ALTERNATIVE SOURCE DEMONSTRATION REPORT FEDERAL CCR RULE

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

Submitted to

AMERICAN ELECTRIC POWER

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CHA8495

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ATTACHMENTS

LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
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
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) following the first semiannual detection monitoring event of 2020. The WBAP is registered as a surface impoundment under Texas Commission on Environmental Quality (TCEQ) Industrial and Hazardous Waste Solid Waste Registration No. 33240.

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the West Bottom Ash Pond (**Figure 1**). In June 2020, a semi-annual assessment monitoring event was conducted at the WBAP in accordance with 40 CFR 257.95(d)(1). 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 (AEP, 2017) 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 the background concentration and the maximum contaminant level (MCL) or, for constituents without an MCL, the risk-based level specified in 40 CFR 257.95(h)(2). 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 0.0134 milligrams per liter (mg/L) exceeded the calculated GWPS of 0.009 mg/L (Geosyntec, 2020a). No other SSLs were identified.

1.1 CCR Rule Requirements

USEPA regulations regarding assessment monitoring programs for CCR landfills and surface impoundments provide owners and operators with the option to make an alternative source demonstration when an SSL is identified (40 CFR 257.95(g)(3)(ii)). An owner or operator may:

> *Demonstrate that a source other than the CCR unit caused the contamination, or that the statistically significant increase resulted from error in sampling, analysis, statistical evaluation, or natural variation in groundwater quality. Any such demonstration must be supported by a report that includes the factual or evidentiary basis for any conclusions and must be certified to be accurate by a*

qualified professional engineer or approval from the Participating State Director or approval from EPA where EPA is the permitting authority. If a successful demonstration is made, the owner or operator must continue monitoring in accordance with the assessment monitoring program pursuant to this section.

Pursuant to 40 CFR 257.95(g)(3)(ii), 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 Federal CCR Rule 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. The methodology used to evaluate the SSL identified for cobalt and the proposed alternative source are described below.

2.1 Proposed Alternative Source

An initial review of site geochemistry, site historical data, and laboratory quality assurance/quality control (QA/QC) data did not identify ASDs due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. Groundwater sampling, laboratory analysis, and statistical evaluations were generally completed in accordance with the Federal CCR Rule and draft TCEQ guidance for groundwater monitoring (TCEQ, 2020). 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 to show that cobalt is present in the aquifer media at the site and that the observed cobalt concentrations were due to natural variation (Geosyntec, 2019a; Geosyntec, 2019b; Geosyntec, 2020b). The previous ASDs discussed how the WBAP itself did not appear to be 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 (**Table 1**).

To support this ASD determination, a grab sample of the pond water was collected from the WBAP on November 4, 2020. Cobalt was detected at a concentration of 0.000501 mg/L in the WBAP sample (**Table 1**). This concentration is lower than all reported cobalt concentrations for in network wells from the most recent 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.

Groundwater cobalt concentrations at the Site vary considerably, even within upgradient monitoring wells. The most recent cobalt concentrations from upgradient wells vary from 0.000799 mg/L at AD-40 to 0.0108 mg/L at B-3 (**Figure 2**). The reported cobalt concentration at downgradient well AD-28, which was identified as an exceedance, was only slightly above the value reported at B-3. The range of cobalt concentrations provides evidence for natural variation of cobalt at the Site, particularly as the concentration at upgradient well B-3 exceeds the GWPS for the WBAP.

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, generated by Auckland Consulting LLC, is provided as **Attachment A**. 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 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 total cobalt, soil samples were submitted for mineralogical analysis to evaluate the presence of cobalt-containing minerals. X-ray diffraction (XRD) analysis of soils from SB-28 identified pyrite (an iron sulfide) in samples collected at 25-30 feet bgs and 40-41 feet bgs at concentrations up to 3% by weight (**Table 2, 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 aquifer solids at SB-28 are distinctly red in color at shallow depths, as illustrated in the photolog of soil cores provided in **Attachment B.** Red color in soils is often associated with the presence of oxidized iron-bearing minerals such as hematite and goethite. Goethite, an iron oxide 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 weathering of pyrite to goethite under oxidizing conditions is also 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 transformation to iron oxide minerals.

As described in an ASD previously generated for the Pirkey Plant's East Bottom Ash Pond, vertical aquifer profiling was used to collect groundwater samples from upgradient locations B-2 and B-3 during the soil boring and sample collection process (EBAP; Geosyntec, 2019c). 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. 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 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 involving iron and sulfur were identified in the EDS spectrum, which further support the identification of pyrite (**Attachment C**). While cobalt was not identified in the EDS spectrum, it is likely present at concentrations below the detection limit.

Naturally occurring cobalt is known to substitute for iron in pyrite, which is then known to weather to iron oxides. The presence of pyrite and iron oxides has been confirmed at AD-28 and across the Site. The presence of these aquifer minerals suggests that pyrite may be providing a source for aqueous cobalt in groundwater. Additionally, the pond was not identified as the source of cobalt at AD-28 based on the low concentrations of cobalt in the pond itself.

