Pirkey Power Plant
West Bottom Ash Pond
Alternate Source Demonstration

The Pirkey West Bottom Ash Pond initiated an assessment monitoring program in accordance with 40 CFR 257.95 on April 3, 2018. Groundwater protection standards (GWPS) were set in accordance with 257.95(d)(2) and a statistical evaluation of the assessment monitoring data was conducted. The statistical evaluation revealed an exceedance of the cobalt GWPS on December 26, 2018. A successful alternate source demonstration (ASD) was completed per 257.95(g)(3), therefore, the Pirkey West Bottom Ash Pond will remain in assessment monitoring. An alternate source demonstration is documentation that shows a source other than the CCR unit was responsible for causing the statistics to exceed the GWPS. The ASD document will explain the alternate cause of the GWPS exceedance. The successful ASD is attached.

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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Submitted by

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March 26, 2019

CHA8462

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LIST OF ACRONYMS

AEP	American Electric Power
ASD	Alternative Source Demonstration
CCR	Coal Combustion Residuals
CFR	Code of Federal Regulations
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
RSL	Regional Screening Level
SPLP	Synthetic Precipitation Leaching Procedure
SSL	Statistically Significant Level
UTL	Upper Tolerance Limit
USEPA	United States Environmental Protection Agency
WBAP	West Bottom Ash Pond

SECTION 1

INTRODUCTION AND SUMMARY

The H.W. Pirkey Plant, located in Hallsville, Texas, has four regulated coal combustion residuals (CCR) storage units, including the West Bottom Ash Pond (WBAP, Figure 1). In 2018, two assessment monitoring events were conducted at the WBAP in accordance with 40 CFR 257.95. 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 regional screening level (RSL). 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 calculated for Appendix IV parameters at the compliance wells to assess whether Appendix IV 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 0.0131 mg/L was above the calculated GWPS of 0.009 mg/L (Geosyntec, 2018). No other SSLs were identified.

1.1 CCR Rule Requirements

United States Environmental Protection Agency (USEPA) regulations regarding assessment monitoring programs for coal combustion residuals (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 Alternative Source Demonstration (ASD) report to document that the SSL identified for cobalt at AD-28 should not be attributed to 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

Initial review of site geochemistry, site historical data, and laboratory QA/QC data did not identify ASDs due to Type I (sampling), Type II (laboratory), or Type III (statistical evaluation) issues. As described below, the SSL has been attributed to natural variation associated with the underlying geology, which is a Type IV issue.

The onsite hydrostratigraphic unit for the WBAP was identified as the clayey and silty sand stratum located between an elevation of approximately 325 and 340 feet above mean sea level (Arcadis, 2016). This unit is within the Reklaw Formation, which consists predominantly of clay and fine-grained sand and is underlain by the Eocene-age Carrizo Sand. The presence of lignite in the area is well-documented (Broom and Myers, 1966; ETTL, 2010).

Soil samples collected across the site identified cobalt in the aquifer material at varying concentrations (Table 1), including locations near the WBAP. The highest reported cobalt concentration of 15 milligrams per kilogram (mg/kg) was collected at AD-30, which is located south of the WBAP and approximately 600 feet northeast of AD-28 (Figure 2). Additionally, mineralogic samples collected from these locations identified the presence of pyrite (cubic FeS_2) and marcasite (orthorhombic FeS_2) at concentrations up to 3% of the total composition of the material (Table 1). Cobalt is known to substitute for iron in crystalline iron minerals such as pyrite and marcasite due to their similar ionic radii (Krupka and Serne, 2002; Hitzman et al., 2019). While not detected in the mineralogical analyses, the presence of limonite (FeO(OH)) in the Reklaw formation has been noted (Brooms and Myers, 1966). In addition to iron sulfides, cobalt can also substitute in iron oxides such as limonite (Hitzman et al., 2019). While soil analytical and mineralogical data are not available for AD-28, the wide distribution of cobalt and iron sulfides across the site suggests that naturally occurring cobalt may be present in the aquifer media near AD-28.

