015). Sample results will be used to develop Site-specific background concentrations for each Appendix III and Appendix IV constituent (**Table 3**). During groundwater sampling activities, water levels will be measured at each well to generate potentiometric maps of monitored hydrogeologic zones [40 CFR 257.93(c)] (USEPA, April 2015). Water levels used for preparation of groundwater elevation contour maps are to be collected during a single 24 to 48-hour period. Field parameters listed on **Table 3** will also be measured during well purging and immediately before samples are collected for laboratory analysis.

An alternative (reduced) detection monitoring frequency may be implemented if favorably supported by an evaluation of the results that considers the following factors [40 CFR 257.94(d)] (USEPA, April 2015):

- Lithology of the aquifer and unsaturated zone;
- Hydraulic conductivity of the aquifer and unsaturated zone;
- Groundwater flow rates; and
- Information documenting that the alternative frequency is no less effective in ensuring that any leakage from the CCR unit is discovered within a timeframe that will not materially delay establishment of an assessment monitoring program.

6. MONITORING WELL DESIGN & INSTALLATION REPORT

The documentation for the design, installation, and development of the wells in the CCR monitoring system is found in *Groundwater Monitoring Well Design, Installation, Development, and Decommissioning Report, October 2017*. This document complies with 40 CFR 257.91(e)(1).

7. CERTIFICATION

The CCR rule requires that the owner must obtain certification from a qualified engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. The certification is based on the information provided and referenced in this document. A copy of the signed and sealed certification is included as **Appendix A**.

8. REFERENCES

- Environmental Consulting & Technology (ECT). 2003. Supplemental Assessment Report, Tampa Electric Company, Big Bend Station. Tampa, Florida.
- Environmental Consulting & Technology (ECT). 2007. Sodium Ground Water Quality Exemption Application for the TECO Big Bend Station. Tampa, Florida.
- Geosyntec Consultants, Inc. 2016. Basins of Design and Preliminary Closure Evaluation Report; Economizer Ash and Pyrite Ponds; Big Bend Power Station, September 2016.
- Geosyntec Consultants, Inc. 2017. Big Bend Power Station Groundwater Monitoring Well Design, Installation, Development, and Decommissioning Report, September 2017.
- Schreuder, Inc. 2002. Revised Groundwater Monitoring Plan, Big Bend Power Station, Tampa, Florida.
- Southwest Florida Water Management District, 2010. 2010 Regional Water Supply Plan, Tampa Bay Planning Region. Brooksville, Florida.
- Tihanksy, A.B. and L.A. Knochenmus. 2001. Karst Features and Hydrogeology in West-central Florida-A Field Perspective. US Geological Survey-Water-Resources Investigations Report 01-4011.
- USEPA, April 2015. 40 CFR Part 257, Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities; Final Rule, EPA-HQ-RCRA-2009-0640.

TABLES

Table 1: Summary of Calculated Hydraulic Conductivity Data

TEC Big Bend Station Economizer Ash and Pyrite Pond System

Apollo Beach, FL

Source	Aquifer System	Horizontal Hydraulic Conductivity (cm/sec)	Vertical Hydraulic Conductivity (cm/sec)
Stone and Webster	SAS	1.7E-03 to 1.1E-05	--
	ICU	3E-07 to 7E-07	--
Seaburn and Robertson	SAS	1.2E-03*	3.9E-05
	ICU	4E-8 to 6E-8	--

Notes:

1. cm/s = centimeters per second
2. SAS indicates surficial aquifer system
3. ICU indicates intermediate confining unit
4. * = average value of three field aquifer tests
5. Sources referenced in Schreuder, Inc. 2002. Revised Groundwater Monitoring Plan, Big Bend Power Station, Tampa, Florida.

