ALTERNATIVE SOURCE DEMONSTRATION REPORT TEXAS STATE CCR RULE

H.W. Pirkey Power Plant
West Bottom Ash Pond
Hallsville, Texas

Submitted to

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ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
EBAP	East Bottom Ash Pond
EDS	Energy Dispersive Spectroscopy
EPRI	Electric Power Research Institute
GSC	Groundwater Stats Consulting, LLC
GWPS	Groundwater Protection Standard
LCL	Lower Confidence Limit
MCL	Maximum Contaminant Level
QA	Quality Assurance
QC	Quality Control
SEM	Scanning Electron Microscopy
SPLP	Synthetic Precipitation Leaching Procedure
SSL	Statistically Significant Level
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
VAP	Vertical Aquifer Profiling
WBAP	West Bottom Ash Pond
XRD	X-Ray Diffraction

SECTION 1

INTRODUCTION AND SUMMARY

This Alternative Source Demonstration (ASD) report has been prepared to address a statistically significant level (SSL) for cobalt in the groundwater monitoring network at the H.W. Pirkey Plant Western Bottom Ash Pond (WBAP), located in Hallsville, Texas, following the second semi-annual assessment monitoring event of 2021.

The H.W. Pirkey Plant has four coal combustion residuals (CCR) storage units regulated by the Texas Commission on Environmental Quality (TCEQ) under Registration No. CCR104, including the WBAP (**Figure 1**). The WBAP is also registered as a surface impoundment under TCEQ Industrial and Hazardous Waste Solid Waste Registration No. 33240. In November 2021, a semi-annual assessment monitoring event was conducted at the WBAP in accordance with 30 TAC §352.951(a). The monitoring data were submitted to Groundwater Stats Consulting, LLC (GSC) for statistical analysis. Groundwater protection standards (GWPSs) were established for each Appendix IV parameter in accordance with the statistical analysis plan developed for the facility (Geosyntec, 2020a) and United States Environmental Protection Agency's (USEPA) *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance* (Unified Guidance; USEPA, 2009). The GWPS for each parameter was established as the greater of either the background concentration or, for constituents with a maximum contaminant level (MCL), the MCL. To determine background concentrations, an upper tolerance limit (UTL) was calculated using pooled data from the background wells collected during the background monitoring and assessment monitoring events.

Confidence intervals were re-calculated for Appendix IV parameters at the compliance wells to assess whether these parameters were present at a statistically significant level (SSL) above the GWPSs. An SSL was concluded if the lower confidence limit (LCL) of a parameter exceeded the GWPS (i.e., if the entire confidence interval exceeded the GWPS). An SSL was identified for cobalt at AD-28 at the WBAP, where the LCL of 0.0135 milligrams per liter (mg/L) exceeded the calculated GWPS of 0.0090 mg/L (Geosyntec, 2021a). No other SSLs were identified.

1.1 CCR Rule Requirements

TCEQ regulations (TCEQ, 2020a) regarding assessment monitoring programs for CCR landfills and surface impoundments provide owners and operators with the option to make an ASD when an SSL is identified (30 TAC §352.951(e)). In making a demonstration under this section, the owner or operator must:

> *Within 90 days of detecting a statistically significant level above the groundwater protection standard of any constituent listed in Appendix IV adopted by reference in § 352.1431 of this title, submit a report prepared and certified in accordance with § 352.4 of this title (relating to Engineering and Geoscientific Information) to the executive director, and any local pollution*

agency with jurisdiction that has requested to be notified, demonstrating that a source other than a CCR unit caused the exceedance or that the exceedance resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality.

Pursuant to 30 TAC § 352.951(e), Geosyntec Consultants, Inc. (Geosyntec) has prepared this ASD report to document that the SSL identified for cobalt at AD-28 is from a source other than the WBAP.

1.2 Demonstration of Alternative Sources

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

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

A demonstration was conducted to show that the SSL identified for cobalt at AD-28 was based on a Type IV cause and not by a release from the Pirkey WBAP.

SECTION 2

ALTERNATIVE SOURCE DEMONSTRATION

The TCEQ CCR rules allows the owner or operator 90 days from the determination of an SSL to demonstrate that a source other than the CCR unit caused the SSL. Descriptions of the regional geology and site hydrogeology and the methodology used to evaluate the SSL identified for cobalt and the proposed alternative source are described below.

2.1 Regional Geology/Site Hydrogeology

The WBAP is positioned on an outcrop of the Eocene-age Recklaw Formation, which consists predominantly of clay and fine-grained sand (Arcadis, 2016). The Recklaw Formation is underlain by the Carrizo Sand, which crops out in the topographically lower southern portion of the plant. The Carrizo Sand consists of fine to medium grained sand interbedded with silt and clay.

The WBAP monitoring well network monitors groundwater within the uppermost aquifer, which was defined by Arcadis (2016) as very fine to fine grained clayey and silty sand located about 7 feet below the WBAP with an average thickness of approximately 15 feet. Geologic cross-section A-A' from the Arcadis (2016) shows the subsurface structure of the uppermost aquifer (indicated on the figure as clayey silty sand, tan to gray) underlying the WBAP and the East Bottom Ash Pond (EBAP). This figure as well as a cross-section location map is provided as **Attachment A**. Geologic cross-section A-A' demonstrates lateral continuity of the uppermost aquifer spanning the entire length of the WBAP.

Groundwater flow direction in the area of the WBAP is west-southwesterly (**Figure 1**). Seasonal variability in groundwater flow has not been observed since the monitoring well network was installed. Groundwater flow velocities in the Uppermost Aquifer in the area of the WBAP have been reported as approximately 5 to 40 feet/year. The WBAP monitoring well network consists of upgradient monitoring wells AD-3 and AD-17, and compliance wells AD-12, AD-18, AD-28, AD-29, and AD-30, all of which are screened within the uppermost aquifer.

2.2 Proposed Alternative Source

An initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify alternative sources for cobalt due to Type I (sampling), Type II (laboratory), Type III (statistical evaluation), or Type V (alternative: anthropologic) issues. Groundwater sampling, laboratory analysis, and statistical evaluations were generally completed in accordance with the 30 TAC §352.931 and draft TCEQ guidance for groundwater monitoring (TCEQ, 2020b). As described below, the SSL has been attributed to natural variation associated with the underlying geology, which is a Type IV (natural variation) issue.

Monitoring well AD-28 is located near the southwest corner of the WBAP, as shown in **Figure 1**. Previous ASDs for cobalt at the WBAP provided evidence that cobalt is present in the aquifer

media at the site and that the observed cobalt concentrations were due to natural variation of native geogenic sources (Geosyntec, 2019a; Geosyntec, 2019b; Geosyntec, 2020b; Geosyntec, 2020c; Geosyntec, 2021a; Geosyntec, 2021b). The previous ASDs discussed how the WBAP was not a source for cobalt in downgradient groundwater, based on observed concentrations of cobalt both in the ash material and in leachate from Synthetic Precipitation Leaching Procedure (SPLP) analysis (SW-864 Test Method 1312 [USEPA, 1994]) of the ash material. Cobalt was not detected in the SPLP leachate above the reporting limit of 0.01 mg/L, which is lower than the average concentration at AD-28 (**Table 1**).

A surface water sample was collected from the WBAP in November 2020 to characterize the total cobalt concentrations. Cobalt was detected at a concentration of 0.000501 mg/L in this sample. No changes to material handling or plant operations have occurred which would change the anticipated cobalt concentrations in the WBAP since this sample was collected. The WBAP ceased receipt of CCR and non-CCR waste streams in March 2022 and commenced closure by removal activities (AEP, 2022). The cobalt concentration from the November 2020 surface water sample is lower than all reported cobalt concentrations for in-network wells from the from the most recent WBAP sampling event, and over an order of magnitude lower than the average concentration observed at AD-28 (**Figure 2; Table 1**). Thus, the WBAP is not the likely source of cobalt at AD-28.

As noted in the previous ASDs, soil samples collected across the site, including from locations near the WBAP, identified cobalt in the aquifer solids at varying concentrations. SB-28 was advanced in the vicinity of AD-28 in April 2020 to re-log the geology at AD-28 and collect samples for laboratory analysis of total metals and mineralogy. The SB-28 field boring log, which was generated by Auckland Consulting LLC, is provided as **Attachment B**. Cobalt was identified at SB-28 at concentrations of 4.53 milligrams per kilogram (mg/kg) at 15.5-16 feet below ground surface (bgs) and 8.70 mg/kg at 40-41 feet bgs (**Table 2**). The 15.5-16 feet bgs interval at SB-28 correlates to the depth of the monitoring well screen of AD-28 (15-35 feet bgs), indicating that naturally occurring cobalt is present in aquifer solids within the AD-28 screened interval. Cobalt was also identified in the aquifer solids at varying concentrations at other locations throughout the site, with the highest value of 23.5 mg/kg reported at AD-41, which is upgradient of the WBAP (**Figure 3**).