Naturally occurring cobalt in the aquifer media is proposed as the alternate source for cobalt concentrations in the groundwater which exceed the GWPS at AD-28. Further investigation shows that a release from the WBAP itself does not appear to be a source for cobalt. Analysis of the bottom ash sluiced to the WBAP had a reported cobalt concentration of 5.8 mg/kg (Attachment A). When Synthetic Precipitation Leaching Procedure (SPLP) analysis (SW-864 Test Method 1312, [USEPA, 1994]) was conducted on the ash sample to evaluate cobalt mobility under simulated conditions, cobalt was not detected above the reporting limit of 0.01 milligrams per liter (mg/L) in the leachate sample (Attachment A). Cobalt was also not detected above the reporting

limit of 0.005 mg/L in a grab sample of the pond water (Attachment B). The reporting limit for both the SPLP and pond water analyses are both over an order of magnitude lower than the average concentration of cobalt observed at AD-28 during the background and assessment monitoring period. The analytical sample results are summarized in Table 2.

Because cobalt mobility is affected by pH, the SPLP test results are likely even more conservative than actual pond conditions, as SPLP is run at a pH of 5 SU, whereas the operational pH of the pond varies between approximately 5.8 and 7.0 SU. According to a recent study, cobalt mobility increases under more acidic conditions, although even at a pH of approximately 5, only 2% of cobalt in fly ash is mobile (Izquierdo and Querol, 2012).

The pond was not identified as the source of cobalt at AD-28 based on the documented low mobility of cobalt under the pond conditions. This is further supported by the lack of detected cobalt in the SPLP and pond water analyses. Instead, the widespread distribution of cobalt within the aquifer material is proposed as the alternate source. This cobalt could be present as substitutions within iron-containing minerals such as pyrite, marcasite, or limonite, all of which are observed across the site.

2.2 Sampling Requirements

As the ASD described 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 of cobalt for AD-28 identified during assessment monitoring in 2018 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 A.

SECTION 4

REFERENCES

AEP, 2017. Statistical Analysis Plan – H.W. Pirkey Power Plant. Hallsville, Texas. January.

Arcadis, 2016. West Bottom Ash Pond – CCR Groundwater Monitoring Well Network Evaluation. H.W. Pirkey Power Plant. May.

Broom, M.E. and Myers, B.N., 1966. Ground-Water Resources of Harrison County, Texas. Texas Water Development Board Report 27. August.

EPRI, 2017. Guidelines for Development of Alternative Source Demonstrations at Coal Combustion Residual Site. 3002010920. October.

ETTL, 2010. Pirkey Power Station, Existing Ash, Surge, Lignite and Limestone Runoff, and Landfill Stormwater Ponds Embankment Investigation, Hallsville, Texas, Geotechnical Investigation. October.

Geosyntec Consultants, 2018. Statistical Analysis Summary, West Bottom Pond. H.W. Pirkey Power Plant. Hallsville, Texas. December.

Hitzman, M.W., Bookstrom, A.A., Slack, J.F., and Zientek, M.L., 2017. Cobalt – Styles of Deposits and the Search for Primary Deposits. USGS Open File Report 2017-1155.