Table 2: CCR Monitoring Well Construction DetailsTEC Big Bend Station Economizer Ash and Pyrite Pond System
Apollo Beach, FL

Well ID	Diameter (in)	Designation	Northing (NAD 1983)	Easting (NAD 1983)	Ground Surface Elevation (ft NAVD 1988)	TOC Elevation* (ft NAVD 1988)	Total Depth (ft bls)	Screen Interval (ft bls)	Top of Screen Elevation (ft NAVD)	Bottom of Screen Elevation (ft NAVD)
BBS-CCR-BW1	2	Background	1256638.34	528461.95	29.10	33.40	40	30-40	-0.90	-10.90
BBS-CCR-BW2	2	Background	1256966.67	527897.28	7.70	12.54	19	9-19	-1.30	-11.30
BBS-CCR-1	2	Detection	1257433.85	528211.74	5.00	9.82	17.5	7.5-17.5	-2.50	-12.50
BBS-CCR-2	2	Detection	1257429.29	528769.31	5.00	9.34	17.5	7.5-17.5	-2.50	-12.50
BBS-CCR-3	2	Detection	1257154.61	529023.26	4.90	9.20	18.5	8.5-18.5	-3.60	-13.60

Notes

1. in = Inches
2. ft bls = Feet Below Land Surface
3. Horizontal datum surveyed to the North American Datum (NAD) of 1983 US State Plane Florida West.
4. Vertical datum surveyed to the North American Vertical Datum (NAVD) of 1988.
5. *Top of casing elevations were revised in September 2016 during final aboveground well completions. The additional PVC stickup was measured in the field and added to the surveyed top of casing elevation.

Table 3: Summary of Detection and Assessment Monitoring Constituents

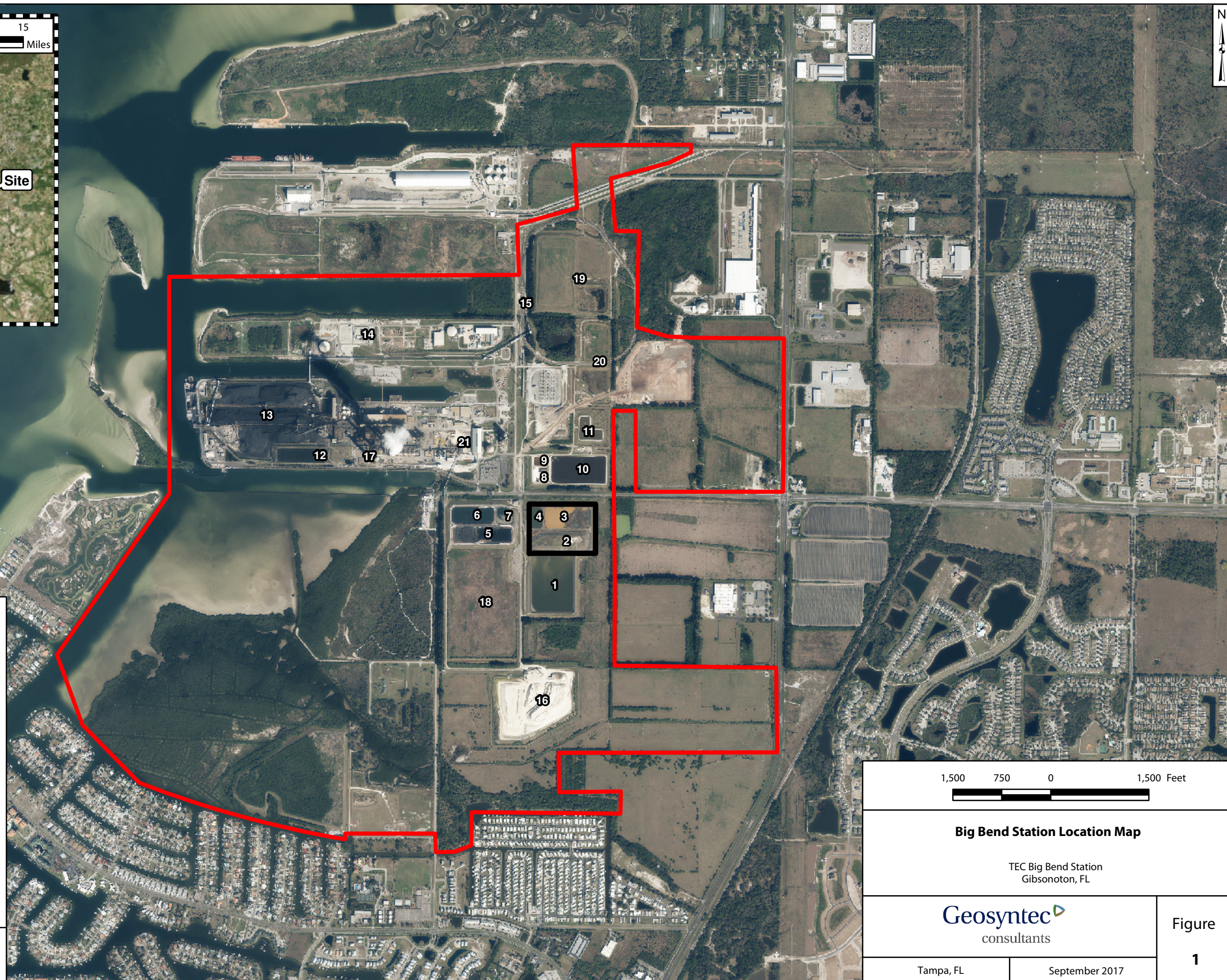
TEC Big Bend Station Economizer Ash and Pyrite Pond System
Apollo Beach, FL

