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May 6, 2019

Tennessee Valley Authority
1101 Market Street
Chattanooga, Tennessee 37402

Engineer's Certification of Placement above the Upper Most Aquifer
New CCR Landfill
EPA Final CCR Rule
TVA Paradise Fossil Plant
Drakesboro, Kentucky

1.0 PURPOSE

The purpose of this document is to certify that the Placement above the Uppermost Aquifer Demonstration for the TVA Paradise Fossil Plant New CCR Landfill is in compliance with the Placement above the Uppermost Aquifer Demonstration specified in the Final CCR Rule at 40 CFR §257.60 presented below is the project background, summary of findings, limitations and certification.

2.0 BACKGROUND

New CCR surface impoundments, and all lateral expansions of CCR units must be constructed with a base that is located no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). For a new CCR landfill, new CCR surface impoundment, or any lateral expansion of a CCR unit, the owner or operator must complete the demonstration no later than the date of initial receipt of CCR in the CCR unit.

3.0 SUMMARY OF FINDINGS

Based on groundwater data collected at the site, the proposed New Landfill meets 40 CFR 257.60(a), as the unit meets the 5-foot minimum required separation between the base of the unit and the upper limit of the uppermost aquifer, as specified in 40 CFR §257.60(a).

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4.0 Qualified Professional Engineer Certification

I, Nicholas Golden, being a Professional Engineer in good standing in the State of Kentucky, do hereby certify, to the best of my knowledge, information, and belief, that the information contained in this certification has been prepared in accordance with the accepted practice of engineering I certify, for the above referenced unit, based on groundwater data collected at the site, that the demonstration meets 40 CFR §257.60(a), as the unit meets the 5 foot minimum required separation between the base of the unit and the upper limit of the uppermost aquifer as included in the Placement above the Uppermost Aquifer for CCR – New CCR Landfill dated April 26, 2019 meets the requirements of 40 CFR § 257.60(a)..

Nicholas Golden
Printed Name

May 6, 2019
Date

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ATTACHMENTS: Placement Above the Uppermost Aquifer for CCR – New Landfill

COAL COMBUSTION PRODUCT DISPOSAL PROGRAM

TENNESSEE VALLEY AUTHORITY – PARADISE FOSSIL PLANT
LANDFILL
DRAKESBORO, KENTUCKY

ENGINEER'S CERTIFICATION
PLACEMENT ABOVE THE UPPERMOST AQUIFER DEMONSTRATION
(40 CFR §257.60)
FOR COAL COMBUSTION RESIDUALS (CCR)
NEW CCR LANDFILL

Prepared for

Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402-2801

May 6, 2019 – Rev 0

Prepared by

AECOM

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1.0 INTRODUCTION

1.1 OBJECTIVE

The purpose of this demonstration is to document compliance with 40 CFR §257.60 of the Environmental Protection Agency Final Coal Combustion Residual Rule (EPA Final CCR Rule). The Placement above the Uppermost Aquifer Demonstration is based on comparing the proposed liner grades to existing pertinent data from groundwater monitoring wells and piezometers in and around the footprint of the proposed new CCR Landfill at the Tennessee Valley Authority (TVA) Paradise Fossil Plant (PAF). All supporting documentation is located in the attached appendices.

1.2 RULE REQUIREMENTS

As required by 40 CFR §257.60(c)(2) of the EPA Final CCR Rule for new landfills, no later than the date of initial receipt of CCR in the CCR unit, TVA must prepare a demonstration that the CCR unit is constructed no less than 1.52 meters (five feet) above the upper limit of the uppermost aquifer, or must demonstrate that there will not be an intermittent, recurring, or sustained hydraulic connection between any portion of the base of the CCR unit and the uppermost aquifer due to normal fluctuations in groundwater elevations (including the seasonal high water table). The “uppermost aquifer” is defined by 40 CFR §257.40 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. This definition includes a shallow, deep, perched, confined or unconfined aquifer, provided it yields usable water.

1.3 METHODOLOGY

The demonstration method involves the use of existing documentation of pertinent geologic and hydrogeological information to develop an estimate of the uppermost aquifer’s uppermost limit, and comparing that to the planned landfill liner grades to confirm adequate vertical separation as defined by the regulation.

1.4 SITE BACKGROUND

Tennessee Valley Authority (TVA) owns and operates the Paradise Fossil Plant (PAF) in Drakesboro, Kentucky. The plant features three units, completed between 1963 and 1970, and three large natural-draft cooling towers. Property of the PAF facility occupies more than 3,400 acres along the western side of the Green River. The plant is located along the west bank of the Green River along State Route 176. The plant is located inside the eastern border of Muhlenberg County as depicted below in **Figure 1**.