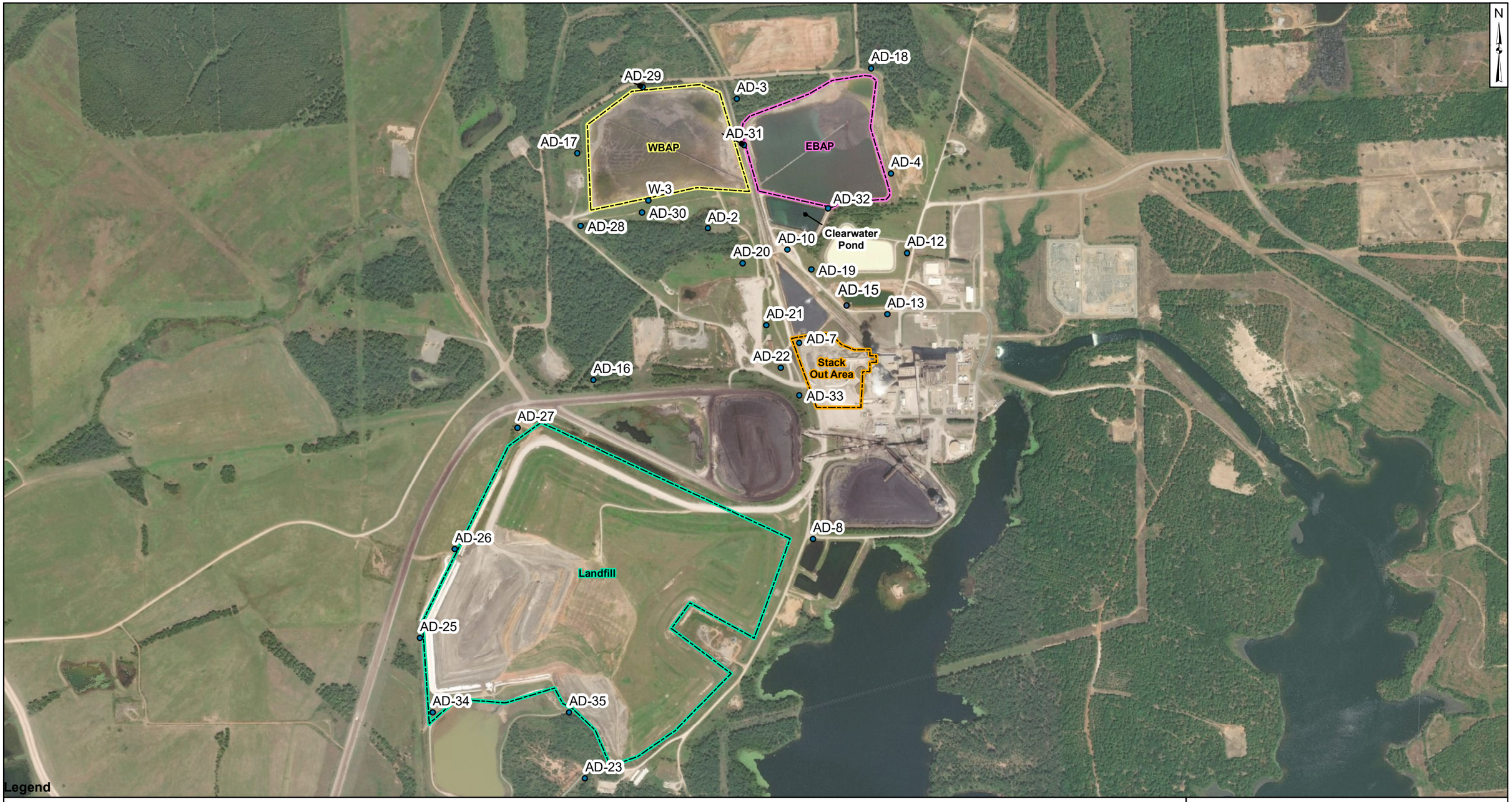
Izquierdo, M. and Querol, X., 2012. Leaching Behaviour of Elements from Coal Combustion Fly Ash: An Overview. *International Journal of Coal Geology*, 94, 54-66.

Krupka, K. M. and Serne, R. J., 2002. Geochemical Factors Affecting the Behavior of Antimony, Cobalt, Europium, Technetium, and Uranium in Vadose Sediments. Pacific Northwest National Lab, PNNL-14126. December.

United States Environmental Protection Agency (USEPA), 1994. Method 1312 – Synthetic Precipitation Leaching Procedure, Revision 0, September 1994, Final Update to the Third Edition of the Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, EPA publication SW-846.

USEPA, 2009. Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities – Unified Guidance. EPA 530/R-09/007. March.

FIGURES



Legend

- AD-15
- Monitoring Wells

Location Boundaries

CCR Units

- EBAP
- Landfill
- Stack Out Area
- WBAP

Notes

- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019
- AD-15 location is approximate.