2.2 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 40 CFR 257.95(g)(3)(ii) and supports the position that the SSL for cobalt identified at AD-28 during assessment monitoring in June 2020 was not due to a release from the WBAP. The identified SSL was, instead, attributed to natural variation in the underlying geology, including the presence of pyrite and goethite in the solid aquifer material. 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 D**.

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	2/11/2019	mg/kg	5.8
SPLP Leachate	2/11/2019	mg/L	<0.01
WBAP Pond Water	11/4/2020	mg/L	0.000501
AD-28 - Average	May 2016 - June 2020	mg/L	0.0146

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

Table 2: Soil Cobalt and Mineralogy Data
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
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 and B-3 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%

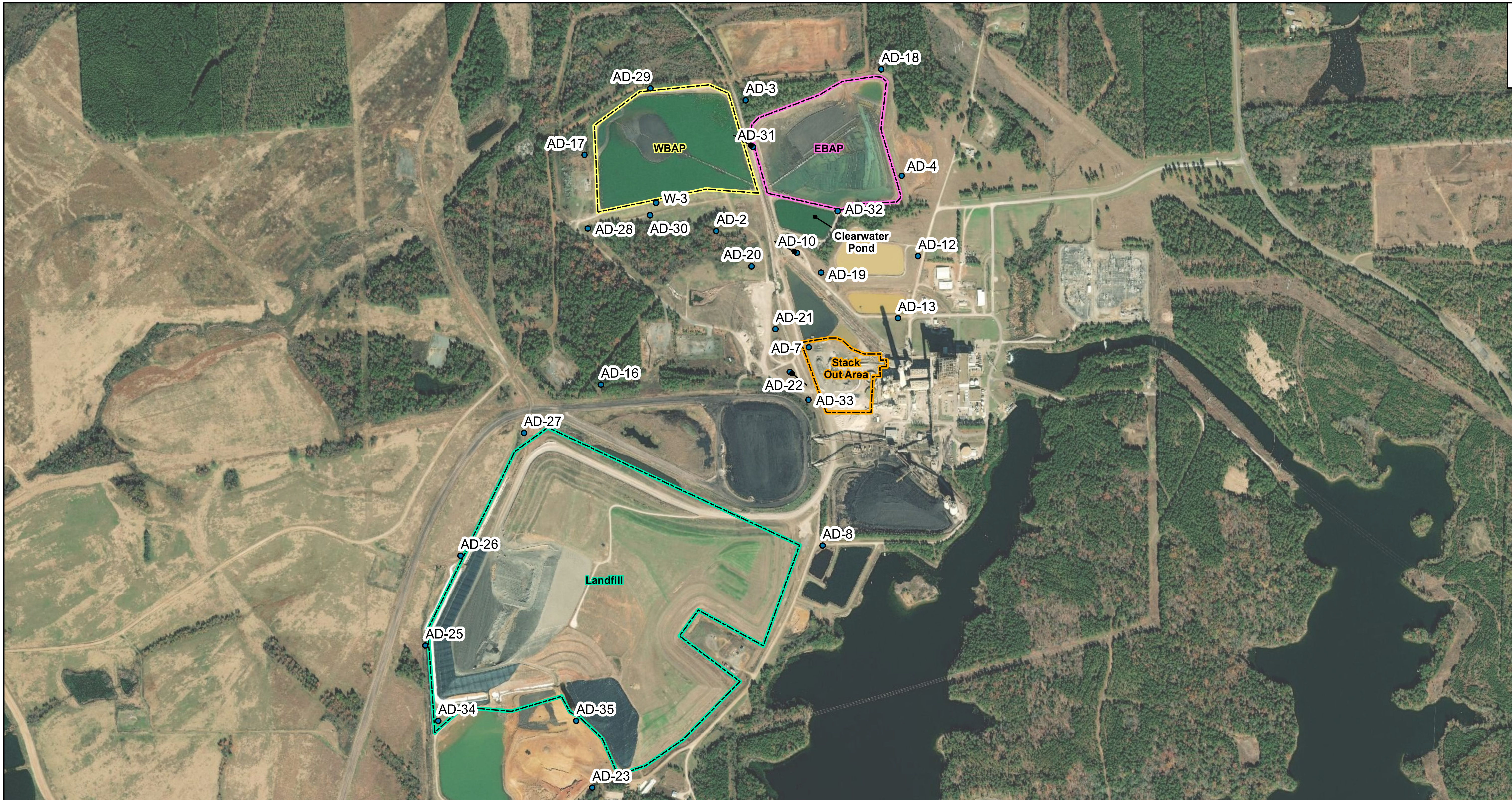
Notes:
Sample depths are shown in feet below ground surface (bgs)
Well AD-28 is screened from 15-35 ft. below ground surface.
Mineralogical components are shown in relative abundance.

