ARCADIS
Infrastructure · Water · Environment · Buildings

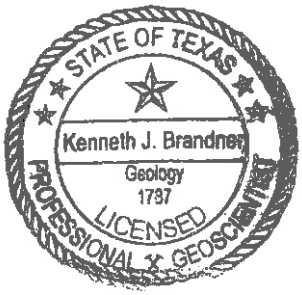
American Electric Power Service Corporation

Stack Out Area - CCR
Location Restriction Evaluation

H. W. Pirkey Power Plant
2400 FM 3251
Harrison County
Hallsville, Texas

July 6, 2016

ARCADIS



Kenneth Brandner, P.E., P.G.
Senior Project Engineer

Matthew J. Lamb
Project Manager

John Holm, P.E.
Principal Engineer

Stack Out Area – CCR Location Restriction Evaluation

H.W. Pirkey Power Plant
2400 FM 3251
Harrison County
Hallsville, Texas

Prepared for:
AEP

Prepared by:
ARCADIS U.S., Inc.
100 E Campus View Blvd
Suite 200
Columbus
Ohio 43235-1447
Tel 614 985 9100
Fax 614 985 9170

Our Ref.:
OH015976.0010

Date:
July 6, 2016

ARCADIS

Table of Contents

ARCADIS

Table of Contents

Figures

Appendices

Acronyms and Abbreviation

AEP	American Electric Power Service Cooperation
amsl	above mean sea level
ARCADIS	ARCADIS U.S., Inc.
BAP	bottom ash pond
CCR	Coal Combustion Residual
CFR	Code of Federal Regulations
EPRI	Electric Power Research Institute
FAP	fly ash pond
FGD	flue gas desulfurization
ft	feet
PTI	Permit to Install
TAC	Texas Administrative Code
TCEQ	Texas Commission on Environmental Quality

1. Objective

This report was prepared by ARCADIS U.S., Inc. (ARCADIS) for American Electric Power Service Corporation (AEP) to assess the location of the existing Stack Out Area relative to the location restrictions included in the Coal Combustion Residual (CCR) requirements, as specified in the Code of Federal Regulations (CFR) 40 CFR 257.60 through 257.64, at the AEP H.W. Pirkey Generating Plant (Plant) located at 2400 FM 3251 in Hallsville, Harrison County, Texas (**Figure 1**). The CCR requirements include an evaluation of the adequacy of the groundwater monitoring well network to characterize groundwater quality up and down gradient of the CCR unit and an evaluation of whether the CCR unit meets up to 5 location restrictions, which include: the base of the CCR unit is 5 feet (ft) above the uppermost aquifer, the CCR unit may not be located in a wetland, within 200 ft of the damage zone of a fault that has displacement during the Holocene, within a seismic impact zones, or in an unstable area. However, because the subject CCR unit for this report (Stack Out Area) is an existing above-grade CCR pile/landfill, this CCR unit is subject to one location restriction: unstable area.

Four regulated CCR units associated with the Plant were identified for review, which include the West Bottom Ash Pond (BAP), East BAP, Stack Out Area, and Landfill (**Figure 2**). This report summarizes the evaluation of the location restriction criteria at the existing Stack Out Area (Site). The evaluation of the groundwater monitoring well network in the uppermost aquifer for the Stack Out Area is not included in this report and will be completed under separate cover.

This evaluation included a review of AEP-provided data associated with previously completed subsurface investigation activities in the vicinity of the Stack Out Area CCR unit, as well as publically-available geologic and hydrogeologic data. The following report also presents the current Conceptual Site Model based on documents reviewed and will further describe the uppermost aquifer.

2. Background Information

The following section provides background information for the AEP H.W. Pirkey Generating Plant Stack Out Area.

2.1 Facility Location Description

The AEP H.W. Pirkey Plant is located in southern Harrison County, approximately 5 miles southeast of Hallsville, Texas, and approximately 8 miles southwest of Marshall, Texas. The Stack Out Area CCR unit is located in the central portion of the Plant, and approximately 1,200 feet northwest of Brandy Branch Reservoir (**Figures 1** and **2**).

2.2 Description of Stack Out Area CCR Unit

The following section will discuss the embankment configuration, area, volume, construction and operational history, and surface water control associated with the Stack Out Area.

2.2.1 Embankment Configuration

The Stack Out Area is an approximate 7-acre storage area for stabilized flue gas desulfurization (FGD) sludge. As shown on **Figure 3**, the Stack Out Area is located directly south of the Surge Pond, directly west of Thickener Tanks 1A and 1B, and directly east of a road that runs south to the on-site Landfill. The dimensions of the Stack Out Area are approximately 650 feet from north to south by 450 feet from east to west.

Stabilized FGD sludge is temporarily stockpiled directly above natural ground surface (native clay) in the Stack Out Area using a radial stacker. The maximum height of the stabilized FGD sludge piles are approximately 41 feet above ground surface. There are no embankments in the Stack Out Area. The stabilized FGD sludge piles are located no closer than approximately 50 feet from the perimeter of the Stack Out Area, thereby preventing the stabilized FGD sludge from migrating beyond the boundaries of the Stack Out Area.

2.2.2 Area/Volume

The Stack Out Area is approximately 7 acres in size. However, as discussed above in Section 2.2.1, the CCR piles in the Stack Out Area are located no closer than approximately 50 feet from the perimeter of the Stack Out Area, therefore the effective storage area of the Stack Out Area is approximately 4.4 acres (550 feet by 350 feet), and the maximum CCR storage volume based on a maximum CCR pile height of 41 feet is 180 acre feet.

2.2.3 Construction and Operational History

The H.W. Pirkey Power Plant was constructed in 1983 and 1984, and began operation in 1985. Throughout the life of the Plant, CCR materials (fly ash, bottom ash, economizer ash, FGD sludge) have been generated. The Stack Out Area receives stabilized FGD sludge (**Figure 3**). Prior to storing the FGD sludge in the Stack Out Area, the FGD sludge is dewatered using belt presses, and the dewatering fluid is routed to the Surge Pond for reuse as FGD makeup water. The stabilized FGD sludge is then stockpiled in the Stack Out Area using a radial stacker with an approximate 3-foot-wide by 120-foot-long conveyor belt.

The stabilized FGD sludge is temporarily stored at the Stack Out Area. The stabilized FGD sludge is removed using front-end loaders or similar equipment, placed into trucks, and disposed of at the on-site Landfill CCR Unit located near the south end of the Plant.

Lithologic data from soil borings and monitoring wells confirm the native soils underling the Stack Out Area consist of low-permeability clay. As shown on Geologic Cross Sections B-B' (**Figure 5**) and E-E' (**Figure 8**), the native clay directly below the Stack Out Area extends from the surface to an average depth of approximately 20 feet. Therefore, as shown on **Figures 5** and **8**, the separation distance between the base of the Stack Out Area and uppermost aquifer exceeds 5 feet.

2.2.4 Surface Water Control

The Stack Out Area contains dewatered FGD sludge that is stockpiled using a radial stacker, therefore no sluice water is present in the Stack Out Area. Storm water in the Stack Out Area follows surface topography via gravity sheet flow. The ground surface elevation in the Stack Out Area ranges from approximately 360 to 365 feet amsl (Akron Consulting, 2015). Storm water flow in the Stack Out Area is in a general northerly direction to the Surge Pond, which is a below-grade (incised) non-CCR unit.

2.3 Previous Investigations

The initial soils investigation and design of the Plant was provided in a January 31, 1983 report prepared by Sargent & Lundy entitled "*Henry W. Pirkey Power Plant, Design Summary for Lignite Storage Area and Wastewater Pond Facilities*". This investigation included advancement of soil borings throughout the Plant, including the Stack Out Area.

In 2009, ETTL Engineers & Consultants (ETTL) conducted geotechnical investigations of earthen embankments associated with several ponds at the Plant. The Stack Out

Area was not included in this evaluation because there are no earthen embankments in the Stack Out Area (ETTL, 2010).

In 2010 and January 2011, Apex Geoscience expanded the groundwater monitoring well system at the Plant, including installation of monitoring wells AD-16 through AD-29. Apex Geoscience also conducted video surveillance of the existing monitoring wells and plugged monitoring wells MW-1, MW-5, MW-6, MW-9, MW-11, MW-14, MW-15, M-2, and M-3 (Apex Geoscience, 2011).

In 2011, Johnson & Pace performed hydraulic analysis of several ponds at the Plant. The Stack Out Area was not included in this evaluation because there is no impounded water in the Stack Out Area (Johnson & Pace, May 2011).

In 2015, Auckland Consulting further expanded the groundwater monitoring well system at the Plant, including installation of monitoring wells AD-30 through AD-35 (Auckland Consulting, 2016).

2.4 Hydrogeologic Setting

The site area is located within the West Gulf Coastal Plain. Cretaceous formations crop out in belts that extend in a northeasterly direction parallel to the Gulf of Mexico, and dip gently southeast. The central and northern portions of the Plant are located on the outcrop of the Eocene-age Recklaw Formation. The Recklaw Formation consists predominantly of clay and fine grained sand, and attains a maximum thickness of approximately 100 feet (Broom, 1966).

The Recklaw Formation is underlain by the Eocene-age Carrizo Sand, which outcrops in the topographically low southern portion of the Plant. The Carrizo Sand consists of fine to medium grained sand interbedded with silt and clay, and attains a thickness of approximately 100 feet (Broom, 1966).

These features are further illustrated on five lines of cross section that were prepared through the Stack Out Area, with three lines trending from west to east (A-A'; B-B'; C-C'), and the other two lines trending from north to south (D-D'; E-E'). The cross section location map is included as **Figure 3** and the lines of cross section are included as **Figure 4** (A-A') through **Figure 8** (E-E').