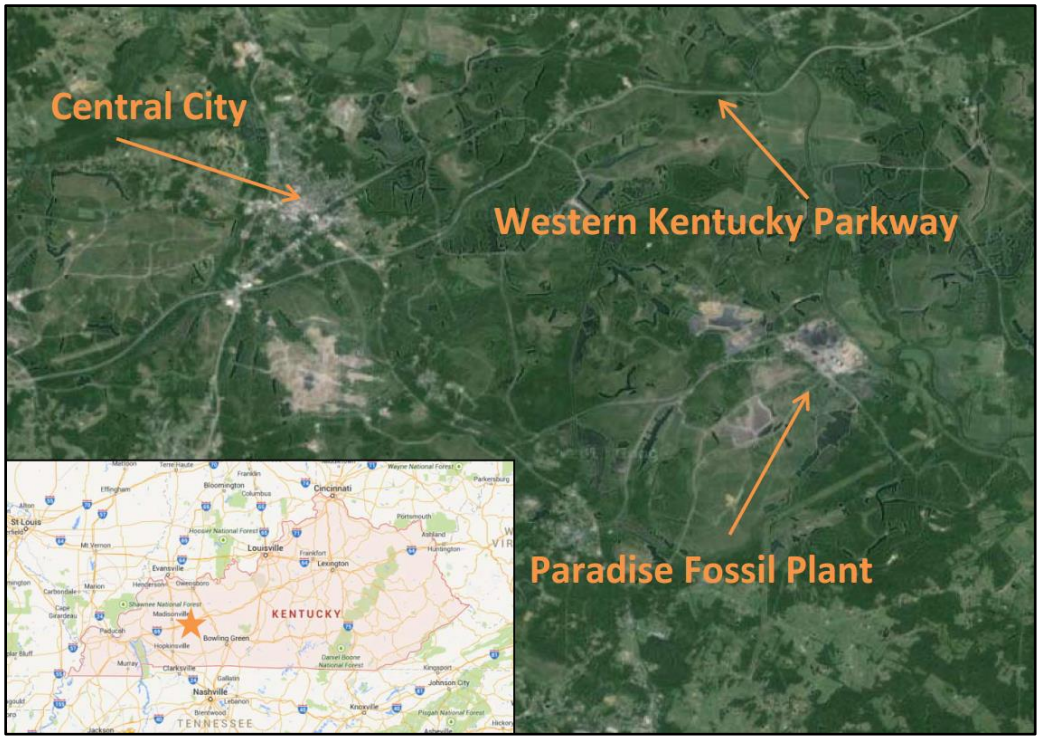

Figure 1: TVA PAF Site Location

TVA intends to construct a new CCR landfill at the PAF facility to provide long-term disposal capacity for CCR materials (fly ash, boiler slag, and gypsum) produced by the facility. The proposed landfill liner will cover approximately 80 acres, and planned construction will include a CCR landfill, two stormwater detention ponds, and a leachate lagoon. The landfill site location is presented in **Figure 2**.

Figure 2: PAF Landfill Site Location

The Site is bounded by Riverside Road to the west, by Jacobs Creek to the south, a PAF facility electrical transmission line easement along the Green River to the northeast, and the PAF power station to the north.

1.5 SITE HISTORY

Based on review of historical mining maps and observations during site investigations, much of the plant property and adjacent parcels have been mined using deep and/or surface mining methods from the 1960s through the 1980s. The area of the proposed landfill was later used for storage of boiler slag fines

Based on observations during site reconnaissance in 2016, the landfill site includes cleared areas of historic mine reclamation, with slopes and sidewalls that are vegetated to varying degrees.

2.0 REGIONAL GEOLOGY

PAF is located within the Western Kentucky Coalfields Section of the Interior Low Plateaus Physiographic Province in western Kentucky. Major geologic units in the area from the ground surface downward include Quaternary-age alluvium and residuum, the upper Pennsylvanian-

age Sturgis Formation and the middle Pennsylvanian-age Carbondale Formation. The Sturgis Formation is made up of the former Lisman and Henshaw formations. Unmined areas, particularly in the flood plain of the Green River, are covered in Quaternary alluvial sands, silts, and clays. Upland areas may be covered by up to 25 feet of residual material derived from the weathering of shale and sandstone bedrock materials.

The bedrock formations on site include several significant coal units. Extensive underground and strip mining operations across the area occurred between the 1960s through the 1980s, which significantly altered the topography and geology within the vicinity of the plant. As such, large areas of the property are underlain by thick mine spoil deposits consisting of a heterogeneous mix of excavated soil, coal, shale, and sandstone bedrock materials. Historical mining maps indicate relict room and pillar structures across the Site from deep subsurface mining of the West Kentucky Coal Seam No. 9 (Coal Seam No. 9).