Constituent	Constituent Reference		Analytical Methods(s)	EPA Primary or Secondary MCL (ug/L)
	40 CFR 257 Appendix III	40 CFR 257 Appendix IV		
Arsenic (Total)		X	EPA 200.8 or 6020	10
Antimony (Total)		X	EPA 200.8 or 6020	6
Barium (Total)		X	EPA 6010	2,000
Beryllium (Total)		X	EPA 6010	4
Boron (Total)	X		EPA 6010	NA
Cadmium (Total)		X	EPA 200.8 or 6020	5
Calcium (Total)	X		EPA 6010	NA
Chloride	X		EPA 300.0	250,000
Chromium (Total)		X	EPA 6010	100
Cobalt (Total)		X	EPA 6010	NA
Fluoride	X		EPA 300.0	4,000
Lead (Total)		X	EPA 200.8	15
Lithium (Total)		X	EPA 6010	NA
Mercury (Total)		X	EPA 7470	2
Molybdenum (Total)		X	EPA 6010	NA
pH	X		Field	6.5-8.5 (STD Units)
Radium 226 and 228 (Total)		X	EPA 903	5 (pCi/L)
Selenium (Total)		X	EPA 200.8 or 6020	50
Sulfate	X		EPA 300.0	250,000
TDS	X		SM2540C	500,000
Thallium (Total)		X	EPA 6020	2

Notes

1. EPA = US Environmental Protection Agency
2. MCL = Maximum Contaminant Level
3. ug/L = Micrograms per liter
4. STD Units = Standard Units
5. pCi/L = picoCuries per liter

FIGURES



- Legend**
1. Long Term Fly Ash Pond/Reclaimed Water Pond (lined)
 2. South Economizer Ash Pond (lined)
 3. North Economizer Ash Pond (lined)
 4. Economizer Ash Suction Pond (lined)
 5. South Bottom Ash Pond (lined)
 6. North Bottom Ash Pond (lined)
 7. Bottom Ash Suction Pond (lined)
 8. Settling Basins (concrete)
 9. Settling Pond (lined)
 10. South Recycle Pond (lined)
 11. North Recycle Pond (lined)
 12. Storm Water Pond
 13. Coal Field
 14. BB Aero Unit CT4
 15. Rail Car Unloading
 16. Gypsum Storage Area
 17. Slag Dewatering Bins
 18. Long Term Bottom Ash Area
 19. Dredge Disposal Area DA-2
 20. Former Spray Field
 21. Limestone and FGD Area
- Approximate Site Boundary
 Economizer Ash and Pyrite Pond System (EAPPS)
- Notes:**
1. Site boundary provided by Tampa Electric Company.
 2. Source of 2014 Aerials: Florida Department of Transportation, Surveying and Mapping Office.