2.4.1 Climate and Water Budget

Average temperatures in Harrison County, Texas range from 47.1° Fahrenheit (F) in January to 83.8°F in July, and the mean annual growing season is 238 days. Average annual precipitation (including liquid water equivalent from snowfall) is approximately 47 inches (Broom, 1966).

2.4.2 Regional and Local Geologic Setting

The central and northern portions of the Plant, including the Stack Out Area, are located on the outcrop of the Eocene-age Recklaw Formation. The Recklaw Formation is underlain by the Eocene-age Carrizo Sand, which outcrops in the topographically low southern end of the Plant (Broom, 1966; Flawn, 1965).

Detailed regional geologic characterization can be found in several published reports including Texas Water Development Report 27 "*Ground-Water Resources of Harrison County, Texas*" (Broom, 1966), The University of Texas at Austin Bureau of Economic Geology "*Geologic Atlas of Texas – Tyler Sheet*" (Flawn, 1965), and U.S. Geological Survey Open-File Report 88-450K "*Petroleum Geology and the Distribution of Conventional Crude Oil, Natural Gas, and Natural Gas Liquids, East Texas Basin*" (USGS, 1988).

Detailed regional and site geologic characterization can also be found in the 2010 ETTL report entitled "*Geotechnical Investigation, Pirkey Power Station, Existing Ash, Surge, Lignite and Limestone Runoff, and Landfill Stormwater Ponds Embankment Investigation, Hallsville, Texas*" (ETTL, 2010).

2.4.3 Surface Water and Surface Water Groundwater Interactions

Figure 9 is a potentiometric surface map based on January 2016 water level data for the uppermost water bearing unit at the Site, and water level elevations in the Site monitoring wells are summarized on **Table 1**. As shown on **Figure 9**, shallow groundwater flow direction in the Stack Out Area is westerly to northwesterly at an average hydraulic gradient of approximately 0.01 foot per foot.

The Stack Out Area is located approximately 1,200 feet northwest of Brandy Branch Reservoir, which was dammed during Plant construction in the 1980's. The normal pool level of Brandy Branch Reservoir is approximately 340 feet amsl. As shown on **Figure 9**, shallow groundwater flow direction at the Site generally follows surface topography to the west and southwest toward Hatley Creek, which is located in a topographically low area approximately one mile west of the Site. Therefore shallow groundwater in the Stack Out Area does not discharge into Brandy Branch Reservoir. Brandy Branch Reservoir likely recharges the uppermost water bearing unit in the southern portion of the Plant, where the pool level in the Reservoir (340 feet amsl) is higher than water level elevations in monitoring wells located southwest (downslope) of the Reservoir.

2.4.4 Water Users

A water well inventory conducted by Banks Information Solutions showed 12 water wells had been drilled within a ½-mile radius of the Site (Banks, 2015). The nearest water well was reportedly drilled approximately 1,000 feet north of the Stack Out Area in 2004 by Bennett Drilling for use as a rig supply well. The water well was screened from 350 to 430 feet below ground surface, therefore this water well is completed in a deeper water bearing unit relative to the uppermost water-bearing unit at the Site.

The second closest water well was reportedly drilled approximately ¼-mile west (downgradient) of the Stack Out Area for NFR Energy in 2008 for use as a rig supply well. The water well was screened from 250 to 310 feet below ground surface, therefore this water well is completed in a deeper water bearing unit relative to the uppermost water-bearing unit at the Site.

All of the water wells identified within a ½-mile radius of the Site were drilled to total depths of 160 feet or deeper except one water well (Well ID: 35-37-4E) that was drilled to a total depth of 55 feet in 1982. This water well was completed with concrete tile from the surface to total depth, and is located approximately ¼-mile east (upgradient) of the Pirkey Power Plant.

3. Unstable Areas

CCR Rule 40 CFR Part 257.64 requires that existing landfills must not be located within an unstable area unless the owner or operator demonstrates that the design of the unit will ensure the integrity of the structural components of the unit. The Stack Out Area consists of stabilized FGD sludge which is stockpiled in above-ground piles, and is a CCR landfill.

3.1 Definition of Unstable Area and local Conditions

3.1.1 CCR Rule Definition

CCR Rule 40 CFR Part 257.53 defines an unstable area as a location that is susceptible to natural or human-induced events or forces capable of impairing the integrity of the CCR unit. These may include poor foundation conditions, areas susceptible to mass movements (landslides), and karst terrains.

3.1.2 Poor Foundation Soils

Lithologic data from soil borings and monitoring wells show the foundation of the Stack Out Area consists of native clay from the base of the CCR unit (ground surface) to a depth ranging from approximately 10 to 20 feet below ground surface. As shown on

Geologic Cross Section B-B' (**Figure 5**) and E-E' (**Figure 8**), the uppermost clay stratum is underlain by a clayey and silty sand stratum. These native sediments provide a stable foundation for the CCR materials that are temporarily stockpiled in the Stack Out Area prior to disposal in the on-site Landfill.

3.1.3 Mass Movements

The Stack Out Area is not located within an area subject to mass movements. This conclusion is supported by the ETTL soil stability report (ETTL, 2010).

3.1.4 Karst

The site area is located on the outcrop of unconsolidated Cretaceous Formations consisting predominantly of sand and clay (Broom, 1966; Flawn, 1965). The Stack Out Area is not located in a karst area.

3.1.5 Subsurface Mining

No subsurface mines are known to exist below the CCR units at the Site.

3.2 Compliance with Unstable Areas Restriction

Based on our site visit and review of available information, the Stack Out Area is not located within unstable areas. Therefore, this CCR unit complies with the requirement for not being located in an unstable area.

4. Summary, Conclusions, and PE Certification

I, Kenneth J. Brandner, certify that this report was prepared under my direction and supervision, and that the information contained herein is true and accurate to the best of my knowledge. Based on my experience and knowledge of the site, as well as the evaluations discussed within this report, the H.W. Pirkey Power Plant Stack Out Area complies with the requirements of the location restrictions sections of 40 CFR 257 Subpart D that apply to existing landfills and therefore the CCR unit is not located in a restricted location.

Kenneth J. Brandner

Printed Name of Registered Professional Engineer

Kenneth J Brandner

Signature

69586	Texas	7-6-16
Registration No.	Registration State	Date

5. References

Akron Consulting, Ltd., "October 2015 Stackout Aerial", October 2015.

AMEC, "Report of Dam Safety Assessment of Coal Combustion Surface Impoundments, American Electric Power (AEP) and Southwest Electric Power Company (SWEPCO) H.W. Pirkey Power Plant, Hallsville, TX", August 2011.

Apex Geoscience Inc., "USWAG Monitoring Wells and Groundwater Evaluation, AEP Pirkey Power Station, Hallsville, Texas", March 2011.

Auckland Consulting, LLC, "Monitoring Well Installation – 2015, Pirkey Generating Station, Hallsville, Texas", January 26, 2016.

Banks Information Solutions, "Water Well Report, Pirkey Power Plant, 2400 FM 3251, Hallsville, Texas, Harrison County", October 8, 2015.

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

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

Fetter, C.W., "Applied Hydrogeology", University of Wisconsin – Oshkosh, 1980.

Flawn, Peter T., "Geologic Atlas of Texas, Tyler Sheet", The University of Texas at Austin Bureau of Economic Geology, March 1965.

George, Peter G., et. al., "Aquifers of Texas", Texas Water Development Board Report 380, July 2011.

Johnson & Pace Incorporated, "Hydrology & Hydraulic Report, North Surge Pond, East & West Ash Ponds, Secondary Ash Pond, Landfill Pond, H.W. Pirkey Power Plant, Hallsville, Texas", May 2011.

Johnson & Pace Incorporated, "East Bottom Ash Pond June 2011 As-Built Plan & Profile, H.W. Pirkey Power Plant, Hallsville, Texas", June 2011.

Sargent & Lundy, "Henry W. Pirkey Power Plant, Design Summary for Lignite Storage Area and Wastewater Pond Facilities", January 31, 1983.

Sargent & Lundy, "Henry W. Pirkey Power Plant Unit 1, Wastewater Ponds – Liner Verification & Monitoring Wells", September 14, 1984.

Southwestern Laboratories, "Subsurface Exploration, Waste Water Ponds, Pirkey Power Plant, Hallsville, Texas", September 7, 1984.

Texas Commission on Environmental Quality, "Groundwater Classification, RG-366/TRRP-8", March 2010.

USGS, Aquifers and Groundwater. 2015. Available online at www.usgs.gov.

USGS, "Petroleum Geology and the Distribution of Conventional Crude Oil, Natural Gas, and Natural Gas Liquids, East Texas Basin", Open-File Report 88-450K, 1988.