3.0 REGIONAL HYDROGEOLOGY

The site is broadly located within the Tradewater/Lower Green Watershed, which drains more than 90,000 miles of waterways in Kentucky (AECOM, 2017). The Green River borders the Landfill to the east. Regionally, moderate to low productivity aquifers are potentially found within the lower to middle Pennsylvanian-aged Tradewater and Caseyville formations below the Carbondale Formation. At PAF and the surrounding areas there is no apparent use of deep bedrock aquifers for water supply, suggesting that if such exist, they may be of marginal productivity or water quality. Alluvial deposits are generally mapped along rivers and streams.

3.1 GROUNDWATER FLOW

Groundwater elevations indicate a site-wide gradient to the east-southeast towards the Green River and Jacob's Creek, mimicking the general topography (AECOM, 2016a; AECOM, 2016b). Groundwater below the Landfill flows from the southwest to the northeast towards the Green River as shown on the Groundwater Contour Map (Figure 3). Shallow groundwater at the site flows east-northeast. In contrast, deep groundwater at the site flows to the southwest.

4.0 UPPERMOST AQUIFER

4.1 AQUIFER DEFINITION

Hydrogeological investigations (AECOM 2016a) and subsequent well network optimization activities were conducted at PAF to identify the most appropriate geologic unit to designate as the uppermost aquifer for the purposing of groundwater monitoring requirements of the CCR Rule for multiple CCR units. Groundwater was encountered in a variety of materials at the Site, including mine spoils, alluvial materials, and within the bedrock in limited primary porosity,

limited secondary porosity, and isolated mined coal zones. None of the explored materials yielded water of sufficient quantity or quality so as to qualify as a high-value aquifer, but at each CCR unit, the available data were used to identify a water bearing zone that was the most productive (i.e. the highest hydraulic conductivity) and most laterally connected (i.e. providing a continuum of flow from upgradient to downgradient relative to the CCR unit), and had the greatest potential to transport groundwater (and potential impact) from the CCR unit vicinity toward other water bodies.

The depth to bedrock across the planned landfill Site is highly variable, so mine spoils, alluvial deposits, and Carbondale Formation bedrock are all encountered at similar elevations around the Landfill and are potentially hydraulically connected. Groundwater generally flows from the northwest to the southeast across the site, discharging into the Green River. As a result, groundwater monitoring targets the all three materials (alluvial deposits, bedrock, and mine spoils) at the Landfill Area.

4.2 AQUIFER CHARACTERISTICS

Hydraulic performance tests were conducted by AECOM during the Hydrogeological Characterization Report analysis to characterize the hydrogeological properties of the various aquifers throughout the Site. Groundwater elevations measured in the wells around the planned Landfill indicate that hydraulic gradient ranges from 0.002 ft/ft to 0.007 ft/ft. Groundwater encountered at PAF has been reported at elevations ranging from 475 ft. msl in the higher, southwestern portions of the site to 367 ft. msl in the lower, eastern portions of the site, resulting in an apparent site-wide gradient to the northeast towards the Green River. Because much of the area has been strip mined or undermined, mine spoil is present in various thicknesses across the site. Spoil deposits are heterogeneous, including fine and coarse grained deposits with highly irregular distribution vertically and horizontally. Groundwater may be found at various depths within mine spoils across most of the site depending on the local character of the spoil. The usability of the spoil groundwater is limited by its highly variable yield characteristics and by its generally low water quality owing to the presence of pyrites and other soluble mineral components of the spoil. Groundwater is also locally present within alluvial materials that are present along select reaches of the Green River and Jacob's Creek.

4.3 PLACEMENT ABOVE THE UPPERMOST AQUIFER

Groundwater levels provided via data collection from monitoring wells between May 2016 and April 2017 were used to interpolate the potentiometric surface within the area of the proposed landfill. Isopach maps are a good three-dimensional representation of the distance between two surfaces. Isopach maps were prepared to compare the highest groundwater surfaces to the

proposed liner grades of the CCR Landfill at PAF. As demonstrated by the isopach maps shown in **Figures 3-5**, the aquifer is not present within 5 feet of the base of the proposed landfill liner at any point. A separate isopach map was prepared for each of the three sampling events that comprised the highest measured groundwater level in each of the groundwater monitoring wells (shown in red in the table below):

Well ID	7/18/2016	2/20/2017	4/10/2017
MW-1	398.92	397.75	397.75
MW-2	410.02	414.41	412.22
MW-3	415.08	414.45	413.77
MW-4	395.86	395.57	395.91
MW-5	410.06	411.31	411.88
MW-6	410.36	398.50	412.42
MW-7[A]	-	396.47	396.60
MW-8[A]	-	395.33	395.49

5.0 CONCLUSIONS

Based on groundwater data collected at the site, the proposed New Landfill meets 40 CFR §257.60(a), as the unit meets the 5 foot minimum required separation between the base of the unit and the upper limit of the uppermost aquifer, as specified in 40 CFR §257.60(a).

6.0 REFERENCES

- AECOM. 2018. Hydrogeological Characterization Report - Proposed CCR Landfill Siting Study, Paradise Fossil Plant – Kentucky.

FIGURES