1,500 750 0 1,500 Feet

Big Bend Station Location Map

TEC Big Bend Station
Gibsonton, FL

Geosyntec
consultants

Tampa, FL September 2017

Figure
1

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400 200 0 400 Feet



**Economizer Ash and Pyrite Pond System
Location Map**

TEC Big Bend Station
Gibsonton, FL

Legend

-  Jackson Branch
-  Economizer Ash and Pyrite Pond System (EAPPS)

Note:
Source of 2014 Aerials: Florida Department of Transportation, Surveying and Mapping Office.

Geosyntec
consultants

Figure

2

Tampa, FL

September 2017

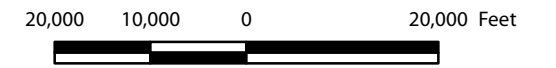
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- Legend**
- Upper Floridan Aquifer Potentiometric Surface
 - Approximate Site Boundary

- Notes**
1. ft NGVD 29 indicates potentiometric contours presented in feet relative to National Geodetic Vertical Datum 1929.
 2. Site boundary as provided by Tampa Electric Company (TEC).
 3. Potentiometric contour for Upper Floridan Aquifer provided by Southwest Florida Water Management District (SFWMD) dated September 2014.
 4. 2013 World Imagery Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.



**Regional Potentiometric Surface Map
for the Upper Floridan Aquifer**

TEC Big Bend Station
Gibsonton, FL

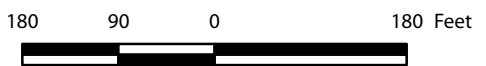
Geosyntec
consultants

Tampa, FL

September 2017

Figure

3



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

TEC Big Bend Station
Gibsonton, FL



Figure
4

Tampa, FL

September 2017

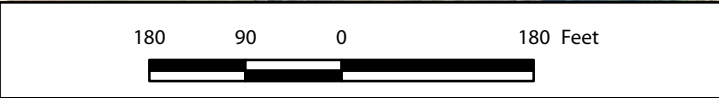
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Legend

- CCR Background Well Location
- CCR Monitoring Well Location
- Jackson Branch
- Economizer Ash and Pyrite Pond System (EAPPS)

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

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



Economizer Ash and Pyrite Pond System
Low Tide Potentiometric Surface Map 6/24/16
 TEC Big Bend Station
 Gibsonton, FL