In addition to the analysis of total cobalt, soil samples were submitted for mineralogical analysis to determine the mineral composition of soils near the WBAP. X-ray diffraction (XRD) analysis of soils from SB-28 identified pyrite (an iron sulfide mineral) in samples collected at 25-30 feet bgs and 40-41 feet bgs at concentrations up to 3% by weight (**Table 3**). Cobalt is known to undergo isomorphic substitution for iron in crystalline iron minerals such as pyrite due to their similar ionic radii of approximately 1.56 angstrom (Å) for iron vs. 1.52 Å for cobalt (Clementi and Raimondi, 1963; Krupka and Serne, 2002; Hitzman et al., 2017). The presence of iron-bearing minerals in soil near the EBAP constitutes a potential source of naturally occurring cobalt.

The aquifer solids at SB-28 are distinctly red in color at shallow depths, as illustrated in the photolog of soil cores provided in **Attachment C.** Red color in soils is often associated with the presence of oxidized iron-bearing minerals such as hematite and goethite. Goethite, an iron

hydroxide mineral (FeOOH), was present at depths up to 16 ft bgs at SB-28 at up to 37% of the total aquifer solids (**Table 3**). The alteration of pyrite to goethite under oxidizing conditions is a well-understood phenomenon, including in formations in east Texas (Senkayi et al., 1986; Dixon et al., 1982). It is likely that the pyrite weathering process is resulting in the release of isomorphically substituted cobalt from the pyrite crystal structure as it undergoes oxidative weathering to iron oxide/hydroxide minerals.

As described in an ASD previously generated for the Pirkey Plant's EBAP, vertical aquifer profiling (VAP) was used to collect groundwater samples from upgradient locations B-2 and B-3 during the soil boring and sample collection process (Geosyntec, 2019b). A groundwater sample was also collected from AD-30, an existing well within the WBAP groundwater monitoring network. Solid phases within these groundwater samples were separated and submitted for analysis of chemical composition and mineralogy. For the VAP samples, separation was completed using a centrifuge due to the high abundance of suspended solids. For the groundwater sample at AD-30, the sample was filtered using a 1.5-micron filter. Based on total metals analysis, cobalt was identified both in the centrifuged solid material collected from upgradient VAP location B-3 [VAP-B3-(40-45)] and in the material retained on the filter after processing groundwater from permanent monitoring wells AD-30, B-2, and B-3 (**Table 2**). The concentrations of cobalt in the solid material retained after filtration were comparable to the bulk soil samples collected from the same locations.

The solid sample [VAP-B3-(40-45)] was submitted for mineralogical analysis via XRD and scanning electron microscopy (SEM) using an energy dispersive spectroscopic analyzer (EDS). The XRD results identified pyrite as approximately 3% of the solid phase (**Table 4**). Pyrite was identified during SEM/EDS analysis of lignite which is mined immediately adjacent to the site. Logging completed while the VAP boring was advanced identified coal at several intervals, including 45 and 48 ft bgs (**Figure 4**). Furthermore, SEM/EDS of both centrifuged solid samples [VAP-B3-(40-45) and VAP-B3-(50-55)] identified pyrite in backscattered electron micrographs by the distinctive framboidal morphology (Harris et al., 1981; Sawlowicz, 2000). Major peaks representing iron and sulfur were identified in the EDS spectrum, which further support the identification of pyrite (**Attachment D**). While cobalt was not identified in the EDS spectrum, it is likely present at concentrations below the detection limit.

The WBAP was not identified as the source of cobalt at AD-28 based on the low concentrations of cobalt in the pond itself. Cobalt concentrations at AD-28 are believed to be a result of natural variability within the aquifer. The presence of pyrite and iron oxides has been confirmed at AD-28 and across the Site. Naturally occurring cobalt is known to substitute for iron in pyrite, which is then known to weather to iron oxides/hydroxides. The weathering of pyritic minerals to iron oxide/hydroxide minerals may be resulting in the release of cobalt into groundwater from the crystal structure of these aquifer minerals.

2.3 Sampling Requirements

As the ASD presented above supports the position that the identified SSL is not due to a release from the Pirkey WBAP, the unit will remain in the assessment monitoring program. Groundwater at the unit will continue to be sampled for Appendix IV parameters on a semi-annual basis.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

The preceding information serves as the ASD prepared in accordance with 30 TAC § 352.951(e) and supports the position that the SSL for cobalt identified at AD-28 during assessment monitoring in November 2021 was not due to a release from the WBAP. The identified SSL was instead attributed to natural variation in the underlying geology. Therefore, no further action is warranted, and the Pirkey WBAP will remain in the assessment monitoring program. Certification of this ASD by a qualified professional engineer is provided in **Attachment E**.

SECTION 4

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TABLES

Table 1: Summary of Key Analytical Data
West Bottom Ash Pond - H.W. Pirkey Plant

Sample	Sample Date	Unit	Cobalt Concentration
Bottom Ash (Solid Material)	2/11/2019	mg/kg	5.8
SPLP Leachate of Bottom Ash	2/11/2019	mg/L	<0.01
WBAP Pond Water	11/4/2020	mg/L	0.000501
AD-28 - Average	May 2016 - November 2021	mg/L	0.0143

Notes:
mg/kg - milligram per kilogram
mg/L - milligram per liter
An average value was calculated for AD-28 using all cobalt data collected under 40 CFR 257 Subpart D

Table 2: Soil Cobalt Data *Geosyntec Consultants, Inc.*
West Bottom Ash Pond - H.W. Pirkey Plant

Location ID	Location	Sample Depth (ft bgs)	Cobalt (mg/kg)
Bulk Soil Samples			
AD-28	WBAP Network	6-6.5	< 2.38
		15.5-16	4.53
		25-30	< 2.50
		40-41	8.70
AD-30	WBAP Network	7	1.00
		23	15.0
B-2	Upgradient	10	2.36
		16	3.62
		71	10.30
		82	7.21
		87	3.11
B-3	Upgradient	10	1.30
		20	0.59
		97	1.11
AD-41	Upgradient	15	<1.0
		35	23.5
		95	1.90
Solid Material Retained After Filtration			
AD-30	WBAP Network	15-25	9.3 J
B-2	Upgradient	38-48	4.3 J
B-3	Upgradient	29-34	12.0
		VAP 40-45	18.0

Notes:
mg/kg- milligram per kilogram
ft bgs - feet below ground surface
J = estimated value

For AD-28 and AD-30, samples were collected from additional boreholes advanced in the immediate area of the location identified by the well ID. Samples were not collected from the cuttings of the borings advanced for well installation. Samples at B-2, B-3, and AD-41 were collected from cores removed from the borehole during well lithology logging.

Depths for samples collected after filtration represent the screened interval for the permanent well where the sample was collected.

Table 3 - AD-28 Mineralogy Results
West Bottom Ash Pond - H. W. Pirkey Plant

Boring ID	**SB-28 (AD-28)**			
Sample Depth Interval	6-6.5	15.5-16	25-30	40-41
Sample Location	Above Screened Interval	Within Screened Interval		Below Screened Interval
Color	Red-brown to yellow-brown	Light gray, light red-brown	Brown, light red-brown	Gray to dark gray
Mineralogy				
Quartz	58%	46%	73%	34%
Pyrite	--	--	3%	3%
K-Feldspar	--	1%	1%	1%
Siderite	--	--	2%	52%
Goethite	37%	15%	--	--
Anhydrite	--	--	--	2%
Clay/Mica	5%	38%	21%	8%

Notes:

Sample depths are shown in feet below ground surface (bgs)

Well AD-28 is screened from 15-35 ft. below ground surface.