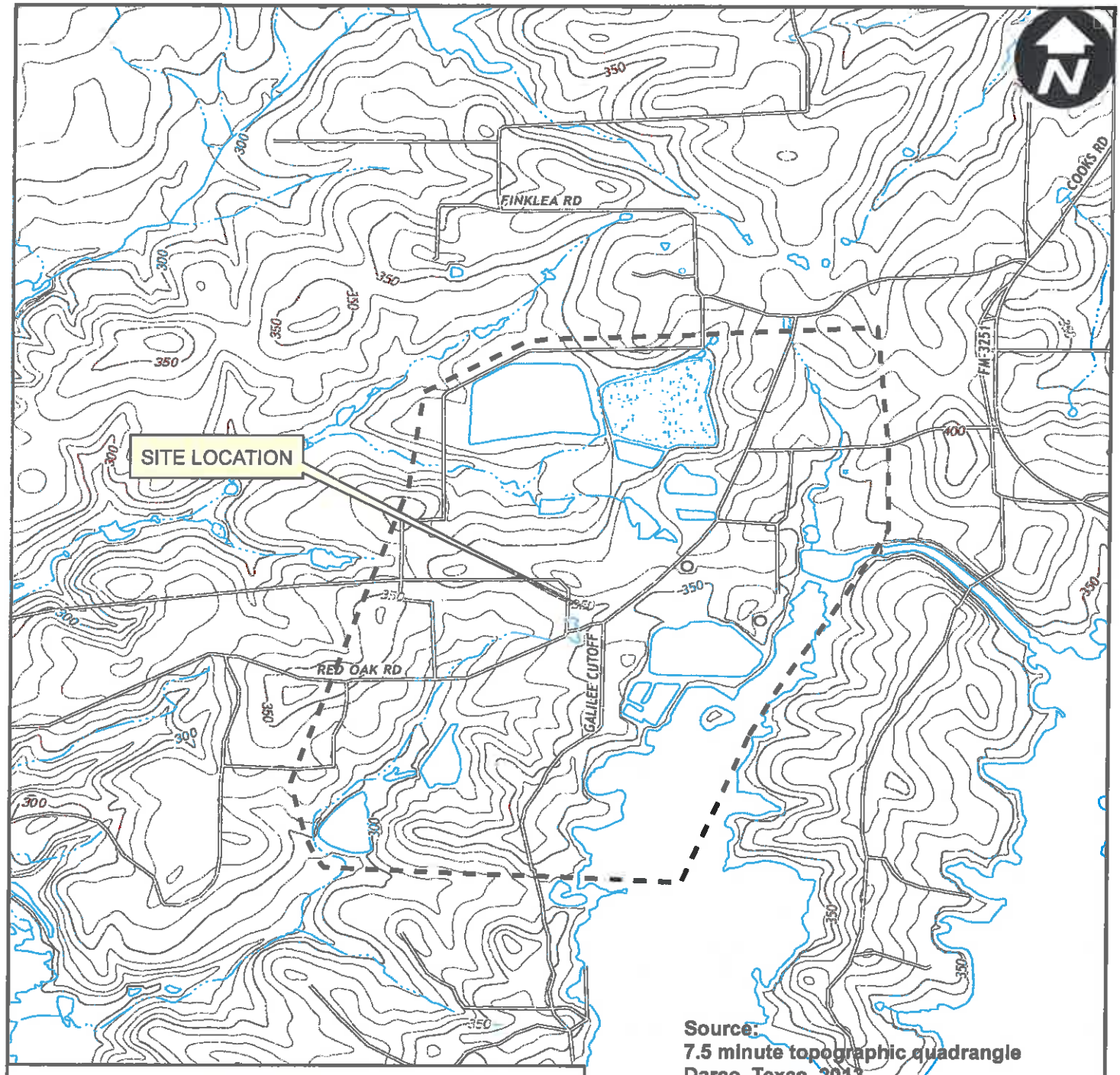
USGS, "Texas Seismic Hazard Map", 2014.

ARCADIS

Table 1
Water Level Data
AEP Pirkey Power Plant - CCR Storage Areas
Hallsville, Harrison County, Texas

Well ID	Latitude	Longitude	Ground Surface Elevation[a]	Top of Casing Elevation[a]	Borehole depth ft. bls	Date Installed	Screen Material	Well diameter inches	Top of Screen[b]		Bottom of Screen[b]		4/13/2011	12/15/2011	6/20/2012	1/23/2013	7/7/2013	1/22/2014	7/9/2014	1/28/2015	1/20/2016
									Depth ft. bls	Elevation ft. msl	Depth ft. bls	Elevation ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl	GW Elev. ft. msl
Monitoring Wells																					
MW-2/AD-2	32° 27' 54.753"	94° 29' 25.282"	341.25	344.04	40	10/7/83	Sch. 40 PVC	4	20	321.25	40	301.25	326.90	327.12	327.17	327.26	326.62	327.70	327.19	328.62	328.55
MW-3/AD-3	32° 28' 6.829"	94° 29' 21.498"	372.76	375.30	57	11/4/83	Sch. 40 PVC	4	37	335.76	57	315.76	342.95	341.59	343.70	341.10	343.27	341.42	343.96	345.01	347.03
MW-4/AD-4	32° 27' 59.247"	94° 29' 4.692"	363.69	366.79	46	10/10/83	Sch. 40 PVC	4	26	337.69	46	317.69	351.45	351.24	352.44	354.42	349.22	355.58	353.33	359.00	359.16
MW-7/AD-7	32° 27' 43.611"	94° 29' 15.611"	359.61	362.79	40	10/3/83	Sch. 40 PVC	4	20	339.61	40	319.61	344.34	343.75	344.15	344.90	343.35	346.61	346.23	349.17	349.31
MW-8/AD-8	32° 27' 25.095"	94° 29' 14.925"	356.92	359.84	35	10/4/83	Sch. 40 PVC	4	20	336.92	35	321.92	341.65	340.29	341.65	340.72	341.25	341.67	343.36	344.03	347.21
MW-10/AD-10	32° 27' 52.446"	94° 29' 16.545"	359.48	362.21	40	10/10/83	Sch. 40 PVC	4	20	339.48	40	319.48	342.03	341.90	342.19	341.41	339.85	342.27	342.22	344.39	343.97
MW-12/AD-12	32° 27' 51.702"	94° 29' 3.238"	378.84	381.99	51	1/30/86	Sch. 40 PVC	4	31	347.84	51	327.84	358.95	357.99	359.33	368.07	357.41	369.97	367.04	372.75	371.05
MW-13/AD-13	32° 27' 46.002"	94° 29' 5.71"	361.98	364.76	40.5	2/23/88	Sch. 40 PVC	4	30.5	331.48	40.5	321.48	349.46	348.91	349.52	350.81	348.61	351.97	351.29	354.47	354.15
AD-16	32° 27' 40.871"	94° 29' 38.637"	356.81	360.05	35	12/30/10	Sch. 40 PVC	2	15.0	341.81	35.0	321.81	338.08	335.50	337.58	335.43	336.67	339.53	340.84	343.34	347.68
AD-17	32° 28' 2.315"	94° 29' 39.45"	342.65	346.09	30	12/30/10	Sch. 40 PVC	2	10.0	332.65	30.0	312.65	322.66	322.29	323.31	323.51	323.06	325.19	324.15	328.42	326.78
AD-18	32° 28' 9.245"	94° 29' 6.469"	360.48	363.42	25	1/3/11	Sch. 40 PVC	2	15.0	345.48	25.0	335.48	355.53	351.54	357.21	355.47	357.23	360.03	358.06	359.88	360.52
AD-19	32° 27' 50.512"	94° 29' 13.973"	359.50	362.82	30	12/30/10	Sch. 40 PVC	2	10.0	349.50	30.0	329.50	344.07	343.58	344.29	344.62	342.60	345.11	345.76	347.92	347.40
AD-20	32° 27' 51.346"	94° 29' 21.576"	352.30	355.79	35	12/28/10	Sch. 40 PVC	2	15.0	337.30	35.0	317.30	334.50	334.63	334.69	334.78	333.38	335.38	334.87	336.88	336.07
AD-21	32° 27' 45.403"	94° 29' 19.195"	347.23	350.72	30	12/27/10	Sch. 40 PVC	2	10.0	337.23	30.0	317.23	340.43	340.02	340.22	341.57	339.16	342.36	341.67	345.45	343.82
AD-22	32° 27' 41.349"	94° 29' 17.779"	355.57	358.51	30	12/16/10	Sch. 40 PVC	2	10.0	345.57	30.0	325.57	343.64	343.16	343.74	344.83	342.90	346.49	345.77	350.24	350.29
AD-23	32° 27' 3.384"	94° 29' 41.258"	346.72	350.10	35	12/15/10	Sch. 40 PVC	2	15.0	331.72	35.0	311.72	319.65	318.94	319.29	318.66	318.87	319.80	319.79	319.84	321.23
AD-24	32° 27' 1.455"	94° 29' 56.388"	287.68	291.14	20	12/27/10	Sch. 40 PVC	2	5.0	282.68	20.0	267.68	282.92	284.29	285.10	285.63	285.06	288.30	287.10	288.56	---
AD-25	32° 27' 17.187"	94° 29' 58.998"	334.15	337.09	30	12/14/10	Sch. 40 PVC	2	10.0	324.15	30.0	304.15	324.51	321.90	323.14	321.94	322.15	322.56	324.24	326.42	327.00
AD-26	32° 27' 25.426"	94° 29' 54.775"	342.41	345.25	40	12/14/10	Sch. 40 PVC	2	10.0	332.41	40.0	302.41	324.53	323.77	323.62	322.32	322.09	323.24	322.51	323.04	326.06
AD-27	32° 27' 36.66"	94° 29' 47.272"	349.83	352.62	37.5	12/15/10	Sch. 40 PVC	2	17.5	332.33	37.5	312.33	325.82	324.54	326.13	325.39	325.35	326.39	327.91	329.69	330.89
AD-28	32° 27' 55.439"	94° 29' 39.418"	335.92	339.40	40	12/28/10	Sch. 40 PVC	2	15.0	320.92	35.0	300.92	319.67	319.16	319.92	320.21	319.69	320.65	320.22	322.16	321.39
AD-29	32° 28' 8.271"	94° 29' 31.939"	350.21	353.37	30	1/3/11	Sch. 40 PVC	2	10.0	340.21	30.0	320.21	334.68	333.37	334.74	337.47	336.84	338.55	335.85	340.57	338.48
AD-30[d]	32° 27' 56.49"	94° 29' 32.53"	339.04	342.02	25	12/8/15	Sch. 40 PVC	2	10.0	329.04	25.0	314.04	---	---	---	---	---	---	---	---	323.70
AD-31[d]	32° 28' 02.48"	94° 29' 20.90"	357.75	360.75	35	12/8/15	Sch. 40 PVC	2	20.0	337.75	35.0	322.75	---	---	---	---	---	---	---	---	346.60
AD-32[d]	32° 27' 56.20"	94° 29' 11.86"	357.23	359.18	33	12/11/15	Sch. 40 PVC	2	13.0	344.23	33.0	324.23	---	---	---	---	---	---	---	---	352.32
AD-33[d]	32° 27' 38.70"	94° 29' 15.82"	359.30	362.37	30	12/11/15	Sch. 40 PVC	2	15.0	344.30	30.0	329.30	---	---	---	---	---	---	---	---	351.13
AD-34[d]	32° 27' 10.13"	94° 29' 57.93"	304.64	307.61	25	12/11/15	Sch. 40 PVC	2	10.0	294.64	25.0	279.64	---	---	---	---	---	---	---	---	307.61
AD-35[d]	32° 27' 09.64"	94° 29' 42.74"	316.01	318.95	20	12/11/15	Sch. 40 PVC	2	3.0	313.01	18.0	298.01	---	---	---	---	---	---	---	---	309.85
Piezometers[c]																					
W-3 (PW-3)	32° 27' 57.6"	94° 29' 31.8"	356.30	356.30	38	10/20/09	Sch. 40 PVC	2	28.0	328.30	38.0	318.30	NM	NM	NM	NM	NM	NM	NM	NM	NM