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
VAP-B3-(40-45) is the centrifuged solid material from the groundwater sample collected at that interval.

FIGURES



Legend

- Monitoring Wells
- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes
- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019

Site Layout

AEP Pirkey Power Plant
Hallsville, Texas

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Figure 1

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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 June 2020
- * - Well most recently sampled August 2019
- ** - Well most recently sampled November 2020
- AD-29 included in the well network for water level measurements only

400 200 0 400
Feet

Cobalt Distribution in Groundwater

AEP Pirkey Power Plant
Hallsville, Texas

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Figure 2

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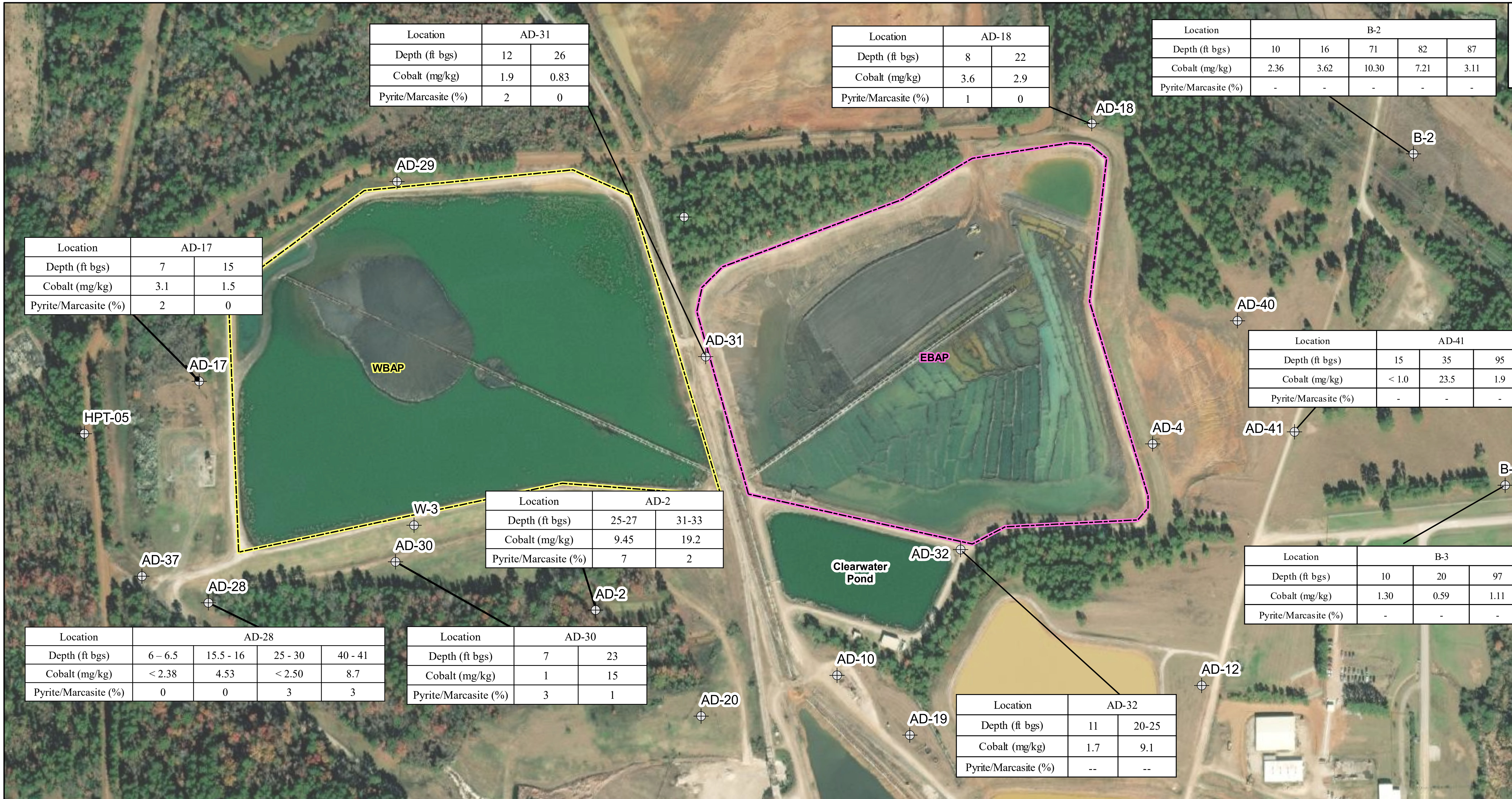

Location	AD-31	
Depth (ft bgs)	12	26
Cobalt (mg/kg)	1.9	0.83
Pyrite/Marcasite (%)	2	0

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 (%)	--	--

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.