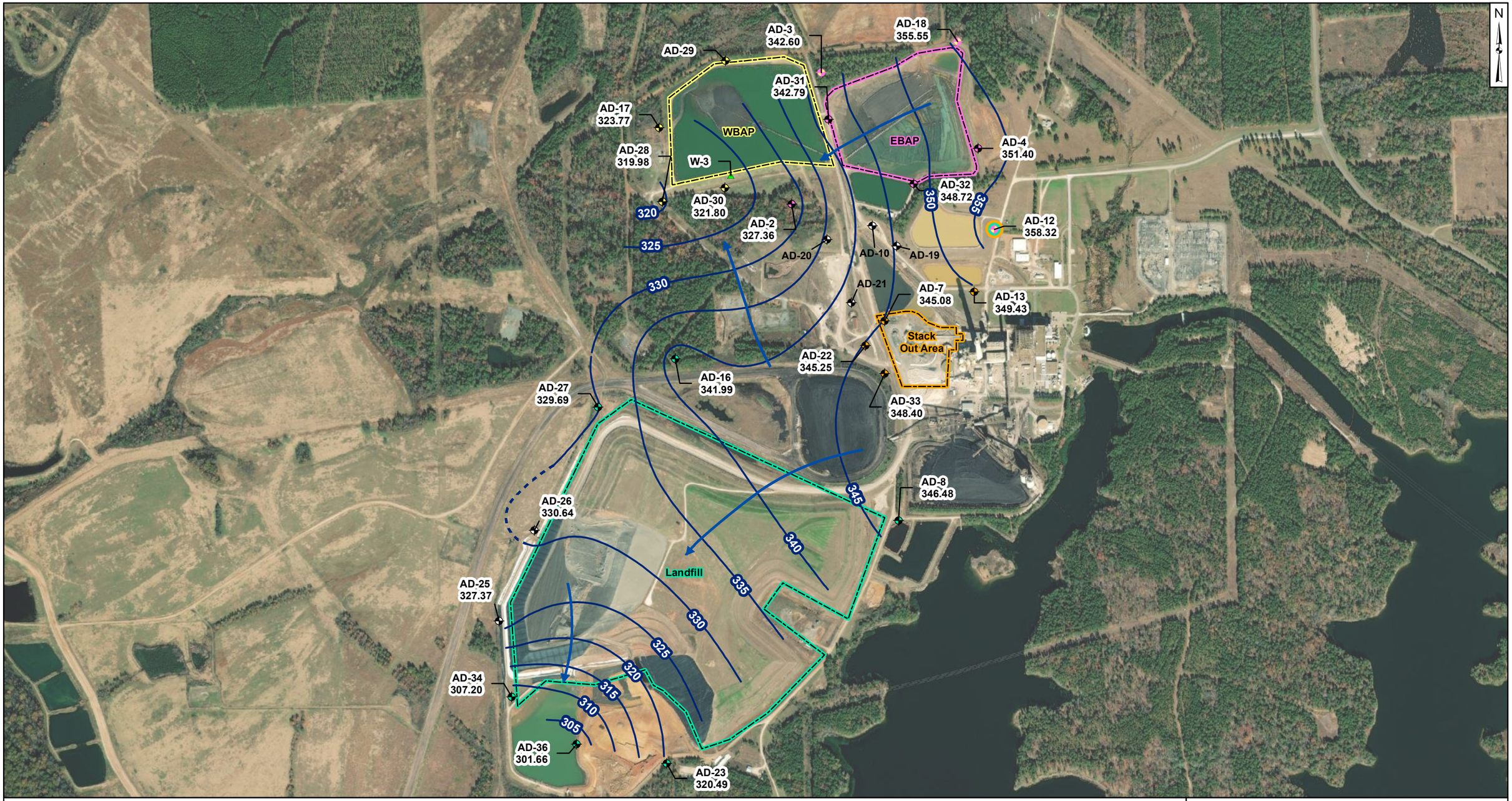
Mineralogical component results are given in relative % abundance.

Table 4: B-3 X-Ray Diffraction Results
West Bottom Ash Pond - H. W. Pirkey Plant

Constituent	VAP-B3-(40-45)
Quartz	15
Plagioclase Feldspar	0.5
Orthoclase	ND
Calcite	ND
Dolomite	ND
Siderite	0.5
Goethite	ND
Hematite	2
Pyrite	3
Kaolinte	42
Chlorite	4
Illite/Mica	6
Smectite	12
Amorphous	15

Notes:
ND: Not detected
Results given in units of relative % abundance
VAP-B3-(40-45) is the centrifuged solid material from the groundwater sample collected at that interval.

FIGURES



Legend

Groundwater Monitoring Wells

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP

- All CCR Unit Networks
- Piezometer
- Groundwater Elevation Contour
- Groundwater Elevation Contours (Inferred)
- Approximate Groundwater Flow Direction

Notes

- Monitoring well coordinates and water level data (collected on November 15 - 17, 2021) provided by AEP.
- Site features based on information available in CCR Groundwater Monitoring Well Network Evaluation (Arcadis, 2016) provided by AEP.
- Groundwater elevation units are feet above mean sea level.
- East and West Bottom Ash Ponds have compacted cohesive soil from elevation 344 to 347 ft. msl (Sargent and Lundy, 1984; AMEC, 2011).
- Clearwater pond base elevation is 344 ft. msl (Sargent and Lundy, 1983).
- AD-10, AD-19, AD-20, AD-21, AD-29, AD-35, and W-3 were not gauged during the May 2021 event.

1,000 500 0 1,000 Feet

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Jan 14, 2022

Geosyntec Consultants, Inc.
Texas Firm
Registration No. 1182

Potentiometric Contours - Uppermost Aquifer
November 2021

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 01/13/2022

Figure 1

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2021\AEP-Pirkey_GW_2021-November.mxd. ASoltero. 1/13/2022. Project/Phase/Task.

AD-3	Results (mg/L)
	0.00587

B-2	Results (mg/L)
	0.00629

AD-18	Results (mg/L)
	0.000801

WBAP	Results (mg/L)
	0.000501

EBAP	Results (mg/L)
	0.000080

AD-17	Results (mg/L)
	0.0118

AD-40*	Results (mg/L)
	0.00159

AD-41*	Results (mg/L)
	0.00801

B-3	Results (mg/L)
	0.00703

AD-30	Results (mg/L)
	0.00455

AD-28	Results (mg/L)
	0.0114

AD-12	Results (mg/L)
	0.00138

AD-29
AD-31
AD-4
AD-32
AD-37
AD-42
AD-43
AD-44
AD-45
AD-38
HPT-05
HPT-09
W-3
AD-2
AD-10
AD-20
AD-19
AD-15
AD-13
AD-21
AD-7
Clearwater Pond
Stack Out Area
WBAP
EBAP

Legend

- Out of Network
- EBAP
- WBAP
- Landfill
- Stackout Area
- EBAP and WBAP
- All CCR Unit Networks
- Piezometer
- EBAP
- Stack Out Area
- WBAP

Notes
- Monitoring well coordinates, site features, and data provided by AEP.
- AD-15 location is approximated
- Samples collected in November 2021
- * - Well most recently sampled August 2019
- AD-29 included in the well network for water level measurements only
- EBAP surface water sample was collected in June 2020
- WBAP surface water sample was collected in November 2020

400 200 0 400 Feet

Aqueous Cobalt Distribution

AEP Pirkey Power Plant
Hallsville, Texas

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Figure **2**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\2021\AEP_WBAP_Pirkey_Cobalt_20210430.mxd. HDuff. 4/30/2021. Project/Phase/Task.

Location	AD-31	
Depth (ft bgs)	12	26
Cobalt (mg/kg)	1.9	0.83
Pyrite/Marcasite (%)	2	0

Location	AD-18	
Depth (ft bgs)	8	22
Cobalt (mg/kg)	3.6	2.9
Pyrite/Marcasite (%)	1	0

Location	B-2				
Depth (ft bgs)	10	16	71	82	87
Cobalt (mg/kg)	2.36	3.62	10.30	7.21	3.11
Pyrite/Marcasite (%)	-	-	-	-	-

Location	AD-17	
Depth (ft bgs)	7	15
Cobalt (mg/kg)	3.1	1.5
Pyrite/Marcasite (%)	2	0

Location	AD-41		
Depth (ft bgs)	15	35	95
Cobalt (mg/kg)	< 1.0	23.5	1.9
Pyrite/Marcasite (%)	-	-	-

Location	AD-2	
Depth (ft bgs)	25-27	31-33
Cobalt (mg/kg)	9.45	19.2
Pyrite/Marcasite (%)	7	2

Location	B-3		
Depth (ft bgs)	10	20	97
Cobalt (mg/kg)	1.30	0.59	1.11
Pyrite/Marcasite (%)	-	-	-

Location	AD-28			
Depth (ft bgs)	6 – 6.5	15.5 - 16	25 - 30	40 - 41
Cobalt (mg/kg)	< 2.38	4.53	< 2.50	8.7
Pyrite/Marcasite (%)	0	0	3	3

Location	AD-30	
Depth (ft bgs)	7	23
Cobalt (mg/kg)	1	15
Pyrite/Marcasite (%)	3	1

Location	AD-32	
Depth (ft bgs)	11	20-25
Cobalt (mg/kg)	1.7	9.1
Pyrite/Marcasite (%)	--	--

AD-29 AD-3 AD-18 B-2 AD-40 AD-17 AD-31 WBAP EBAP HPT-05 AD-4 AD-41 B-3 W-3 AD-30 AD-2 AD-37 AD-28 Clearwater Pond AD-32 AD-10 AD-12 AD-20 AD-19

N

Legend

- Monitoring Wells
- EBAP
- WBAP

Notes
- Monitoring well coordinates provided by AEP.
- AD-2 and AD-28 samples collected on April 20, 2020
- All other data provided by AEP, 2019.
- ft bgs: feet below ground surface.
- mg/kg: milligrams per kilogram.
- -- not analyzed.