(a) Source: Apex Geoscience Inc. (March 23, 2011).
(b) Screen length and screened intervals for AD-2 through AD-12 estimated from video surveillance (Apex Geoscience Inc., March 23, 2011).
(c) Souce: EETL (October 2010).
(d) Source: Auckland Consulting LLC (January 26, 2016). Monitoring wells AD-30 through AD-35 installed during December 2015.
Groundwater Elevation Source: AEP, Pirkey Monitoring Well Groundwater Elevations through January 2015.
NM - Not Measured



Source:
7.5 minute topographic quadrangle
Darco, Texas, 2013
Easton, Texas, 2013

0 2,000 4,000
SCALE IN FEET

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

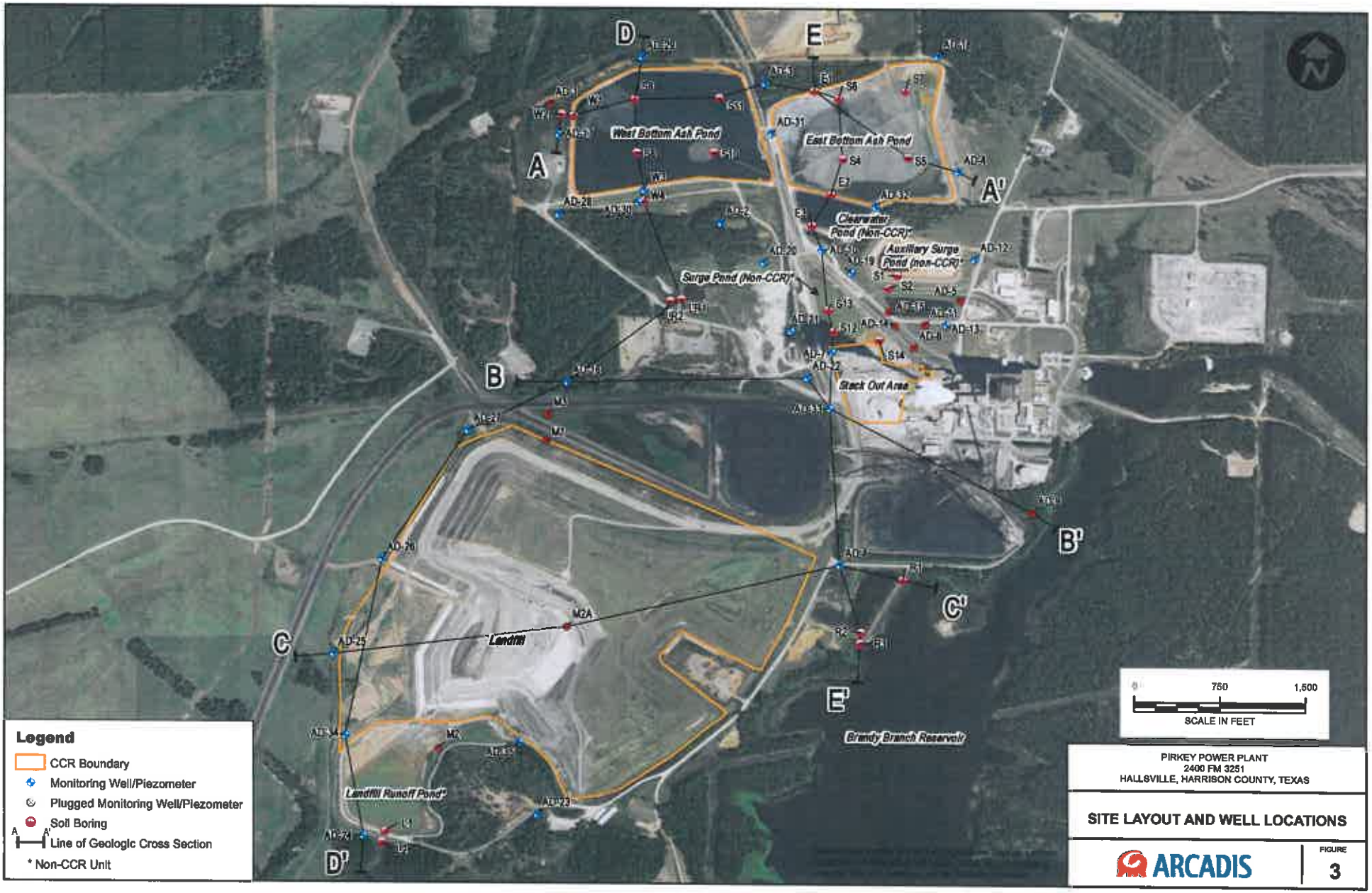
SITE LOCATION MAP

ARCADIS

FIGURE 1

Document Path: Z:\GISPROJECTS_ENVAEP\Pirkey Plant\MXD\Figure 1 - Site Location Map.mxd

Document Path: Z:\GIS\PROJECTS_ENVAE\PP\Pirkey Plant\MXD\Figure 2 - Plant and CCR Unit Location Map.mxd



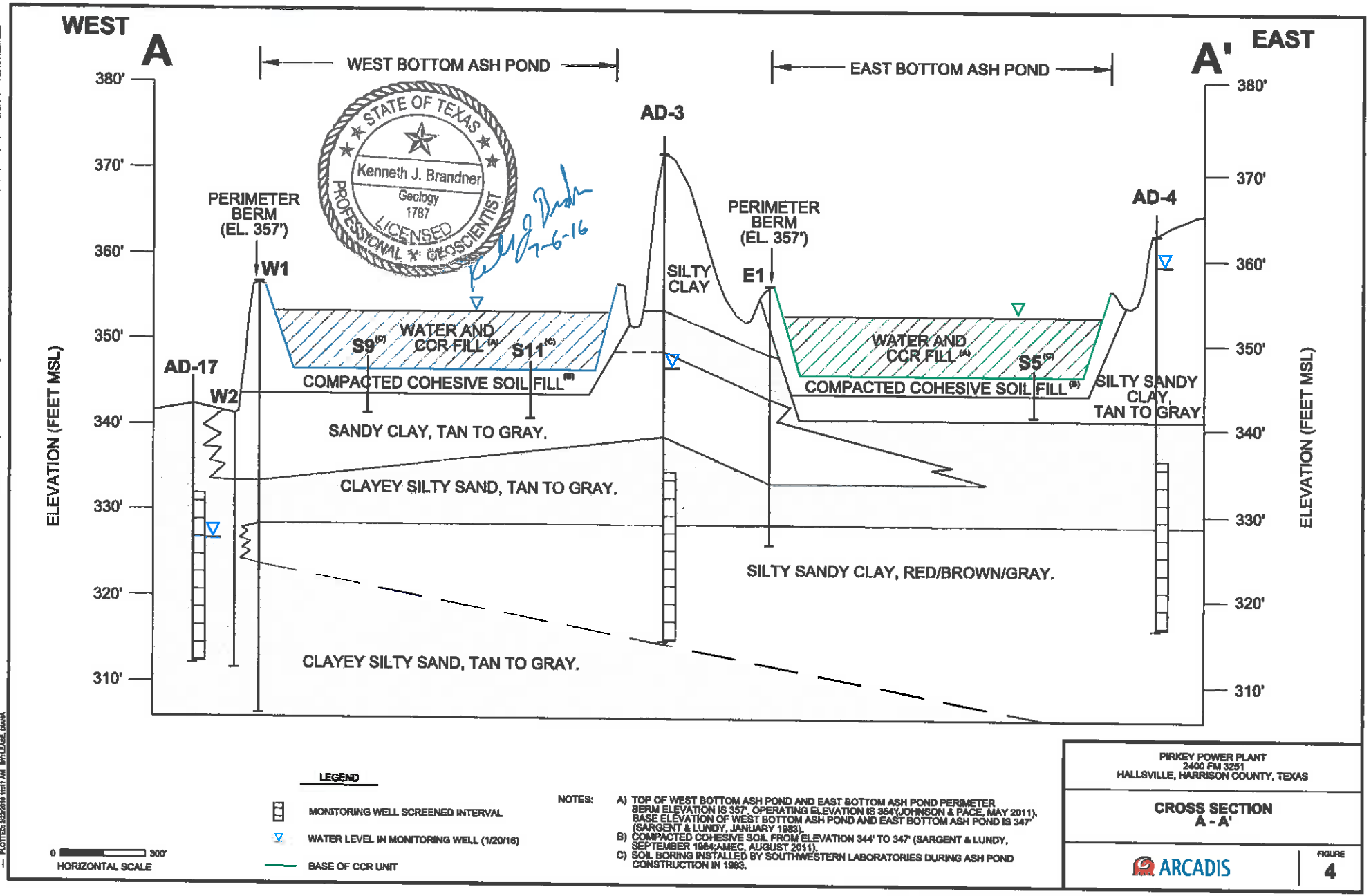
PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