Cobalt Distribution in Soil

AEP Pirkey Power Plant
Hallsville, Texas

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Figure 3

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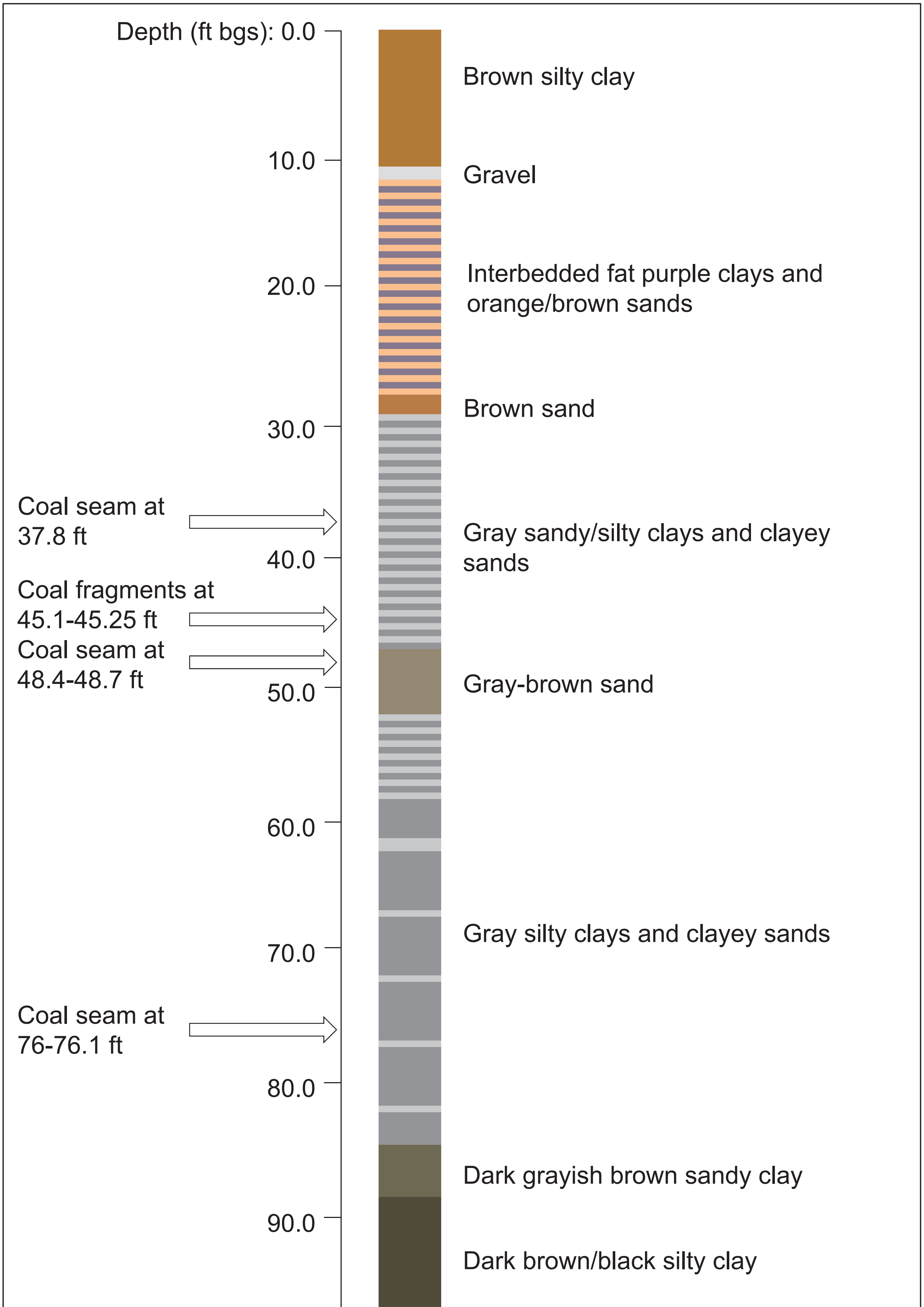

Notes:
- Ft = feet
- Bgs = below ground surface
- Boring completed May 2019
- Total depth of 97.5 ft bgs
- Well installed in offset boring screened at 29-34 ft bgs

