PUBLIC SERVICE COMPANY OF OKLAHOMA (PSO)

NORTHEASTERN POWER STATION



Groundwater Monitoring Network Report

Revision 3 – April 2025

Record of Plan Revisions						
Revision Number	Revision Description					
1	May 2018	 3.1.2 Overall Flow Conditions – revised description to include gw information from all MWs screened in the shale Unit. This modified the gw flow to a radial flow. 3.3.1 Overview – revised to include a description of the 17 wells set in the deep shale unit. 3.3.1.3 Key Flow Directions – revised to indicate a gw radial flow, not a north to south gw flow. 3.3.2 Gaps in the monitoring Well Network – changed to recommend further evaluation of gw to identify unimpacted locations that might serve as background wells. 3.3.3 Recommended Monitoring Well Network-Changed to recommend MWs 1D-6D, 9D-13D, and 14-17 as monitoring well network. 				
Revision 2	Dec. 2022	 2.3.2 Regional Geologic Setting – revised to reflect that the Oologah formation is approximately 80-100 feet thick in the vicinity of the Landfill 3.1 Hydrostratigraphic Units – revised to remove the shale unit, as it is not a unit of interest 				

		3.1.2 Overall Flow Conditions – revised to indicate that groundwater is associated with discontinous fratures, joints, or cavities in the limestone
		3.2.2 Identified Onsite Hydrostratigraphic Unit(s) – Uppermost Aquifer – revised to indicate that the limestone is the identified hydrostratigraphic unit of interest
		3.5 Review of Revised Monitoring Network - added MW-18 and MW-19 as background wells
		Appendix D – Geologic Cross Sections – revised to illustrate that the limestone/shale contact occurs at greater depth based on observations from additional borings
	Apr. 2025	Minor miscellaneous edits incorporated throughout to reflect current site conditions, update references, and similar.
Povision 3		2.4 Previous Investigations and Studies – updated to reflect communication between ODEQ and PSO regarding background wells included in the network
Revision 3		3.5 Review of Revised Monitoring Network – removed MW-18 and MW-19 as background wells and added SP-4 and SP-5R as background wells
		Appendix C – Geologic Cross Sections – revised to extend cross section A-A' north to encompass SP-5R.



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GROUNDWATER MONITORING NETWORK EVALUATION REPORT

COAL COMBUSTION RESIDUALS LANDFILL

American Electric Power – Public Service Company of Oklahoma Northeastern Power Station Oologah, Oklahoma

Prepared for

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Project Number: CHC8069

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ACRONYMS AND ABBREVIATIONS

AEP	American Electric Power
CCR	coal combustion residuals
CGGB	Cherokee Group Groundwater Basin
cm/sec	centimeters per second
ft bgs	feet below ground surface
ft amsl	feet above mean sea level
HDPE	high-density polyethylene
MW	monitoring well
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NPS	Northeastern Power Station
OAC	Oklahoma Administrative Code
ODEQ	Oklahoma Department of Environmental Quality
OGS	Oklahoma Geological Survey
OPDES	Oklahoma Pollutant Discharge Elimination System
OWRB	Oklahoma Water Resource Board
PE	Professional Engineer
PSO	Public Service Company of Oklahoma
SCB	slag-cement-bentonite
TDS	total dissolved solids
USGS	United States Geological Survey



1. INTRODUCTION

1.1 Purpose

The purpose of this report is to provide an evaluation and certification of the revised groundwater monitoring network for the existing coal combustion residuals (CCR) Landfill at Public Service Company of Oklahoma's (PSO's) Northeastern Power Station (NPS). PSO is a business unit of American Electric Power (AEP). The groundwater monitoring network was previously assessed and certified by Terracon Consultants, Inc. (Terracon) (Terracon 2017b, 2018) and more recently was revised at the request of the Oklahoma Department of Environmental Quality (ODEQ) to incorporate two new background monitoring wells (Geosyntec Consultants, Inc. [Geosyntec] 2022a). This revised groundwater monitoring network was approved by ODEQ in January 2023 (ODEQ 2023a). ODEQ subsequently provided notice that the newly incorporated background wells (MW-18 and MW-19) were not suitable background wells for the Landfill (ODEQ 2023b). ODEQ agreed with PSO's recommendation to remove MW-18 and MW-19 from the network and include both SP-4 and SP-5R as background wells for the Landfill (ODEQ 2024).

The revised groundwater network with background monitoring wells SP-4 and SP-5R was evaluated by Geosyntec to assess compliance with Oklahoma Administrative Code (OAC) 252:517-9-2, which sets out the regulatory requirements for design and construction of groundwater monitoring systems for CCR disposal units. The results of this evaluation are presented herein.

1.2 Organization of Report

This report is organized as follows:

- Section 2 presents background information on the NPS and the Landfill;
- Section 3 presents an evaluation of the revised groundwater monitoring network; and
- Section 4 provides lists of references used to develop this report.

Supporting documentation is provided in **Appendices A** through **E**. The certification of the revised groundwater monitoring system by a qualified Professional Engineer (PE) is provided in **Appendix F**.

1.3 Coordinate System and Datum

The horizontal coordinate values provided in this report are based upon the North American Datum of 1983 (NAD83), Oklahoma North Zone. The vertical datum utilized for reporting the elevations within this report is the North American Vertical Datum of 1988 (NAVD88).

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2. BACKGROUND INFORMATION

Except where noted, the primary source of the background information presented in Sections 2.1 to 2.3 is Terracon (2018).

2.1 Facility Location Description

The NPS is located southeast of the junction of U.S. Highway 169 and Oklahoma Highway 88 approximately one mile south of Oologah, Rogers County, Oklahoma (**Figure 1**). The facility property consists of an approximately 1,230 acres located in Sections 3 and 4, Township 22 North, Range 15 East, and Sections 33 and 34, Township 23 North, Range 15 East (I.M.) in Rogers County, Oklahoma (Site). Four electric generating Units are present at the facility. Units 1 and 2 are gas-fired, while Units 3 and 4 are coal-fired units. Unit 4 ceased operation in April 2016. A site map showing the location of the NPS and the relative positions of the Landfill and the Bottom Ash Pond, the other regulated CCR unit at the facility, is presented in **Figure 2**.

2.2 Landfill Description

2.2.1 Construction and Operational History

The Landfill was permitted by the Oklahoma State Department of Health in March 1978 (Oklahoma State Department of Health, 1978). The Landfill permit has subsequently been modified and re-issued through the ODEQ. The Landfill currently operates under Permit No. 3566010 issued January 4, 2016.

The Landfill was constructed in a depression where gravel pit mining or limestone quarrying operations took place historically. Portions of the upper limestone rock appear to have been removed, primarily within the western portion of the Landfill. The permitted footprint of the Landfill includes a 44-acre CCR disposal area with a total disposal capacity of 2.463 million cubic yards. The total footprint of the Landfill includes a stormwater collection basin (Basin C), and a leachate impoundment between the Landfill and the basin (**Figure 2**).

A dike structure was constructed along the south boundary of the Landfill to contain the waste and isolate the Landfill from the Verdigris River. This dike was initially built to an elevation of 610 feet above mean sea level (ft amsl) with a crest width of 10 to 12 feet and 3:1 side slopes when the NPS was constructed (Terracon, 2012). An additional construction event raised the dike to the current crest elevations of greater than 630 ft amsl, with a crest width of approximately 25 feet, 3:1 interior slopes, and exterior side slopes ranging from approximately 4:1 to 2.5:1. The dike materials consist of red-brown clay with limestone gravel mixed with varying amounts of ash material and larger rock. Limestone with some thin shale beds, followed by shale, underlies the constructed dike.

To control seepage of groundwater flowing beneath the Landfill and into the Verdigris River, a 2,200-foot long slurry wall and 1,400-foot long grout curtain was installed within the constructed dike on the southeast side of the Landfill (Terracon 2017a). The slurry cutoff wall was constructed by excavating an approximately 3-foot-wide trench to the top of limestone bedrock (typically 20

to 25 feet below ground surface [ft bgs]) along the southern edge of the Landfill and pumping a slag-cement-bentonite (SCB) slurry into the trench. The grout curtain was installed by injecting grout to a maximum depth of approximately 40 ft bgs into 3-inch borings spaced as needed to effectively prevent seepage through approximately 1,400 feet of the 2,200-foot-long slurry cutoff wall. The construction of these features was completed in 2013.

In 2012, a 60-mil high-density polyethylene (HDPE) geomembrane intermediate liner and an overlying leachate collection system were installed over intermediate grades of previously placed waste to limit infiltration of precipitation through the waste mass. The intermediate liner system extends across approximately 33 acres of the Landfill (Terracon 2012) and slopes downward from west to east (towards the leachate impoundment) at grades from approximately 645 ft to 615 ft amsl. As of November 2024, waste was being placed in Cell 1 of the Landfill and the remainder of the Landfill (inactive Cells 2 to 4) was covered with a temporary geomembrane cover (rainflap) and temporary Wind Defender® geotextile cover (GEI Consultants, Inc. [GEI] 2024). The extent of temporary cover as of the date of the most recent satellite imagery (December 2023) is shown in **Figure 3**.

2.2.2 Surface Water Control

OAC 252:517-13-2 requires the owner of operator of a CCR landfill to design, construct, operate, and maintain run-on and run-off controls to manage and control the peak stormwater discharge from a 24-hour, 25-year storm event. As described by Terracon (2021), the built-up perimeter dike and roadways provide topographic controls to prevent run-on from outside the landfill footprint. Further, the Landfill perimeter drainage channels inside the diked area were designed to manage the run-off from operating and closed landfill areas. The drainage channels are generally sloped to drain to the northeast portion of the Landfill towards Basin C (**Figure 2**). As designed, the run-on and run-off control systems are capable of managing and controlling a 24-hour, 25-year storm event. Discharges of stormwater collected in Basin C is managed as part of the facility Oklahoma Pollutant Discharge Elimination System (OPDES) program under Permit No. OK0034380.

2.3 Hydrogeologic Setting

2.3.1 Climate and Water Budget

The average annual precipitation in Rogers County is approximately 45.92 inches, with monthly totals averaging between about 1.98 inches in the driest months (January and February) to about 6.07 inches in the wettest month (May). Average temperatures range from highs in the low 80s Fahrenheit in July and August to highs in the mid to high 30s Fahrenheit in December and January¹.

2.3.2 Regional Geologic Setting

Shallow bedrock in Rogers County consists predominantly of Pennsylvanian-age limestones, shales, and sandstones of the Marmaton Group, underlain by the Cherokee Group (Oklahoma

¹<u>https://climate.ok.gov/index.php/climate/climate_normals_by_county/my_county_or_town</u> accessed April 14, 2025.



Geological Survey [OGS] 2022; OGS 2008; Woodruff and Cooper 1928). The generalized stratigraphic column of the regional geology in the Site vicinity is summarized below:

Series	Group	Formation		
		Oologah		
Desmoinesian	Marmaton	Labette		
		Fort Scott Limestone		
		Senora		
	Cherokee	Boggy		
		Savanna		

The surficial geology of the Site and surrounding area is shown in Figure 4.

Regional geologic mapping information (OGS 2022) indicates that the majority of the Site is underlain by the Oologah Formation, which is generally characterized as a medium to dark gray, massive to thinly bedded argillaceous limestone with a small amount of fissile shale (Oakes 1952; OGS 2022). The limestone is typically dense to moderately crystalline and unjointed. In the Site vicinity, the Oologah Formation is approximately 80 to 100 feet thick.

The Oologah Formation conformably overlies the Labette Formation, a grayish brown to dark gray, laminated clayshale. The clayshale contains some zones of weakly calcareous shale, and multiple horizons of sandy shale to sandstone. Concretions composed of hematite and/or siderite usually occur throughout the formation (OGS 2022). The thickness of the Labette Formation typically ranges from approximately 180 to 250 feet thick (Oakes 1952).

The Labette Formation is underlain by the Fort Scott Formation which consists of three members, in descending order: the Higginsville Limestone; the Little Osage Shale; and the Blackjack Creek Limestone. The Fort Scott Formation limestone members consist primarily of a light gray, thin to medium, wavy-bedded fossiliferous wackestone and mudstone (OGS 2004).

2.3.3 Regional Hydrogeologic Setting

The Oklahoma Water Resources Board (OWRB) defines major and minor aquifers as follows (OWRB 2025):

"Major groundwater basin (aquifer) is defined as a distinct underground body of water overlain by contiguous land and having substantially the same geological and hydrological characteristics and from which groundwater wells yield at least fifty (50) gallons per minute on the average basin wide if from a bedrock aquifer and at least one hundred fifty (150) gallons per minute on the average basin wide if from an alluvium and terrace aquifer, or as otherwise designated by the Board."



"Minor groundwater basin (aquifer) is defined as a distinct underground body of water overlain by contiguous land and having substantially the same geological and hydrological characteristics and which is not a major groundwater basin."

Regional geologic mapping information (OWRB 2025) indicates that the Site is located within the Cherokee Group (CG) groundwater basin (minor bedrock aquifer) and in the vicinity of the Verdigris River groundwater basin (minor alluvial aquifer). The CG basin rock units include shale; well cemented, fine to very fine-grained sandstones; and unjointed limestones characterized as dense to moderately crystalline and thin to massively bedded (Belden 1996). The Cherokee Group minor aquifer is not a major source of water in Rogers County due to poor-yielding wells and the readily available water from lakes and rivers².

The CG basin contains three sandstone units (the Warner Sandstone, the Blue Jacket Sandstone, and the Chelsea Sandstone) that provide the only significant bedrock sources of groundwater in Rodgers County (Belden 1996; Osborn and Hardy, 1999). All three sandstone units underlie the Labette Formation. In many areas, the yields from these CG sandstones are typically too small to supply enough water for household use (Osborn and Hardy, 1999).

Groundwater encountered within the limestone in the CG basin generally occurs in secondary openings such as joints, fractures, and solution cavities. Yields in the shale and limestone formations are locally dependent upon the connectivity of these secondary features (Osborn and Hardy, 1999). The average yield of wells in the Pennsylvanian and Mississippian Age rocks is estimated to be 0.5 gallons per minute (Marcher and Bingham, 1971).

2.3.4 Regional Hydrology

The Verdigris River generally flows to the south and defines the southeast border of the Landfill (**Figure 2**). The surface elevation of the Verdigris River at a gauging station south of the Landfill is approximately 544 ft amsl³. The river flow is controlled by the Oologah Dam located approximately 1 mile north and east of the Site (**Figure 1**). The dam was constructed to create Oologah Lake, with an approximate elevation of 638 ft amsl⁴. Fourmile Creek flows generally south and joins the Verdigris River at a point south of the landfill.

The Verdigris River Groundwater Basin is divided into the upper reach (north of Oologah Lake) and the southern reach (south of Oologah Lake). The southern reach has an average thickness of approximately 40 feet, and a mean saturated thickness of 10 to 18 feet (Belden 1996).

2.3.5 Groundwater Resources and Usage

Based on the OWRB on-line well database, there are no known private or public groundwater wells within one mile of the Landfill (<u>https://www.owrb.ok.gov/maps/pmg/owrbdata_GW.html</u> accessed April 14, 2025). The closest wells are two private wells located approximately 2 miles

² <u>https://www.cityoftulsa.org/government/departments/water-and-sewer/water-supply/</u> accessed April 14, 2025.

³ https://waterdata.usgs.gov/monitoring-location/07176000/ accessed April 14, 2025.

⁴ <u>https://www.swt-wc.usace.army.mil/OOLO.lakepage.html</u> accessed April 14, 2025.



from the Landfill. The well located approximately 2 miles north of the Landfill was plugged in 2010 (**Figure 5**). The well located approximately 2 miles south of the Landfill is a historic well. Additional information on the wells is provided as **Appendix A**. The Site is not located over the groundwater recharge area for a principal bedrock aquifer (Terracon 2018). Groundwater quality in the uppermost hydrostratigraphic unit (limestone) that underlies the Landfill area is generally fair to poor (Terracon 2018).

2.4 Previous Investigations and Studies

Several site groundwater, environmental, and geotechnical investigations and studies have been conducted at the NPS during its operational history. More recent efforts for the Landfill have focused on the evaluation of the groundwater monitoring network (Terracon 2018; Geosyntec, 2022a), and the development of a groundwater monitoring network that meets the requirements of OAC 252:517-9-2.

In 2018, ODEQ stated that monitoring wells MW-7D and MW-8D, located north of the Landfill, were not suitable as representative background wells due to the high concentrations of chloride and salts and the observed groundwater mounding within the Landfill (ODEQ 2018). All monitoring well locations for the CCR units at the NPS are shown in **Figure 6**. Terracon (2018) subsequently certified a groundwater monitoring network that included 15 compliance wells. However, ODEQ requested that replacement background wells also be included in the network. AEP evaluated monitoring wells SP-6 and SP-7 as potential background monitoring wells, but ODEQ determined they were also not suitable due to elevated concentrations of total dissolved solids (TDS) and chloride (ODEQ 2019).

Additional investigations were conducted by Geosyntec pursuant to a Hydrogeologic and Geotechnical Drilling Plan (Drilling Plan), submitted by AEP in February 2020 and approved by ODEQ in June 2020, to continue an evaluation for a suitable background well location (AEP 2020). The investigations were performed to evaluate the hydraulic connectivity of wells in the vicinity of the Landfill, assess the lithology of the downgradient and proposed upgradient locations, and characterize the direction and magnitude of groundwater flow across the Site. Pumping tests performed by Geosyntec in October 2020 indicated minimal response in wells across the Landfill to pumping, suggesting most of the wells are not hydraulically connected.

In 2021, Geosyntec advanced five borings (LF-01-2021 to LF-05-2021) in the vicinity of the Landfill to depths ranging from approximately 100 to 149 ft bgs. Rock core samples were collected from each of the five borings for petrographic analysis, x-ray diffraction, x-ray fluorescence, and cation exchange capacity analysis. Downhole geophysics were also performed in four of the borings to assess the lithology, detect and characterize fractures, and assess the vertical migration of groundwater.

During the downhole geophysical logging, the depth at which water was encountered varied from approximately 6 to 60 ft bgs. The presence of water in some wells, but not others along a similar horizon, suggests that groundwater is not laterally continuous across the site. This was further supported by a colloidal borescope evaluation completed by Geosyntec in 2022 which found either



no significant groundwater movement or potential flow in varying directions at different groundwater monitoring wells. These results were documented in the Site Investigation Report submitted to ODEQ in June 2022 (Geosyntec 2022b).

Monitoring wells MW-18 and MW-19 were installed in August 2022 as background monitoring wells for the Landfill (**Figure 6**), with subsequent approval from ODEQ in January 2023 (ODEQ 2023a). However, following submittal of the first several rounds of groundwater data from MW-18 and MW-19, ODEQ determined that MW-19 and MW-19 also do not appear to be appropriate background monitoring wells due to the elevated chloride and TDS concentrations at both locations. ODEQ instead recommended inclusion of SP-5R, which is a background monitoring well for the Bottom Ash Pond (ODEQ 2023b; ODEQ 2023c). PSO submitted documentation showing that they disagreed with the characterization of MW-18 and MW-19 as inappropriate for background monitoring locations; however, PSO also provided evidence that SP-5R and SP-4, which are both background monitoring locations for the Bottom Ash Pond (Terracon 2017b), had similar geochemical composition as MW-18 and MW-19 and could serve as acceptable background monitoring locations for the Landfill (AEP 2024). ODEQ accepted the use of SP-4 and SP-5R as background monitoring locations for the Landfill in October 2024 (ODEQ 2024). Communications between ODEQ and PSO related to the selection of the background monitoring locations are provided in **Appendix B**.

3. MONITORING NETWORK EVALUATION

The current monitoring well network for the Landfill certified by Geosyntec (2022a), excluding previous background wells MW-18 and MW-19 and adding new background monitoring wells SP-4 and SP-5R, was evaluated in accordance with OAC 252:517-9-2 to determine if the wells included in this revised network could accurately represent the quality of background and downgradient groundwater. In addition, the revised well network was evaluated with respect to the appropriateness of the number, locations, and depths of wells. This included characterizing the site-specific hydrogeologic conditions listed in OAC 252:517-9-2(b) that can affect the design of the monitoring network.

3.1 Hydrostratigraphic Units

The Oologah limestone unit underlying the Landfill is the primary hydrostratigraphic unit of interest. Slug testing conducted in the limestone unit indicates a geometric mean hydraulic conductivity of 2.2×10^{-5} cm/sec (data collected by Terracon).