SITE LAYOUT AND WELL LOCATIONS

ARCADIS

FIGURE 3

Document Path: Z:\GIS\PROJECTS_ENVAE\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:

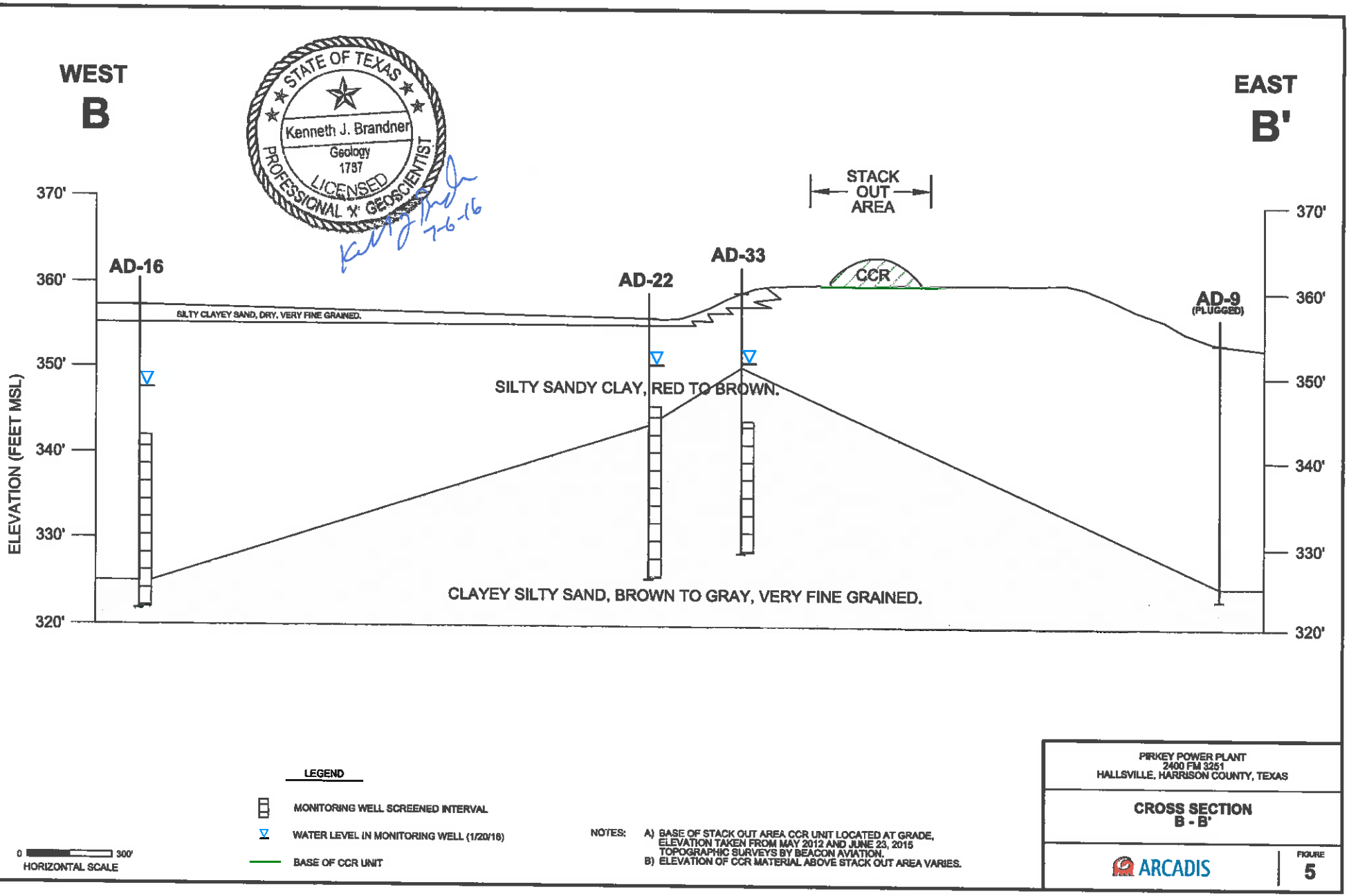
A) TOP OF WEST BOTTOM ASH POND AND EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357'. OPERATING ELEVATION IS 354'(JOHNSON & PACE, MAY 2011). BASE ELEVATION OF WEST BOTTOM ASH POND AND EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (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

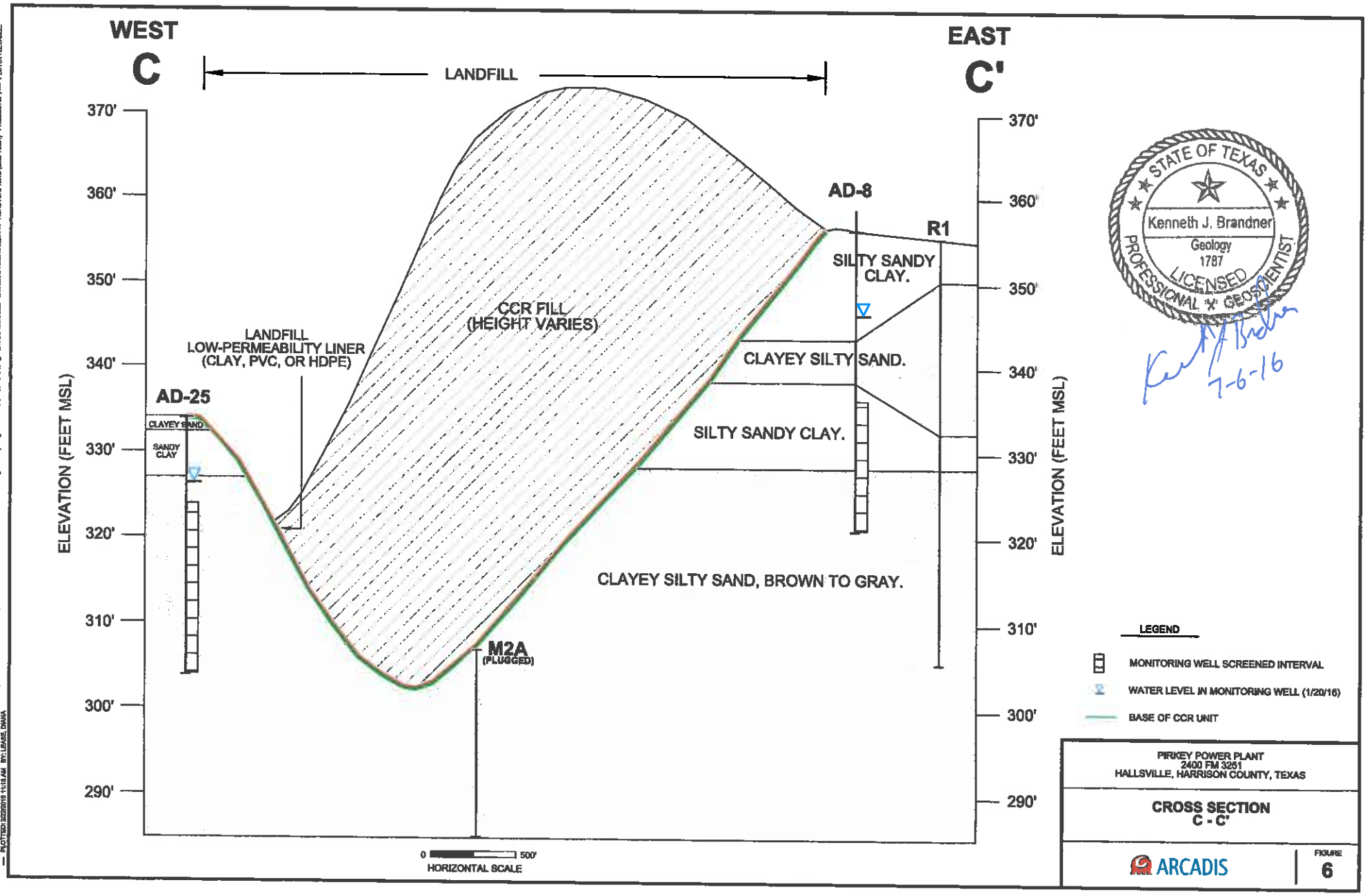


PIRKEY POWER PLANT
2400 FM 3251
HALLSVILLE, HARRISON COUNTY, TEXAS

CROSS SECTION
B - B'