B-3 Visual Boring Log

AEP Pirkey Powerplant
Hallsville, TX

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Figure

4

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

ATTACHMENT A

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

Margin	TEST ASSIGNMENT (Sample Interval)	SAMPLE NO. (Recovery)	DEPTH FT.	SAMPLES	CONDITION OR CONSISTENCY	COLOR	MINOR MATERIALS OR ADJECTIVES	PREDOMINATE MATERIAL	CHARACTERISTICS OR MODIFICATIONS	SEAT - 6"	1st - 6"	2nd - 6"	UNIFIED SOIL CLASSIFICATION	N - VALUE OR HAND PENETROMETER
0 / SM	0-5	4'	0		0-2	Br, Lt. Br / Lt. Rd Br	Si	Sa	Silty sand, trace clay & roots, trace fine iron ore gravel,				moist	(0-2)
2'			2										moist	(2-5)
					2-10'	Rd Br, Yllw Br	Si, Gr	Cl	Clay - some silt, trace v.f. sand, trace coarse iron ore concretions,				moist	(5-10)
CL	5-10	1.5'							- some v.f. sand, ironstone layer @ 6-6.5'					
10'			10											
SC-SM	10-15	1'			10'-16-	Rd Br, Lt. Br	Si Cl	Sa	Clayey vf to f Silty Sand with clay in thin lenses, trace cemented clayey sand				v. moist	(10-15)
	15-20	1.5'				Lt. Br and 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')					
	30-35	NR												
	35-40	NR												
									B.T. @ 40'					
40'									*Split Spoon Driven from 40-41'					
SC	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 v.f. 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 B

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

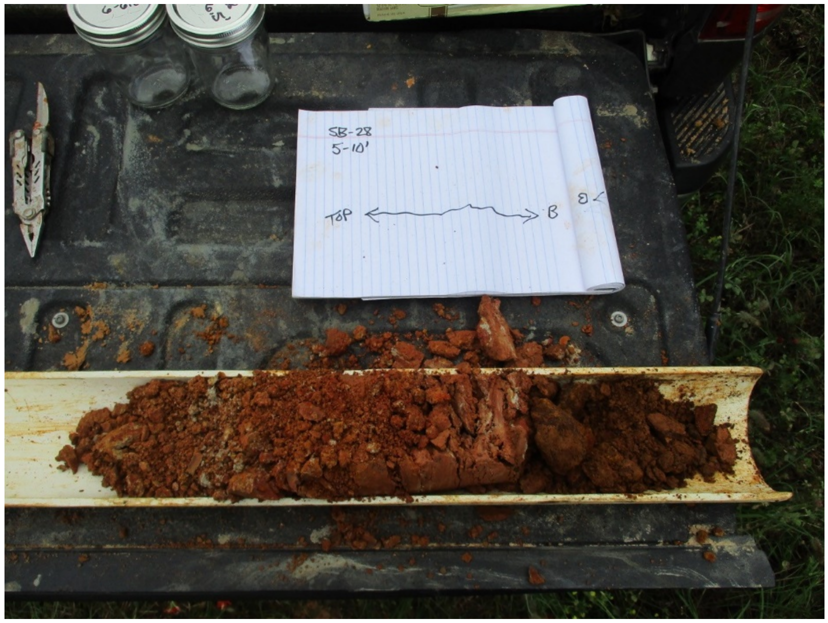
Comments:
0-5 foot interval of SB-28.

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

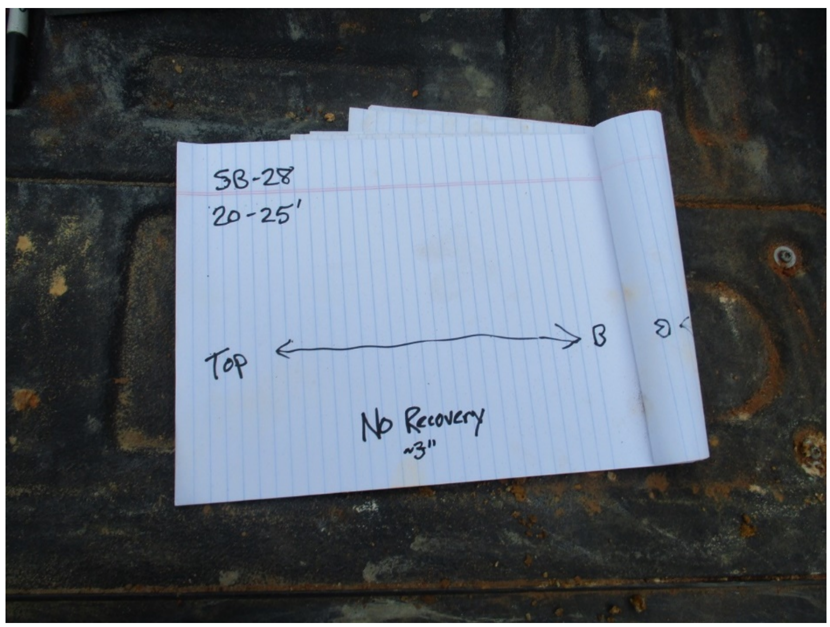
Comments:
15-20 foot interval of SB-28. Recovery of this interval was limited. A sample was collected from this interval from 15.5-16 ft. bgs.