3.1.1 Horizontal and Vertical Position Relative to CCR Unit

Groundwater at the Site is unconfined and is encountered within the fractured limestone of the Oologah Formation and in the shale deposits of the Labette Formation. Geologic data from soil borings collected at the Site indicate that the first geological unit encountered is a limestone unit of the Oologah formation; the ash was placed in the Landfill directly above the limestone. Although quarrying of the limestone occurred within the current footprint of the Landfill, the thicknesses of the limestone unit beneath the Landfill still ranges from 80 feet to 90 feet. The limestone unit conformably overlies the shale unit. The full depth of the shale unit was not determined at the Site during monitoring well installation or advancement of borings LF-01-2021 through LF-05-2021. Literature estimates its thickness at 180 ft to 250 ft (Oakes, 1952). Geologic cross-sections illustrating the general depth of the water-bearing formations are provided in **Appendix C**.

3.1.2 Overall Flow Conditions

The wide range of groundwater elevations and the fact that several wells do not consistently yield water indicate that groundwater within the uppermost aquifer occurs sporadically and is likely associated with small discontinuous fractures, joints, or cavities in the limestone (Geosyntec 2022a). Several of the monitoring wells at the Landfill have been dry for their operational life, despite their position at the same general horizon as other wells that contain water. Pump testing completed by Terracon found that multiple wells in the vicinity of the Landfill were incapable of producing a minimum yield of 150 gallons per day (Terracon 2017a). The groundwater potentiometric contour map from November 2024 (**Figure 7**) indicates a variety of groundwater flow directions, suggesting that the limited groundwater occurrence within the wells is likely associated with localized fractures and other void spaces within the rock. There also appears to be seasonal and temporal fluctuations in the groundwater flow directions.



The depth to water in monitoring wells at the Landfill, including background wells SP-4 and SP-5R, has ranged from 3.4 to 77.5 ft bgs. Available groundwater elevations are summarized in **Table 1**. Field observations, including the colloidal borescope study described in Section 2.4, indicate there is little interconnected groundwater at the Site. Establishing a unified groundwater flow direction (for the purpose of establishing upgradient wells) is therefore difficult due to lack of water and a general lack of pore space within the rock. The limited data suggest that groundwater flow is variable across the Site, but likely flows toward either the Verdigris River or Fourmile Creek, depending on the proximity of the well to the waterbody.

3.2 Uppermost Aquifer

3.2.1 Regulatory Definition

The term "uppermost aquifer" is defined in OAC 252:517-1-3 as: "the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within the facility's property boundary. Upper limit is measured at a point nearest to the natural ground surface to which the aquifer rises during the wet season." Aquifer is defined as "a geologic formation, group of formations, or portion of a formation capable of yielding usable quantities of groundwater to wells or springs." "Usable" groundwater is not defined in OAC 252:517.

3.2.2 Identified Onsite Hydrostratigraphic Unit(s) – Uppermost Aquifer

As previously discussed, the hydrostratigraphy in the vicinity of the Landfill is characterized by a water-bearing system comprised of Pennsylvanian-age limestones and shales of the Oologah and Labette Formations and the Quaternary alluvium. Observational data indicate groundwater occurs mainly along small discontinuous fractures, joints, or cavities in the limestone. For the purpose of specifying the uppermost aquifer, the on-site hydrostratigraphic unit in the area of the Landfill is identified to be the Oologah Limestone unit first encountered at approximately 610-620 ft amsl. The SCB slurry wall/grout curtain along the southern edge of the Landfill has established a groundwater flow boundary condition, impeding groundwater flow toward the Verdigris River in the limestone unit that is present in that area.

3.3 Overview of Groundwater Monitoring System Regulatory Requirements

According to OAC 252:517-9-2, a groundwater monitoring system must consist of a sufficient number of appropriately located wells in order to yield groundwater samples from the uppermost aquifer that accurately represent both the quality of groundwater passing the waste boundary of the CCR unit and the quality of background groundwater that has not been affected by leakage from the CCR unit. Upgradient background wells must be located beyond the upgradient extent of potential contamination, whereas downgradient wells should monitor contaminants leaking into the groundwater and must be located at the downgradient perimeter of the CCR unit. The groundwater monitoring system must include a minimum of one upgradient and three downgradient monitoring wells, though additional monitoring wells should be installed as



necessary based upon site-specific technical information (e.g., aquifer thickness, groundwater flow rates and direction).

3.4 Previous Monitoring Network

The original groundwater monitoring network proposed to comply with OAC 252:517-9-2 consisted of background monitoring locations MW-7D and MW-8D and downgradient (i.e., compliance) monitoring locations MW-3D, MW-6D, MW-9D, and MW-15 (Terracon 2017b). At the request of ODEQ, the certified network was expanded to include all deep wells surrounding the unit (Terracon 2018) and exclude MW-7D and MW-8D as background monitoring wells. ODEQ also requested installation of new potential background monitoring wells due to the concentrations of chloride and salts and the observed groundwater mounding within the Landfill (ODEQ 2018). Two background monitoring wells, MW-18 and MW-19 were incorporated into the groundwater monitoring network in 2022. However, ODEQ determined that MW-18 and MW-19 were not suitable background wells due to their elevated chloride and TDS concentrations (ODEQ 2023b). Relevant well locations are shown in **Figure 6**.

3.5 Review of Revised Monitoring Network

3.5.1 Overview

The current groundwater monitoring well network certified by Geosyntec (2022a) consists of 15 groundwater wells used for compliance monitoring: MW-1D, MW-2D, MW-3D, MW-4D, MW-5D, MW-6D, MW-9D, MW-10D, MW-11D, MW-12D, MW-13D, MW-14, MW-15, MW-16, and MW-17. The revised monitoring network consists of the 15 existing compliance wells listed above, two new background monitoring wells (SP-4 and SP-5R), and two groundwater level observation wells (MW-7D and MW-8D). The locations of these groundwater monitoring wells are shown in **Figure 8**.

The monitoring wells were installed in a 4-inch borehole and have 2-inch diameter PVC casings, 10-ft long screens, and a 0.01-inch slot size. The screen interval for all wells is situated in the limestone unit. A well construction table that summarizes the location, ground surface elevation, borehole depth, installation data, and associated well construction details for the monitoring well network is included in **Table 2**. The associated boring logs and well construction diagrams are provided in **Appendix D** and **Appendix E**, respectively.

3.5.2 Compliance Assessment

Review of the groundwater monitoring well network in relation to the geologic and hydrogeologic conditions in the area of the NPS Landfill indicates that it consists of a sufficient number of wells installed at the appropriate locations and depths to yield groundwater samples from the uppermost aquifer that accurately represent the quality of background groundwater and groundwater passing the waste boundary of the Landfill. The groundwater monitoring well network is also capable of providing a system for detection of potential contamination in the uppermost aquifer nearest the waste boundary. In particular, the downgradient groundwater monitoring wells are appropriately positioned based on their close proximity to the downgradient waste boundary of the Landfill and



the documented hydrogeology and groundwater flow directions at the Site. From on the above review, the groundwater monitoring network around the NPS Landfill meets the requirements of OAC 252:517-9-2. Certification of the groundwater monitoring network for the NPS Landfill by a qualified Professional Engineer is provided in **Appendix F**.

4. **REFERENCES**

- American Electric Power Service Corporation (AEP), 2016. *History of Construction CFR* 257.73(c)(1). October 2016.
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TABLES

Northeastern Power Station Landfill

Date	MW-1D	MW-2D	MW-3D	MW-4D	MW-5D	MW-6D	MW-7D	MW-8D	MW-9D
3/2008		597.19	595.14	583.00					
7/2008		592.76	594.65	581.80					
10/2008		588.30	594.20	581.35					
11/2008	587.02	589.20	594.10	581.57	591.89	600.51	586.54	569.47	
11/2008	581.61	593.71	593.81	581.38	586.31	600.59	574.25	567.12	
3/2009	585.17	583.06	593.70	582.02	616.25	599.49	581.24	574.67	
6/2009	585.83	585.66	593.74	581.44	616.29	599.98	577.00	576.20	
9/2009	582.60	585.41	593.53	581.47	615.95	599.83	574.77	574.36	
12/2009	582.84	585.68	593.44	578.48	615.14	599.76	575.28	577.70	
3/2010	580.25	585.37	593.70	582.28	618.54	599.98	575.28	576.87	
6/2010	583.91	595.40	593 52	581.76	616 35	600.27	575.28	587.94	586 32
9/2010	581.71	580.27	593.04	581.08	612.95	599 53	575.28	575 19	585.01
12/2010	582.60	578.73	593.16	581.34	612.55	599.45	575.28	571.56	583.30
3/2011	562.00	583 30	593.29	582.01	614 51	599.61	575.28	578.62	583.56
6/2011	583 31	584 39	593.04	581.41	614.65	599.98	575.28	584.69	584.97
0/2011	582.54	582.41	504.45	581.20	612.82	600.18	575.28	586.25	584.25
9/2011	592.54	596 47	502.70	581.20	616.02	600.18	575.20	500.53	584.06
2/2012	581 60	500.47	502.52	581.09	612 47	600.45	575 20	602 44	584.00
5/2012	592.22	592.77	502.42	591.42	(12.21	600.43	575.20	003.40	594.06
0/2012	582.23	577.01	502.20	501.42	611.00	600.01	575.20	502.00	582.42
9/2012	585.23	570.40	595.30	581.57	011.00	000.01	575.28	592.89	582.42
12/2012	584.24	579.40	502.29	582.00	011.//	600.39	575.28	393.63	582.10
5/2013	584.54	5/9.40	593.38	582.00	014.00	600.78	575.28	600.19	582.55
0/2013	583.02	588.22	593.42	581.74	615.57	601.38	575.28	604.77	582.71
9/2013	583.73	582.71	593.36	581.42	614.04	601.93	575.28	599.83	583.58
12/2013	584.28	581.38	593.37	583.76	610.97	601.91	575.28	597.83	582.28
3/2014	581.73	578.89	593.44	582.02	611.96	601.49	575.28	606.54	581.95
6/2014	582.46	587.92	593.65	581.96	612.38	601.90	575.28	603.14	581.17
9/2014	582.99	582.89	593.51	581.31	613.56	601.90	575.28	598.66	582.00
3/2015	584.03	580.88	593.76	582.01	612.72	601.85	575.28	599.14	581.43
6/2015	584.65	591.00	593.81	582.09	619.73	604.26	575.28	589.88	582.32
9/2015	585.24	586.64	593.51	581.55	615.86	603.82	575.28	590.94	583.04
12/2015	585.76	598.04	593.78	581.98	615.29	603.43	575.28	585.16	581.41
3/2016	586.65	584.14	592.57	581.94	612.75	601.75	575.28	596.93	581.63
5/2016	587.10	583.74	593.61	582.05	616.09	603.02	575.28	586.54	581.35
7/2016							575.28	583.39	
9/2016	587.68	578.79	592.95	581.59	611.55	602.91	575.28	577.05	581.02
3/2017	584.74	579.38	593.50	582.08	612.34	601.86	575.28	582.44	579.45
7/2017		-	592.63			602.60	575.28	568.45	576.68
5/2018	584.03	583.06	593.58	581.85	614.64	602.71	575.28	606.96	580.01
7/2018	583.30	577.88		581.58	607.46		575.28		
8/2018	583.51	577.93		581.33	605.79		575.28		
10/2018			593.56	581.59	594.92	602.32	575.28	596.60	580.44
1/2019	584.01	588.59	593.96	582.10	611.46	602.61	575.28	597.59	580.52
8/2019	585.36	580.28	593.31	581.27	612.64	603.83	575.28	606.19	583.49
6/2020	586.79	580.55	593.42	581.19	614.40	603.92	575.28	620.43	610.81
10/2020	587.11	578.02	593.02	581.13	607.19	602.85	575.28	598.07	581.22
4/2021	584.65	583.32	593.46	581.56	615.09	602.71	575.28	595.20	586.17
12/2021	585.65	578.04	592.18	581.14	611.19	602.28	575.28	594.91	579.43
6/2022	586.39	590.96	592.45	581.24	614.33	601.80	575.28	603.56	581.09
11/2022	586.86	577.40	592.74	580.93	609.92	601.82	575.28	597.07	581.51
12/2022	584.42	579.09							580.46
1/2023	582.13								579.89
2/2023	581 41	583 55							578 41
3/2023	581 53	583.24							578 16
4/2022	581.76	581.67							580.05
5/2023	582.02	580.42							580.72
6/2022	582.05	570.45	592.52	580.07	611.67	601.02	614.75	605.09	570.75
0/2023	581 70	579.00	502 74	580.00	600.00	602.26	614.00	500.20	592.01
10/2023	502.07	501.40	502.05	591.20	(11.57	002.20	014.80	399.29	586.01
4/2024	582.87	581.48	592.85	581.20	611.57	602.18	614.72	610.44	586.01
8/2024			592.72	580.72	611.21	602.44			592.14
10/2024	583.73	577.38	592.85	580.80	606.78	602.43	613.21	601.40	592.11

Notes:

1. Groundwater elevations are in feet above mean sea level

-- : not measured

Table 1. Groundwater Elevation Data

Northeastern Power Station Landfill

Date	MW-10D	MW-11D	MW-12D	MW-13D	MW-14	MW-15	MW-16	MW-17	SP-4	SP-5R
3/2008										
7/2008										
10/2008										
11/2008										
11/2008										
3/2009										
6/2009										
9/2009										
12/2009										
3/2010										
6/2010	568.21	578.10	609.56	587.19						
9/2010	568.18		604.83	577.93						
12/2010			604.16	575.18						
3/2011			605.84	574.22						
6/2011	568.53		606.56	582.72					607.21	
9/2011			605.78	576.90					611.11	
12/2011	569.18	578.19	608.52	602.42					623.29	
3/2012	569.57	578.20	610.64	579.21					619.31	
6/2012	569.97	578.22	606.33	581.63					624.58	623.86
9/2012	570.28	578.31	604.03	577.57					615.45	621.55
12/2012	570.56	578.40	604.53	575.42					623.94	623.87
3/2013	570.86	578.55	607.36	578.37					617.19	625.73
6/2013	569.07	578.71	608.69	580.37					619.48	625.48
9/2013	568.31	578.30	606.49	581.38					625.83	623.97
12/2013	569.86	578.94	605.50	579.81					626.87	625.06
3/2014	570.13	579.03	604.06	579.17					627.12	625.72
6/2014	570.49	579.11	608.19	576.62					619.27	625.94
9/2014	570.81		606.40	578.46					625.71	623.83
3/2015	571.40		605.72	577.07					626.37	627.35
6/2015	571.29		605.48	580.87					614.66	624.76
9/2015	572.07	579.69	607.93	604.84						
12/2015	572.33	579.75	615.49	582.68					614.43	627.42
3/2016	572.71	579.88	607.16	581.85	565.11	582.77	576.97	578.89	626.17	624.94
5/2016	572.93	579.97	607.09	587.31	564.73	581.72	577.08	581.64	625.64	626.14
7/2016					565.87	577.33	576.85	584.02		622.81
9/2016	573.33		603.41	580.00	566.86	576.57	576.15	586.96	626.64	622.21
3/2017	573.28		604.96	577.78	603.60	573.39	575.02	586.60	618.65	625.45
7/2017					563.26	577.90	575.65	579.49	607.38	624.68
5/2018	571.00	580.59	608.05	584.28	568.68	581.86	575.97	584.41	624.71	624.18
7/2018	570.02	580.00	603.58	573.11	567.46		575.30	583.07	618.75	622.64
8/2018	570.11	580.02	603.71	573.27	566.25		575.76	581.46		
10/2018			603.82			576.91				
1/2019	570.55	580.01	610.53	573.65	565.59	587.29	577.24	582.14		
8/2019	571.36	580.16	605.01	581.64	572.07	577.99	574.66	585.63	614.16	624.78
6/2020	572.43	580.54	605.56	581.91	574.49	578.15	574.58	589.96	614.33	623.76
10/2020	572.81	580.64	604.38	576.55	572.29	576.32	575.11	591.11	619.87	622.62
4/2021	569.49	580.77	608.59	586.53	566.38	581.97	574.57	592.76	609.43	625.62
12/2021	570.38	580.92	604.69	581.03	570.98	576.45		594.34	626.80	624.24
6/2022	571.01	581.02	610.95	587.20	572.16	590.44	573.45	594.99	624.52	626.15
11/2022	571.46	581.05	604.13	580.03	575.42	575.97	573.39	595.35	624.86	621.78
12/2022	570.60	579.37		576.44	570.86		573.68	582.53		
1/2023					569.77					
2/2023		579.54		573.37	565.65		573.95	582.01		
3/2023		579.54		574.02	565.73		573.83	579.29		
4/2023		579.57		573.72	563.90		573.84	579.72		
5/2023		579.57		573.69	563.37		573.83	580.18		
6/2023		579.65	605.00	575.10	564.08	577.20	573.71	580.68	625.58	623.89
10/2023		579.68	604.96	573.92	565.51	576.96	573.92	582.11	624.67	623.27
4/2024		579.79	606.69	574.55	572.30	580.06	574.55	584.33	626.26	625.66
8/2024			606.56			577.25				
10/2024		579 94	604 28	580.66	581 18	575 96	574.03	586 36	628.15	621 34

Notes: 1. Groundwater elevations are in feet above mean sea level

-- : not measured

Table 2. Monitoring Well Construction Details

Northeastern Power Station Landfill

Well	Northing	Easting	Well Type	Well Installation Date	Ground Surface Elevation (ft amsl)	TOC Elevation (ft amsl)	Depth of Boring (ft bgs)	Top of Screen Depth (ft bgs)	Bottom of Screen Depth (ft bgs)	Top of Screen Elevation (ft amsl)	Bottom of Screen Elevation (ft amsl)
MW-1D	523686.304	2645057.265	Compliance	10/23/2008	635.23	638.07	55.00	44.00	54.30	591.23	580.93
MW-2D	522471.781	2645469.122	Compliance	3/4/2008	634.82	638.19	59.00	48.70	59.00	586.12	575.82
MW-3D	523757.544	2646483.016	Compliance	2/21/2008	627.66	630.65	60.00	49.70	60.00	577.96	567.66
MW-4D	524600.354	2647286.261	Compliance	2/22/2008	621.93	625.00	50.00	39.70	50.00	582.23	571.93
MW-5D	522972.588	2645074.989	Compliance	10/23/2008	633.83	636.84	55.00	44.72	55.02	589.11	578.81
MW-6D	523164.691	2645924.793	Compliance	10/23/2008	633.72	636.66	57.00	44.92	55.22	588.80	578.50
MW-7D	524374.436	2646221.476	Groundwater Level Observation	10/22/2008	623.58	626.46	55.00	45.25	55.55	578.33	568.03
MW-8D	524132.607	2644340.341	Groundwater Level Observation	10/21/2008	626.04	629.32	60.00	49.95	60.25	576.09	565.79
MW-9D	522801.582	2645670.148	Compliance	4/6/2010	633.90	637.04	60.00	49.70	60.00	584.20	573.90
MW-10D	523610.582	2644505.475	Compliance	4/12/2010	636.14	639.32	68.00	57.70	68.00	578.44	568.14
MW-11D	522957.409	2644691.687	Compliance	4/14/2010	625.97	628.27	48.00	37.70	48.00	588.27	577.97
MW-12D	522602.404	2644852.955	Compliance	4/19/2010	620.91	623.67	42.00	31.70	42.00	589.21	578.91
MW-13D	522278.258	2645126.061	Compliance	4/20/2010	616.11	619.06	45.00	34.70	45.00	581.41	571.11
MW-14	523973.970	2645004.652	Compliance	3/1/2016	637.61	640.89	76.00	65.50	75.90	572.11	561.71
MW-15	522514.178	2645493.825	Compliance	2/23/2016	634.34	637.71	71.00	61.05	71.45	573.29	562.89
MW-16	522854.903	2645701.422	Compliance	2/25/2016	634.34	637.26	61.00	50.80	61.20	583.54	573.14
MW-17	583877.724	2644536.271	Compliance	2/29/2016	634.06	636.52	56.00	45.50	55.90	588.56	578.16
SP-4	526097.286	2644600.665	Background	4/6/2011	636.16	639.16	35.00	25.00	35.30	611.16	600.86
SP-5R	528122.598	2643903.251	Background	4/11/2012	628.17	631.17	75.00	34.70	75.00	593.47	553.17

Notes:

1. Information for wells MW-1D through MW-17 provided by Terracon (2018).

2. Information for wells SP-4 and SP-5R provided by Terracon (2017b).

3. Northing and Easting are in NAD83 State Plane OK North. Elevations are based on NAVD88.

4. The Northing and Easting measurements were taken at the top of casing (TOC).

5. MW-7D and MW-8D are former background wells that are currently only monitored for water level.

ft amsl = feet above mean sea level

ft bgs = feet below ground surface



FIGURES





\annarbor-01\data\Projects\AEP\2025 - Northeastern LF GWMN\GIS Files\AEP-Northeastern_SiteLayout_2025-0109.aprx. OAdeyemo.