ARCADIS

FIGURE
5



STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

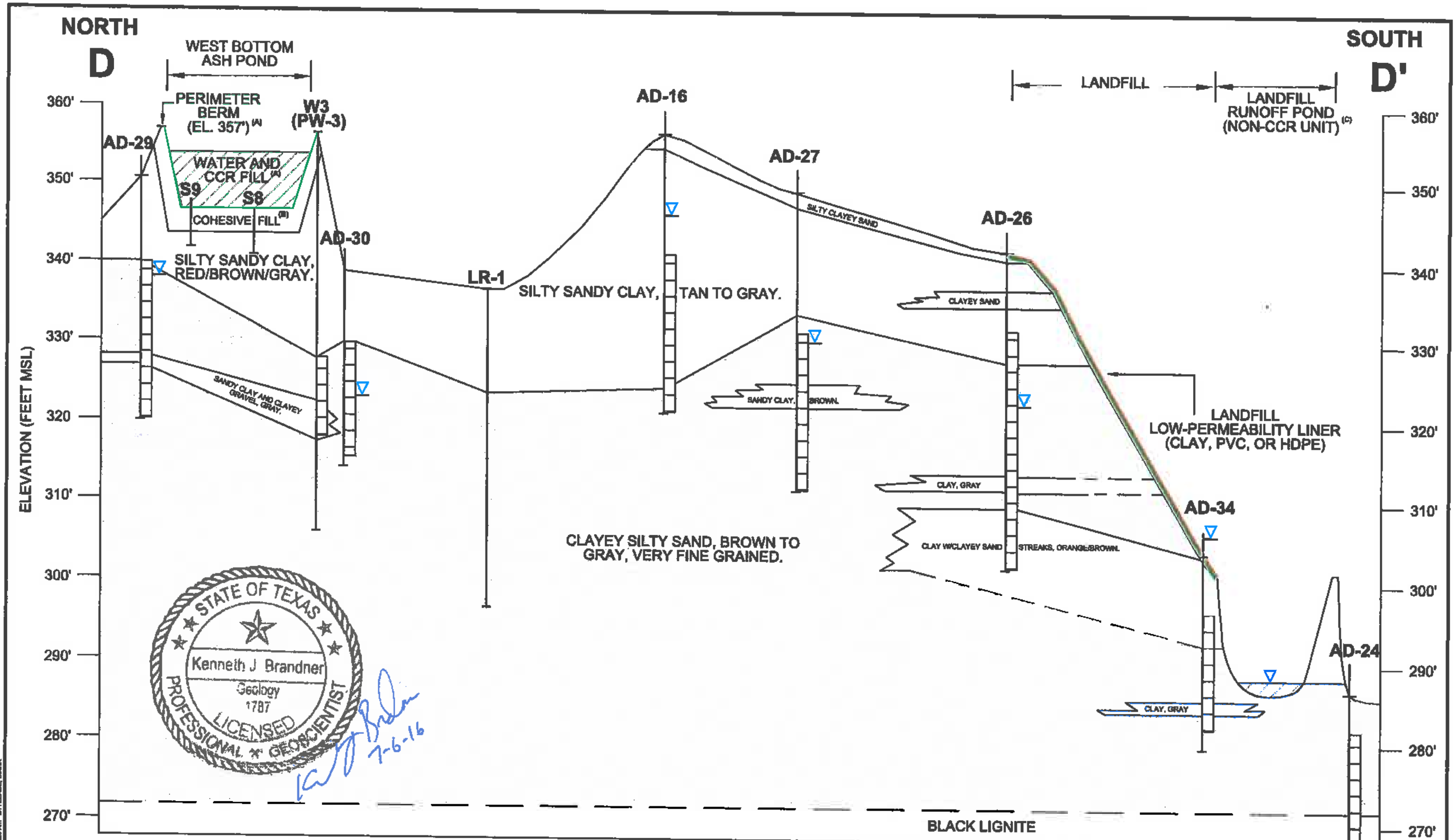
7-6-16

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

CROSS SECTION
C - C'

ARCADIS

FIGURE
6



LEGEND

MONITORING WELL SCREENED INTERVAL

WATER LEVEL IN MONITORING WELL (1/20/16)

BASE OF CCR UNIT

0 800'
HORIZONTAL SCALE

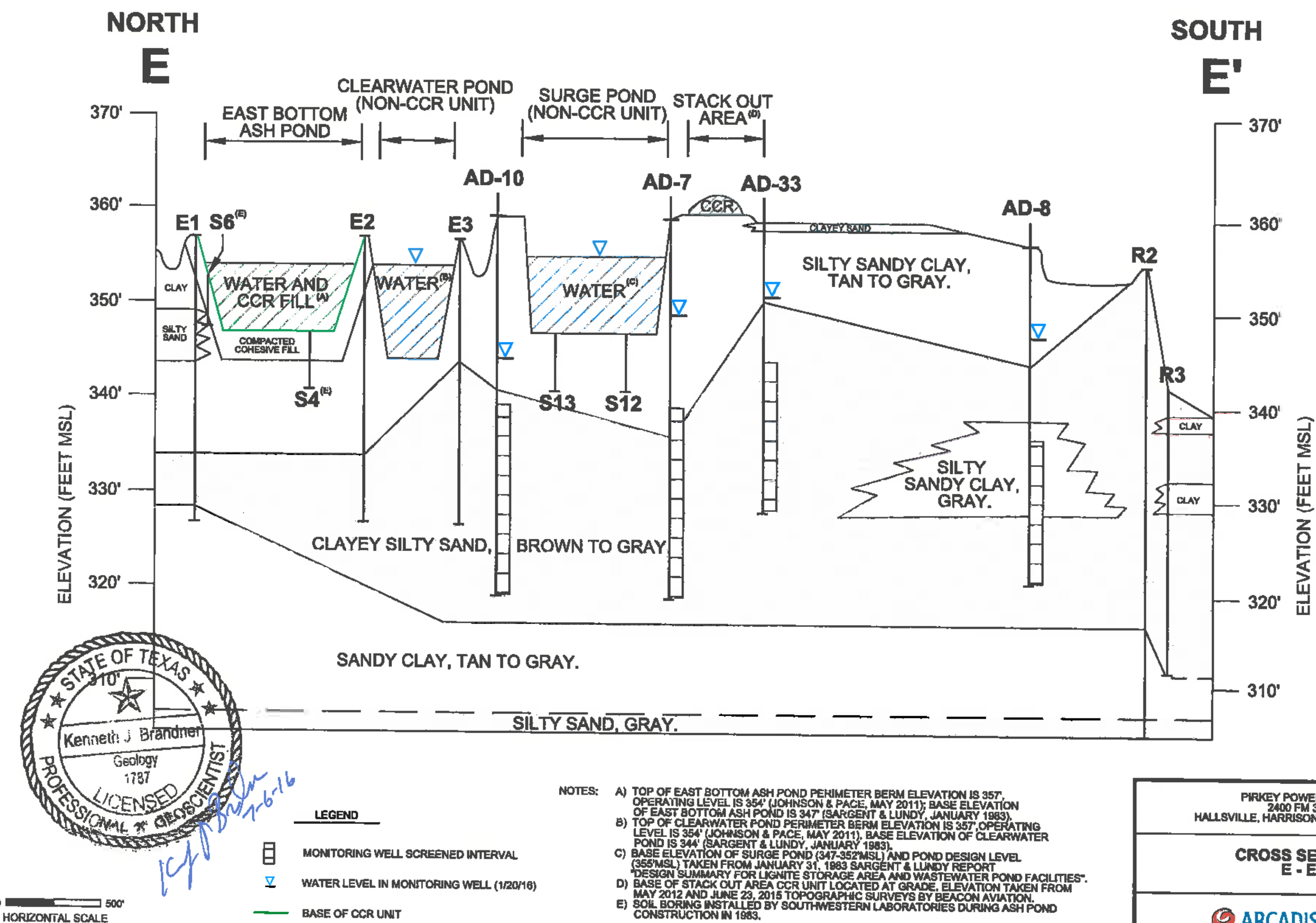
NOTES:
A) TOP OF WEST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF WEST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) COMPACTED COHESIVE SOIL FROM ELEVATION 344' TO 347' (SARGENT & LUNDY SEPTEMBER 1984; AMEC, AUGUST 2011).
C) LANDFILL RUNOFF POND PERIMETER BERM APPROXIMATE ELEVATION 302' MSL. BASE OF LANDFILL RUNOFF POND APPROXIMATE ELEVATION 286' MSL. NORMAL OPERATING LEVEL 288' MSL (JOHNSON & PACE MAY 2011).

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

CROSS SECTION
D - D'

ARCADIS

FIGURE
7



STATE OF TEXAS
Kenneth J. Brandner
Geology
1787
LICENSED
PROFESSIONAL GEOSCIENTIST

7-6-16

LEGEND

MONITORING WELL SCREENED INTERVAL

WATER LEVEL IN MONITORING WELL (1/20/16)

BASE OF CCR UNIT

NOTES:

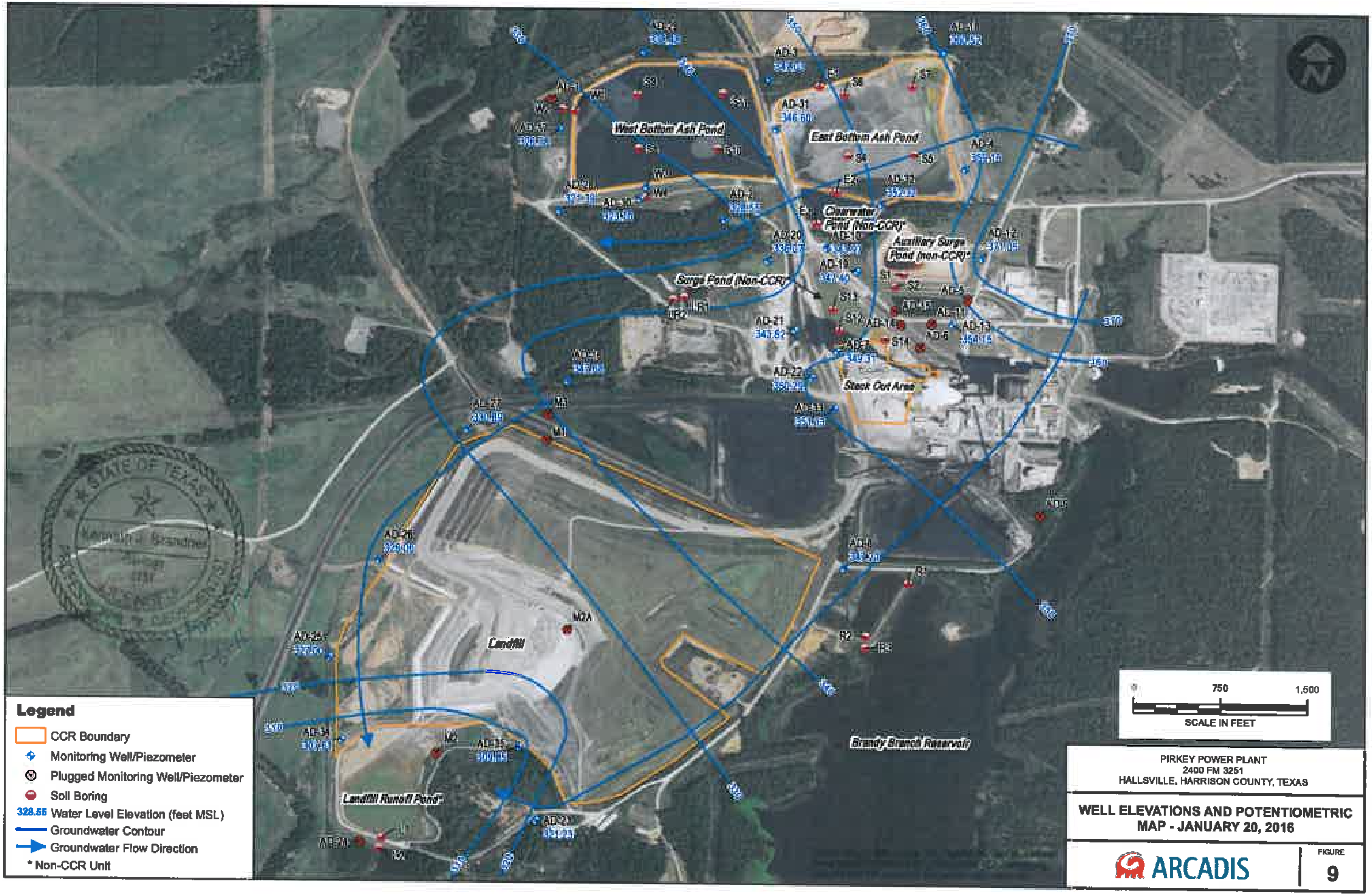
A) TOP OF EAST BOTTOM ASH POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011); BASE ELEVATION OF EAST BOTTOM ASH POND IS 347' (SARGENT & LUNDY, JANUARY 1983).
B) TOP OF CLEARWATER POND PERIMETER BERM ELEVATION IS 357', OPERATING LEVEL IS 354' (JOHNSON & PACE, MAY 2011). BASE ELEVATION OF CLEARWATER POND IS 344' (SARGENT & LUNDY, JANUARY 1983).
C) BASE ELEVATION OF SURGE POND (347-352'MSL) AND POND DESIGN LEVEL (355'MSL) TAKEN FROM JANUARY 31, 1983 SARGENT & LUNDY REPORT "DESIGN SUMMARY FOR LIGNITE STORAGE AREA AND WASTEWATER POND FACILITIES".
D) BASE OF STACK OUT AREA CCR UNIT LOCATED AT GRADE. ELEVATION TAKEN FROM MAY 2012 AND JUNE 23, 2015 TOPOGRAPHIC SURVEYS BY BEACON AVIATION.
E) SOIL BORING INSTALLED BY SOUTHWESTERN LABORATORIES DURING ASH POND CONSTRUCTION IN 1983.

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

CROSS SECTION
E - E'

ARCADIS

FIGURE
8



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

WELL ELEVATIONS AND POTENTIOMETRIC MAP - JANUARY 20, 2016

ARCADIS

FIGURE 9

Appendix A

Boring/Well Construction Logs

832964

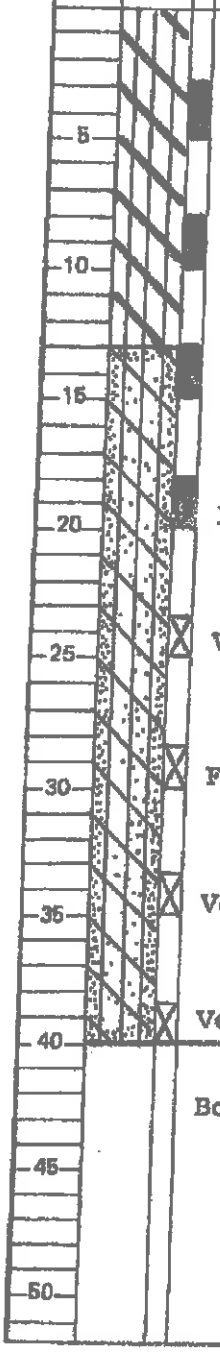
LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-6
LOCATION: Hallsville

Date: 10-3-83 Type: Auger Ground Elevation:

Legend: ▩ Sample X Penetration ▼ Water



Description of Stratum
Stiff tan and grey clay w/silt lenses and iron ore
Very stiff tan and grey clay w/silt lenses and iron ore
Firm tan and grey clayey silty sand
Loose brown and grey clayey silty sand
Very dense grey clayey silty sand 25-25=11½" 50 B/11½"
Firm grey clayey silty sand 7-7-17 24 B/F
Very dense grey clayey silty sand 25-25=9" 50 B/9"
Very dense grey clayey silty sand 18-32=10½" 50 B/10½"
Bottom of boring at 40 feet.

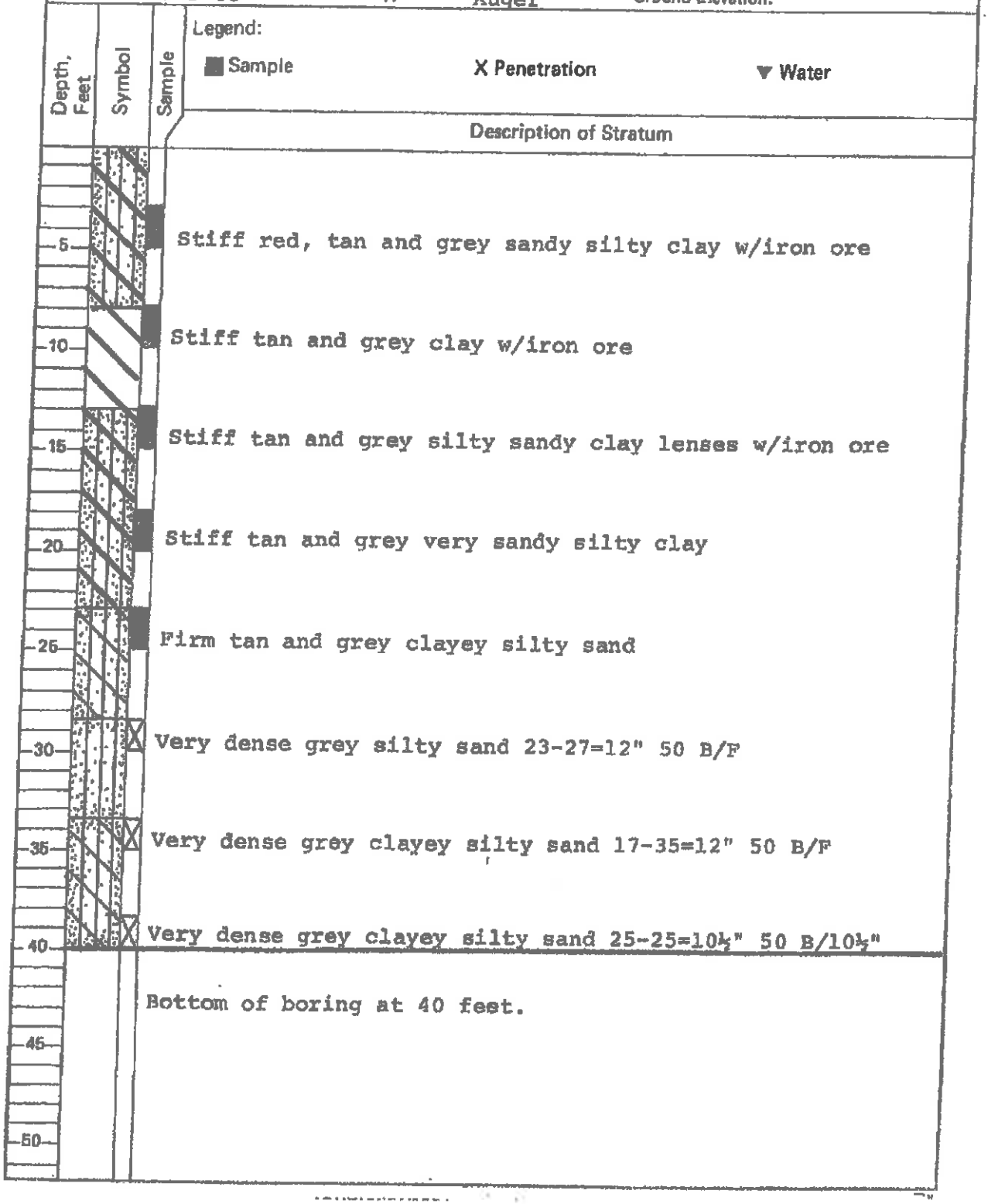
832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: MW-7
LOCATION: Hallsville

Date: 10-3-83 Type: Auger Ground Elevation:



Description of Stratum

Stiff red, tan and grey sandy silty clay w/iron ore

Stiff tan and grey clay w/iron ore

Stiff tan and grey silty sandy clay lenses w/iron ore

Stiff tan and grey very sandy silty clay

Firm tan and grey clayey silty sand

Very dense grey silty sand 23-27=12" 50 B/F

Very dense grey clayey silty sand 17-35=12" 50 B/F

Very dense grey clayey silty sand 25-25=10½" 50 B/10½"

Bottom of boring at 40 feet.

832964

LOG OF BORING

PROJECT: Monitor Wells at Metal Cleaning Waste Pond BORING NO.: MW-12
CLIENT: Southwestern Electric Power Company LOCATION: Hallsville, TX

Date: 1/30/86 Type: Rotary N 6+13.25; W-6+90.36 Ground Elevation: 378.41

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Brown and tan sandy clay
10			Brown, tan and gray sandy clay
15			Tan and gray sandy clay
20			Brown and tan sandy clay
25			Gray and tan sandy clay
30			Brown and gray clay
35			Brown and gray clay
40			Gray silty sand
45			Gray silty sand
50			Gray silty sand

Water encountered at 27.5 feet.
Bottom of Boring at 51 feet.