Geosyntec
 consultants

Figure
5

Tampa, FL

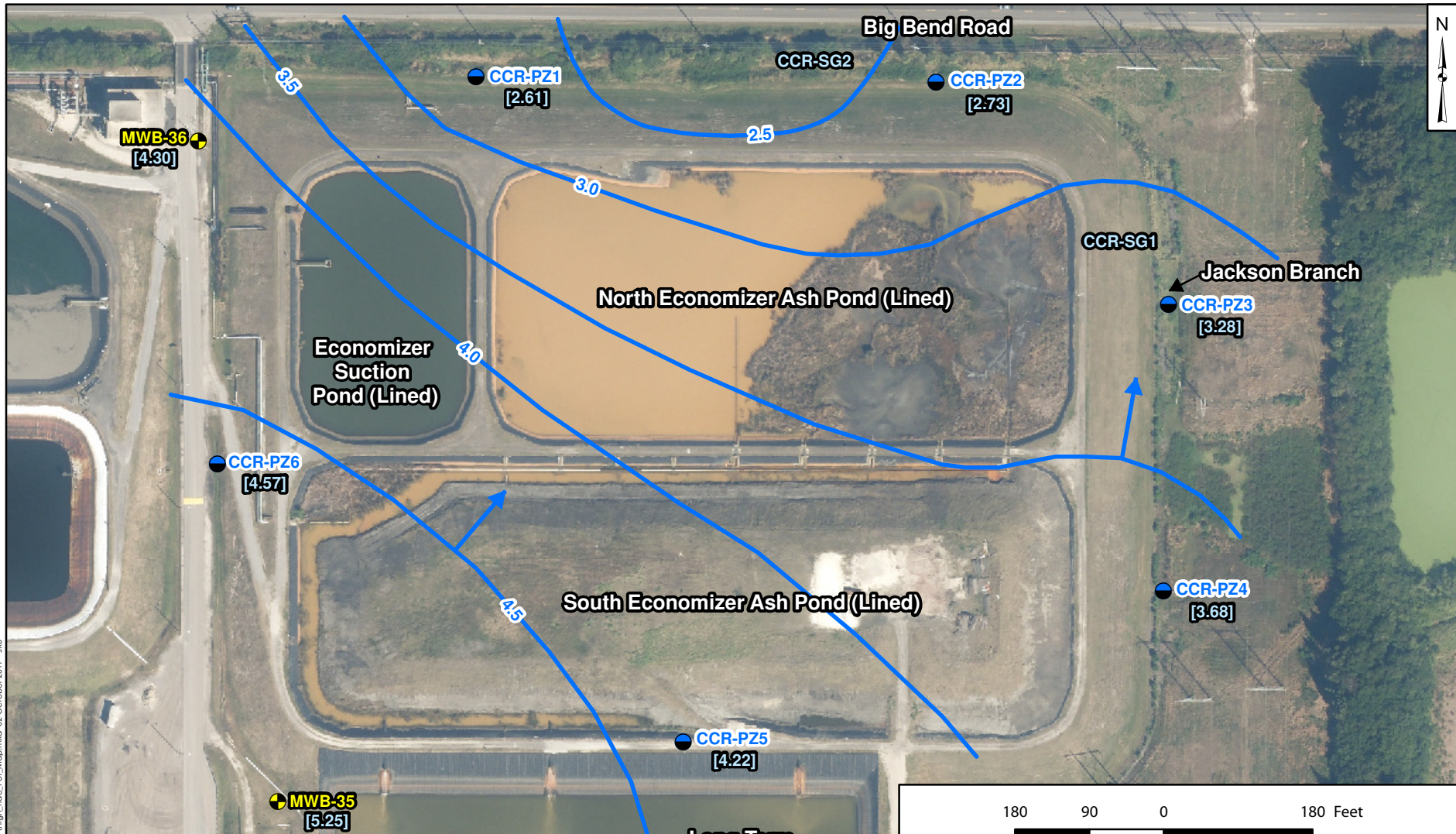
September 2017

- 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 indicates North American Vertical Datum of 1988.
2. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

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180 90 0 180 Feet



**Economizer Ash and Pyrite Pond System
High Tide Potentiometric Surface Map 6/28/16**

TEC Big Bend Station
Gibsonton, FL

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Figure

6

Tampa, FL

September 2017

- 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:

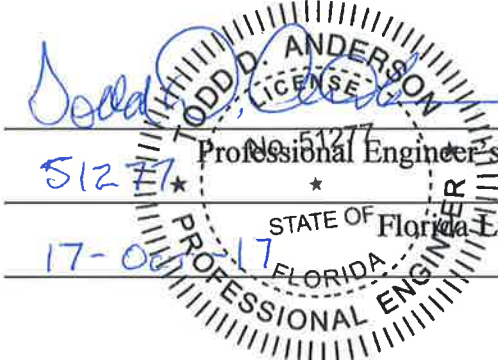
1. NAVD88 indicates North American Vertical Datum of 1988.
2. 2014 Aerial Imagery source, Florida Department of Transportation Surveying and Mapping Office APLUS website.

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APPENDIX A
Groundwater Monitoring System Certification

FINAL CERTIFICATION

I, Todd D. Anderson, being a Registered Professional Engineer, in accordance with the State of Florida Professional Engineer's Registration, possessing the technical knowledge and experience to make the specific technical certifications required under 40 C.F.R Part 257, Subpart D, Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments, and being licensed in the state where the CCR unit is located, do hereby certify to the best of my knowledge, information, and belief, that the groundwater monitoring system that is the subject of this certification has been designed and constructed to meet the requirements of 40 C.F.R. § 257.91.


Professional Engineer's Signature
51277 * *
17-00-17 * *
STATE OF Florida License No.
FLORIDA
PROFESSIONAL ENGINEER
Date