- 🔲 Landfill

Geosy	Figure					
COII	consultants					
Columbus, Ohio	April 2025	2				







Z:\PROJECTS\CHW8290 - AEP Northeastern Plant FS Assessment\7.0 Figures\7.4 GIS\MXD\AEP_NE_Geology.mxd. CWallace. 9/21/2022.















APPENDIX A Abandoned Well Information



County Rogers

Finding Location

Well Name



MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board 3800 North Classen Boulevard Oklahoma City, OK 73118 Telephone (405) 530-8800

		WELL I	D NUMBER: <u>128560</u>
Quarters <u>NW-SE-NE</u>	Section <u>28</u>	Township <u>23N</u>	Range <u>15EI</u>
Latitude _36.44752_	I	_ongitude95,7074_	
Date collected(latitude and	longitude), if different	from date the well was d	Irilled: 01/25/2010

Method latitude and longitude was collected: ______ Derived from GIS______

Variance Request No. (if applicable) <u>n/a</u>

Phone (405) 544-3675 Zip <u>68179</u>

Water Rights #: ____ USE OF WELL: __Agriculture (non irr)_

NEW WELL CONSTRUCTION DATA

TYPE OF WORK: Groundwater Well

WELL OWNER - NAME AND ADDRESS

Well Owner Union Pacific Rail Road

Date Well or Boring Was Completed 02/25/2010

Address/City/State 1400 Douglas St. Omaha NE

Number of wells or borings represented by this log _1____

* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

CASING INFORMATION *Note: If surface casing is used please indicate that on the appropriate well casing information line. Surface Pipe Material: ______ Surface Pipe Diameter ______ inches Surface Pipe From _____ ft to _____ ft

SCREEN OR PERFORATION INFORMATION

FILTER PACK INFORMATION

Filter Pack Material: ____

WELL SEAL INFORMATION

Type of Surface Seal <u>n/a</u> Type of Annular Seal <u>n/a</u> Filter Pack Seal Material <u>n/a</u>

TYPE OF COMPLETION: ___

HYDROLOGIC INFORMATION

Surface Seal Interval: From <u>n/a</u> ft to <u>n/a</u> ft

Annular Seal Interval: From <u>n/a</u> ft to <u>n/a</u> ft

Filter Pack Seal Interval: From <u>n/a</u> ft to <u>n/a</u> ft

LITHOLOGY DESCRIPTION

	ENCOUN		
MATERIAL	FROM (ft.)	TO (ft.)	SATURATED
no lithological description obtained			

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? <u>n/a</u>

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? <u>n/a</u>

Distance of Well is <u>n/a</u> from possible source. Type of possible source: <u>n/a</u>

PLUGGING INFORMATION

 Date Well or Boring Was Plugged _01/25/2010_
 Total Depth of well being plugged _55 ft.

 Was the well contaminated or was it plugged as though it was contaminated? _No_
 If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? _No_

 Was the grout tremied? _Yes_
 Backfilled from _0 ft. to _4 ft.

 Backfilled with _Native Materials_
 Backfilled from _0 ft. to _55 ft.

 Grouted with _Cement_
 Grouted from __ft. to _55 ft.

Firm Name <u>BOART LONGYEAR, CO.</u> Operator Name <u>CURTIS WRIGHT</u> Date <u>03/19/2010</u> Comments: n/a D/PC No. <u>DPC-0671</u> OP No. <u>OP-1722</u>



	Legal Location North								
	X								
« One Mile»									
	Each square is 10-acres								

MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board 3800 North Classen Boulevard Oklahoma City, OK 73118 Telephone (405) 530-8800

North	 - 	WELL ID NUMBER: <u>9668</u>
		Quarters Section 15 Township 22N Range 15EI
+		Latitude <u>36.384336</u> Longitude <u>-95.701148</u>
		Date collected(latitude and longitude), if different from date the well was drilled: <u>01/08/1998</u> Method latitude and longitude was collected: Interpolation from PLSS
		Interpolation returne and iongrade was concercu. <u>Interpolation response</u>

Variance Request No. (if applicable) <u>n/a</u>

Phone _____ Zip ____

Water Rights #:

USE OF WELL: Domestic

TYPE OF WORK: <u>Groundwater Well</u>

Address/City/State _____OK_

County Rogers

Well Owner <u>Not Avail.</u>

Finding Location

Well Name

NEW WELL CONSTRUCTION DATA

WELL OWNER - NAME AND ADDRESS

Date Well or Boring Was Completed <u>01/01/1907</u> Number of wells or borings represented by this log <u>1</u> * (Borings are within the same 10 acre-tract and with the same general depths and lithologies) Hole Diameter <u>6</u> inches to a depth of <u>80</u> ft.

CASING INFORMATION *Note: If surface casing is used please indicate that on the appropriate well casing information line. Surface Pipe Material: _____ Surface Pipe Diameter _____ inches Surface Pipe From ____ ft to ____ ft

SCREEN OR PERFORATION INFORMATION
FILTER PACK INFORMATION

Filter Pack Material:

WELL SEAL INFORMATION

Type of Surface Seal <u>n/a</u>	Surface Seal Interval: From $\underline{n/a}$ ft to $\underline{n/a}$ ft
Type of Annular Seal <u>n/a</u>	Annular Seal Interval: From $\underline{n/a}$ ft to $\underline{n/a}$ ft
Filter Pack Seal Material <u>n/a</u>	Filter Pack Seal Interval: From $\underline{n/a}$ ft to $\underline{n/a}$ ft

TYPE OF COMPLETION: ____

HYDROLOGIC INFORMATION

Depth to water at time of drilling	ft	Estimated yield of well	gpm	First water zone	ft
- · · · · · · · · · · · · · · · · · · ·			- or		

LITHOLOGY DESCRIPTION

	ENCOUN	1	
MATERIAL	FROM	ТО	SATURATED
	(ft.)	(ft.)	
Unknown	0	80	N

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? <u>n/a</u>

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? <u>n/a</u>

Distance of Well is <u>n/a</u> from possible source. Type of possible source: <u>n/a</u>

PLUGGING INFORMATION

 Date Well or Boring Was Plugged _n/a
 Total Depth of well being plugged _ ft.

 Was the well contaminated or was it plugged as though it was contaminated? _n/a
 If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? _n/a

 Was the grout tremied? _n/a
 Backfilled with _n/a
 Backfilled from ____ft. to ____ft.

 Grouted with _n/a
 Grouted from ____ft. to ____ft.
 Grouted from ____ft. to ____ft.

Firm Name
Operator Name
Date 01/01/1907
Comments: n/a

D/PC No. ____ OP No. ____



APPENDIX B ODEQ and PSO Communications



SCOTT A. THOMPSON Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

MARY FALLIN Governor

January 16, 2018

RECEIVED JAN 2 4 2018

Ms. Jill Parker-Witt, P.E. American Electric Power 502 North Allen Avenue Shreveport, LA 71101r

Re: Groundwater Monitoring Network for CCR Compliance – Landfill Public Service Company of Oklahoma-Northeastern Power Station Rogers County Solid Waste Permit No. 3566010

Dear Ms. Parker-Witt:

On October 19, 2017, the Oklahoma Department of Environmental Quality (DEQ) received Report 1 – Groundwater Monitoring Network for CCR Compliance for the Non-Hazardous Industrial Waste Landfill (Report) from American Electric Power – Public Service Company of Oklahoma (AEP-PSO) for the Northeastern Power Station (NPS). The Report was submitted for compliance with OAC 252:517-9-1(b).

The existing monitoring well network surrounding the landfill consists of monitoring wells MW1S, MW2S, MW3S, MW4S, MW5S, MW6S, MW7S, MW8S, MW9S, MW10S, MW11S, MW12S, MW13S, MW1D, MW2D, MW3D, MW4D, MW5D, MW6D, MW7D, MW8D, MW9D, MW10D, MW11D, MW12D, MW13D, MW-14, MW-15, MW-16 and MW-17. Thirteen shallow monitoring wells, MW1S-13S, are screened primarily in the gravelly clay, ash and limestone. Fifteen deeper monitoring wells, MW1D, MW3D, MW3D, MW5D, MW6D, MW7D, MW8D, MW9D, MW10D, MW11D, MW12D, MW13D, MW-14, MW-15, MW-16 and MW-17 are constructed primarily in the Labette shale. Monitoring wells MW2D and MW4D are screened in both the limestone and shale.

A 2,200 foot long slurry wall/grout curtain was constructed in 2011 on the southeastern border of the landfill as a barrier to mitigate contaminated groundwater seeping into the Verdigris River. Monitoring wells MW13S, MW13D, MW2S, MW2D, MW9S, MW9D, MW6S, MW6D, MW3S, and MW3D were constructed between the slurry wall and the Verdigris River to monitor groundwater and determine the performance of the slurry wall/grout curtain.

AEP-PSO evaluated the existing network as required by OAC 252:517-9-2 and proposes to cease monitoring all shallow groundwater wells (MW1S, MW2S, MW3S, MW4S, MW5S, MW6S, MW7S, MW8S, MW9S, MW10S, MW11S, MW12S, MW13S) and some of the deeper shale wells (MW1D, MW2D, MW4D, MW5D, MW10D, MW11D, MW12D, MW13D, MW-14, MW-16 and MW-17). AEP-PSO has proposed to monitor MW7D and MW8D as the upgradient

Ms. Jill Parker-Witt, P.E. American Electric Power – Northeastern Power Station January 16, 2018 Page 2 of 3

monitoring wells and MW3D, MW6D, MW9D, and MW15 as the downgradient monitoring wells.

DEQ has evaluated the proposal and has the following concerns:

1. Monitoring wells MW13S, MW13D, MW2S, MW2D, MW9S, MW6S, MW3S, and MW3D in addition to MW6D and MW9D are needed to monitor the performance of the slurry wall/grout curtain.

The proposed monitoring network does not adequately monitor the performance of the slurry wall/grout curtain. Groundwater in MW9S consistently shows levels of arsenic, lead, mercury, nickel, selenium, vanadium and an elevated pH greater than 12. Some of the aforementioned monitoring wells that are dry at sampling events document the ability of the slurry wall/grout curtain to prevent seepage of contaminated groundwater.

2. Monitoring wells MW13S and MW13D, located south of the southern end of the slurry wall/grout curtain, are needed to detect groundwater contamination that may flow around the end of the slurry wall/grout curtain and seep into the Verdigris River.

The proposed monitoring network does not adequately monitor groundwater south of the slurry wall without MW13S and MW13D. Trace amounts of chromium, nickel, and vanadium have been measured in MW13S and MW13D.

3. AEP-PSO submitted the Groundwater Sampling and Analysis Plan (SAP) separately and it will be addressed in a separate letter; however, the proposed monitoring network discontinues the sampling of monitoring wells that have low volume, low yield or are consistently dry without attempting alternative sampling methods.

AEP-PSO has not addressed alternative sampling methods prior to removing monitoring wells from the existing network. Additionally, monitoring wells located east of the landfill, that are dry; indicate the positive performance of the slurry wall/grout curtain to curtail groundwater seepage to the Verdigris River.

DEQ suggests the following to address its concerns:

• AEP-PSO separates the existing monitoring network into a performance monitoring network and a groundwater monitoring network. The performance monitoring network, consisting of monitoring wells MW13S, MW2S, MW9S, and MW3S are to be sampled semi-annually to determine the performance of the slurry wall/grout curtain in the limestone and gravelly clay. When all background data samples in MW6S have been completed, MW6S may also be sampled on a semi-annual basis.

Ms. Jill Parker-Witt, P.E. American Electric Power – Northeastern Power Station January 16, 2018 Page 3 of 3

Monitoring wells MW1S, MW4S, MW5S, MW7S, MW8S, MW10S, MW11S, MW12S, MW13S will monitor conditions in the limestone and gravelly clay that may be related to the slurry wall/grout curtain performance via groundwater mounding. Monitoring wells MW1D, MW2D, MW3D, MW4D, MW5D, MW6D, MW7D, MW8D, MW9D, MW10D, MW11D, MW12D, MW13D, MW-14, MW-15, MW-16 and MW-17 will monitor groundwater conditions in the shale for detection monitoring. Due to groundwater mounding centered at the landfill, the proposed background wells (MW7D and MW8D) may not be appropriate for statistical analyses using interwell comparisons. Also in the November 17, 2016 groundwater monitoring report, MW8D is excluded as representing background in the shale per DEQ letter dated July 25, 2014 due to high concentrations of certain constituents.

• AEP-PSO addresses the potential of contaminated groundwater migrating past the ends of the slurry wall/grout curtain as well as other pathways due to groundwater mounding and evaluates other methods of contaminant detection related to performance and detection monitoring.

Please provide a revised groundwater monitoring network that addresses the items in this letter. If you have any questions or comments concerning this letter please contact Ms. Cindy Hailes at (405) 702-5114.

Sincerely,

Hillary Young, P.E.

Chief Engineer Land Protection Division

HY/ckh



SCOTT A. THOMPSON Executive Director

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

KEVIN STITT Governor

June 25, 2019

Ms. Jill Parker-Witt, P.E. American Electric Power 502 North Allen Avenue Shreveport, LA 71101

Re: Monitoring Well SP-6 Analysis Report Public Service Company of Oklahoma-Northeastern Power Station Ash Landfill Rogers County Solid Waste Permit No. 3566010

Dear Ms. Parker-Witt:

On March 19, 2019, the Department of Environmental Quality (DEQ) received, by email, the Analysis Report (Report) for Oklahoma Administrative Code (OAC) 252:517 Appendix A anions and mercury in Monitoring Well SP-6 for Northeastern Power Station Landfill (Landfill). The Report was used to determine if SP-6 is acceptable as an upgradient background well for statistical analysis in the Landfill monitoring well network.

In a letter dated April 13, 2018, NPS determined that MW-7D and MW-8D were not appropriate upgradient background wells for statistical analyses due to groundwater mounding at the landfill and elevated salts not reflective of groundwater geochemistry across the site. In an email dated January 11, 2019, DEQ approved SP-6 to commence background monitoring to determine its use as a potential background monitoring well and NPS added SP-7 as a second potential background monitoring well.

SP-6 was sampled on January 16, 2019. Chloride (14,133 mg/L) and TDS (22,956 mg/L) in SP-6 exceeded the concentrations of MW-7D and MW-8D and all downgradient monitoring wells sampled in the October 22, 2018 sampling event.

After reviewing the Report, it appears that SP-6 is not a suitable upgradient background monitoring well for the Landfill. Please submit the analytical results from all samplings from monitoring well SP-7 when complete.

If you have any questions, please contact Ms. Cynthia Hailes, P.E. at (405) 702-5114.

Sincerely,

Hillary Young, P.E

Chief Engineer Land Protection Division

HY/ckh

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Scott A. Thompson Executive Director



Kevin Stitt Governor

January 27, 2023

Ms. Jill Parker-Witt, P.E. American Electric Power 502 North Allen Avenue Shreveport, LA 71101

Re: Revised Groundwater Monitoring Well Network Report – CCR Landfill Public Service Company of Oklahoma-Northeastern Power Station, Rogers County Solid Waste Permit No. 3566010

Dear Ms. Parker-Witt:

On June 23, 2020, the Oklahoma Department of Environmental Quality (DEQ) approved the Hydrogeologic and Geotechnical Drilling Plan submitted by American Electric Power's Northeastern Power Station (NPS). On December 5, 2022, by email, DEQ received the Revised Groundwater Monitoring Well Network Report – CCR Landfill Report (Report) for NPS's Coal Combustion Residuals (CCR) Landfill. The Report was developed by Geosyntec Consultants on behalf of NPS and documents the installation of background monitoring wells MW-18 and MW-19.

The groundwater monitoring system for the CCR landfill is comprised of downgradient monitoring wells MW-1D, MW-2D, MW-3D, MW-4D, MW-5D, MW-6D, MW-9D, MW-10D, MW-11D, MW-12D, MW-13D, MW-14, MW-15, MW-16 and MW-17. Previous upgradient monitoring wells MW-7D and MW-8D were determined unsuitable for background monitoring wells. Through geophysical analyses, pump tests and the use of a colloidal borescope, the most likely site to locate the new background monitoring wells was determined. Background monitoring wells MW-18 and MW-19 were installed in August 2022 upgradient of the CCR landfill and north of the coal pile.

From the boring logs in Appendix C of the Report, MW-18 was drilled to 94 feet below ground surface (bgs) and the 2-inch casing was screened from 80.4 feet bgs to 90 feet bgs. MW-19 was drilled to 94 feet bgs and the 2-inch casing was screened from 80.4 feet bgs to 90 feet bgs. Water level elevations during November 2022 were 565.78 feet above mean sea level (asl) and 632.89 feet asl, respectively for MW-18 and MW-19. Boring logs and geophysical logs of the two monitor wells showed an upper clay of 5 to 10 feet thick over limestone to 94 feet. Several fractured zones and shaley zones were reported in the limestone section that are located mostly above the screened section. However, the screened interval in MW-19 included a small part of the interbedded shale which might explain the larger amount of water in that well compared to nearby MW-18. No water quality data was submitted with the report.

In a letter dated August 31, 2022, DEQ did not approve using both wells together to collect one background sample or the proposed sampling protocols of once every 3 months. In an email, received by DEQ on October 5, 2022, NPS stated that during the development of the groundwater monitoring wells, they ran dry. NPS anticipated difficultly obtaining a complete set of groundwater

707 N. ROBINSON ST., OKLAHOMA CITY, OK 73102 · OFFICE: 405-702-0100 STATE OF OKLAHOMA · OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY · DEQ.OK.GOV Ms. Jill Parker-Witt, P.E. American Electric Power – Northeastern Power Station January 27, 2023 Page 2 of 2

samples during each visit but were modifying their sampling effort to attempt to collect 8 background samples within 12 months.

DEQ approves the Report as submitted. Please keep DEQ apprised of the background sampling events. If you have any questions, please contact Cindy Hailes at (405) 702-5114 or Kaylee Daneshmand at (405) 702-5196.

Sincerely,

Hillary Young, P.I

Chief Engineer Land Protection Division

HY/ckh



June 21, 2023

Ms. Jill Parker-Witt, P.E. American Electric Power 502 North Allen Avenue Shreveport, LA 71101

Re: Response to Information Requested; 2023 Annual Groundwater Monitoring Report Public Service Company of Oklahoma-Northeastern Power Station Ash Landfill Rogers County Solid Waste Permit No. 3566010

Dear Ms. Parker-Witt:

On May 4, 2023, the Oklahoma Department of Environmental Quality (DEQ) received the Response to Information Requested (Response) from the Annual Groundwater Monitoring Report – Landfill CCR Management Unit (Report) for Northeastern Power Station (NPS) Ash Landfill (Landfill). The purpose of the submittal is to provide DEQ with the analytical reports for new upgradient wells MW-18 and MW-19.

The analytical results for MW-18 and MW-19 were provided in the Response. The Response states that the analytical results were not included in the Report due to background data that is still in the development process. American Electric Power/ Public Service Company of Oklahoma (AEP/ PSO) will include all analytical data collected since the wells were installed and include an updated data table in the annual groundwater report for 2023.

In January 2020, DEQ issued a Notice of Deficiency (NOD) for a boron alternate source demonstration (ASD) submitted in 2018, which presented revised statistical results through intrawell analyses; and agreed that an interwell statistical error had occurred related to the inappropriate use of MWs 7D and 8D to establish upgradient background conditions. Therefore, in the interim prior to instituting an assessment monitoring program, a background well representative of the aquifer must be established and intrawell statistical analyses will be conducted for Appendix A parameters at the detection monitoring network.

In 2019 NPS continued to evaluate the sampling results of the detection monitoring program using intrawell statistical methodology; and sampled monitor wells SP-6 and SP-7 for use as possible upgradient background wells. However, neither of them were deemed suitable because of different aquifer chemistry than in the landfill monitor well network. Based on additional hydrogeologic information obtained from a 2019 extensive study at the nearby bottom ash pond (BAP), NPS submitted a *Hydrogeological Drilling Plan* (Plan) for the Landfill in February 2020 that proposed to install borings, collect / evaluate additional aquifer characterization data, revise the site conceptual model, and propose a suitable location for a background monitoring well in a report to be submitted in December 2020. On June 22, 2022, DEQ received the Hydrogeological Drilling Report that included a summary of the investigation findings. Two new upgradient monitoring

Ms. Jill Parker-Witt, P.E. American Electric Power – Northeastern Power Station June 21, 2023 Page 2 of 2

wells, MW-18 and MW-19, were installed north of the Landfill in August 2022 to evaluate the background groundwater conditions. In a letter dated January 27, 2023, DEQ approved the revised groundwater monitoring well network design report.