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

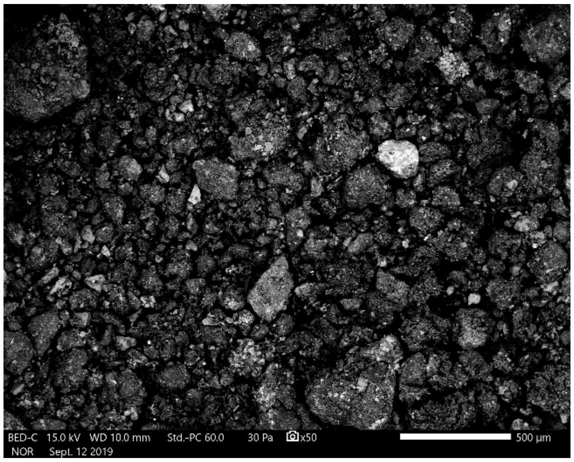
Comments:
Bottom of SB-28. The boring log indicates no recovery of soil from the 30-40 foot interval. A sample was collected from this interval.

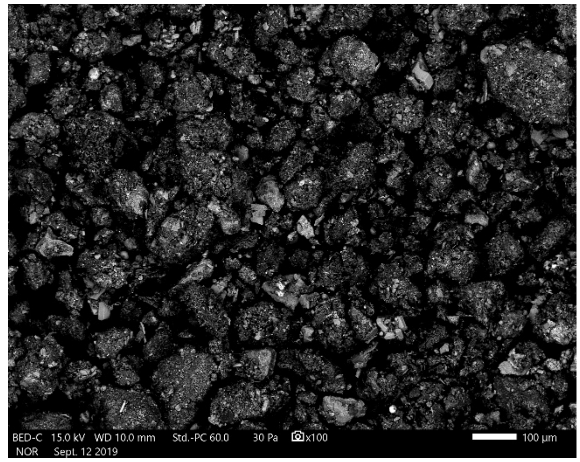
ATTACHMENT C
SEM/EDS Analysis

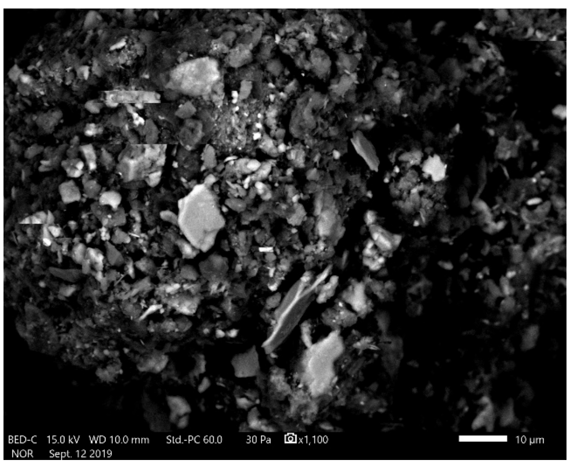
September 16, 2019

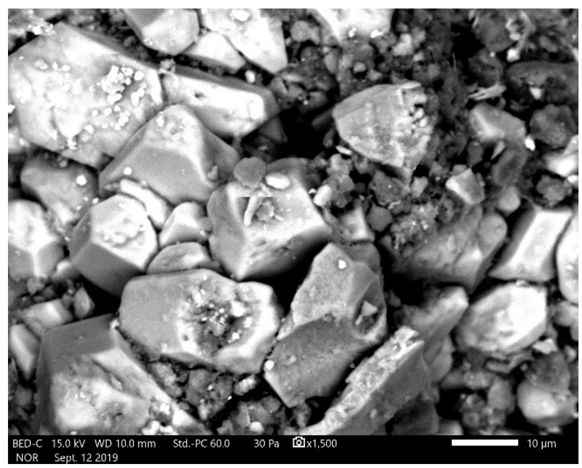
Dr. Bruce Sass
941 Chatham Lane, Suite 103, Columbus, OH 43221