0 380 760 1,520 2,280 3,040 Feet

Site Layout

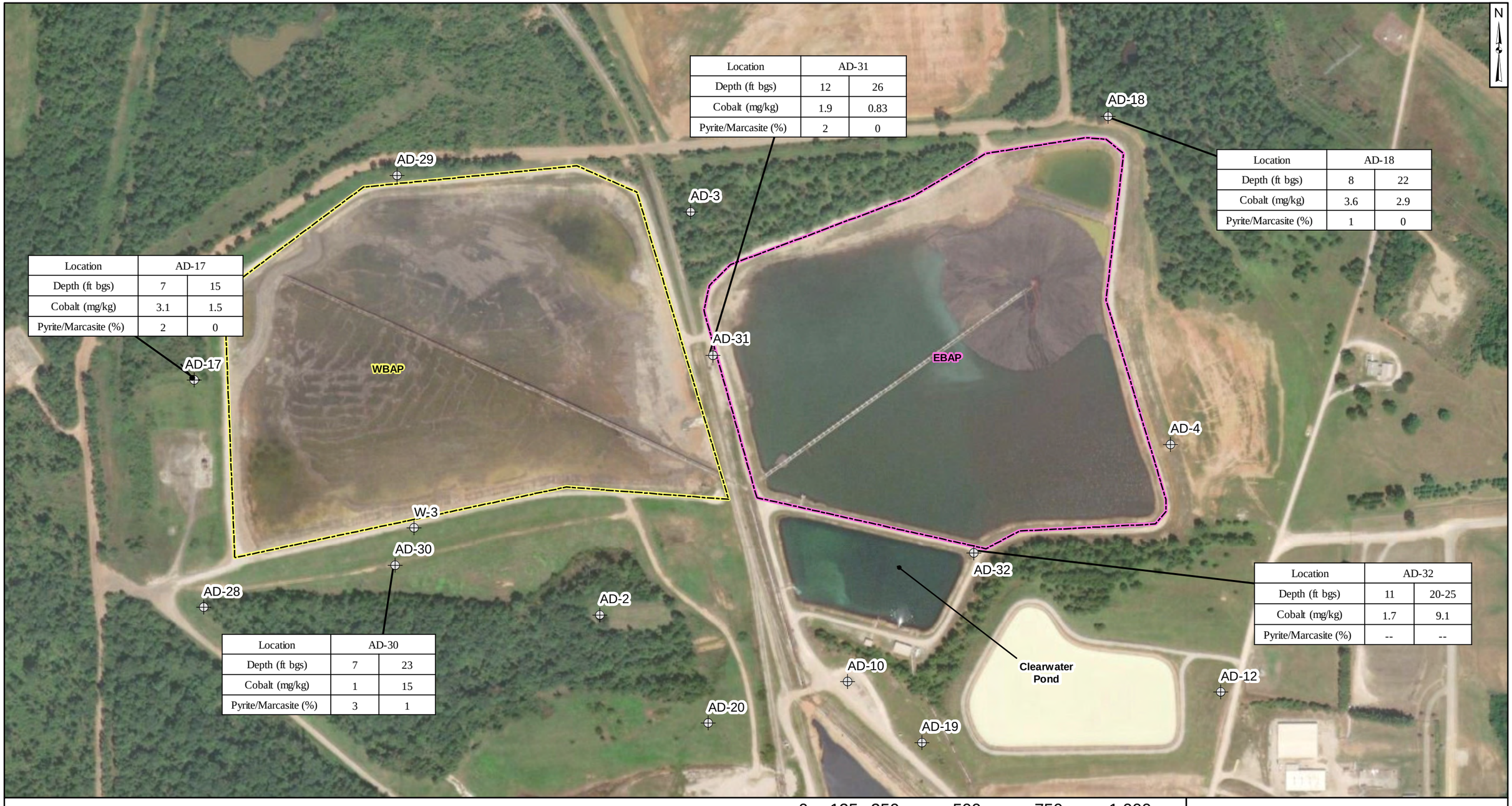
AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/03/25

Figure **1**

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\Site_Layout_20190322.mxd. HDuff. 3/25/2019. 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	AD-17	
Depth (ft bgs)	7	15
Cobalt (mg/kg)	3.1	1.5
Pyrite/Marcasite (%)	2	0

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

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

Legend

Monitoring Wells

Notes
- Monitoring well coordinates provided by AEP.
- Data provided by AEP, 2019
- ft bgs: feet below ground surface
- mg/kg: milligrams per kilogram

0 125 250 500 750 1,000 Feet

Soil Chemical and Mineralogical Analysis Results

AEP Pirkey Power Plant
Hallsville, Texas

Geosyntec consultants

Columbus, Ohio | 2019/03/25

Figure 2

P:\Projects\AEP\Groundwater Statistical Evaluation - CHA8423\Groundwater Mapping\GIS Files\MXD\Pirkey\Pirkey_SoilChem_minerals_March2019.mxd. SKaroly. 3/25/2019. Project/Phase/Task.