The submitted analytical data for MW-18 and MW-19, as well as the Groundwater Data Summary Table of the April 13, 2023 email, appear to show concentrations similar the MW-7D and MW-8D, as well as SP-6 and SP-7, in terms of elevated chloride concentrations and total dissolved solids compared to the CCR Landfill monitoring network geochemistry. Consequently MW-18 and MW-19 also do not appear to be appropriate background monitoring wells and may be potentially impacted by the old oil well and waterline rerouting as described in the June 23, 2022 Final Report Hydrogeological Drilling – CCR Landfill. DEQ believes MW-18 and MW-19 should not be used as background for interwell statistical analyses at the landfill.

With the determination that MW-18 and MW-19 are not suitable background wells for the landfill, NPS is out of compliance with OAC 252:517-9-4(e) Establish background and 9-5(b) Monitoring frequency, that require a background well and eight independent samples prior to October 17, 2017. Since it has taken many years and significant costs to NPS in attempts to establish an appropriate upgradient background well location, DEQ recommends using SP-5, the upgradient background monitor well for the CCR surface impoundment, as a background monitor well for interwell analyses at the landfill.

The report is accepted as submitted. If you have any questions, please contact Kaylee Daneshmand at (405) 702-5196 or kaylee.daneshmand@deq.ok.gov.

Sincerely,

Hillary Young, P.E.

Chief Engineer Land Protection Division

HY/kd



November 7, 2023

Ms. Rebecca Jones, P.G. American Electric Power 502 North Allen Avenue Shreveport, LA 71101

 Re: Response to Background Wells; 2023 Annual Groundwater Monitoring Report Public Service Company of Oklahoma-Northeastern Power Station Ash Landfill
 Rogers County Solid Waste Permit No. 3566010

NOTICE OF DEFICIENCY

Dear Ms. Jones:

On May 4, 2023, the Oklahoma Department of Environmental Quality (DEQ) received the Response to Information Requested regarding the Annual Groundwater Monitoring Report submitted by Public Service Company of Oklahoma (PSO) for the Northeastern Power Station (NES) Ash Landfill. The submittal provided DEQ with the analytical reports for new upgradient wells MW-18 and MW-19. After review of the provided reports, DEQ responded in a letter dated June 21, 2023, determining MW-18 and MW-19 unsuitable as background wells. Subsequently, DEQ received the Response to Background Wells; 2023 Annual Groundwater Monitoring Report (Response) dated August 31, 2023 submitted by PSO for the NES coal combustion residuals (CCR) Landfill.

In the June 21, 2023 letter, DEQ stated it found the analytical data for MW-18 and MW-19 to show elevated chloride and total dissolved solids (TDS) compared to the CCR Landfill monitoring network geochemistry, and similar to wells previously deemed unsuitable for background monitoring. In the Response, PSO reiterated its finding of MW-18 and MW-19 as appropriate background wells based on the screened interval placed in limestone bedrock that likely contains increased organic matter and/ or thin shale lenses like the compliance wells of the landfill. MW-18 and MW-19 were placed in a location where there was no indication of oil and gas exploration or proximity to the water line relocation work. The Response also states MW-18 and MW-19 are close enough to the CCR Landfill. However, PSO did not provide any chemical evaluations (in the form of statistics or geochemical diagrams such as Piper Plots) to show the samples from MW-18 and MW-19 meet the performance standard of Oklahoma Administrative Code (OAC) 252:517-9-2(a)(2) by accurately representing the quality of groundwater passing the waste boundary of the landfill.

In the June 21, 2023 letter, DEQ suggested using MW-5R, the upgradient well for the CCR surface impoundment, as the background well for the CCR Landfill. The Response states MW-5R is too far from the CCR Landfill and due to the hydraulic gradient, it would take approximately 100 years

Ms. Rebecca Jones, P.E. American Electric Power – Northeastern Power Station November 7, 2023 Page 2 of 2

to pass through the waste boundary, therefore not meeting the requirements of OAC 252:517-9-2(a). In accordance with OAC 252:517-9-2(a), a determination of background quality may include sampling of wells that are not hydraulically upgradient if they are representative of background water quality. Additionally, OAC 252:517-9-2(a)(2) requires accurate <u>representation</u> of the quality of groundwater passing the waste boundary of the CCR landfill, not that the water must pass through the CCR landfill. The Response also states the groundwater level in MW-5R is above the screened interval, so it is not clear what interval the water is flowing from; and due to the length of the screen, it is also not clear if it is monitoring the same geological matrix as that underneath the landfill. DEQ recognizes the conditions identified at MW-5R and believes that the well is screened in part across the same geologic section underlying the landfill; and further since it is being used as a background well for the surface impoundment, it could also be used for the CCR Landfill.

DEQ maintains that MW-18 and MW-19 are not suitable background wells unless additional information can be provided that demonstrates MW-18 and MW-19 are reflective of groundwater chemistry at the CCR Landfill, by providing chemical evaluations as described above. The Response also noted that no Appendix B parameters have been shown to have elevated concentrations in MW-18 and MW-19; however, barium at MW-19 greatly exceeds the MCL of 2,000 μ g/L, lithium greatly exceeds the GWPS of 40 μ g/L at both monitoring wells and there are other exceedances for combined radium, lead, arsenic, cobalt and possibly thallium (due to reporting limits greater than the MCL) in one well or both wells. Please provide chemical evaluations for MW-18, MW-19 and MW-5R in comparison to the geochemistry of the compliance wells for the CCR landfill. Also provide an explanation for the elevated chloride and TDS concentrations in MW-18 and MW-19.

If you have any questions, please contact Kaylee Daneshmand at (405) 702-5196 or kaylee.daneshmand@deq.ok.gov.

Sincerely,

Hillary Young, P.E. Chief Engineer Land Protection Division

HY/kd

	Ms. Rebecca D. Jones American Electric Power 400 W. 15th Street, Suite 1500 Austin, TX 78701-1677	ելուլիուլիուլելելեն, ուլելինեն են ներեններներներներներներ
OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY LAND PROTECTION DIVISION 707 NORTH ROBINSON, P.O. BOX 1677		LOTAH RANYOR

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American Electric Power P.O. Box 220 Oologah, OK 74053

AEP.com

May 29, 2024

Via electronic mail

Ms. Hillary Young Oklahoma Department of Environmental Quality (ODEQ) 707 North Robinson, P.O. Box 1677 Oklahoma City, OK 73101-1677

Re: Response to Background Wells Landfill; 2023 Annual Groundwater Monitoring Report Public Service Company of Oklahoma-Northeastern Power Station Ash Landfill Rogers County Solid Waste Permit No. 3566010

Dear Ms. Young,

On November 7, 2023, Oklahoma Department of Environmental Quality (ODEQ) requested addition information for the upgradient wells MW-18 and MW-19 and recommended the use of SP-5R as the background well for the Northeastern Power Station (NPS) Ash Landfill (Landfill) by Public Service Company of Oklahoma (PSO).

Below is a discussion comparing the chemical evaluation for MW-18, MW-19, and SP-5R and an explanation for the elevated chloride and TDS concentrations in MW-18 and MW-19. A figure is attached showing the location of the bottom ash pond monitoring well locations (Figure 3) and the landfill monitoring well locations (Figure 4).

A Piper Diagram is generated by calculating the relative proportions of the major anions (carbonate + bicarbonate alkalinity, chloride, and sulfate) and cations (calcium, magnesium, and sodium + potassium) for each sample of interest. The relative samples are then plotted on the three components of the Diagram:

- Cation triangle: The bottom left triangle represents the dominant cations in each sample.
- Anion triangle: The bottom right triangle represents the dominant anions in each sample.
- Central diamond: The cation and anion distribution are combined to represent the relative major ion composition of the different samples.

The nearer samples plot together on the triangles or central diamond, the more similar their geochemical compositions are. Samples which have different compositions will plot in separate portions of the cation and anion triangles.

Well IDs	Classification	Piper Diagram Symbology
SP-5R	Existing background well for the BAP	Hollow orange symbol
MW-18, MW-19	Recently installed background monitoring wells for the LF	Hollow red symbols
MW-7D, MW-8D	Original background wells for the LF network which were removed at the request of DEQ ¹	Hollow pink symbols
MW-3D, MW-6D, MW-9D, MW-15	Downgradient wells included in the LF network since 2017	Dark blue filled symbols
MW-4D, MW-5D, MW-12D	Downgradient wells added to the LF network in 2019 when sufficient background data was available	Light blue filled symbols
Leachate Samples	Two samples collected in 2017 to represent Landfill Leachate	Partially filled gray symbols

A Piper Diagram was generated to illustrate groundwater composition for the following wells:

The most recent sample with all major cation and anion data for each of the locations above is shown on the Piper Diagram. The input concentrations for each sample are provided in **Table 1**. The analytical laboratory report for the 2017 leachate samples is also attached.

A review of the Piper Diagram provided in **Figure 1** finds that the samples generally cluster into three types:

- Downgradient wells, including both the original network wells and the additional background wells added in 2019
- All background locations, including SP-5R, the wells originally identified for the LF background (MW-7D and MW-8D) and the more recently installed background locations (MW-18 and MW-19)
- Landfill leachate

The cation composition of the Landfill leachate is dominated by monovalent cations (sodium + potassium), as shown by the location of the gray symbols in the bottom right corner of the cation triangle. A review of the input concentration shows that sodium concentrations in the leachate are over two orders of magnitude greater than the other cations (calcium and magnesium) in the leachate. Similarly, the Landfill leachate anion composition is dominated by sulfate, as shown by

¹ ODEQ. 2014. Trend Analysis for MW-8D, Public Service Company of Oklahoma, Northeastern Power Station Ash Landfill, Rogers County, Permit No. 3566010. July 25.

the concentrations of sulfate relative to the other anions in **Table 1** and the location of the gray symbols in the top corner of the anion triangle.

The Leachate samples are distinct from both the upgradient and downgradient groundwaters, as evidenced by the three different clusters of samples on the Piper Diagram. This suggests that any differences between upgradient and downgradient groundwater quality are not necessarily attributed to impacts from the Landfill. The background wells generally have a slightly greater contribution of calcium and magnesium to groundwater compared to leachate, as illustrated by the location of the orange/red symbols closer to the center of the cation triangle than leachate. Likewise, the anion distribution of the background wells is generally dominated by high relative concentrations of chloride. One exception is the anion distribution at MW-7D, which appears anomalously low in chloride and elevated in alkalinity and sulfate compared to the other background wells. As described below, the high chloride concentrations in the background wells appears to be driven by the relative abundance of the shale lenses within the bedrock lithology. While the measured concentrations of anions may vary between background locations, with SP-5R having lower chloride than MW-18 or MW-19, the tightness of the distribution of the background locations on the Piper Diagram suggests they are composed of a similar groundwater which is affected by dilution.

The downgradient samples have a higher relative abundance of divalent cations (calcium and magnesium) than either the background wells or the leachate. This is illustrated by the distribution of the blue symbols in the center of the cation triangle. The relative abundance of anions in the downgradient wells is more variable, with low abundances of chloride and changing contributions of sulfate and alkalinity. This is illustrated by the distribution of the blue symbols along the left edge of the anion triangle. These results suggest a greater influence of limestone bedrock (composed largely of calcium carbonate, calcite [CaCO3]) on groundwater composition at the downgradient locations than the background wells, which are more influenced by shale.

One outlier for the downgradient locations is MW-12D, which is very similar to the background locations in both cation and anion composition (note the location of the blue yield sign near the background red/orange symbols on the Piper Diagram). This is likely due to the variable abundance of interbedded shale within the limestone lithology at that location.

As shown on the Piper diagram (**Figure 1**), the anionic composition of MW-18 and MW-19 is predominantly chloride. While the reported chloride values at MW-18 and MW-19 are higher than the other background wells (**Table 1**), these concentrations are not anomalous for natural waters.

Nearly the entire anion component of average MW-18 and MW-19 groundwater consists of chloride (97% for MW-18 and 98% for MW-19 by milliequivalents per liter). TDS is calculated by summing the total concentration of dissolved substances in water. The ionic composition of a water sample consists almost entirely of major ions (major cations and major anions), therefore nearly half of the TDS value in these monitoring wells is determined by chloride concentrations

(with the other half consisting of the combined major cations). Elevated TDS values are an artifact of the high chloride values observed in the background monitoring wells. These chloride concentrations are likely a function of natural geochemistry. As such, the elevated TDS values are also a function of natural geochemistry.

The source of chloride within MW-18 and MW-19 groundwater likely originates from the lithologies present in the screened interval and the depositional history of those lithologies. PSO previously demonstrated findings to DEQ that the screened interval of monitoring wells MW-18 and MW-19 contain significant amounts of organic matter and thin shale lenses among limestone, similar to the Landfill compliance wells.

MW-18 and MW-19 are screened within interbedded limestone and shale which comprise the Pawnee Limestone member of the Pennsylvanian Oologah Formation. The Oologah Formation consists of marine limestones and shales. The Pawnee Limestone member of the Oologah Formation specifically represents a cyclic depositional sequence which featured transgressive and regressive periods which cause the deposition of interbedded sequences of limestone and shale². In such depositional environments, fine grained shales are deposited and cyclically exposed to high ionic strength marine waters which are concentrated in chloride. Fine-grained marine shales specifically are known to retain this chloride for long periods, resulting in elevated concentrations in formation water³. Transgression-regression cycling creates sequences in which saline marine waters saturate open pore space in these sediments, which are then in turn retained due to the subsequent deposition of and burial by additional fine-grained sediment, trapping the marine water at the time of deposition. While the original water within the pore space is typically replaced by meteoric recharge early after deposition, the dissolved ions (i.e., chloride) in the water are typically retained by membrane filtration as an effect of the clay mineralogy of the shales⁴. In addition to the retention of marine water within the pore space of fine-grained sedimentary rocks, deposited sediment in cyclic marine environments also become impregnated with soluble salts like halite (crystalline sodium chloride, NaCl) or sylvite (crystalline potassium chloride, KCI), which contain chloride in the crystal structure². These evaporites are known to be highly soluble and subject to dissolution during pore fluid evolution. Dissolution of these salts results in further increases to the concentrations of aqueous chloride in pore fluid from rocks of coastal marine origin, regardless of whether the evaporite minerals are still present currently.

Due to the specific depositional environment associated with the screened lithologies of MW-18 and MW-19, elevated chloride concentrations would be expected and are associated with cyclical saturation of sediment with marine waters during deposition and early burial. These

² Price, R.C. 1984. Stratigraphy and depositional environments of the Pawnee Limestone, Middle Pennsylvanian (Desmoinesian), in Mid-Continent North America and Equivalent Strata (Oologah Limestone) in Northern Oklahoma. In Limestones of the Mid-Continent, p. 377-391.

³ Hem, J.D. 1985. Study and interpretation of the chemical characteristics of natural water. United States Geological Survey Water-Supply Paper 2254. Third edition.

⁴ Drever, J. 1988. The geochemistry of natural waters. Englewood Cliffs, N.J., Prentice Hall.

elevated chloride concentrations are the main driver of the elevated TDS concentrations that are also reported at MW-18 and MW-19.

The piper diagram and analytical data demonstrates that SP-5R is an appropriate background well for the landfill; therefore, PSO will revise the groundwater monitoring network to add SP-5R as the background well.

PSO proposes to include SP-4 as an additional background well for the landfill. Monitoring well SP-4 is the second background well for Northeastern's bottom ash pond and will be used to provide additional background data for the landfill. Once ODEQ approves or comments on the updated background wells (SP-5R and SP-4), PSO will update the groundwater monitoring well network certification, update the statistical analysis plan, and submit them to ODEQ for approval. The first half 2024 groundwater samples collected in April 2024 will compare the downgradient samples to the updated groundwater monitoring network once approval has been received from ODEQ. At that time, PSO will determine if resampling is necessary for the landfill groundwater monitoring network.

PSO also proposes to conduct a feasibility study to replace the downgradient monitoring wells that appear to be drilled through ash. According to the cross section included as **Figure 2**, monitoring wells MW-2D, MW-9D, MW-6D, and MW-15 are drilled through ash. PSO would like to determine if the ash is influencing the groundwater samples for those wells. If suitable downgradient locations are found, a work plan will be submitted to ODEQ for approval.

Please do not hesitate to contact me if you have any questions or would like to discuss. I can be reached by email at: RDJones2@aep.com or by phone at: (737) 330-3725.

Sincerely,

hebecca D Jones

Rebecca Jones, P.G. Environmental Services

cc: Brian Newton– AEP/PSO Kaylee Daneshmand - ODEQ

Table 1. Geochemical Data Summary Northeastern Landfill

Classification	Well ID	Sample Date	Total Alkalinity	Calcium	Chloride	Magnesium	рН	Potassium	Sodium	Sulfate	Charge Imbalance Error
			mg/L	mg/L	mg/L	mg/L	SU	mg/L	mg/L	mg/L	%
BAP Background	SP-5R	3/25/2020	328	49.2	790	33	8.8	2.96	449	0.8	-6.4
Updated Network	MW-12D	10/10/2023	133	59.1	12.5	6.85	8.09	1.62	212	489	0.3
Original Network	MW-15	10/10/2023	155	122	15.7	37.1	8.02	1.85	144	619	-1.6
LF Background	MW-18	10/10/2023	517	1120	16600	533	6.82	30.3	8290	114	-1.8
LF Background	MW-19	10/10/2023	514	642	18100	439	7.28	28.1	7750	9	-12.6
Original Network	MW-3D	10/10/2023	362	113	12.8	37.4	7.55	1.63	54.3	174	7.9
Updated Network	MW-4D	10/10/2023	366	166	32.5	20.6	7.1	1.53	73.3	282	5.5
Updated Network	MW-5D	10/10/2023	717	241	50.3	78.7	7.43	1.78	67	278	9.2
Original Network	MW-6D	10/10/2023	361	168	27	30.7	7.61	2.64	119	454	0.9
Original Network	MW-9D	10/10/2023	338	186	25.5	76.3	8.32	3.97	137	783	-3.2
LF Original Background	MW-7D	10/4/2017	702	297	418	74.2	7.16	15.2	1050	1257	18.5
LF Original Background	MW-8D	9/13/2017	526	479	12331	342	6.89	41	3970	126	-23.3
LF Leachate	n/a	6/5/2017*	765	189	174	20	-	173	12200	40000	-25.9
LF Leachate	n/a	8/23/2017	580	80.4	200	1.24	-	180	15500	46700	-21.9

Notes:

*Total sulfate and chloride data were not available. Dissolved sulfate and chloride were used for the analysis.

LF: Landfill

mg/L: milligrams per liter

n/a: not applicable

SU: standard units

%: percent

Figure 1. Piper Diagram Northeastern Landfill



% meq/kg





12% as to not ark hit because restand, projects/aEP, WEW other zero MODS/64PMEP Northeastern, BAP, She Larout, Reviewer, NRV erk h. 1/26/2018, Project Prozente.





October 3, 2024

Ms. Rebecca Jones, P.G. American Electric Power 502 North Allen Avenue Shreveport, LA 71101

Re: Response to Background Wells; 2023 Annual Groundwater Monitoring Report Public Service Company of Oklahoma-Northeastern Power Station Ash Landfill, Rogers County Solid Waste Permit No. 3566010

Dear Ms. Jones:

On September 6, 2024, DEQ received the Response to Background Wells (Response) for the Coal Combustion Residual (CCR) Landfill, submitted by Public Service Company of Oklahoma (PSO) for the Northeastern Power Station (NES) Ash Landfill. The Response was submitted in response to a letter issued by DEQ on July 25, 2024, requesting that PSO provide a Piper diagram that includes SP-4 to support its inclusion as a background well for the landfill.

The Response included an updated Piper diagram showing the geochemistry of upgradient and downgradient groundwater and landfill leachate. The samples were clustered into three grouping types:

- Downgradient wells, including MW-3D, MW-4D, MW-5D, MW-6D, MW-9D, MW-12D, and MW-15;
- Background wells, including SP-4, SP-5R, MW-7D, MW-8D, MW-18, and MW-19; and
- Landfill leachate

The Response also included a table of the sample concentrations used to generate the Piper diagram. PSO stated that the Piper diagram and analytical data demonstrate that SP-4 is an appropriate background well for the landfill. The groundwater monitoring network and groundwater sampling and analysis plan will be revised to identify SP-4 and SP-5 as a background wells for DEQ's review and approval.