300 150 0 300 Feet

Cobalt Distribution in Soil

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2022/05/23

Figure 3

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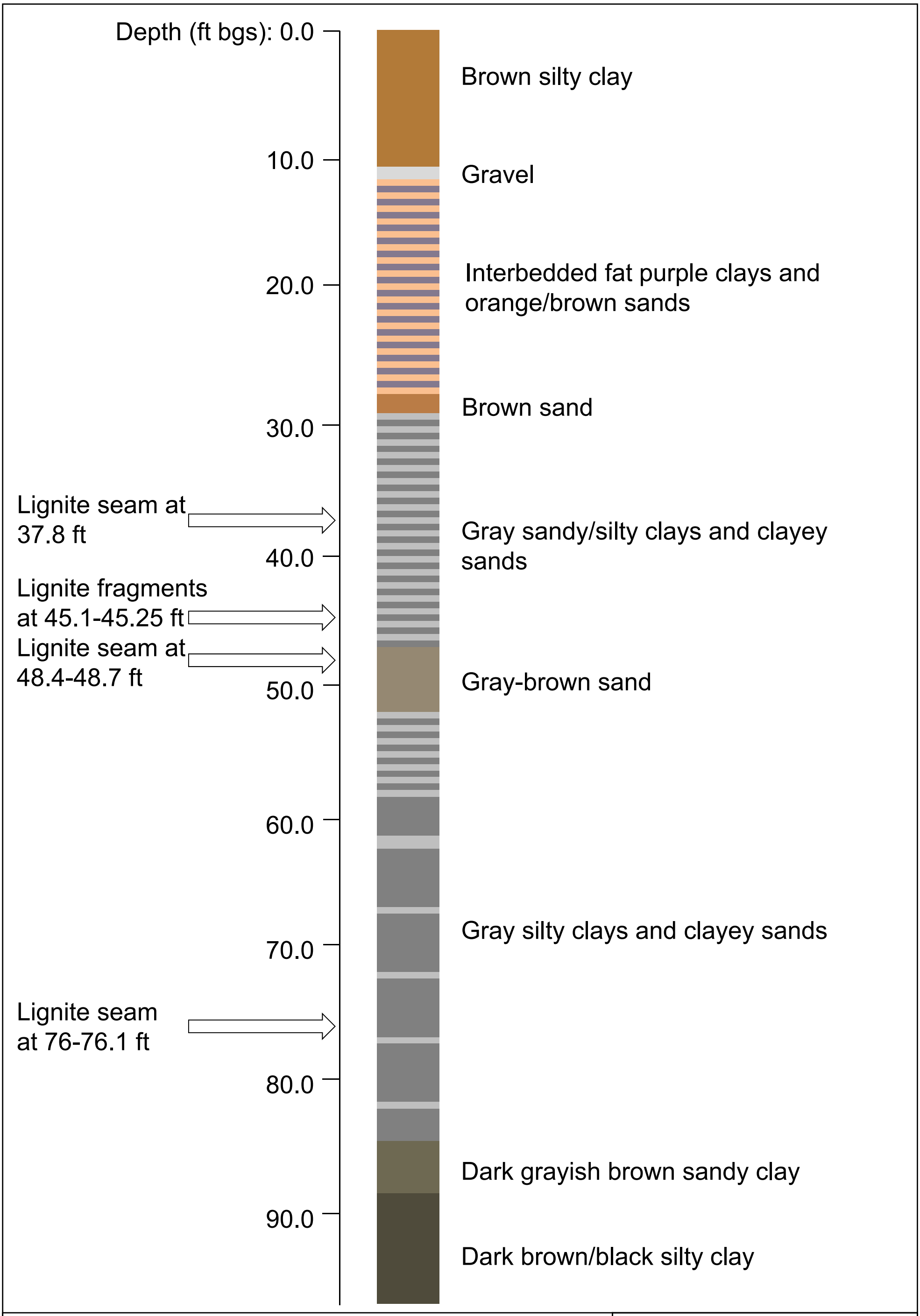


Notes:
- Ft = feet
- Bgs = below ground surface
- Boring completed May 2019
- Total depth of 97.5 ft bgs
- Well installed in offset boring screened at 29-34 ft bgs