TABLES

Table 1: Soil Cobalt and Mineralogy Data
West Bottom Ash Pond - H.W. Pirkey Plant

Location ID	Sample Depth (ft bgs)	Cobalt (mg/kg)	Pyrite/Marcasite (%)
AD-15	13	0.85	--
	40-43	0.79	--
AD-16	10	0.17	0
	19	0.44	1
AD-17	7	3.10	2
	15	1.50	0
AD-18	8	3.60	1
	22	2.90	0
AD-30	7	1.00	3
	23	15.0	1
AD-31	12	1.90	2
	26	0.83	0
AD-32	11	1.70	--
	20-25	9.10	--
AD-33	11	0.61	1
	21	0.64	--
AD-34	6	1.10	1
	24	6.50	2
AD-35	2	2.10	2
	17	0.18	0

Notes:
'--' - analysis not completed
mg/kg- milligram per kilogram
ft bgs - feet below ground surface

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.

Table 2: Summary of Key Analytical Data
West Bottom Ash Pond - H.W. Pirkey Plant

Sample	Unit	Cobalt Concentration
Bottom Ash	mg/kg	5.8
SPLP Leachate	mg/L	<0.01
WBAP Pond Water	mg/L	<0.005
AD-28 - Average	mg/L	0.0148

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.

ATTACHMENT A
Bottom Ash and Bottom Ash SPLP
Laboratory Analytical Data

Client Sample ID: CCR SAMPLE-WBAP-1

Date Collected: 02/11/19 16:40
Date Received: 02/13/19 09:40

Lab Sample ID: 490-168389-1

Matrix: Solid
Percent Solids: 75.9

Method: 9056 - Anions, Ion Chromatography - Soluble

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	1.3	U	1.3	1.0	mg/Kg	☼		02/14/19 00:30	1

Method: 6010C - Metals (ICP)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	11	U	11	1.1	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Arsenic	**2.2**		2.2	1.3	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Barium	**250**		2.2	1.1	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Beryllium	**0.25**	**J**	1.1	0.22	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Boron	**93**		11	4.8	mg/Kg	☼	02/13/19 16:11	02/18/19 22:40	1
Cadmium	1.1	U	1.1	0.11	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Chromium	**12**		1.1	1.0	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Cobalt	**5.8**		2.2	1.1	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Lead	**1.2**	**F1**	1.1	0.56	mg/Kg	☼	02/13/19 16:11	02/19/19 18:53	1
Lithium	**4.2**	**J**	11	1.1	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Molybdenum	11	U	11	5.6	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1
Selenium	2.2	U	2.2	1.2	mg/Kg	☼	02/13/19 16:11	02/19/19 18:53	1
Thallium	2.2	U	2.2	0.67	mg/Kg	☼	02/13/19 16:11	02/16/19 23:06	1

Method: 7471B - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.13	U	0.13	0.039	mg/Kg	☼	02/14/19 10:07	02/14/19 13:12	1

Client Sample Results

Client: Burns & McDonnell
Project/Site: CCR App III & IV GW Monitoring - Texas

TestAmerica Job ID: 490-168389-1
SDG: AEP-Pirkey Plant

Client Sample ID: CCR SAMPLE-WBAP-1

Date Collected: 02/11/19 16:40
Date Received: 02/13/19 09:40

Lab Sample ID: 490-168389-1

Matrix: Solid

Method: 9056 - Anions, Ion Chromatography - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	**0.035**	**J B**	0.10	0.010	mg/L			02/19/19 23:08	1