PSO will begin the feasibility study that was proposed in the May 29, 2024 letter to replace downgradient monitoring wells 2D, 6D, 9D and 15 that appear to be drilled through ash. If suitable downgradient locations are found, a work plan to install replacement wells will be submitted to DEQ for approval.

The Response is accepted as submitted. If you have any questions, please contact Kaylee Daneshmand at (405) 702-5196 or kaylee.daneshmand@deq.ok.gov.

Sincerely. Hillary Young, P.E. Chief Engineer Land Protection Division

HY/kd



APPENDIX C Geologic Cross Sections



- Bottom Ash Pond
- 🛄 Landfill

- C-C'

	ologan, okianoma
Geosy	ntec⊳

consultants

Columbus, Ohio

April 2025





<Sharepoint> Geosyntec\SB Geoscience - Projects\AEP Northeastern Landfill\17_Illustrator



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Sharepoint> Geosyntec\SB Geoscience - Projects\AEP Northeastern Landfill\17_Illustrator



APPENDIX D Well Boring Logs

		erracon	FI	ELI	DE	BOF	211	NG	LOG
	Cons	ulting Engineers and Scientists	BORING NO.:	MW-1D			F	PAGE: 1 o	f 2
25809 In PH. (501	terstate-30 I) 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	55	FEE	T BELOW	/ GR	OUND SU	RFACE (BGS)
CLI	ENT:	AMERICAN ELECTRIC POWER		PROJE	CT: NE	PLANT LAP	IDFILI	_	
JOE	3 NO.:	216-003-35087115-017		DRILLIN	IG CO.	: MOHAW	<		
LOO	GGED	BY: CLANCY MCCLINTOCK		DRILLE	R: KEVI	N			
DA		RILLED: 9/30/08		RIG TY	PE: STR	RATASTAR	25/CN	VIE 55	
DR	ILLING	G METHOD: HOLLOW STEM AUGEF	र						
SAN	MPLIN	IG METHOD: SPLIT SPOON/NX RO	CK CORE						
	N: 36	° 24' 59.77" E: 95° 92' 01.47" G.S	635.23 S. ELEV.	Litho.	Run	%		Blow	
		DESCRIPTION		Symbol	#	Recovery	RQD	Count per 0.5'	Remarks
	_								
Elev.	Depth BGS								
	0 —	0'-3.5' GRAVELLY CLAY							
	_	dark brown, Limestone fragments							
	_								
	5 —	3.5'-41' <u>LIMESTONE</u> gray_crystalline_some thin mud seams	s, some bedding						
	_	plane fractures, dry	s, como sociality		1	95	40		
	_								
	10 —								Void at 9'-11.5'
	-				2	40	0		
	_								
	- 15 —				~	100			
	-				3	100	44		
	_								Wet zenze 18 El 201
	20 _								PR=0.35ft/min.
	- 20				4	85	27		
	20 —				5	90	28		
	_								
	30 —				6	90	45		
	_								
					L				
	35 —				7	100	68		PR=0.25ft/min.
	_								
	_				8				

		2119CON	FI	ELI	DE	BOR		NG	LOG
(Consul	ting Engineers and Scientists	BORING NO .:	MW-1D			Ρ	AGE: 2 of	2
25809 Inte PH. (501)	rstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	55	FEET	F BELOW	GRO	DUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
	40 — –	41'-55' <u>SHALE</u> dark gray to black, hard, some beddir	ng plane fractures		8	60	64		
	- 45 — -				9	80	65		
	- - 50								
	-				10	100	48		
	55 — -	Total Depth = 55'							
	60								
	- - 65 —								
	- - - 70 —								
	-								
	75 — - -								
	 80 -								
	- 85 — -								
	- - 90 —								
	- - 95 -								

	Terracon	FI	EL	DE	BOF	211	NG LOG
	Consulting Engineers and Scientists	BORING NO .:	B-2/MW-	2D		Ρ	AGE: 1 of 2
25809 Int PH. (501)	erstate-30 BRYANT, AR. 72022 847-9292 FAX. (501) 847-9210	TOTAL DEPTH	: 59	FEE	T BELOW	/ GRC	DUND SURFACE (BGS)
CLIE	ENT: AMERICAN ELECTRIC POWER	•	PROJE	CT: NE	PLANT LAN	DFILL	
JOB	NO.: 216-003-35077150-004		DRILLI	NG CO.	: MOHAW	<	
LOG	GED BY: MR		DRILLE	R: KEV	IN		
DAT	E DRILLED: 2/19/08		RIG TY	PE: STR	RATASTAR	25	
DRI	LING METHOD: HSA / AIR HAMMER		·				
SAM	1PLING METHOD: CONTINUOUS SAMPL	ER					
Depth	N: E: TO	C:	Litho.	Run	%		
BGS	DESCRIPTION		Symbol	#	Recovery	RQD	Remarks
0-	0'-9' GRAVELY CLAY, red to brown, dry, tra	ce silt, firm.					H.S.A. 0'-28'. Air Hammer 28'-59'
5	9'-10' SILTY SAND, gray, dry 10'-22' SILT, tan, soft to hard bedded layers,	, dry to 19'.					5-7' Pushed shelby tube. Poor recovery due to gravel.
- 20 -							Wet at 19'.
- - 25 -	22'-28' GRAVELY CLAY, brown, some limes fragments, wet.	tone rock	* *				Hard Limestone bed 23' to 24'.
30 -	28'-33' LIMESTONE, gray, massive bedded,	dry.					Auger refusal at 28' (Limestone).
	33'-55' SHALE, gray to black, hard to weathe	ered, dry.					

Terracon	F	IEL	D	BO	RI	NG LOG
Consulting Engineers and Scientists	BORING NO .:	B-2/MW-	2D		F	PAGE: 2 of 2
25809 Interstate-30 BRYANT, AR. 72022 PH. (501) 847-9292 FAX. (501) 847-9210	TOTAL DEPTH	: 59'	FE	ET BELC	W GR	OUND SURFACE (BGS)
CLIENT: AMERICAN ELECTRIC POWER	·····	PROJE	CT: N	IE PLANT L	ANDFILL	•
JOB NO.: 216-003-35077150-004		DRILLI	NG C	О.: мона	WŘ	
LOGGED BY: MR		DRILLE	:R: к	EVIN		
DATE DRILLED: 2/19/08		RIG TY	PE: s	STRATASTA	AR 25	
DRILLING METHOD: HSA/HAMMER						
SAMPLING METHOD: CONTINUOUS SAMPL	_ER					
Depth N: E:	TOC:	Litho	Run	%		
BGS DESCRIPTION		Symbol	#	Recovery	RQD	Remarks
40						
45	bedded.					Moist thin mud beds at 50'-54'. Wet at 55'.
60 - Total Depth = 59' bgs.						
70 — - - 75 — - - - - - - - - - - - - - - - - - - -						

	lerracon	F	EL	D	BO	RI	NG LOG	
Consulting Engineers and Scientists BOR			0.:	B-3	3/MW-3D		PAGE: 1	
25809 In PH. (501	terstate-30 BRYANT, AR. 72022) 847-9292 FAX. (501) 847-9210	TOTAL DEI	PTH: 6	0	FEET	BELOW	GROUND SURFACE (BGS)	
CLI	ENT: AMERICAN ELECTRIC POWER		PROJECT: NE PLANT LANDFILL					
JOE	3 NO.: 216-003-35077150-005		DRILLING CO.: MOHAWK					
LOC	GGED BY: MR		DRILLER: KEVIN					
DAT	E DRILLED: 2/20/08		RIG TYPE: STRATASTAR 25					
DRILLING METHOD: HSA / AIR HAMMER								
SAN	IPLING METHOD: CONTINUOUS SAMPLER							
Depth	N: E: ELEV:		Litho	Run	%			
BGS	DESCRIPTION		Symbol	#	Recovery	RQD	Remarks	
0.								
	0'-17' GRAVELY CLAY, brown, dry, trace silt and f	ine sand.					H.S.A. 0'-20' Reamed out with 6" air hammer. 8'-10' Pushed shelby tube. Poor recovery.	
-	17' 25' SHALE, hard to weathered, some this also	hada					Moist zone at 17.5'	
-	17-20 SHALE, Hard to weathered, some thin clay	ueds.						
20 — - - 25 —							Moist zone at 19.5'. Tried to core beginning at 20', but rock too hard.	
- - 30 —	25'-45' LIMESTONE, dark gray, some thin shale b dry, massive bedding	eds,						

lerracon		FIELD BORING LOG								
	Consulting Engineers and Scientists	BORING NO.: B-3/MW-3D PAGE: 2								
25809 Interstate-30 BRYANT, AR. 72022 PH. (501) 847-9292 FAX. (501) 847-9210			TOTAL DEPTH: 60 FEET BELOW GROUND SURFACE (
Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Remarks			
40 40 45 	45'-60' SHALE, black, hard, dry.						No show of groundwater, but			
50 — 55 — 55 — - - - - - - - - - - - - - - - - - - -							water seeped in boring overnight.			
60	T.D. @ 60'									
75 — - - -										
	Terracon	FI	EL	DI	BOF	RIN	IG LOG			
-------------------------------	---	---------------	----------------------	--------------	---------------	-------	--	--		
	Consulting Engineers and Scientists	BORING N	0.:	B-4/M	W-4D	PA	GE: 1			
25809 Int PH. (501)	erstate-30 BRYANT, AR. 72022 847-9292 FAX. (501) 847-9210	TOTAL DEI	PTH: 50	0	FEET BEI	.OW G	ROUND SURFACE (BGS)			
CLIE	ENT: AMERICAN ELECTRIC POWER		PROJ	ECT: NE	PLANT LAN	DFILL				
JOB	NO.: 216-003-35077150-006		DRILLING CO.: MOHAWK							
LOG	GED BY: MR		DRILL	ER: KEV	/IN					
DAT	E DRILLED: 2/21/08		RIG T	YPE: ST	RATASTAR	25				
DRI	LLING METHOD: HSA / AIR HAMMER									
SAN	PLING METHOD: CONTINUOUS SAMPLER /	NX ROCK COF	RE							
Depth			Litho.	Run	% December	POD	Bomarka			
BGS	DESCRIPTION		Symbol	#	Recovery	RQD	Remarks			
- 0	0'-16' GRAVELY CLAY, brown, dry, some limeston rock fragments.	e					H.S.A. 0'-16'. cored 16'-35'. Reamed out with 6" air hammer.			
5 - - -										
	13' Some silt and fine sand.									
- 15 —			• •							
-	16'-38' LIMESTONE, gray, massive bedding, som shale beds, some horizontal bedding plane feature	e thin es.		1 16'-20'	50	60	Rock at 16'.			
20 — - -				2 20'-25'	80	50				
25 — 				3 25'-30'	95	80				
30 	2" Vertical fracture.			4 30'-35'	95	75				

	lerracon	F	IEL	DE	BOR	IN	G LOG
C	consulting Engineers and Scientists	BORING	NO.: B	-4/MW-4	 D	PAG	E: 2
25809 Inter PH. (501) 8	State-30 BRYANT, AR. 72022 347-9292 FAX. (501) 847-9210	TOTAL D	EPTH:	50	FEET BEI	LOW G	ROUND SURFACE (BGS)
Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Remarks
_							
	38'-40' SHALE, black, hard.						
40 —							
· _							
45 —							
_							Wet at 45'.
50 —	T.D. @ 50'						
-	1.U. (U) UU						
_							
- 55 —							
_							
-							
- 60 —							
-							
-							
65							
- 50							
_							
70 — _							
-							
						:	
75 —							
-							
-							

		- Pffe	CON	FI	ELI	DE	BOF	211	NG	LOG
(Cons	ulting Enginee	rs and Scientists	BORING NO .:	MW-5D			F	PAGE: 1 of	⁻ 2
25809 Inter PH. (501) 8	rstate-30 347-9292		BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 55	FEE	L BELOM	/ GR	OUND SU	RFACE (BGS)
CLIE	NT: /	AMERICAN EL	ECTRIC POWER		PROJE	CT: NE	PLANT LAN	IDFILL	-	
JOB	NO.:	216-003-3508	7115-021		DRILLIN	IG CO.	: MOHAW	(
LOG	GED	BY: CLANCY	McCLINTOCK		DRILLE	R: kevi	N			
DATE	E DR	RILLED: 10/7/0)8		RIG TY	PE: STR	RATASTAR	25/CN	/IE 55	
DRIL	LINC	G METHOD:	HOLLOW STEM AUGER	२						
SAM	PLIN	IG METHOD	: SPLIT SPOON/NX RO	CK CORE						
	N: 36	° 24' 52.71"	E: 95° 42' 01.46" G.S	S. ELEV. 633.83	Litho.	Run	%		Blow	
		[DESCRIPTION		Symbol	#	Recovery	RQD	Count per 0.5'	Remarks
Elev. E	Depth BGS									
	0 —	0'-10' GRAVE	LLY CLAY						5-6-4	
	-	brown, silty w	ith orange mottles, dry						6	
	_									
	ST -	Shelby Tube f	rom 3'-5'							
					/_/				5-6-4	
									6	
	ST -	Shelby Tube f	rom 8'-10'							
	-	10'-40' LIMES	TONE	racturas						
	_	gray, crystain	ie, some bedding plane i	Tactures		1	60	61		
	-									PR=0.2 ft/min.
	15 —									
	_	- Some thin sh	nale beds			2	100	39		
	_									
	20 _					3	100	36		
	-									
	_					4	100	50		
	25 —					4	100	58		
	_									
						_				
	30 —					5	90	39		
	_									
	_					_				
	35 —					6	20	31		
	_									
	_					7	100	58		

		2119CON	FIELD BORING LOG						
	Consu	ting Engineers and Scientists	BORING NO.:	MW-5D			Ρ	AGE: 2 of	2
25809 Inte PH. (501)	erstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	55	FEE	T BELOW	GRO	DUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
	40 — - -	40'-55' <u>SHALE</u> dark gray, dry							
	 45				8	100	75		
	- - 50				9	100	81		
	- - 55 -	Total Depth = 55'							
	60 — - -								
	65 — - - -								
	- 75 — - -								
	 80 								
	- 85 — -								
	- - 95 —								