B-3 Visual Boring Log

AEP Pirkey Powerplant
Hallsville, TX

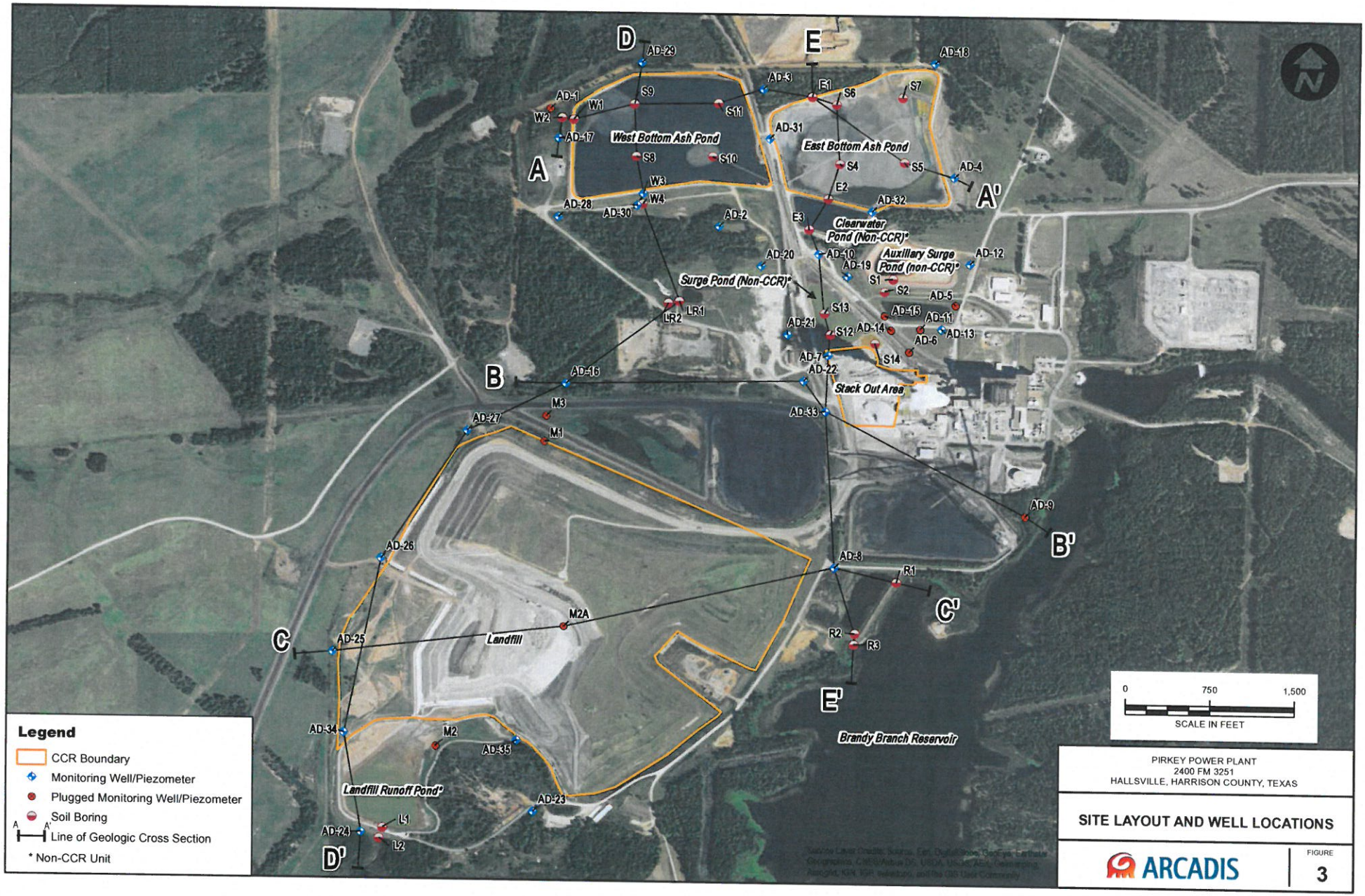
Geosyntec consultants

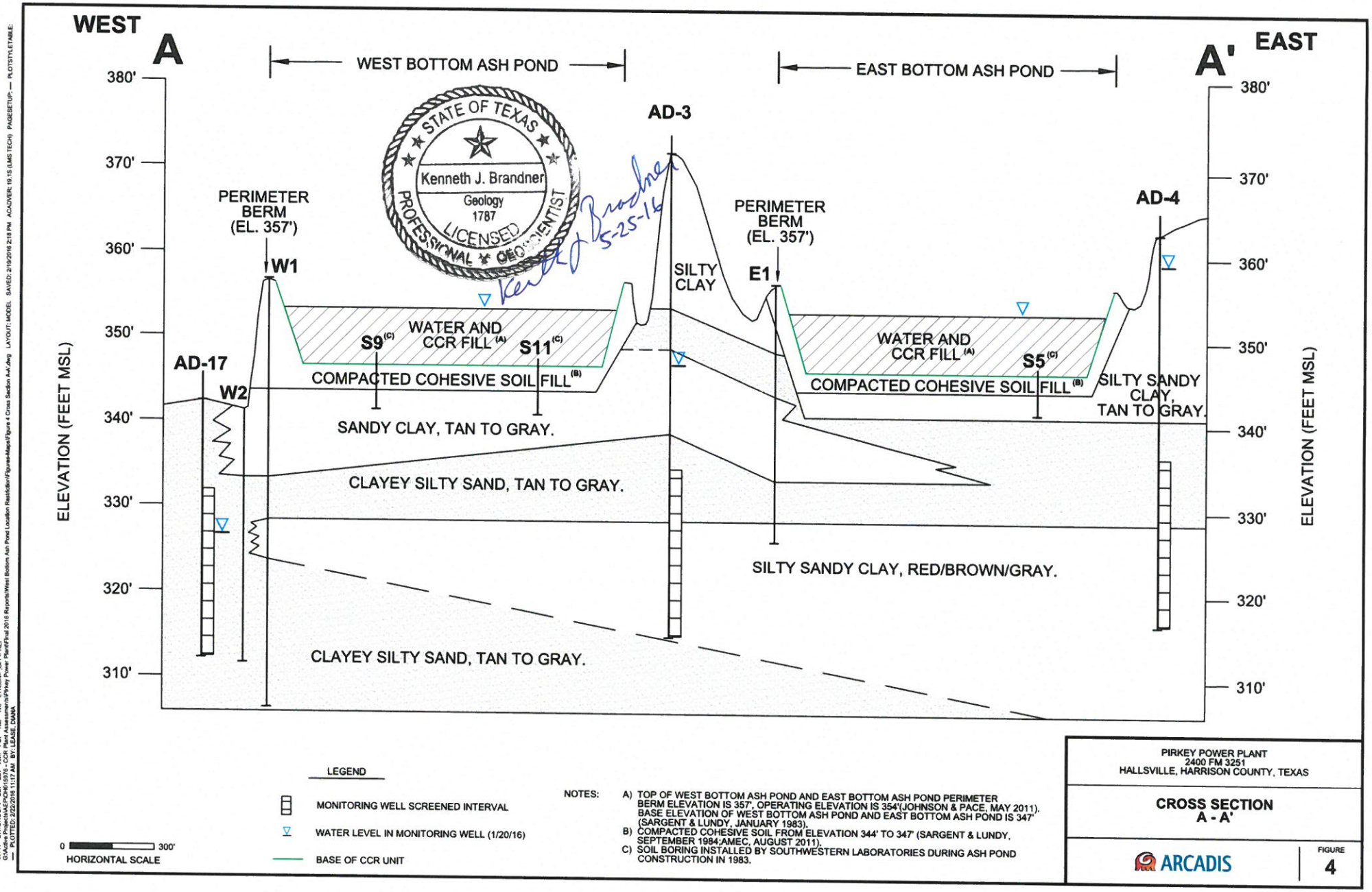
CHA8462 | March 2020

Figure 4

\\annarbor-01\data\Projects\AEP\Legal Department - ASD Review\Pirkey\2019-05 Field Investigation\Field Forms\Compiled Boring Logs\Visual boring logs

ATTACHMENT A
Geologic Cross-Section A-A'


D
E
A
A'
B
B'
C
C'
D'
E'
AD-29
AD-18
AD-3
AD-1
E1
S6
S7
S9
W1
S11
W2
AD-17
West Bottom Ash Pond
AD-31
East Bottom Ash Pond
S8
S10
S4
S5
AD-4
W3
E2
W4
AD-28
AD-30
AD-2
AD-32
E3
Clearwater Pond (Non-CCR)*
AD-20
AD-10
Auxiliary Surge Pond (non-CCR)*
AD-12
AD-19
S1
Surge Pond (Non-CCR)*
S2
AD-5
LR2
LR1
S13
AD-15
AD-11
AD-21
S12
AD-14
AD-13
AD-6
AD-7
S14
AD-16
AD-22
Stack Out Area
M3
AD-27
AD-38
M1
AD-9
AD-26
AD-8
R1
M2A
AD-25
Landfill
R2
R3
AD-34
M2
AD-35
Landfill Runoff Pond*
AD-23
AD-24
L1
L2
Brandy Branch Reservoir
0
750
1,500
SCALE IN FEET
Legend
CCR Boundary
Monitoring Well/Piezometer
Plugged Monitoring Well/Piezometer
Soil Boring
Line of Geologic Cross Section
* Non-CCR Unit
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS
SITE LAYOUT AND WELL LOCATIONS
ARCADIS
FIGURE
3
Document Path: Z:\GIS\PROJECTS_ENVAEP\Pirkey Plant\MXD\Figure 3 - Site Layout and Well Locations.mxd



LEGEND

- MONITORING WELL SCREENED INTERVAL
- WATER LEVEL IN MONITORING WELL (1/20/16)
- BASE OF CCR UNIT

0 300'
HORIZONTAL SCALE

NOTES:

A) TOP OF WEST BOTTOM ASH POND AND EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING ELEVATION IS 354'(JOHNSON & PACE, MAY 2011). BASE ELEVATION OF WEST BOTTOM ASH POND AND EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (SARGENT & LUNDY, SEPTEMBER 1984;AMEC, AUGUST 2011).
C) SOIL BORING INSTALLED BY SOUTHWESTERN LABORATORIES DURING ASH POND CONSTRUCTION IN 1983.

PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION
A - A'

ARCADIS

FIGURE
4

ATTACHMENT B
SB-28 Boring Log

PROJECT NO. _____ PROJ. _____ BOR. NO. SB-28

LOCATION AD-28/MW-28 - Pirkey Power Plant ELEV. _____ DATE 4/20/20

SILTS & SANDS		COHESIVE SOILS - CLAYS			COLORS	MATERIALS	SAND ADJ.	CHARACTERTICS
CONDITION		CONSISTENCY	PENETROMETER	N - VALUE	Li .... Light .....Br ....Brown	Cl ..... Clay, Clayer	F.....Fine	Calc ..... Calcareous
VLo ..... Very Loose	0- 4	Vso.. Very Soft	0 - 0.25	<2	Dk ... Dark .....Bk ....Black	Si ..... Silt, Silty	M ....Medium	Lig ..... Lignite
Lo ..... Loose	4-10	So.... Soft	0.25 - 0.5	2 - 4	G ..... Grey ....Bl ....Blue	Sa .... Sand, Sandy	Co....Coarse	Org ..... Organic
MDe ..... Med. Dense	10-30	Mst.. Stiff	0.5 - 1.0	4 - 8	T ..... Tan .....Gr ....Grenn	Ls .... Limestone	Si.....Silty	Lam ..... Laminate
De ..... Dense	30-50	St..... Stiff	1.0 - 2.0	8 - 15	R ..... Red .....Y .....Yellow	Gr .... Gravel		Sls ..... Slickensided
VDe ..... Very Dense	>50	VSt.. Very Stiff	2.0 - 4.0	15 - 30	Rdish.Reddish.Wh ...White	SiS ... Siltstone		SL ..... Slightly
		H..... Hard	> 4.0	>30		SS .... Sandstone		Sm(s) ... Seam (s)
						Sh..... Shale, Shaley		Nod ..... Nodules