Method: 6010C - Metals (ICP) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:32	1
Arsenic	0.010	U	0.010	0.0086	mg/L		02/19/19 16:41	02/20/19 13:32	1
Barium	**0.11**		0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:32	1
Beryllium	0.0040	U	0.0040	0.0020	mg/L		02/19/19 16:41	02/20/19 13:32	1
Boron	**0.15**		0.050	0.020	mg/L		02/19/19 16:41	02/20/19 13:32	1
Cadmium	0.0010	U	0.0010	0.00050	mg/L		02/19/19 16:41	02/20/19 13:32	1
Chromium	0.0050	U	0.0050	0.0030	mg/L		02/19/19 16:41	02/20/19 13:32	1
Cobalt	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:32	1
Lead	0.0050	U	0.0050	0.0020	mg/L		02/19/19 16:41	02/20/19 13:32	1
Lithium	**0.016**	**J B ***	0.050	0.010	mg/L		02/19/19 16:41	02/20/19 13:32	1
Molybdenum	0.050	U	0.050	0.030	mg/L		02/19/19 16:41	02/20/19 13:32	1
Selenium	**0.0052**	**J**	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:32	1
Thallium	0.010	U	0.010	0.0050	mg/L		02/19/19 16:41	02/20/19 13:32	1

Method: 7470A - Mercury (CVAA) - SPLP West

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.00020	U	0.00020	0.00010	mg/L		02/19/19 16:03	02/21/19 15:39	1

General Chemistry

Analyte	Result	Qualifier	RL	RL	Unit	D	Prepared	Analyzed	Dil Fac
Percent Solids	**75.9**		0.1	0.1	%			02/17/19 12:25	1

ATTACHMENT B

Bottom Ash Pond Water Laboratory Analytical Data

Client Sample ID: SW-WBAP-1

Date Collected: 12/15/18 14:15
Date Received: 12/18/18 10:30

Lab Sample ID: 490-165222-5

Matrix: Water

Method: 9056A - Anions, Ion Chromatography

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Fluoride	**0.88**	**J**	1.0	0.010	mg/L			12/20/18 19:29	1
Sulfate	**1400**		1000	6.0	mg/L			12/30/18 09:25	200
Chloride	**61**	**B**	15	1.0	mg/L			12/30/18 09:08	5

Method: 6020A - Metals (ICP/MS) - Total Recoverable

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Antimony	0.0030	U	0.0030	0.00080	mg/L		12/19/18 14:26	12/27/18 15:30	1
Arsenic	**0.0030**	**J**	0.0050	0.00040	mg/L		12/28/18 12:47	01/03/19 11:39	1
Barium	0.20	U	0.20	0.00010	mg/L		12/19/18 14:26	12/27/18 15:30	1
Beryllium	**0.00029**	**J**	0.0040	0.00010	mg/L		12/19/18 14:26	12/26/18 22:24	1
Boron	**7.3**	**J ***	10	0.35	mg/L		12/28/18 12:47	01/03/19 11:48	10
Cadmium	0.0050	U	0.0050	0.00010	mg/L		12/19/18 14:26	12/27/18 15:30	1
Calcium	**220**		1.0	0.053	mg/L		12/19/18 14:26	12/26/18 22:24	1
Chromium	0.0050	U	0.0050	0.00050	mg/L		12/19/18 14:26	12/27/18 15:30	1
Cobalt	0.0050	U	0.0050	0.00010	mg/L		12/19/18 14:26	12/27/18 15:30	1
Lead	**0.00077**	**J**	0.0050	0.00010	mg/L		12/19/18 14:26	12/21/18 21:37	1
Lithium	**0.053**		0.040	0.0030	mg/L		12/19/18 14:26	12/21/18 21:37	1
Molybdenum	**0.0047**	**J**	0.010	0.0010	mg/L		12/19/18 14:26	12/26/18 22:24	1
Selenium	**0.015**		0.010	0.00030	mg/L		12/19/18 14:26	12/26/18 22:24	1
Thallium	0.0020	U	0.0020	0.00080	mg/L		12/19/18 14:26	12/21/18 21:37	1

Method: 7470A - Mercury (CVAA)

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Mercury	0.00020	U	0.00020	0.00010	mg/L		12/20/18 12:26	12/21/18 12:20	1

General Chemistry

Analyte	Result	Qualifier	RL	MDL	Unit	D	Prepared	Analyzed	Dil Fac
Total Dissolved Solids	**2000**		50	14	mg/L			12/19/18 23:00	1

ATTACHMENT C
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

Beth Ann Gross
Signature

Geosyntec Consultants
8217 Shoal Creek Blvd., Suite 200
Austin, TX 78757

Texas Registered Engineering Firm
No. F-1182

79864	Texas	3/26/2019
License Number	Licensing State	Date