Consulting Engineers and Scientifis BORING NO.: MW-6D PAGE: 1 of 2 20:00000000000000000000000000000000000		erracon	FI	ELI	DE	BOF	211	NG	LOG
Bits methods Betty methods First Analysis (Constraint) TOTAL DEPTH: 57 FEET BELOW GROUND SURFACE (BGS) CLIENT: AMERICAN ELECTRIC POWER PROJECT: NE PLANT LANDFILL JOB NO. 2 16-000-35087115-023 DRILLING CO.: MOHAWK LOGGED BY: ISSUE (See State Sta	Cons	ulting Engineers and Scientists	BORING NO .:	MW-6D			F	PAGE: 1 of	F 2
CLIENT: AMERICAN ELECTRIC POWER PROJECT: NE PLANT LANDFILL JOB NO: 215:003-3507115:023 DRILLING CO: MOHAWK LOGGED BY: CLANCY MCCUNTOCK DRILLER: KEVIN DATE DRILLED: 102/08 RIG TYPE: STRATASTAR 25/CME 55 DRILLING METHOD: FOLLOW STEM AUGER SAMPLING METHOD: SPLIT SPOONNX ROCK CORE N:36* 24* 54.41* E:95* 41* 51.01* Deptid # N:36* 24* 54.41* E:95* 41* 51.01* DESCRIPTION Symbol #: 35* 24* 54.41* E:95* 41* 51.01* DESCRIPTION Symbol #: 36* 24* 54.41* E:95* 41* 51.01* DESCRIPTION Symbol #: 36* 24* 54.41* E:95* 41* 51.01* DESCRIPTION Symbol #: 58 Body Court per 0.4* Remarks #: 58 Body #: 58 Body #: 58 Statistic per 0.4* Bits Statistic per 0.4* Statistic per 0.4* Statistic per 0.4* #: 58 Statistic per 0.4* Statistic per 0.4* Statistic per 0.4* #: 58 Statistic per 0.4* Statistic per 0.4* Statist	25809 Interstate-30 PH. (501) 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH:	57	FEE	T BELOW	/ GR	OUND SU	RFACE (BGS)
JOB NO.: 216-003-35087115-023 DRILLING CO.; MOHAWK LOGGED BY: CLANCY McCLINTOCK DRILLER: KEVIN DATE DRILLED: 10/208 RIG TYPE: STRATASTAR 25:CME 56 DRILLING METHOD: SULTOCOK CORE SAMPLING METHOD: SULTOCOK CORE N:36° 24' 54.41" EISS' 41' 51.01" 0.6° 24' 54.41" EISS' 67 AVELLY CLAY red to brown with orange mottles, dry, some limestone 5 15 Shelby Tube from 8-10' 16 15' 5' 17: 45 5' 5' 20 28.5'-33.5' LIMESTONE 30 28.5'-33.5' LIMESTONE 31 95 30 28.5'-33.5' LIMESTONE 31 1 35 33.5'-67' SHALE 35 33.5'-67' SHALE 36 1	CLIENT:	AMERICAN ELECTRIC POWER		PROJE	CT: NE I	PLANT LAN	IDFILL	-	
LOGGED BY: CLANCY MCLINTOCK DRILLER: KEVIN DATE DRILLED: 10/208 RIG TYPE: STRATASTAR 25/CME 55 DRILLING METHOD: HOLLOW STEM AUGER SAMPLING METHOD: SPLIT SPONNAR ROCK CORE N:36* 24* 54.41* E:35* 41* 51.01* Elso: 45* 24* 54.41* E:35* 41* 51.01* DESCRIPTION Symbol # # Pepth Elow, BSS 9 0*12* GRAVELLY CLAY red to brown with orange motiles, dry, some limestone fragments ST Shelby Tube from 8*10' 1 12 15* 28* 36* RAVELLY CLAY red to brown diff 12* 15* ASH tan, wet 1 20 21 23 24 30 23.5*33.5* LIMESTONE interbedded with thin shale bads 30 31.5*57* SHALE dark gray with some thin fissile beds, hard & britte	JOB NO.	216-003-35087115-023		DRILLING CO.: MOHAWK					
DATE DRILLED: 10/2/08 RIG TYPE: STRATASTAR 25/CME 55 DRILLING METHOD: POLLOW STEM AUGER SAMPLING METHOD: SPLIT SPOONNX ROCK CORE N:36" 24" 54.41" EI 95" 41" 51.01" G.8. ELV. 63.7.2 DESCRIPTION Symbol # Renarks 0 0 0 0 0 0 0 0 0 0 0 0 12:15" ASH 13:-28.5 GRAVELLY CLAY red to brown with orange mottles, dry, some limestone red to brown, dry 12:15" ASH 12:15" ASH 13:-28.5 GRAVELLY CLAY red to brown, dry 12:15" ASH 13:-28.5 GRAVELLY CLAY red to brown, dry 12:15" ASH 14:10:10:10:10:10:10:10:10:10:10:10:10:10:	LOGGE	BY: CLANCY MCCLINTOCK		DRILLER: KEVIN					
DRILLING METHOD: HOLLOW STEM AUGER SAMPLING METHOD: SPLIT SPOONNX ROCK CORE N:36" 24' 54.41" E 95" 41' 51.01" C.S. ELEV. 633.72 Lifthic Run % % Blow 0.5 Remarks DESCRIPTION Symbol Remarks 0.00 DESCRIPTION Symbol Remarks Elev. Depth Image: Colspan="2">Remarks BGS Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2">Colspan="2" Oppin Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2" Colspan="2"	DATE DI	RILLED: 10/2/08		RIG TY	PE: STF	RATASTAR	25/CN	/IE 55	
SAMPLING METHOD: SPLIT SPOONINX ROCK CORE N:36":24'54.41" E:95":41'51.01" GS.ELEV. 633.72 Liftho. Run % Recovery ROD BBW Remarks Depth 0 0'-12' GRAVELLY CLAY Symbol # Recovery ROD BBW Remarks Elev. BGS 0'-12' GRAVELLY CLAY red to brown with orange mottles, dry, some limestone fragments * * * * * 8 7 8	DRILLIN	G METHOD: HOLLOW STEM AUGER	२						
N:36° 24' 54.41* E:85° 41' 51.01* G.S. ELEV. 633.72 Lifting. Run % Recovery ROD Blow count per 0.5* Remarks Elev. BGS 0 0'-12' GRAVELLY CLAY 7.6.5 6 7.7.6.5 6 Str Shelby Tube from 3'-5' *** 1 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 6 8.7.8 6 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.8 8.7.5 8.7.5 6 9 9 7.7.5 6 <	SAMPLI	IG METHOD: SPLIT SPOON/NX RC	CK CORE						
Elev. Depth BCS Image: Constraint of the provided with the shale beds Image: Constraint of the provided with the shale beds, hard & britte Image: Constraint of the provided with the shale beds, hard & britte Elev. Depth BCS Image: Constraint of the provided with the shale beds, hard & britte Image: Constraint of the provided with the shale beds, hard & britte Image: Constraint of the provided with the shale beds, hard & britte	<u>N: 36</u>	<u>5° 24' 54.41"</u> <u>E: 95° 41' 51.01</u> " <u>G.S</u> DESCRIPTION	S. ELEV. 633.72	Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
Elev. BGS Image: Constraint of the state of the									
Elev. Depth BGS Image: Constraint of the second secon									
0 0'-12' <u>GRAVELLY CLAY</u> red to brown with orange mottles, dry, some limestone rigments 7.6.5 ST Shelby Tube from 3'-5' 8.7.8 ST Shelby Tube from 8'-10' 8.7.8 12'-15' ASH tan, wet 9.10-7 15'-28.5' <u>GRAVELLY CLAY</u> red to brown, dry 9.10-7 15'-28.5' <u>GRAVELLY CLAY</u> red to brown, dry 9.10-7 15'-28.5' <u>GRAVELLY CLAY</u> red to brown, dry 9.10-7 20 8.7.8 20 9.10-7 15'-28.5' <u>GRAVELLY CLAY</u> red to brown, dry 9.10-7 20 9.10-7 20 9.10-7 10'-13-8 10'-13-8 7.7-5 6 10'-13-8 9.5'-57' <u>SHALE</u> 30 1 95 31.5'-57' <u>SHALE</u> 1 95 33.5'-57' <u>SHALE</u> 2 100 83	Depth Elev. BGS								
ST Shelby Tube from 3'-5' Shelby Tube from 8'-10' Shelby Tube from 8'-10' 12'-15' ASH tan, wet 15'-28.5' GRAVELLY CLAY red to brown, dry <u>9-10-7</u> <u>6</u> <u>5-5-16</u> <u>12'-12'-13</u> <u>6</u> <u>12'-12'-13</u> <u>6</u> <u>12'-12'-13</u> <u>6</u> <u>10'-13-8</u> <u>6</u> <u>10'-13-8</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>50+</u> <u>7-7-5</u> <u>6</u> <u>50+</u> <u>7-7-5</u> <u>6</u> <u>50+</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>6</u> <u>7-7-5</u> <u>7-6</u> <u>7-7-5</u> <u>7-6</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-6</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-6</u> <u>7-7-5</u> <u>7-6</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u> <u>7-7-5</u>	0 -	0'-12' <u>GRAVELLY CLAY</u> red to brown with orange mottles, dry, fragments	some limestone					<u>7-6-5</u> 6	
ST 10 Shelby Tube from 8'-10' 8 * * * 8 * *	ST - 5	Shelby Tube from 3'-5'							
ST- Shelby Tube from 8'-10' 10 12'-15' ASH tan, wet 15 15'-28.5' GRAVELLY CLAY red to brown, dry 20 12'-12'-13 6 20 12'-12'-13 6 20 12'-12'-13 6 20 12'-12'-13 6 20 12'-12'-13 6 20 12'-12'-13 6 20 10'-13-8 6 20 10'-13-8 6 21 10'-13-8 6 30 50+ 6 31.5'-57' SHALE dark gray with some thin fissile beds, hard & brittle 2 21 100 83				8 8				<u>8-7-8</u> 6	
12-15' ASH tan, wet 12-15' ASH tan, wet 9-10-7 6 15'-28.5' GRAVELLY CLAY red to brown, dry 9 20 9 12-12-13 6 20 9 20 9 20 9 20 9 20 9 20 9 20 9 20 9 20 9 21 10-13-8 6 10-13-8 6 10-13-8 6 5 50+ 6 28.5'-33.5' LIMESTONE interbedded with thin shale beds 1 30 1 95 76 33.5'-57' SHALE dark gray with some thin fissile beds, hard & brittle 2 100 83	ST - 10	Shelby Tube from 8'-10'							
15 15'-28.5' GRAVELLY CLAY red to brown, dry 12-12-13 20 12-12-13 20 10-13-8 25 10-13-8 26 50+ 30 10-13-8 10-13-8 50+ 10-13-8 50+ 10-13-8 50+ 10-13-8 50+ 11 95 76 33.5'-57' SHALE 11 95 76 11 95 76 10-13-8 11 95 76 10-13-8 11 95 76 10-13-8 11 95 76 10-13-8 11 95 76 10-13-8 11 95 76 10-13-8 11 95 76 10-13-8 12-13-10 10-13-8 10-13-8 13-35'-57' SHALE 11 95 13-35'-57' SHALE 100 83		12'-15' <u>ASH</u> tan, wet						<u>9-10-7</u> 6	
20 20 12-12-13 6 20 10-13-8 6 25 10-13-8 6 30 7-7-5 6 30 50+ 6 33.5'-57' SHALE dark gray with some thin fissile beds, hard & brittle 1 95 76 32 100 83 100 83	15	15'-28.5' <u>GRAVELLY CLAY</u> red to brown, dry		* *				<u>5-5-16</u> 6	
25 1 95 76 1 95 76 30 28.5'-33.5' LIMESTONE interbedded with thin shale beds 1 95 76 PR=0.25 ft/min. 30 33.5'-57' SHALE dark gray with some thin fissile beds, hard & brittle 2 100 83 8	20 -							<u>12-12-13</u> 6	
25 - </td <td></td> <td></td> <td></td> <td>8</td> <td></td> <td></td> <td></td> <td><u>10-13-8</u> 6</td> <td></td>				8				<u>10-13-8</u> 6	
30 28.5'-33.5' LIMESTONE interbedded with thin shale beds 1 95 76 Wet at 28' PR=0.25 ft/min. 35 33.5'-57' SHALE dark gray with some thin fissile beds, hard & brittle 2 100 83	25 —			• •				<u>7-7-5</u> 6	
30 interbedded with thin shale beds 1 95 76 33.5'-57' SHALE dark gray with some thin fissile beds, hard & brittle 2 100 83		28.5'-33.5' LIMESTONE						<u> </u>	Wet at 28'
33.5'-57' <u>SHALE</u> dark gray with some thin fissile beds, hard & brittle 2 100 83	30 -	interbedded with thin shale beds			1	95	76		PR=0.25 tt/min.
	35 —	33.5'-57' <u>SHALE</u> dark gray with some thin fissile beds, ł	nard & brittle						
					2	100	83		

		2119COU	FIELD BORING LOG						LOG
1	Consul	ting Engineers and Scientists	BORING NO.:	MW-6D			Р	AGE: 2 of	2
25809 Inte PH. (501)	erstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	57	FEET	BELOW	GRO	DUND SU	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
	40 — – – –				3	100	90		
	45 — _ _ _				4	100	67		
	50 — — — —				5	100	92		
		Total Depth = 57'							
	65 — - -								
	_ 70 — _ _								
	_ 75 — _ _								
	 80 								
	90 — 90 — – –								
	95 —								

Terracon	FI	ELI	DE	BOF	211	NG	LOG
Consulting Engineers and Scientists	BORING NO .:	MW-7D			F	PAGE: 1 of	[:] 2
25809 Interstate-30 BRYANT, AR. 72022 PH. (501) 847-9292 FAX. (501) 847-9210	TOTAL DEPTH	55	FEE	T BELOW	/ GR	OUND SU	RFACE (BGS)
CLIENT: AMERICAN ELECTRIC POWER		PROJE	CT: NE I	PLANT LAN	IDFILI	-	
JOB NO.: 216-003-35087115-025		DRILLING CO.: MOHAWK					
LOGGED BY: CLANCY MCCLINTOCK		DRILLER: KEVIN					
DATE DRILLED: 10/9/08		RIG TY	PE: STF	RATASTAR	25/CN	ЛЕ 55	
DRILLING METHOD: HOLLOW STEM AUGE	R						
SAMPLING METHOD: SPLIT SPOON/NX RO	DCK CORE						
N: 36° 25' 06.30" E: 95° 41' 47.03" G	S. ELEV. 623.58	Litho.	Run	%		Blow	
DESCRIPTION		Symbol	#	Recovery	RQD	Count per 0.5'	Remarks
Depth Elev. BGS							
0 — 0'-16.5' GRAVELLY CLAY							
gray and red, mottled, wet							
		× ×					
ST – Shelby Tube from 8'-10', dry							
						<u> 12-6-6 </u>	Wet at 12'
						0	
- 15		• •				<u>3-5-6</u>	
16.5'-38' <u>LIMESTONE</u>	La la salatta s					Ŭ	
dark gray, fossiliterous, some thin sha	le bedding					-	
			1	100	79		
25 —							
			2	100	100		
30 —							
			3	100	96		
35 —							
			4	90	100		
38'-55' SHALE dark grav with intermit	tent limestone beds						
						1	

		2119COU	FI	ELI	DE	BOR		NG	LOG
25809 Inte	Consul	ting Engineers and Scientists	BORING NO.:	MW-7D			P	AGE: 2 of	2
PH. (501)	847-9292	FAX. (501) 847-9210	TOTAL DEPTH	55	FEET	L BELOW	GR	DUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
	40 — - -				5	100	88		
	45 — - -	SHALE dark gray with intermittent li	mestone beds		6	100	87		
	- 50 — - -				7	100	91		
	- 55 — -	Total Depth = 55'							
	- - 60 - -								
	- 65 — -								
	- 70 — -								
	- 75 — -								
	- 80 — -								
	- 85 — -								
	- 90 — -								
	- - 95 —								

	/ 10	enc	CON	FI	EL	DE	BOF	211	NG	LOG
	Cons	ulting Enginee	rs and Scientists	BORING NO .:	MW-8D			F	PAGE: 1 of	f 2
25809 lr PH. (501	terstate-30) 847-9292		BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	60	FEE	T BELOW	/ GR	OUND SU	RFACE (BGS)
CLI	ENT:	AMERICAN EL	ECTRIC POWER		PROJECT: NE PLANT LANDFILL					
JOE	3 NO.	216-003-3508	7115-027		DRILLI	NG CO.	MOHAW	<		
LO	GGED	BY: CLANCY			DRILLE	R: KEVI	N			
DA	re df	RILLED: 10/13	/08		RIG TY	PE: STR	RATASTAR	25/CN	/IE 55	
DR	LLING	G METHOD:	HOLLOW STEM AUGER	२	-					
SAI	MPLIN	IG METHOD	: SPLIT SPOON/NX RO	CK CORE						
	N: 36	° 25' 04.35" [E: 95° 42' 10.11" G.S DESCRIPTION	S. ELEV. 626.04	Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
Elev.	Depth BGS									
	0 —	0'-43' <u>LIMEST</u>	ONE	- h - dd'r - olan -					<u>5-17-50+</u>	
		fractures, foss	ark gray, crystalline, som siliferous, shale beds bec	coming thicker at 29'					6	
	-					1	90	79		
	5 —					2	90	79		
	-					3	100	79		
						4	100	79		
	- "					5	100	79		
	-									
	20 —									
						6	100	79		
	-									
	 25 —									
	-					7	100	79		
	30 —							1		
	-					8	100	79		
	- 35 —									
	-					9	100	79		
	-									

•		2fracon	FIELD BORING LOG						
	Consul	ting Engineers and Scientists	BORING NO .:	MW-8D			Ρ	AGE: 2 of	2
25809 Inte PH. (501)	erstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	60	FEET	F BELOW	GRO	DUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
	40 — - -	43'-60' SHALE			10	100	66		
	45 — - -	dark gray, some mud seams, wet			11	100	68		Wet at 45'
	_ 50 — _ _				12	100	83		
	_ 55 — _ _ _				13	100	78		
		Total Depth = 60'							
	 65 								
	- 70 — - -								
	- 75 — -								
	 80 - -								
	- - 85 -								
	- - 95 —								

		erracon	FI	EL	DE	BOF		NG	LOG
	Cons	ulting Engineers and Scientists	BORING NO.:	MW-9D			F	PAGE: 1 of	⁻ 2
25809 lr PH. (50	nterstate-30 1) 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 60	FEE ⁻	F BELOW	/ GR	OUND SU	RFACE (BGS)
CLI	ENT:	AMERICAN ELECTRIC POWER		PROJE	CT: NE I	PLANT LAN	IDFILL	_	
JOE	3 NO.:	216-003-35107060-001		DRILLI	NG CO.	: MOHAWP	<		
LO	GGED	BY: CLANCY McCLINTOCK		DRILLE	R: KEVI	N WILKIE			
DA	TE DF	RILLED: 4/6/2010		RIG TY	PE: GER	со			
DR	ILLING	G METHOD: HOLLOW STEM AUGER	R, AIR HAMMER, W	IRE LINE C	ORING W	/ITH AIR			
SA	MPLIN	IG METHOD: SPLIT SPOON & WIRE	E LINE CORING						
	N: -8	597.75 E: 1910.436 G.S	. ELEV. 633.90	Litho.	Run	%		Blow	
		DESCRIPTION		Symbol	#	Recovery	RQD	Count per 0.5'	Remarks
Elev.	Depth BGS								
633.90	0 —	0'-5' GRAVELLY CLAY	HSA						HSA: 0' - 30'
		brown, slightly slity, solt, dry							AIR HAMMER: 30' - 60'
	-								WLC: 30' - 58'
628.90	5 —	5'-10.5' <u>GRAVELLY CLAY</u>						5' - 6.5'	
	-	(gravel becoming larger)		× ×				<u>3-5-7</u>	
								15	
623.90	10 —							10' - 11 5'	Wet at 10.5'
	7	10.5'-12' <u>ASH</u> grav to tan, slightly gravelly, soft, wet						<u>7-7-8</u>	
	-	12'-20.5' <u>ASH</u>						16	
618.90	15 —	tan, slightly gravelly, soft, wet							Hard layer from
								15' - 16.5' 27-22-50/0 5	16' - 17'
	-							2 <u>7-22-30/0.</u> 3 18	
613.90	20 -							201 21 51	
		20.5'-21' <u>COAL</u> black	/					<u>10-10-4</u>	Wet at 21'
	-	21-26.5 <u>ASH</u> tan, slightly gravelly, soft, wet						18	
608.90	25 —								
								25' - 26.5' 9-21-18	
	-	27'-28.5' CLAY brown, slightly gravelly	v, soft, wet					18	B 14 4
603.90	30 —	28.5'-30' HSA - SHALE dark gray							Resistance at 28.5' (shale)
		dark gray, thin horizontal bedding, som	e fossils present						
					30' - 38'				
598.90	35 —				1	100	93		ROP=0.5ft/min.
	-								
		38'-40' <u>SHALE</u>							
	-	dark gray, thin horizontal bedding, som	e fossils present		2	80	64		

'		erracon	FIELD BORING LOG						
	Consu	ting Engineers and Scientists	BORING NO .:	MW-9D			Ρ	AGE: 2 of	2
25809 Inte PH. (501)	erstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	60	FEE1	F BELOW	GRO	DUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
593.90	40 —	40'-60' <u>SHALE</u> dark gray, thin horizontal bedding, so	me fossils present		38' - 48' 2	80	64		ROP=0.25ft/min.
588.90	45 — - -								
583.90	50 — -				48' - 58'				
578.90	55 — - -				3	100	96		ROP=0.5ft/min.
573 90	- 60	Over drill to 60' with air hammer							
573.90	60 - - - 65 - 70 - 70 - 70 - 80 - 90 - 90 -	Total Depth of Boring = 60' bgs							

	/m	erracon	FI	ELI	DE	BOF	211	NG	LOG	
	Cons	ulting Engineers and Scientists	BORING NO .:	MW-10D			F	PAGE: 1 of	F 2	
25809 In PH. (501	terstate-30) 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 68	FEE	r below	/ GR	OUND SU	RFACE (BGS)	
CLI	ENT:	AMERICAN ELECTRIC POWER		PROJECT: NE PLANT LANDFILL						
JOE	3 NO.:	216-003-35107060-003		DRILLI	NG CO.	: MOHAW	<			
LOC	GGED	BY: CLANCY MCCLINTOCK		DRILLE	R: KEVI	N WILKIE				
DA	TE DF	RILLED: 4/7/2010 thru 4/9/2010		RIG TY	PE: GEF	со				
DRI	LLIN	G METHOD: AIR HAMMER, WIRE LII	NE CORING WITH A	I AIR						
SAN	MPLIN	IG METHOD: WIRE LINE CORING								
	N: -7	762.059 E: 764.463 G.S DESCRIPTION	.ELEV. 636.14	Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks	
Elev.	Depth BGS									
636.14	0 — - -	0'-3' <u>TOPSOIL</u> black	HSA						HSA: 0' - 3' AIR HAMMER: 3' - 68'	
631.14 626.14	- 5 — - - 10 —	3'-22' <u>LIMESTONE</u> light gray, fine graded, micritic, fossils a present, massive bedding, mostly horiz some angular bedding @ ~30°	WLC and calcite crystals contal bedding,		3' - 13' 1	90	76		WLC: 3' - 68' Resistance at 3' ROP=0.5ft/min.	
621.14 616.14		22'-32' <u>LIMESTONE</u>			13' - 23' 2	100	94		ROP=0.5ft/min.	
611.14 606.14		becoming more gray, fine graded, micr calcite crystals present, massive beddi horizontal bedding present, massive be horizontal bedding, some angular bedd 24' - 32' Becoming weathered and foss 29' - 30' Highly weakend zone 31' - 35' Thin shale layers in Limestone 32'-46' <u>LIMESTONE</u>	itic, fossils and ng, mostly adding, mostly ing @ ~30° il increase		23' - 33' 3	100	80		ROP=0.5ft/min. Wet at 29' - 30'	
601.14	35 -	gray, crystalline, fossils and calcite crys bedding becoming thinner, moist betwe planes, some small cavities with calcite	stals present, een bedding e crystal growth		33' - 46' 4	80	52		ROP=0.5ft/min.	