Sample Interval - TEST ASSIGNMENT	SAMPLE NO. Recovery	DEPTH FT.	SAMPLES	STRATUM DESCRIPTION: CONDITION OR CONSISTENCY	COLOR	MINOR MATERIALS OR ADJECTIVES	PREDOMINATE MATERIAL	CHARACTERISTICS OR MODIFICATIONS	STANDARD PENETROMETER: SEAT - 6"	1st - 6"	2nd - 6"	UNIFIED SOIL CLASSIFICATION	N - VALUE OR HAND PENETROMETER
0													
0-5	4'			0-2	Br, Lt. Br, Lt. Rd Br	Si	Sa	Silty sand, trace clay & roots, trace fine rnd ore gravel,				moist	(0-2)
SM 2'		2		2-10'	Rd Br, Yllw Br	Si, Gr	Cl	Clay - some silt, trace vf. sand, trace coarse iron ore concretions,				moist	(2-5)
CL												moist	(5-10)
5-10	1.5'							- some vf. sand, ironstone layer @ 6-6.5					
10'								clayey vf to f					
10-15	1'	10		10'-16'	Rd Br, Lt. Gr	Si Cl	Sa	Silty Sand with clay in thin lenses, trace cemented clayey sand				V. Moist	(10-15)
SC-SM													
15-20	1.5'				Lt. Gr & Lt. Rd Br			- clay lense @ 15' (6")				v. moist	(15-16)
16'								- ironstone layer @ 15.5' & cemented sand to 16'					
SM													
20-25	3"			16-40	Br, Lt. Rd Br	Si	Sa	Silty Sand - some ironstone				Saturated @ 16' to 40'	
					Gray			- gray @ 20'					
25-30	3"							+ some cemented clayey sand (only recovery @ 25-30')		(only recovery @ 25-30')			
30-35	NR												
35-40	NR												
								B.T. @ 40'					
40'													
SC								* Split Spoon Driven from 40-41'					
40-41	1'			40-41	Gray, Dk Gray	Cl	Sa	clayey sand w/ lenses of cemented sand @ 41.5-41.75				V. Moist	40-41
								trace gypsum crystals @ 40-41'					
								* 6-6.5' collected @ 1140					
								* 15.5-16' collected @ 1215					
								* 25-30' collected @ 1230					
								* 40-41' collected @ 1300					

Type Boring HSA Dry Auger ☒ Rotary Wash ☐

SEEPAGE @ 16 FT. WHILE DRILLING, W.L. @ ___ FT. ON COMPL.
(OR) BAILED TO ___ FT. UPON COMPLETION.
W.L. @ ___ FT AND CAVED TO ___ FT. ON _____.

* GPS: 32.46544°, -94.49432 (18' W-NW of AD-28/MW-28)

ATTACHMENT C

SB-28 Boring Photographic Log

GEOSYNTEC CONSULTANTS
Photographic Record

Geosyntec consultants

Client: American Electric Power	**Project Number: CHA8495/12A/02**
Site Name: H.W. Pirkey Plant WBAP	**Site Location: Hallsville, Texas**

Photograph 1

Date: 4/21/2020

Direction: N/A

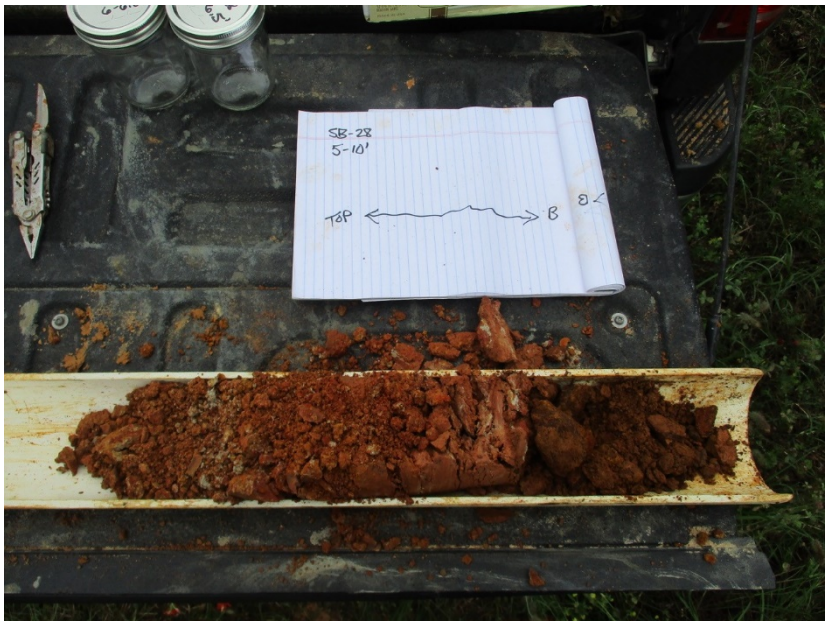
Comments:
Multiple sections of core from soil boring SB-28 advanced near downgradient monitoring well AD-28 within the Western Bottom Ash Pond (WBAP) CCR unit. 5-foot pushes were used. Note the reddish color indicating the presence of oxidized iron-bearing minerals.

Photograph 2

Date: 4/21/2020

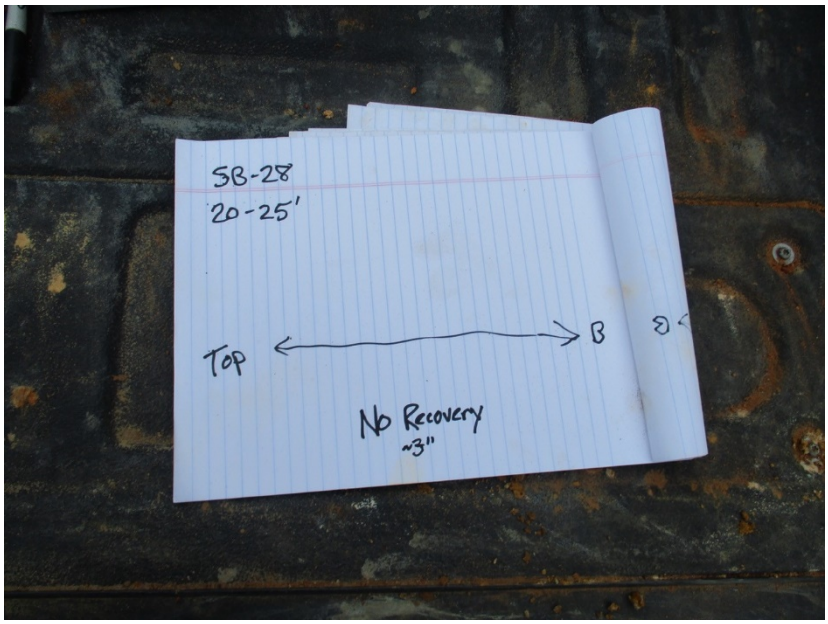
Direction: N/A

Comments:
0-5 foot interval of SB-28.

Photograph 3	
Date: 4/21/2020	
Direction: N/A	
Comments: 5-10 foot interval of SB-28. Recovery of this interval was limited. A sample was collected from this interval from 6-6.5 ft. below ground surface (bgs).	

Photograph 4	
Date: 4/21/2020	
Direction: N/A	
Comments: 10-15 foot interval of SB-28. Recovery of this interval was limited.	

Photograph 5	
Date: 4/21/2020	
Direction: N/A	
Comments: 15-20 foot interval of SB-28. Recovery of this interval was limited. A sample was collected from this interval from 15.5-16 ft. bgs.	

Photograph 6	
Date: 4/21/2020	
Direction: N/A	
Comments: Field geologist's note indicating that very little of the 20-25 foot interval of SB-28 was recovered.	