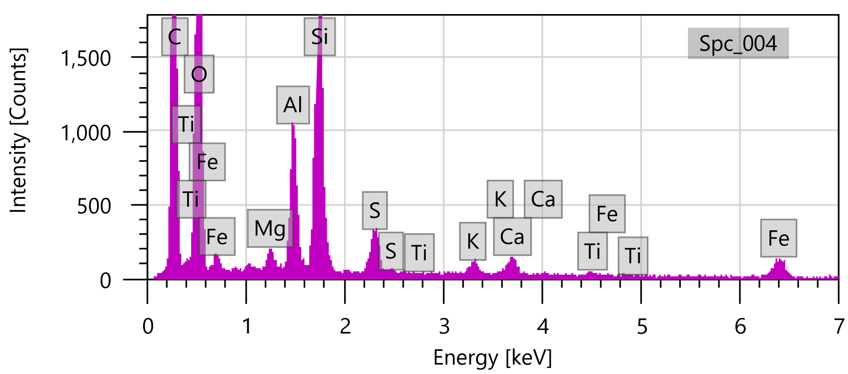
via Email: BSass@geosyntec.com



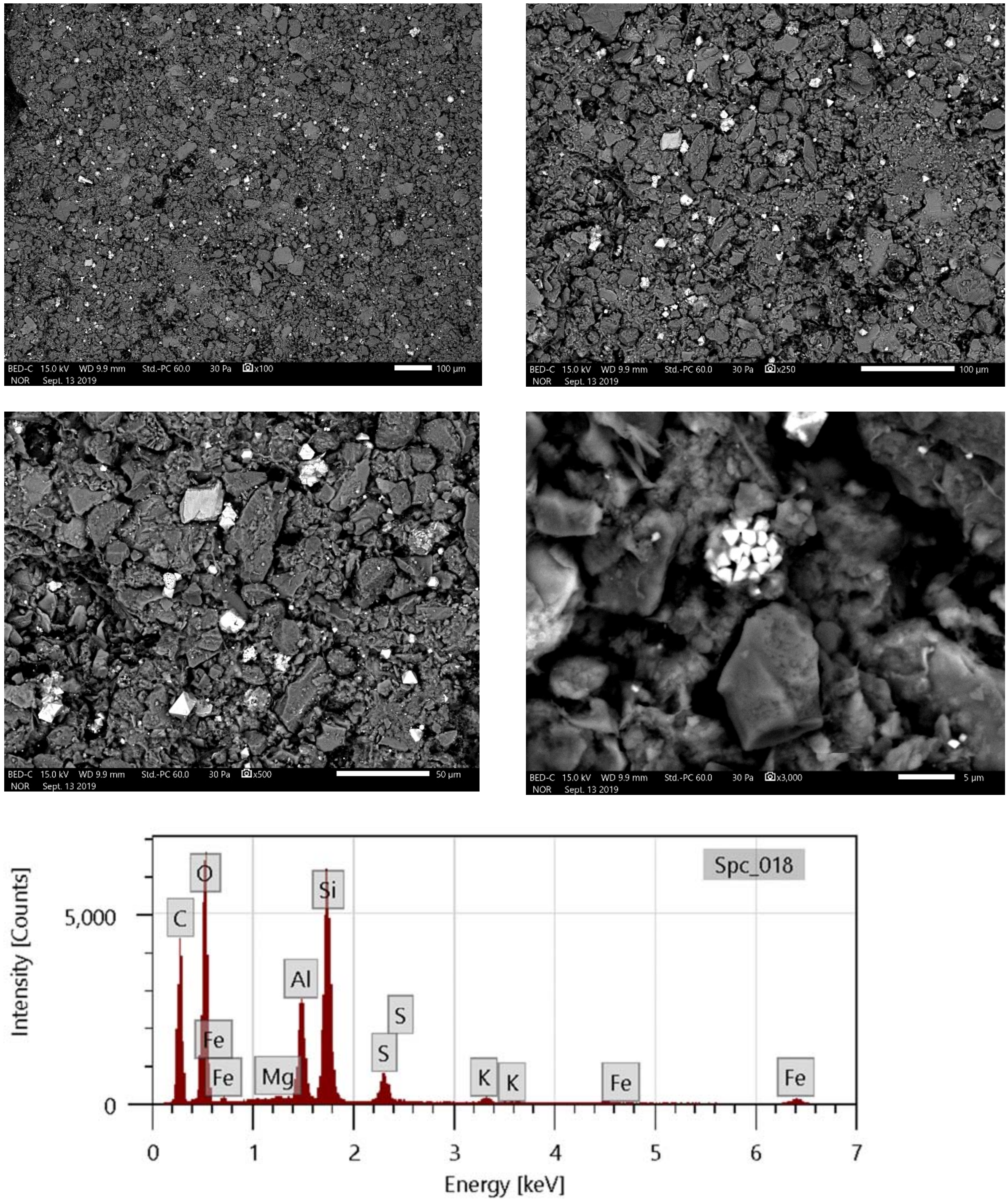




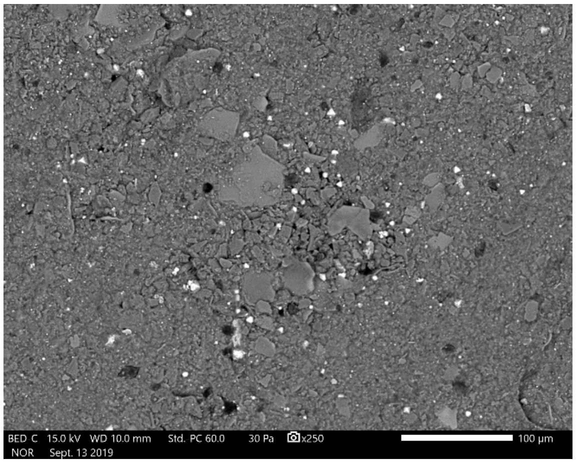


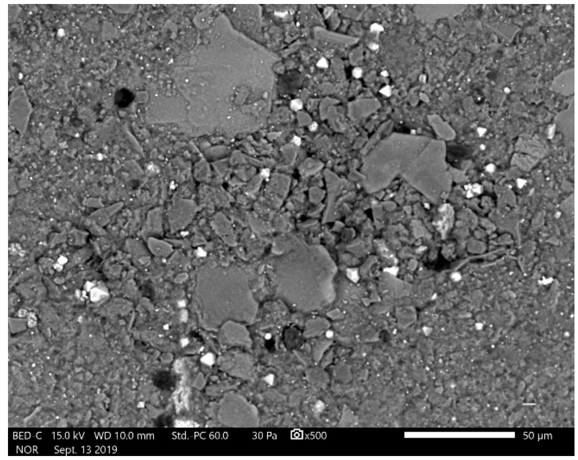


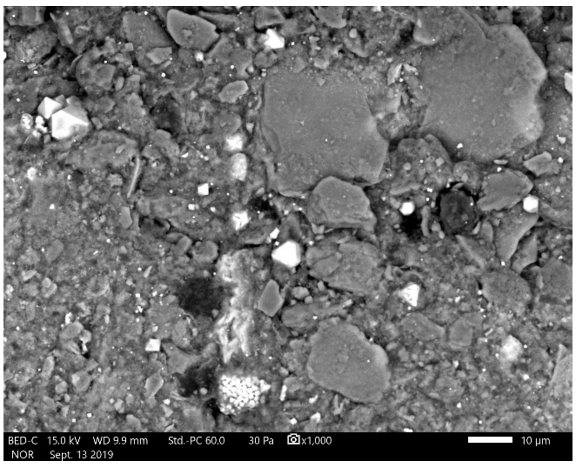
Lignite. Backscattered electron micrographs show the sample at 100X, 1,100X, and 1,500X. EDS spectrum at bottom is an area scan of the region shown in top right micrograph. Bright particles are mostly quartz and feldspar. Major peaks for carbon, oxygen, silicon, and aluminum suggest coal and clay.

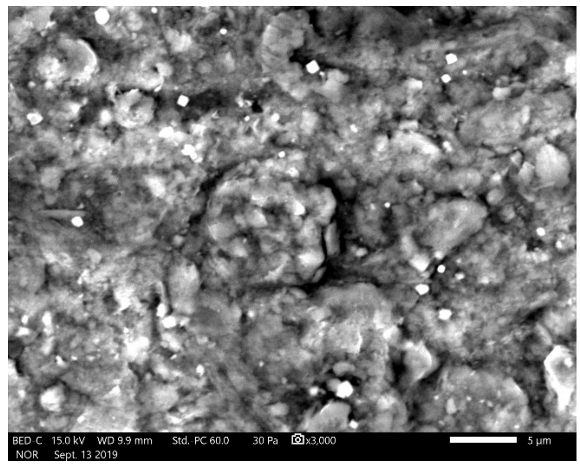


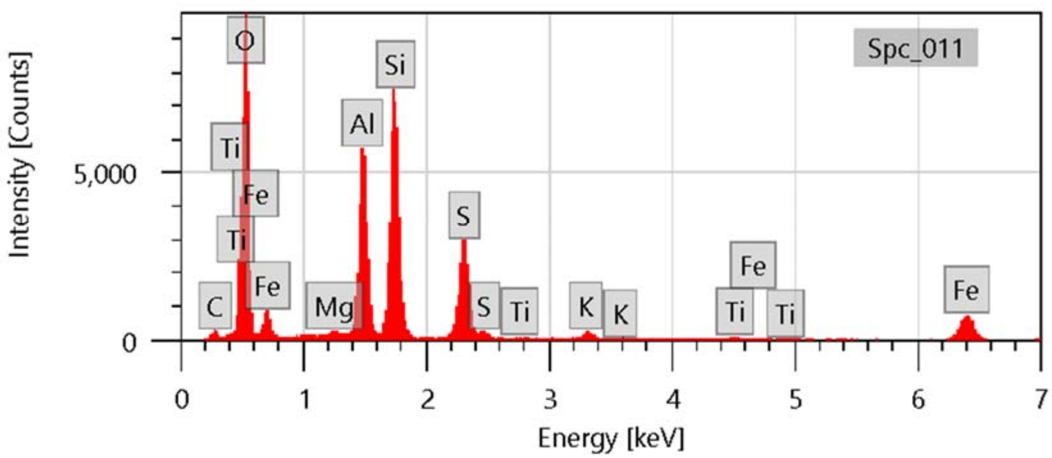
Sample VAP B3 40-45. Backscattered electron micrographs show the sample at 100X, 250X, 500X, and 3000X. EDS spectrum at bottom is an area scan of the region shown at 500X. Bright particles are pyrite (framboid in bottom right micrograph). Major peaks for carbon, oxygen, silicon, and aluminum suggest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

www.CTLGroup.com

ATTACHMENT D

Certification by 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 40 CFR 257.95(g)(3)(ii) have been met.

Beth Ann Gross
Printed Name of Licensed Professional Engineer

Signature

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

Texas Registered Engineering Firm
No. F-1182

79864	Texas	12/31/2020
License Number	Licensing State	Date