FIELD BORING LOG

BORING NO .: MW-10D

PAGE: 2 of 2

25809 Inte PH. (501)	09 Interstate-30 BRYANT, AR. 72022 (501) 847-9292 FAX. (501) 847-9210			FEE1	BELOW	GRC	OUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION	Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
596.14 591.14	40	32'-46' <u>LIMESTONE</u> gray, crystalline, fossils and calcite crystals present, bedding becoming thinner, moist between bedding planes, some small cavities with calcite crystal growth		33' - 46' 4	80	52		ROP=0.5ft/min.
586.14		46'-68' <u>SHALE</u> dark gray to black, few fossils, thin bedding, H.C. odor, dry, hard		46' - 53' 5	95	61		ROP=0.5ft/min.
581.14 576.14				53' - 63' 6	98	85		ROP=0.5ft/min.
571.14				63' - 68' 7	95	48		ROP=0.25ft/min.
	- 70 - -	Total Depth of Boring = 68' bgs						
	- 75 — - -							
	85 -							
	90							

		erra		FI	EL	DE	BOF		NG	LOG
	Cons	ulting Engineer	s and Scientists	BORING NO .:	MW-11D			F	PAGE: 1 of	f 1
25809 lr PH. (501	nterstate-30 1) 847-9292		BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 48	FEE	L BELOM	/ GR	OUND SU	RFACE (BGS)
CLI	ENT:	AMERICAN ELE	CTRIC POWER	•	PROJECT: NE PLANT LANDFILL					
JOE	3 NO.:	216-003-35107	060-005		DRILLI	NG CO.	: MOHAWP	<		
LO	GGED	BY: CLANCY	McCLINTOCK		DRILLE	R: KEV	N WILKIE			
DA	TE DF	RILLED: 4/13/20	010 / 4/14/2010		RIG TY	PE: GEI	со			
DR	LLING	G METHOD: A	AIR HAMMER, WIRE L	INE CORING WITH A	IR					
SAI	MPLIN	IG METHOD:	WIRE LINE CORING							
	N: -84	419.377	E: 935.471 G	.S. ELEV. 625.97	Litho.	Run	%		Blow	
		C	ESCRIPTION		Symbol	#	Recovery	RQD	Count per 0.5'	Remarks
Elev.	Depth BGS									
625.97	0	0'-3' LIMESTO	NE	WLC						AIR HAMMER:
	_					-				0' - 3' & 3' - 48'
	_	3'-27' <u>LIMESTO</u>	ONE							WLC: 3' - 48'
620.97	5 —	gray, crystallin small cavities v	e, lots of fossils, calcite with crvstal growth	e crystals, hard, few						
	_		, ,			3' - 13'				
	_					1	100	75		ROP=0.25ft/min.
615,97	10 —									Moist at 10'
	_					-				
	_									
610.97	- 15 —					-				
	-	26' - 33' Becon becomes a dar	nes weathered between ker grav	n bedding planes and		401 001				
						2	100	83		ROP=0.25ft/min.
605.97	20 -									
	-					-				
	_									
600 97	25 —					-				
000.07										
	_	dark gray, som	l <u>ONE</u> le fossils, micritic, thin i	interlayered shale in		23' - 33'	90	33		ROP=0 25ft/min
505 07	30 _	LS				Ŭ				1.01 0.201011111.
595.91	- 30					-				
		32'-48' <u>SHALE</u>	·			ļ				
500.07	25 _	dark gray to bla	аск, some tossils, thin l	bedding						
090.97	- 35					33' - 43' 1	100	71		
						4	100			
	_									

llefracon	
Conculting Engineers and Scientists	

FIELD BORING LOG

	Consul	ting Engineers and Scientists	BORING NO.: MW-11D			PAGE: 2 of 2			
25809 Inte PH. (501)	rstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	48	FEE1	F BELOW	GRO	OUND SUP	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
585.97	40 —				33' - 43' 4	100	71		ROP=0.25ft/min.
580.97					43' - 48' 5	100	91		ROP=0.25ft/min.
		Total Depth of Boring = 48' bgs							
	- 55 -								
	- 65 -								
	- - 70 -								
	- 75 — -								
	- 80 - -								
	90 — 90 —								
	95 —								

	/	erracon	F	FIELD BORING LOG					
	Cons	ulting Engineers and Scientists	BORING NO .:	MW-12D			F	PAGE: 1 of	f 2
25809 lr PH. (501	nterstate-30 1) 847-9292	BRYANT, AR. 720. FAX. (501) 847-92	TOTAL DEPTH	: 42	FEE	L BELOM	/ GR	OUND SU	RFACE (BGS)
CLI	ENT:	AMERICAN ELECTRIC POWER		PROJECT: NE PLANT LANDFILL					
JOE	3 NO.:	216-003-35107060-007		DRILLI	NG CO.	: MOHAW	<		
LO	GGED	BY: CLANCY McCLINTOCK		DRILLER: KEVIN WILKIE					
DA	TE DF	RILLED: 4/15/2010 / 4/16/2010 / 4/19	/2010	RIG TY	PE: GEI	¯со			
DR	ILLING	G METHOD: AIR HAMMER, WIRE	LINE CORING WITH A	AIR					
SAI	MPLIN	IG METHOD: WIRE LINE CORING	3			-	-		
	N: -8	778.028 E: 1088.459 DESCRIPTION	G.S. ELEV. 620.91	Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
Elev.	Depth BGS								
620.91	0 —	0'-2' <u>LIMESTONE</u>	WLC		-				AIR HAMMER: 0' - 2' & 2' - 42'
615.91	5	2'-11' <u>LIMESTONE</u> gray, crystalline, high fossil content, dry	calcite crystal growth,		2' - 7' 1	95	15		WLC: 2' - 42'
610.91	- - 10 - -	11' - 19' Becoming a darker gray 11' - 22' Very thin shale layers intert	edded in limestone		7' - 12' 2	90	51		ROP=0.1ft/min.
605.91									
600.91	20 —	19'-22' <u>LIMESTONE</u> dark gray, becoming very crystalline fossil content, brittle	, thin bedding, high		12' - 22' 3	95	29		
595.91	- - 25 - - -	dark gray, few fossils, natural gas oc	or		22' - 28' 4	100	74		
590.91	30 —				28' - 32' 5	100	80		Water at 32'
585.91	35 —				32' - 42' 6	95	94		

•	Terracon		FI	EL	DE	BORING LOG			
	Consul	ing Engineers and Scientists	BORING NO.:	MW-12D			Ρ	AGE: 2 of	2
25809 Inte PH. (501)	rstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	42	FEET	F BELOW	GRO	DUND SUF	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
580.91	40 _				32' - 42'				ROP=0 1ft/min
		Total Depth of Boring = 42' bgs			6	95	94		
	45								
	45 —								
	- 50 -								
	55 —								
	-								
	60 —								
	- 65 -								
	70 —								
	_								
	/5 _								
	80 —								
	85 —								
	_								
	90 —								
	95 —								

	Terracon			FIELD BORING LOG						LOG
	Cons	ulting Enginee	rs and Scientists	BORING NO .:	MW-13D			F	PAGE: 1 o	f 2
25809 lr PH. (50	nterstate-30 1) 847-9292		BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 45	FEE	L BELOM	/ GR	OUND SU	RFACE (BGS)
CLI	ENT:	AMERICAN ELE	ECTRIC POWER		PROJECT: NE PLANT LANDFILL					
JO	3 NO.:	216-003-35107	7060-009		DRILLING CO.: MOHAWK					
LO	GGED	BY: CLANCY	McCLINTOCK		DRILLE	R: KEVI	N WILKIE			
DA	TE DF	RILLED: 4/20/2	2010		RIG TY	PE: GEI	¯со			
DR	ILLING	G METHOD:	AIR HAMMER, WIRE L	INE CORING WITH A	AIR .					
SA	MPLIN	IG METHOD	WIRE LINE CORING					_		
	N: -9 ⁻	108.428 [E: 1354.192 G.	S. ELEV. 616.11	Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
Floy	Depth									
EIEV.	0			WIC				-		
010.11										AIR HAMMER. 0' - 4' & 4' - 45' WLC: 4' - 42'
611.11	5	 4'-11' <u>LIMESTONE</u> dark gray, crystalline, fossils present, massive bedding, calcite crystal growth, biomicritic - 				4' - 11' 1	95	58		
606.11	10 - -	11'-13' <u>LIMES</u> gray, crystallir	<u>TONE</u> ne, high fossil content, di	у						Very hard at 11' - 12' Switched to small air
601.11		13'-21' <u>SHALE</u> dark gray, HC	 odor, few fossils			11' - 22' 2	90	53		hammer (4") at 11' - 12'
596.11	20 — 	21' - 42' Becol	ming darker and more fi	ne						
591.11	25 —					22' - 27' 3	100	90		
586.11	- 30 -					27' - 32' 4	100	100		
581.11	35					32' - 45' 5	95	78		

		erracon	FIELD BORING LO					LOG	
(Consult	ing Engineers and Scientists	BORING NO .:	MW-13D			P	AGE: 2 of	2
25809 Inte PH. (501)	rstate-30 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	45	FEE	Γ BELOW	GRO	OUND SU	RFACE (BGS)
Elev.	Depth BGS	DESCRIPTION		Litho. Symbol	Run #	% Recovery	RQD	Blow Count per 0.5'	Remarks
576.11	40				32' - 42'				
	+	Air hammer to 45'			5	95	78		
571.11	45 —	Total Depth of Boring = 45' bgs							
	_								
	- 50 —								
	_								
	-								
	-								
	_								
	60 —								
	-								
	65 — -								
	_								
	-								
	/0 <u> </u>								
	_								
	- 75 —								
	_								
	-								
	80 —								
	_								
	-								
	85 —								
	-								
	90 — -								
	95 —								

		ferra	CON	FI	ELI	D BORING LOG				
(Consu	llting Engine	ers and Scientists	BORING NO .:	MW-14D	PAGE: 1 of 1				
25809 PH. (5	1-30 South 501) 847-929	92	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 76'	FEET BELOW GROUND SURFACE (BGS)				
CL	IENT	: AMERICAN EL	ECTRIC POWER		PROJE	CT: NE - CCR WELL INSTALL				
JC	B NO).: 216-001-3515	7183		DRILLIN	IG CO.: ANDERSON ENGINEERING				
LC	GGE	D BY: RAH			DRILLER: GARY MOYERS					
DA	ATE D	RILLED: 03/01	/2016		RIG TYI	PE: CME 75 BUGGY				
DF	RILLIN	IG METHOD:	HSA / AIR ROTARY		•					
SA	MPLI	NG METHOD): 5' CONTINUOUS SAN	IPLER, LOGGED BY	CUTTING	3				
	<u>N:</u> N	NA	E: NA G.	s. elev. Na	Litho.					
			DESCRIPTION		Symbol	Remarks				
	Depth BGS									
	0 —	0'-6' SILTY C	LAY W/ LIMESTON	IE GRAVEL						
	_	tan and gray	clay w/intermittent g	jravel						
	-	6'-43' SILTY	CLAY W/ LIMESTO	NE GRAVEL		CL 70 la sead by outlines				
	- 10 -	crystalline to	micritic			6 - 76 logged by cuttings				
	_									
	_									
	20 —									
	_									
	30 —									
	-									
	40 -									
	40 -		_							
	_	43'-76' SHAL	.E gray, hard							
	- 50									
	50 —				 					
	-									
					$\begin{array}{c} - \begin{array}{c} - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \end{array} \\ - \end{array} \\ - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \begin{array}{c} - \end{array} \\ - \bigg \\ - $					
	60 —									
	_				 					
	-					fracture @ 67' w/ moist cuttings				
	/0 _									
	-									
	_	Total Depth of	of Boring at 76' bgs			Boring terminated @ 76'				
	80 —									
	-									

	٦	Ferracon	FI	ELI	D BORING LOG
0	Consi	lting Engineers and Scientists	BORING NO .:	MW-15D	PAGE: 1 of 1
25809 PH. (9 I-30 South 501) 847-92	BRYANT, AR. 72022 292 FAX. (501) 847-9210	TOTAL DEPTH	: 71'	FEET BELOW GROUND SURFACE (BGS)
CL	IENT	: AMERICAN ELECTRIC POWER		PROJE	CT: NE - CCR WELL INSTALL
JC)B NC	D.: 216-001-35157183		DRILLIN	IG CO.: ANDERSON ENGINEERING
LC	GGE	D BY: RAH		DRILLE	R: GARY MOYERS
DA	ATE D	DRILLED: 02/23/2016		RIG TY	PE: CME 75 BUGGY
DF	RILLIN	NG METHOD: HSA / AIR ROTARY			
SA	AMPL	ING METHOD: 5' CONTINUOUS SAM	MPLER, LOGGED BY	CUTTING	5
	N:I	NA E: NA G.	S. ELEV. NA	Litho.	
		DESCRIPTION		Symbol	Remarks
	Depth BGS				
	0 —	0'-11' SILTY, GRAVELLY, CLAY	FILL		
	-				
	-	-			
	10 —				
	-	tan, fine and dry			
	-	15'-27' SILTY CLAY W/ ZONES	OF GRAVELLY		
	20 —	stiff, brown, dry			
	-	-			
	-	- 27'-30' WEATHERED L.S. W/ GI	RAVELLY CLAY	<u> </u>	
	30 —	30'-41' LIMESTONE			30' - 71' logged by cuttings
	-	crystalline, hard, light gray to gra	У		
	-	-			
	40 —				
	-	41'-71' SHALE hard, grav to dark grav			
	-	-			
	- 50 —				
	-				water not encountered while drilling
	-				
	60 -				
	-	-			
	-				
	- 70				
	- 10	Total Depth of Boring at 71' bgs			Boring terminated @ 71'
	-				
	-	-			
	- 08				
	-				

			suscon	FI	E		BORING LOG			
Co	ns	ulti	ng Engineers and Scientists	BORING NO .:	MW-1	6D	PAGE: 1 of 1			
25809 I-30 PH. (501)	0 Sou 847-	uth 9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH:	: 6′	I' FEE	T BELOW GROUND SURFACE (BGS)			
CLIE	ΞN	T: /	MERICAN ELECTRIC POWER		PRC	JECT: NE	- CCR WELL INSTALL			
JOB	Ν	0.:	216-001-35157183		DRII	LING CO	.: ANDERSON ENGINEERING			
LOG	G	ED	BY: rah		DRILLER: GARY MOYERS					
DAT	Έ	DR	LLED: 02/25/2016		RIG	TYPE: CM	IE 75 BUGGY			
DRIL	L	ING	METHOD: HSA / AIR ROTARY		•					
SAM	1PI	LIN	G METHOD: 5' CONTINUOUS SAM	IPLER, LOGGED BY	CUTT	ING				
Depth	Sa	mpl	N: NA E: NA	ELEV:NA		Litho.				
BGS	Int	terva	DESCRIPTIO	N		Symbol	Comments			
0 -			0'-10' SILTY CLAY W/ SOME dark brown	GRAVEL						
5 —										
10 —			10'-26' ASH				moisture beginning @ 19'			
			tan, fine							
15 — — —										
20										
25 —							28' - 61' logged by cuttings			
			26'-27' SILTY CLAY dark gray to black							
30			27'-28' clay w/ bentonite slurry greeni	sh gray, dry						
35 —			dark gray, hard							
40 —							fractures w/ moist cuttings @ 30' and 52'			
45										
50										
55 —							Boring terminated @ 61'			
60 -										
	Π		Total Depth of Boring at 61' bo	gs						
65 —										

٦ſe	rracon	FI	EI		BORING LOG
Consulting	Engineers and Scientists	BORING NO .: I	MW-1	7D	PAGE: 1 of 1
25809 I-30 South PH. (501) 847-9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH:	56	s' FEE	T BELOW GROUND SURFACE (BGS)
CLIENT: AME	ERICAN ELECTRIC POWER		PRO	JECT: NE	- CCR WELL INSTALL
JOB NO.: 216	6-001-35157183		DRIL	LING CO	.: ANDERSON ENGINEERING
LOGGED BY: RAH			DRIL	LER: GAR	RY MOYERS
DATE DRILL	ED: 02/29/2016		RIG	TYPE: CM	IE 75 BUGGY
DRILLING M	IETHOD: HSA / AIR ROTARY	·			
SAMPLING N	METHOD: 5' CONTINUOUS SAM	PLER, LOGGED BY	CUTTI	NG	
Depth Sample N	I: NA E: NA	ELEV:NA		Litho.	
BGS Interval	DESCRIPTIO	N		Symbol	Comments
0 <u> </u>)'-12' SILTY, GRAVELLY CLA	Y FILL		[]]]	
	ed and brown				
5 -				////	
	12'-13' ASH		/		
	13'-25' SILTY CLAY W/ L.S. G	RAVEL			
	orown				
20 _					
25 _ 2	25'-30' LIMESTONE				25' - 56' logged by cuttings
- r - r	hard, light gray				
30 - 3	30'-31' CLAY-FILLED ZONE				
	noist				
	31'-56' SHALE Jark gray				
	0,				
40 _					fractures w/ moist cuttings @ 39', 43', 50'
45 —					
50 -					
55 -					
	Fotal Depth of Boring at 56' bg	IS			Boring terminated @ 56'
60 -					

			erracon	F	ELI	DB	BORING LOG
	С	onsu	Iting Engineers and Scientists	BORING NO.:	SP-4		PAGE: 1 of 1
25809 I-3 PH. (501	30 So) 847-	uth •9292	BRYANT, AR. 72022 FAX. (501) 847-9210	TOTAL DEPTH	: 35	FEET	BELOW GROUND SURFACE (BGS)
CLI	EN	T: A	MERICAN ELECTRIC POWER		PROJE	CT: NE P	LANT POND WELLS - OOLOGAH, OK.
JOE	3 N	0.::	216-003-35117075-005		DRILLIN	IG CO.:	МОНАШК
LOC	GG	ED I	BY: ADAM HOOPER		DRILLE	R: KEVIN	I WILKIE
DAT	ΓE	DRI	LLED: 4/6/2011		RIG TY	РЕ: ВК-6	6
DRI	LL	ING	METHOD: 6.25" AIR HAMMER		-		
SAN	ΜP	LIN	G METHOD: LOGGED BY CUTTING	S			
Depth	۱Sa	ample		G.S. ELEV.: N/A	Litho.	PID	0
BGS		terva	DESCRIPTION		Symbol	(ppm)	Comments
0.	╢	_					
-	$\left\ \right\ $		red with limestone and chert gra	avel			vvet in clay above
-							
. _ ·	$\left \right $						
5-	11						
	$\left \right $						
-	11						
10 - 9' - 16' <u>LIMESTONE</u>							
-	$\left \right $		light gray, neavily weathered wit	in red clay			
	11						
-	$\left \right $						
15 -	11						
			tan/light gray, heavily weathered	d micritic with			
	$\left\{ \right\}$		chert pebbles				
20 -	11						
20	$\left \right $						
-	$\left \right $						
	11						
25 -	$\left \right $						
-	11						
-]		28' - 35' LIMESTONE				
-	$\left\{ \right\}$		light gray, crystalline				
30 -	1						
.	$\left\ \right\ $						
-	$\left\ \right\ $						
35 -	Ц	$ \rightarrow$					No water encountered
			I otal Depth of Boring at 35' bgs				

Terracon	FI	ELD	BORING	LOG
Consulting Engineers and Scientists	BORING NO	D.: SP-	5R PAGE: 1 of	2
25809 I-30 South BRYANT, AR. 72022 PH (501) 847-9292 EAX (501) 847-9210	TOTAL DEP	2 TH: 75	FEET BELOW GROUND	
CLIENT: AMERICAN ELECTRIC POWER		PROJECT:	NE PLANT POND WELLS - OOLO	GAH, OK.
JOB NO.: 219-003-35117075-013		DRILLING (СО.: монаwк	
LOGGED BY: ADAM HOOPER		DRILLER: J	EREMY	
DATE DRILLED: 4/11/2012		RIG TYPE:	BK-66	
DRILLING METHOD: 6.25" AIR HAMMER				
SAMPLING METHOD: LOGGED BY CUTTINGS				
Depth N: N/A E: N/A G.S. ELE BGS DESCRIPTION	V. N/A	Litho. Symbol	Remarks	
_ 0' - 4' <u>SILTY CLAY</u> brown -			0' - 35' Lithology descriptior original SP-5 boring log. Co interval were not obtained c	i provided by uttings for this luring re-drill.
5 4' - 12' <u>LIMESTONE</u> light gray, crystalline with interbedded da limey shale	ırk			
10 — - - 12' - 20' <u>LIMESTONE</u> - dark gray				
20 – 20' - 30' <u>LIMESTONE</u> light gray, fine grained, crystalline	-			
30 — 30' - 35' <u>LIMESTONE</u> - light gray, crystalline with interbedded da - limey shale -	ırk			

	Terracon	FIE	LD	BORING LOG
	Consulting Engineers and Scientists	BORING NO .:	SP-5R	PAGE: 2 of 2
25809 I-30 PH. (501)	South BRYANT, AR. 72022 847-9292 FAX. (501) 847-9210	TOTAL DEPTH:	75	FEET BELOW GROUND SURFACE (BGS
Depth BGS	DESCRIPTION	Liti Syn	no. nbol	Remarks
Deptn BGS 40	35' - 75' LIMESTONE light gray, crystalline			Remarks Re-drill of SP-5 35' - 75' Logged by cuttings Water at 61' bgs after 24 hours.
	Total Depth of Boring at 75' bgs			



APPENDIX E Well Completion Reports

MONITORING WELL I	NSTALLATION RECORD
JOB Name AMERICAN ELECTRIC POWER - NE PLANT	Well NumberMW-1D
Job Number 35087115 Installation Date	10/23/08 Location OOLOGAH, OK.
Datum Elevation 638.07	Surface Elevation 635.23
Datum for Water Level Measurement 2" PVC	
Screen Diameter & Material 2" PVC	
Cranular Backfill Motorial 12–20 SAND	Terracon Representative MR/JA
Drilling Method HOLLOW STEM AUGER/AIR ROTARY	Drilling Contractor MOHAWK
Lockable Casing —	
Well Cap —	
Metal Well Protector—	
Concrete Pad	Stickup: <u>3.1</u>
Ground Surface	
Solid Piper	
Solia Kisei —	
Flush Joint ———	I enath of Solid
	riser: 44.0'
	Total Depth of
Donth to Top of	Monitoring w_u_57.40'
Bentonite Seal 39'	from TOC
Depth to Top of	
Primary Filter Pack 42	
	I enath of Screen
Screen —	and Bottom Cap.
Total Depth Drilled Can—	
<u>55</u> fbgs	
F771	
Portland/Bentonite Grout	
Bentonite Pellets (No	ot to Scale)
Granular Backfill	
	MONITORING WELL INSTALLATION RECORD
IELGCOU	PROJECT NUMBER: 216-003-35087115
Consulting Engineers and Scientists 25503 Interdate 30 South BRYANT, AR 72022	WELL NUMBER: MW-1D
PH. (501) 847-9232 FAX. (501) 847-9210	DRAWING NUMBER: 035 CHECKED BY: MR