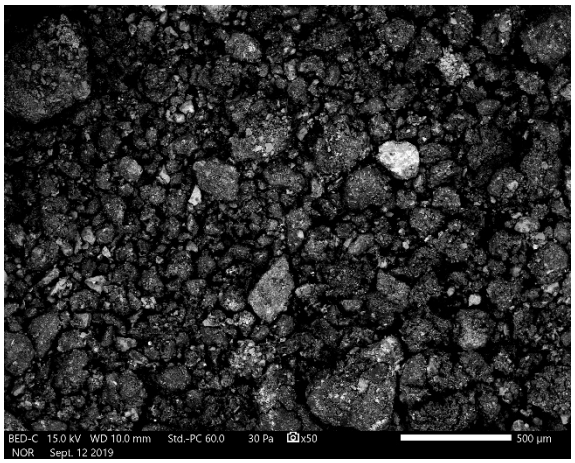
Photograph 7	
Date: 4/21/2020	
Direction: N/A	
Comments: 25-30 foot interval of SB-28. Very little of this interval was recovered. Note the color change of the soil from red to dark brown/black. A sample was collected from this interval.	

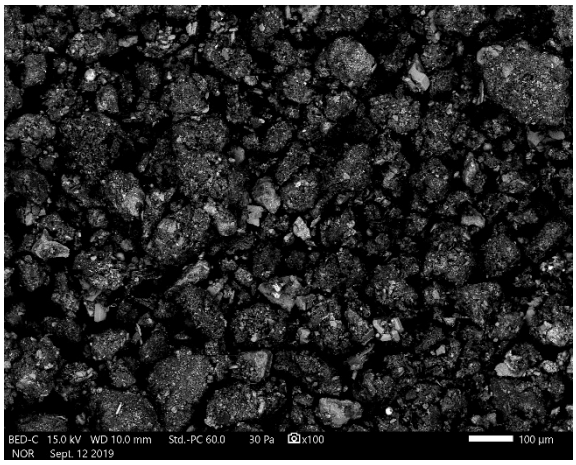
Photograph 8	
Date: 4/21/2020	
Direction: N/A	
Comments: Bottom of SB-28. The boring log indicates no recovery of soil from the 30-40 foot interval. A sample was collected from this interval.	

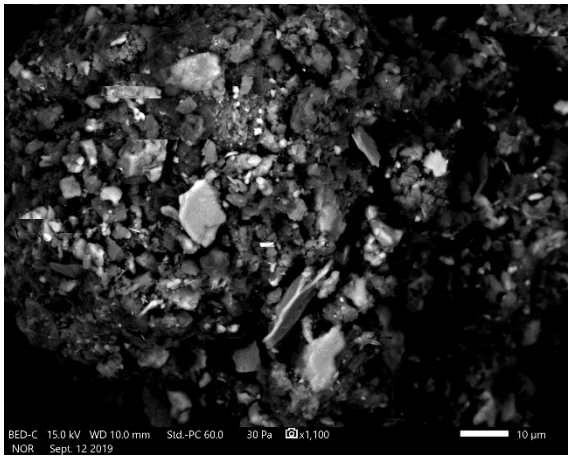
ATTACHMENT D
SEM/EDS Analysis

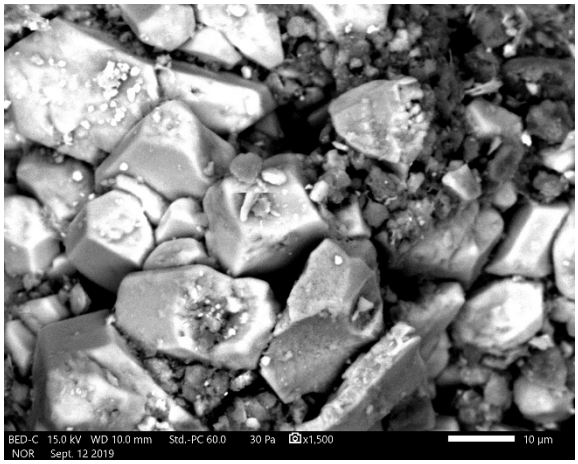
September 16, 2019

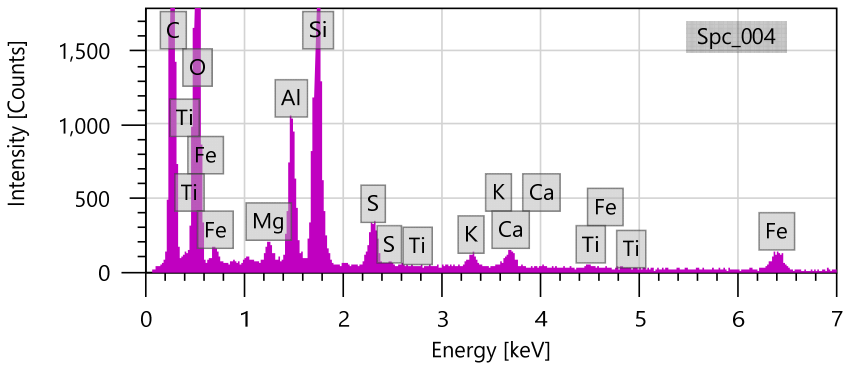
Dr. Bruce Sass
941 Chatham Lane, Suite 103, Columbus, OH 43221
via Email: BSass@geosyntec.com