SOUTHWESTERN LABORATORIES

Observation Well Installation Report

Location	Date	Station #	City
Pirkey Power Plant	2-23-88	Elev. 361.85 0+33.3N, 8+84.7 W.	Hallsville, Texas

Project	Observation Well Number	Location
880284	MW-13	

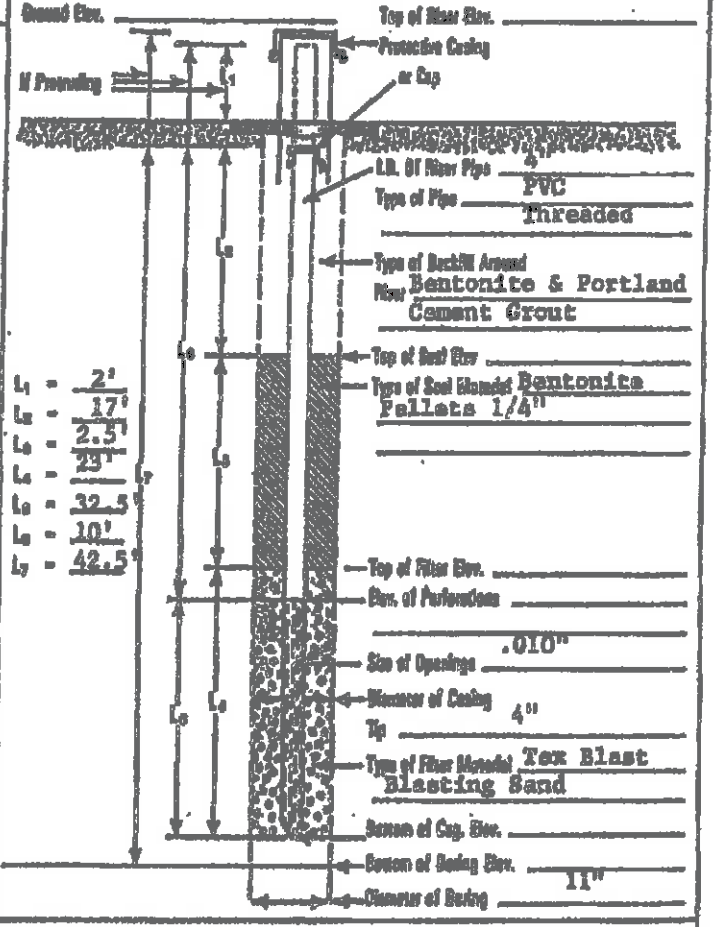
Type of Rig	Installed By	Date	Time
CME 55	DS, DY, LM	2-23-88	

Method of Installation: Hollow-stem auger

Log of Boring and Observation Well

Boring			Observation Well
Depth in ft.	Casing Interval	Description	

Type of Observation Well: ☐ Flush ☒ Locking Cap ☒ Protruding ☐ Manhole



Remarks: L2, L5, L7 are measured from the top of the PVC pipe, which protrudes 2' above the ground surface.

Supervised By

APEX PROJECT NO.: 110-089 ☐ BORING BORING NUMBER: ____ ■ MONITOR WELL MONITOR WELL NUMBER: AD-22

FACILITY NAME: AEP- Firkey Power Plant FACILITY ID NO.: N/A

FACILITY ADDRESS: Hallsville, Texas

DRILLING COMPANY/METHOD/RIG: Apex Geoscience Inc. / Hollow-stem Augers/ CME-55 Track Rig

DRILLER: Ed Wilson, Apex Geoscience Inc. COMPLETION DATE: 12/16/2010

PREPARED BY: David Bedford LOGGED BY: David Bedford

LATITUDE: N 32°27'03.3" Datum: WGS-84
LONGITUDE: W94°29'41.3" WELL LOCATION: Triangle- South side Quonset Hut

DEPTH (FEET)	PID (PPM)	SAMPLE INTERVAL	WELL LOG AND COMPLETION DETAILS	USCS CODE	SOIL DESCRIPTION AND COMMENTS	Odor	Moisture
1				0-0.5 SC	Clayey sand, light brown, very fine grained	None	Moist
2				0.5-12 CL	Lean clay, light brown mottled with light gray	None	Slightly Moist
3					Few iron ore (small) pebbles in clayey sandy streaks		
4							
5							
6							
7							
8							
9							
10							
11							
12							
13			▽	12-20 SC	Clayey sand, grayish brown with orangish brown streaks, very fine grained	None	Slightly Wet
14					Slightly wet @ 12.5' from seepage		
15					Large amount of iron ore 15-17'		
16							
17							
18					Very firm 18-18.5'		
19							
20							
21				20-25 SC	(Dense crystalline rock 21-21.1'), light brown clayey sand, greenish black, mica, black clay streaks, very fine grained, wet @ 20'	None	Wet
22							
23							
24							
25							
26				25-30 SM	Sand, greenish brown (1') grading to orangish brown, silty, very fine grained	None	Wet
27							
28							
29							
30							
31					Boring Terminated at 30'		
32							
33							
34							
35							
36							
37							
38							
39							
40							

Cement Bentonite Filter Sand ▽ Water Level

Apex geoscience inc.

Total Depth: 30 feet
Filter Sand (Size/Interval): 8-30'
Grout (Type/Interval): Grout from 0-2'; Bentonite from 2-8'
Surface Completion ☐ Flush ■ Above Ground

Riser Interval: +3 (ags)-10'
Screen Interval: 10-30'
Water level: 12.5'
3'

Note: This log is not to be used seperate from this report.

Hydrex ENVIRONMENTAL, INC.

Monitor Well

Monitor Well No.: AD-33

PROJECT INFORMATION

PROJECT:	Pirkey Power Plant
PROJECT NO.:	I-04-1821
LOGGED BY:	Jeffrey D. Sammons, P.G.
SUPERVISING PG:	Jeffrey D. Sammons, P.G.
COMPLETION:	12/11/2015
DEVELOPMENT:	12/15/2015
SITE LOCATION:	2400 FM 3251, Hallsville, Texas
WELL OWNER:	AEP

DRILLING INFORMATION

DRILLER:	Buford Collier
DRILLER'S LICENSE NO.:	60089
RIG TYPE:	Geoprobe 3230DT
METHOD OF DRILLING:	Hollow Stem Auger
SAMPLING METHODS:	Split Core
SURFACE ELEVATION:	382.37 (Top of Casing)
HOLE DIAMETER:	8.25"
LATITUDE	32° 27' 38.70" LONGITUDE 94° 28' 15.82"

STATE OF TEXAS — JEFFREY D. SAMMONS — GEOLOGY #10070 — LICENSED PROFESSIONAL GEOSCIENTIST — 1.21.16

▽ Water Level Upon Installation ▽ Water Level at Time of Drilling ■ Geotechnical Lab Sample

TBPG No. 50027

DESCRIPTION	USCS	DEPTH	SAMPLE	% MOISTURE	% FINES	LL	PL	PI	WELL CONSTRUCTION
									Locking Well Casing Cover; Locking Well Cap; Protective Well Casing; Concrete Pad; Ground Surface; Cement
CLAYEY SAND: very fine to fine sand, some silt, dark brownish black and brown, very moist	SC	0–1							
FAT CLAY: trace sand and silt, reddish brown and light gray - some iron ore gravel at 2.0' - some silt and ironstone in thin seams at 2.5', light gray, yellowish brown, and reddish brown,	CH	1–4		29	93	74	32	42	
CLAYEY SAND: interbedded clays and fine to very fine sand and silt, some iron ore gravel, light reddish brown and light gray	SC	4–8							Bentonite; 2" Sch. 40 PVC Riser
- some clay and trace of iron ore gravel at 11', light gray and reddish brown, moist		8–11		21	35	35	23	12	
- trace clay at 13', thin saturated ironstone and gravel seams at 13' to 16', reddish brown, light reddish brown, and light gray - dark reddish brown at 15' - clay lense at 15.5' to 16.5', light reddish brown and light gray		11–16							
SILTY CLAYEY SAND: very fine to fine sand, reddish brown, very moist to saturated	SM-SC	16–20							
- some clay lenses and iron ore gravel at 20' - clayey at 20.5' to 21' - trace clay at 21', light gray, saturated		20–21		23	19	27	18	9	20/40 Silica Sand; 0.010" Slotted Sch. 40 PVC Well Screen
- some iron ore gravel at 28', reddish brown, very moist		21–28							
CLAYEY SAND: very fine to fine sand, dark gray and gray, moist	SC	28–30		23	30	25	18	7	PVC Bottom Cap

NOTES: This log should not be used separately from the original report. Not all USCS descriptors were laboratory verified.

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: S-12
LOCATION: Hallsville, TX

Date: 9-15-83 Type: Ground Elevation: 348.3

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
			Red and grey sandy silty clay
			Red and grey clay w/silt lenses
5			Red and grey clay
			Bottom of boring at 6 feet.
			No water encountered.
10			
15			
20			
25			
30			
35			
40			
45			
50			

832964

LOG OF BORING

PROJECT: Waste Water Ponds
CLIENT: SWEPCO

BORING NO.: S-14
LOCATION: Hallsville, TX

Date: 9-15-83 Type: Ground Elevation: 352.9

Legend: ■ Sample X Penetration ▼ Water

Depth, Feet	Symbol	Sample	Description of Stratum
5			Brown and red clay w/silt lenses Brown and red slightly silty clay Brown and red sandy silty clay
10			Bottom of boring at 6 feet. No water encountered.
15			
20			
25			
30			
35			
40			
45			
50			

Appendix B

Photographic Log

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
1	8/19/2015

Direction Photo Taken:

East Southeast

Description:

P8190405
AD-21 Ground water monitoring well northeast of Stack Out Area.

ARCADIS

PHOTOGRAPHIC LOG

Project Name:	Location:	Project No.
AEP – Pirkey Power Plant	Hallsville, Harrison County, Texas	OH015976.0001

Photo No.	Date:
2	8/19/2015

Direction Photo Taken:

Southeast

Description:

P8190438
Stack Out Area