MONITORING WELL	INSTALLATION RECORD
Job Name AEP NORTHEASTERN PLANT LANDFILL	Well Number MW-2
Job Number 35077150 Installation Date	3/4/08 Location OOLOGAH, OK.
Datum for Water Level Measurement T.O.C.	
Screen Diameter & Material 2" PVC	Slot Size0.01
Riser Diameter & Material 2" PVC	Borehole Diameter 6.25"
Granular Backfill Material 12–20 SAND	Terracon RepresentativeMERRICK_ROTENBERRY
Lockable Casing	
Vented Cap -	\neg
Aluminum Well Protector –	
Ground Surface	
Solid Riser	
Chuck Is int	
Flush Joint	Length of Solid
	riser: 51.26
	Monitoring
Depth to Top of 40 bgs	Well: 61.56
	from TOC
Depth to Top of	
Primary Filter Pack 45 bgs	
Lievation 303	
	Length of Screen
Screen —	10.3
Total Depth Drilled	
59fbgs600	<u>》《《外班》》《》《</u>
Bentonite Chips	
Bentonite Plug (N	ot to Scale)
Granular Backfill	
	MONITORING WELL INSTALLATION RECORD
lierracon	PROJECT NUMBER: 216-003-35077150
Consulting Engineers and Scientists 25809 H30 BRYANT, AR 72022	WELL NUMBER: MW-2
PH. (501) 847-9292 FAX. (501) 847-9210	DRAWING NUMBER: 016 CHECKED BY: MR

MONITORING WELL	INSTALLATION RECORD
Job NameAEP_NORTHEASTERN_PLANT_LANDFILL	Well Number <u>MW-3</u>
Job Number35077150 Installation Date	2/21/08 Location OOLOGAH, OK.
Datum Elevation 630.65	Surface Elevation627.66
Datum for water Level Measurement 1.0.0.	Slot Size 0.01
Riser Diameter & Material 2" PVC	Borehole Diameter 6.25"
Granular Backfill Material 12-20 SAND	Terracon RepresentativeMERRICK_ROTENBERRY
Drilling Method AIR_ROTARY	Drilling Contractor MOHAWK
Lockable Casing - Vented Cap - Aluminum Well Protector -	
Concrete Pad Ground Surface	
Solid Riser	Length of Solid
Depth to Top of 40 bgs Bentonite Seal	riser: <u>52.74</u> Total Depth of Monitoring Well: <u>63.04</u> from TOC
Depth to Top of Primary Filter Pack45 bgs Elevation 582'	
Screen —	Length of Screen and Bottom Cap. 10.3
Total Depth Drilled Cap — 60fbgs	
Bentonite Chips	
Bentonite Plug (N	ot to Scale)
Granular Backfill	
TECRETCOCO Consulting Engineers and Scientists 25809 I-30 PH. (501) 847-9292 FAX. (501) 847-9210	MONITORING WELL INSTALLATION RECORD PROJECT NUMBER: 216-003-35077150 WELL NUMBER: MW-3 DRAWING NUMBER: 017 CHECKED BY: MR

MONITORING WELL	INSTALLATION RECORD
Job NameAEP_NORTHEASTERN_PLANT_LANDFILL	Well Number 4
Job Number 35077150 Installation Date	2/22/08 Location OOLOGAH, OK.
Datum Elevation625.00	Surface Elevation621.93
Datum for Water Level Measurement 1.0.C.	
Riser Diameter & Material 2" PVC	Borehole Diameter 6.25"
Granular Backfill Material 12-20 SAND	Terracon RepresentativeMERRICK_ROTENBERRY
Drilling Method AIR ROTARY	Drilling Contractor MOHAWK
Lockable Casing - Vented Cap - Aluminum Well Protector -	
Ground Surface	147914 22 CT 14774 A 149
Solid Riser	
Flush Joint	
Depth to Top of 32 bgs	Length of Solid riser: <u>43.65</u> Total Depth of Monitoring Well: <u>53.95</u> from TQC
Depth to Top of Primary Filter Pack36 bgs Elevation 585'	
Screen —	Length of Screen and Bottom Cap. 10.3
Total Depth Drilled Cap — 50 fbgs	
Bentonite Chips	
Bentonite Plug (N	ot to Scale)
Granular Backfill	
Tigercacon Consulting Engineers and Scientists 25509 1-30 PH, (501) 847-9232 FAX, (501) 847-9210	MONITORING WELL INSTALLATION RECORD PROJECT NUMBER: 216-003-35077150 WELL NUMBER: MW-4 DRAWING NUMBER: 018 CHECKED BY: MR

MONITORING WELL	NSTALLATION RECORD
Job Name AMERICAN ELECTRIC POWER - NE PLANT	Well Number MW-5D
Job Number 35087115 installation Date	10/23/08 Location OOLOGAH, OK.
Datum Elevation 636.84	Surface Elevation 633.83
Datum for Water Level Measurement	0. (0) 0. 01 ¹⁰
Screen Diameter & Material 2 PVC	Siot Size6 25"
Cropular Pool/fill Motorial 12-20 SAND	Terracon Representative MR/JA
Drilling Method HOLLOW STEM AUGER/AIR ROTARY	Drilling ContractorMOHAWK
Lockable Casing –	\neg
Well Cap —	
Matal Wall Protector -	
Organista Dad	Stickup: 3.3'
Ground Surface	
Solid Riser —	
Flush Joint	
	Length of Solid
	Total Depth of
	Monitoring
Depth to Top of 39'	Well: 58.32
	from TOC
Denth to Top of	
Primary Filter Pack 42'	
0	and Bottom Cap.
Screen —	10.3'
Total Depth Drilled	
55' fbgs Cap —	
Portland/Bentonite Grout	
Bentonite Pellets (N	ot to scole)
Granular Backfill	
	MONITORING WELL INSTALLATION RECORD
	PROJECT NUMBER: 216-003-35087115
Consulting Engineers and Scientists 25309 Interstate-30 South BRYANT, AR 72022	WELL NUMBER: MW-5D
PH. (501) 847-9292 FAX. (501) 847-9210	

MONITORING WELL	INSTALLATION RECORD
JOD NAME AMERICAN ELECTRIC POWER NE PLANT	Well Number MW-6D
Job Number 35087115 Installation Date	10/23/08 Location OOLOGAH, OK.
Datum Elevation 636.66	Surface Elevation633.72
Datum for Water Level Measurement ?" PVC	Slot Size 0.01"
Screen Diameter & Material 2" PVC	Borehole Diameter 6.25"
Granular Backfill Material 12-20 SAND	Terracon Representative MR/JA
Drilling Method HOLLOW STEM AUGER/AIR ROTARY	Drilling ContractorMOHAWK
Lockable Casina –	
Well Cap	
wen cop —	\sum
Metal Well Protector —	
Concrete Pad	Stickup: <u>3.0'</u>
Ground Surface	
Solid Riser	
Flush Joint ———	Length of Solid
	riser: <u>44.92'</u>
	Total Depth of Monitoring
Depth to Top of	Well: 58.22'
Bentonite Seal40	from TOC
Depth to lop of Drimary Eiltor Back 43'	
	Length of Screen
Screen —	
Total Depth Drilled	
55 fbgs Cap —	
Portland/Bentonite Grout	
Bentonite Pellets (N	lot to Scale)
Granular Backfill	
	MONITORING WELL INSTALLATION RECORD
IIBUGCOII	PROJECT NUMBER: 216-003-35087115
Consulting Engineers and Scientists 25609 Interstate-30 South BRYANT, AR 72022	WELL NUMBER: MW-6D
PH (501) 847-9292 FAX (501) 847-9210	



MONITORING WELL IN	ISTALLATION RECORD
Job Name AMERICAN ELECTRIC POWER - NE PLANT	Well Number WW-80
Job Number 35087115 Installation Date1	Surface Elevation 626.04
Datum Elevation 629.52 T.O.C.	
Datum for Water Level Measurement. 2" PVC	Slot Size0.01"
Riser Diameter & Material 2" PVC	Borehole Diameter 6.25
Granular Backfill Material <u>12-20 SAND</u>	Terracon RepresentativeMOHAWK
Drilling Method HOLLOW STEM AUGER/AIR ROTARY	
Lockable Casing —	
Well Cap	
H L L Well Protoctor	
Metal Well Protector	
Concrete Pad	Stickup: <u>3.2'</u>
Ground Surface	
Solid Riser	
Flush Joint ————	Length of Solid
Depth to Top of 46'	Total Depth of Monitoring Well: <u>63.45'</u> from TOC
Depth to Top of Primary Filter Pack50'	
Screen	Length of Screen and Bottom Cap. 10.3'
Total Depth Drilled Cap — 60'fbgs	
Portland/Bentonite Grout	
Bentonite Pellets (No	ot to Scale)
Granular Backfill	
Tigercacon Consulting Engineers and Scientists 2509 Interstate-30 South BRYANT, AR. 72022 FAX (501) 647-5210	MONITORING WELL INSTALLATION RECORD PROJECT NUMBER: 216-003-35087115 WELL NUMBER: MW-8D DRAWING NUMBER: 046 CHECKED BY: MR

1
MONITORING WELL INS	STALLATION RECORD	
Job Name AEP NORTHEAST STATION HYDROGEOLOGIC INVE	ESTIGATION Well Number MW-9D	
Job Number 35107060 Installation Date 4/6/	/2010 Location OOLOGAH, OK.	
Datum Elevation637.04'	Surface Elevation633.90'	
Datum for Water Level Measurement TOP OF CASING		
Screen Diameter & Material 2" PVC	, Slot Size0.01"	
Riser Diameter & Material 2" PVC	Borehole Diameter 6"	
Granular Backfill Material 12-20 SAIND	Terracon RepresentativeCLANCY MICLINTOCK	
Drilling Method Dr		
Lockable Cover Vented Cap		
Well Protector	A P	
Ground Surface Solid Riser		
Flush Joint		
Depth to Top of Bentonite Seal	Length of Solid riser: <u>52.79</u> Total Depth of Monitoring	
Depth to Top of Lower Granular Material ————————————————————————————————————	Well: 63.09 from TOC	
Total Depth Drilled Screen	Length of Screen and Bottom Cap 10.3'	
Portland-Bentonite Grout (Not to Scale) Image: Bentonite Plug Image: Bentonite Plug		
Granular Backfill Material		
ZESSO9 INTERNSTATE 30 S BRYANT, AR. 72002 PH. (501) 847-5220 FAX. (501) 847-5210	MONITORING WELL INSTALLATION RECORD PROJECT NUMBER: 216-003-35107060 WELL NUMBER: MW-9D DRAWING NUMBER: 012 CHECKED BY: MR	

MONITORING WELL INSTALLATION RECORD		
Job Name AEP NORTHEAST STATION HYD	ROGEOLOGIC INVESTIGAT	TION Well Number MW-10D
Job Number 35107060 Installat	on Date 4/12/2010	LocationOOLOGAH, OK.
Datum Elevation 639.32'	Sur	rface Elevation636.14'
Datum for Water Level Measurement	TOP OF CASING	
Screen Diameter & Material 2" PVC		Slot Size0.01"
Riser Diameter & Material 2" PVC		Borehole Diameter 6"
Granular Backfill Material <u>12-20 SAND</u>		_Terracon Representative CLANCY McCLINTOCK
Drilling Method W.L.C., AIR HAMMER	Drilling Cor	ntractor MOHAWK
Lockable Cover — Vented Cap —		
wen Frot	ector	P
Concrete Pa Ground Surface Solid Riser — Flush Joint — Depth to Top of Depth to Top of Lower Granular Material		Length of Solid riser: 61.03 Total Depth of Monitoring Well: 71.33 from TOC
Total Depth Drilled 68 fbgs	Screen	Length of Screen and Bottom Cap 10.3'
Portland-Bentonite Grout Bentonite Plug Granular Backfill Material	(Not to Sca	ale)
Tigerragon Consulting Engineers and Scientists 25509 INTERSTATE 30 S PH (501) 847-9232 FAX (501) 847	2202 9210 MO PROJU WELL DRAW	ONITORING WELL INSTALLATION RECORD ECT NUMBER: 216-003-35107060 NUMBER: MW-10D MING NUMBER: 014 CHECKED BY: MR

MONITORING WEL	L INSTALLATION RECORD
Job NameAEP NORTHEAST STATION HYDROGEOLO	OGIC INVESTIGATION Well Number MW-11D
Job Number 35107060 Installation Date	<u>4/14/2010</u> Location OOLOGAH, OK.
Datum Elevation 628.27	Surface Elevation 625.97'
Datum for Water Level Measurement TOP OF	- CASING
Screen Diameter & Material	Slot Size0.01"
Riser Diameter & Material 12 20 SAND	Borehole Diameter 6"
Drilling Method	Unling Contractor WOHAWK
Lockable Cover	r —
Vented Cap	$\rho \sim \langle \rangle$
Well Protector —	
Concrete Rad-	
Ground Surface	
Solid Riser	
Sond Misch	
Flush Joint	
	Length of Solid
Depth to Top of	
Bentonite Sedi	Total Depth of
	Soc Oct Monitoring
Depth to Top of Lower	Well: 51.34
Granular Material ————	from TOC
	Length of Screen
Total Depth Drilled Screen -	and Bottom Cap
48fbgs	10.3'
Portland—Bentonite Grout	6
((Not to Scale)
Bentonite Plug	
Granular Backfill Material	
	MONITORING WELL INSTALLATION RECORD
llerracon	
Consulting Engineers and Scientists	WELL NUMBER: AMA 44D
25809 INTERSTATE 30 S BRYANT, AR 72202 PH 150 N 847-9292 EAX 150 N 847-9292	DRAWING NUMBER: 016 CHECKED BY MR
FAX (001) 047-7210	

MONITORING WELL IN	ISTALLATION RECORD
Job Name AEP NORTHEAST STATION HYDROGEOLOGIC IN	/ESTIGATIONWell Number MW-12D
Job Number 35107060 Installation Date 4	19/2010 Location OOLOGAH, OK.
Datum Elevation623.67'	Surface Elevation 620.91'
Datum for Water Level Measurement TOP OF CASIN	G
Screen Diameter & Material 2" PVC	Slot Size0.01"
Riser Diameter & Material 2" PVC	Borehole Diameter 6"
Granular Backfill Material 12-20 SAND	Terracon Representative CLANCY McCLINTOCK
Drilling Method W.L.C., AIR HAMMER	Drilling Contractor MOHAWK
Lockable Cover Vented Cap Well Protector	
Concrete Pad	
Ground Surface	A CONTRACTOR OF THE OWNER
Solid Riser	4 2
Flush Joint	4
	Length of Solid
Depth to lop of	riser: 34.66
Bentonite Seal	Total Depth of
Depth to Top of Lower Granular Material ————————————————————————————————————	Well: <u>44.96</u> <i>Well: 100</i> <i>from TOC</i>
Total Depth Drilled Screen	Length of Screen and Bottom Cap <u>10.3'</u>
Portland-Bentonite Grout (Not Image: Sentonite Plug Image: Sentonite Backfill Material	to Scale)
Consulting Engineers and Scientists 25609 INTERSTATE 30 S BRYANT, AR 72202 PH. (501) 847 922 FAX (501) 847 9210	MONITORING WELL INSTALLATION RECORD PROJECT NUMBER: 216-003-35107060 WELL NUMBER: MW-12D DRAWING NUMBER: 018 CHECKED BY: MR

lob Number 35107060 Installation Date 4/	STIGATION Well Number MW-13D	_
Datum Elevation 619.06'	Surface Elevation 616.11'	
Datum for Water Level Measurement TOP OF CASIN		
Screen Diameter & Material 2" PVC	Slot Size0.01"	
Riser Diameter & Material 2" PVC	Borehole Diameter 6"	
Drilling Method WI C AIR HAMMER	Terracon RepresentativeCLANCY McCLIN TOC	K
		-
Vented Can		
Well Protector	A P	
Concrete Pad —		
round Surface		
	A Reader the second states and the second	
Solid Riser		
Flush Joint		
	Length of Solid	
Depth to Top of	riser: 37.25	
Dentonite Sedi	Total Depti	h
	Monitoring	
Depth to Top of Lower	Well: 4/	1.5
Granular Material —	from IOC	
	Length of Screen	
Total Depth Drilled Screen	and Bottom Cap	
45fbgs	10.3'	
Dertiend Derte He On t		
/ Fortiana-Bentonite Grout	Scale)	
网 Bentonite Plug	oodioy	
Granular Backfill Material		
Terracon	MONITORING WELL INSTALLATION RECORD	D
Consulting Engineers and Scientists	PROJECT NUMBER: 216-003-35107060	
	WELL NUMBER: MW-13D	









MONITORING WELL INSTALLATION RECORD	
Job Name_AEP NE PLANT POND WELLS	Well Number <u>SP-4</u>
Job Number <u>35117075</u> Installation Date	e <u>4/6/2011</u> Location OOLOGAH, <u>OK</u> .
Datum Elevation <u>N/A</u>	Surface Elevation <u>N/A</u>
Datum for Water Level Measurement <u>T.O.C.</u>	
Screen Diameter & Material <u>2 PVC</u>	Slot_Size <u>0.01</u>
Grapular Backfill Material 12-20 SAND	Terracon Representative ADAM HOOPER
Drilling Method <u>6.25</u> " AIR HAMMER	Drilling Contractor_MOHAWK
Lockable Casing -	
Vented Cap-	$\setminus \setminus$
Aluminum Well Protector –	
Concrete Pad—	Stickup: <u>3</u>
Ground Surface	
Solid Riser	
Sona Miser	
- , , , , ,	
Flush Joint	Length of Solid
	riser: <u>25</u>
	Total Depth of Monitoring
Depth to Top of 16' has	Well: 38.3'
Bentonite Seal 10 bgs	from TOC
Depth to lop of Primary Filter Pack 22.5' bas	
Printury Filter Fuck22.0 090	
	Length of Screen
Screen —	and Bottom Cap.
35' fbas Cap —	
1595	
Bentonite Grout	
Bentonite Chips (N	ot to Scale)
Granular Backfill	
	MONITORING WELL INSTALLATION RECORD
ILLIGLON	PROJECT NUMBER: 216-003-35117075
Consulting Engineers and Scientists 25809 I-30 South BRYANT, AR. 72022	WELL NUMBER: SP-4
PH. (501) 847-9292 FAX. (501) 847-9210	DRAWING NUMBER: 010 CHECKED BY: MR

MONITORING WELL INSTALLATION RECORD	
Job Name AEP_NE_PLANT_POND_WELLS	Well Number SP-5R
Job Number 35117075 Installation Date	4/11/2012 Location OOLOGAH, OK.
Datum Elevation <u>N/A</u>	Surface ElevationN/A
Datum for Water Level Measurement 1.0.C.	01-1.01
Screen Diameter & Material 2" PVC	Boroholo Diamotor 6.25"
Granular Backfill Material 12–20 SAND	Terracon Representative ADAM HOOPER
Drilling Method 6.25" AIR HAMMER	
Lockable Casing – Vented Cap – Aluminum Well Protector – Concrete Pad Ground Surface	Stickup: <u>3'</u>
Solid Riser ———— Flush Joint ————	Length of Solid riser: <u>34.7'</u> Total Depth of Monitoring
Depth to Top of 28.5' bgs Bentonite Seal 28.5' bgs Depth to Top of Primary Filter Pack 31' bgs	Well: <u>78'</u> from TOC
Screen — Total Depth Drilled Cap — fbgs	Length of Screen and Bottom Cap. 40.3'
Bentanite Grout	
Bentonite Chips (N	ot to Scale)
Granular Backfill	
ZEGEORACION Consulting Engineers and Scientists 25809 I-30 South BRYANT, AR. 72022 PH, (501) 847-9292 FAX. (501) 847-9210	MONITORING WELL INSTALLATION RECORD PROJECT NUMBER: 216-003-35117075 WELL NUMBER: SP-5R DRAWING NUMBER: 014 CHECKED BY: MR



APPENDIX F Certification by a Qualified Professional Engineer

Certification by Qualified Professional Engineer

I certify that, based on my review of the available information, the groundwater monitoring system proposed herein for the NPS Landfill has been designed and constructed to meet the requirements of OAC 252:517-9-2.

Beth Ann Gross Printed Name of Licensed Professional Engineer

Beth am Geors

Signature



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

Oklahoma Firm Certificate of Authorization No. 1996 Exp. 6/30/2026

79864 License Number

Oklahoma Licensing State <u>April 28, 2025</u> Date