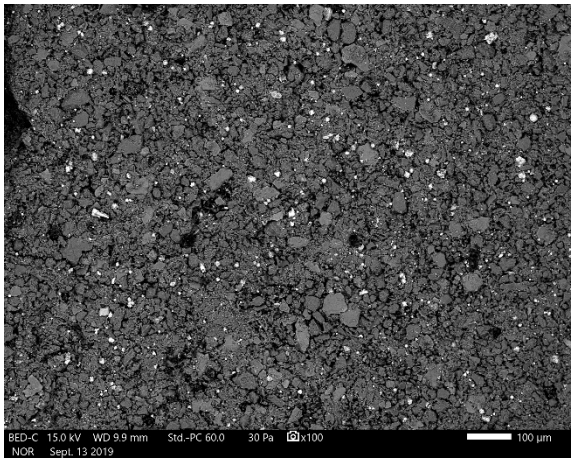


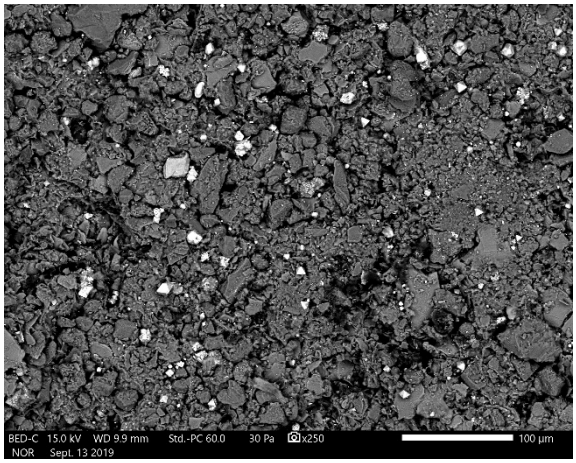


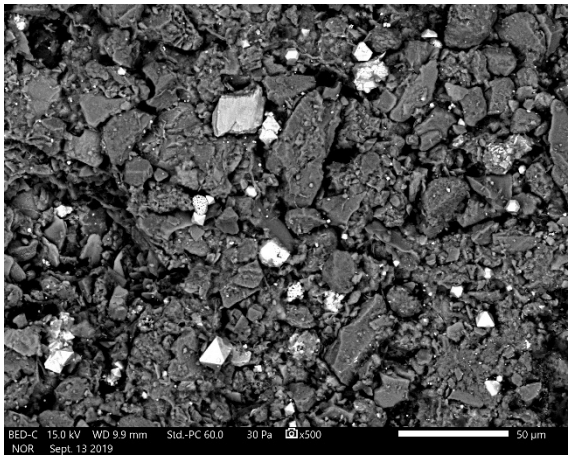


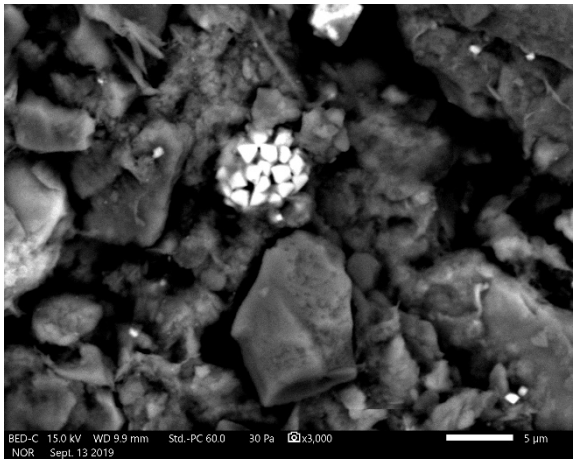


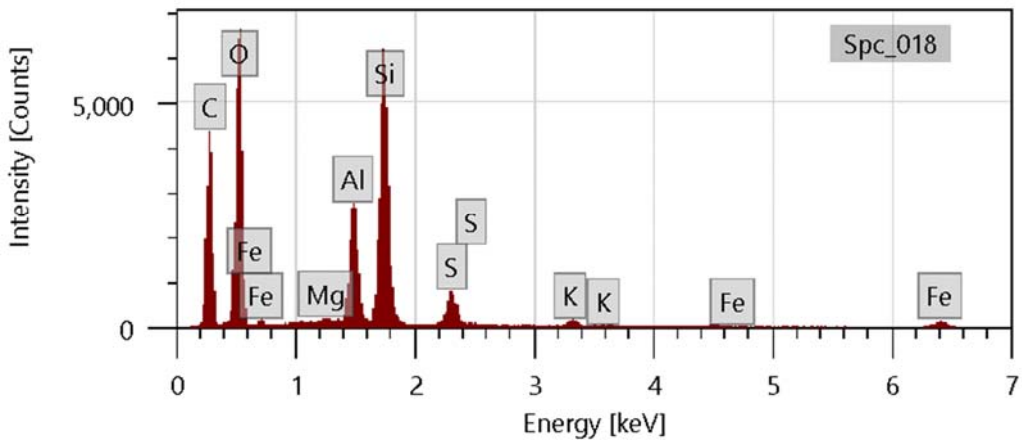
Lignite. Backscattered electron micrographs show the sample at 100X, 1,100X, and 1,500X. EDS spectrum at bottom is an area scan of the region shown in top right micrograph. Bright particles are mostly quartz and feldspar. Major peaks for carbon, oxygen, silicon, and aluminum suggest coal and clay.



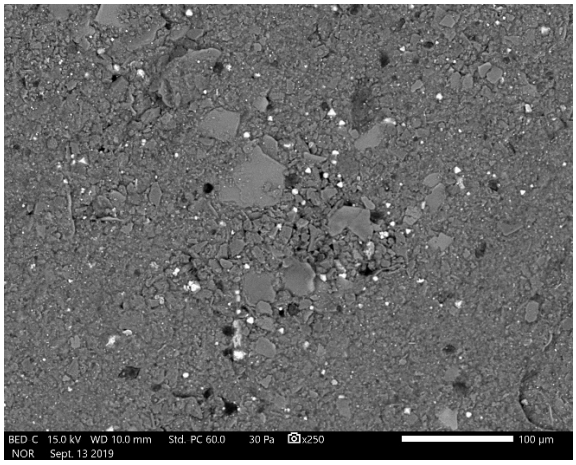


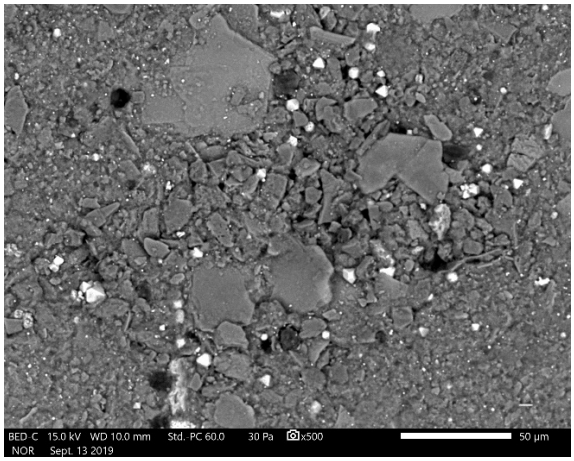


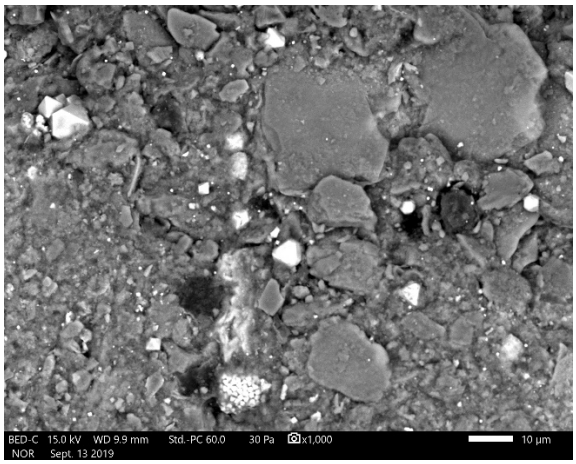


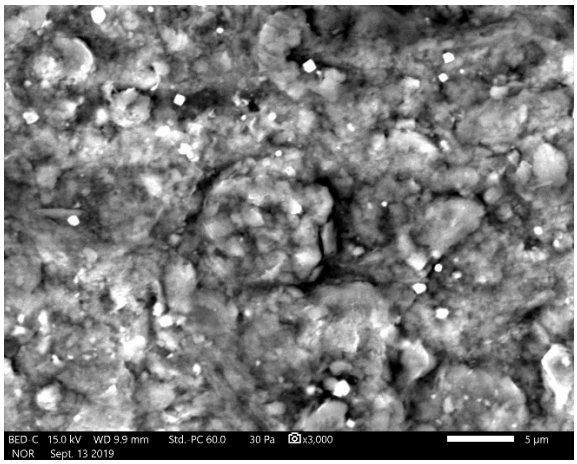


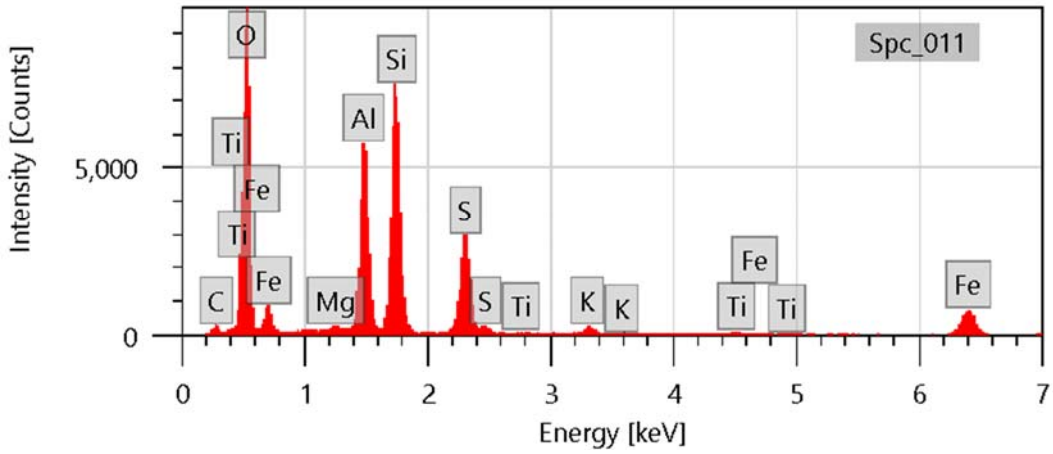
Sample VAP B3 40-45. Backscattered electron micrographs show the sample at 100X, 250X, 500X, and 3000X. EDS spectrum at bottom is an area scan of the region shown at 500X. Bright particles are pyrite (framboid in bottom right micrograph). Major peaks for carbon, oxygen, silicon, and aluminum suggest coal and clay.











Sample VAP B3 50-55. Backscattered electron micrographs show the sample at 250X, 500X, 1000X, and 3000X. EDS spectrum at bottom is an area scan of the region shown at 3000X. Bright particles are mostly pyrite (framboid in bottom left micrograph); occasional particles of Fe-Ti oxide are detected. Major peaks for oxygen, silicon, and aluminum suggest clay. Large blocky particles are mostly quartz, feldspar, and clay.

ATTACHMENT E
Certification by a Qualified Professional Engineer

CERTIFICATION BY A QUALIFIED PROFESSIONAL ENGINEER

I certify that the selected and above described alternative source demonstration is appropriate for evaluating the groundwater monitoring data for the Pirkey West Bottom Ash Pond CCR management area and that the requirements of 30 TAC § 352.951(e) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Beth Ann Gross
Signature

Geosyntec Consultants
2039 Centre Pointe Blvd, Suite 103
Tallahassee, Florida 32308

Texas Registered Engineering Firm
No. F-1182

79864	Texas	6/16/2022
License Number	Licensing State	Date