2017 GROUNDWATER MONITORING & CORRECTIVE ACTION REPORT

COAL ASH PONDS
ELMER SMITH STATION
DAVIESS COUNTY
OWENSBORO, KENTUCKY

Prepared For:
OWENSBORO MUNICIPAL UTILITIES
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CEC Project 164-014

JANUARY 30, 2018

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1.0 INTRODUCTION

The United States Environmental Protection Agency (USEPA) issued 40 C.F.R. § 257, Subpart D, *Disposal of Coal Combustion Residuals from Electric Utilities* (CCR Rule) on April 17, 2015. The CCR Rule regulates disposal of coal combustion residuals (CCR) in new and active landfills and impoundments. Civil & Environmental Consultants, Inc. (CEC) has been engaged by Owensboro Municipal Utilities (OMU) to provide the 2017 Groundwater Monitoring and Corrective Action Report for the Coals Ash Ponds (aka the Site) at the Elmer Smith Station (ESS) as required by the CCR Rule. This document summarizes the monitoring activity through 2017, including sampling events and changes to the Groundwater Monitoring System (GMS) network. It is intended that this document will be placed in the facility operating record as required by 40 C.F.R. §257.105(h)(1), and posted on the publicly accessible website as required by 40 C.F.R. §257.107(h)(1).

2.0 SITE OVERVIEW

2.1 BACKGROUND

The Ash Pond area associated with the ESS is less than 10 acres in size and consists of three separate unlined ash settling basins (Ponds 1, 2, and 3). A site location map and a site and vicinity aerial map showing the location of the Ash Ponds are provided as Figures 1 and 2, respectively. The basins are not used for the disposal of CCR but for the temporary storage of CCR material prior to being excavated and transported off-site for disposal or beneficial re-use. Pond 1 is used for Unit 1 boiler slag; Pond 2 receives other ash and water plant blowdown (lime softening sludge); and, Pond 3 receives no ash directly and is used for final settling prior to discharge. Other plant discharges, including coal pile runoff, Flue Gas Desulfurization (FGD) blowdown, roof and floor drains, etc. are also conveyed through the ponds. Based on a review of aerial images, contour data from the USGS National Map, Owensboro East Quadrangle, and a site map prepared by others labeled "Structural Fill Finish Grading" dated August 28, 1962[1], the Ash Ponds appear to be incised in the native soils to a depth of approximately 8 feet below ground surface (bgs). This was confirmed through knowledge of site personnel.

CEC assisted OMU with the design and installation of a permanent GMS to comply with the GMS performance standard contained within the Federal CCR Rule (Section 257.91), as documented in the GMS Certification Report dated October 17, 2017. Prior to the installation of the GMS, groundwater monitoring had not been conducted at the site.

2.2 HYDROGEOLOGIC SETTING

Subsurface conditions encountered at the site, as evidenced by the soil borings advanced in association with a Preliminary Hydrogeologic Investigation and the permanent GMS wells, are consistent with Quaternary-aged alluvium, and buried outwash (Tazewell age) typically found within the Ohio River Valley[2]. Variable thicknesses of fine-grained silt and clay lenses are interbedded with deposits of coarser-grained, poorly-graded sand beneath a thin veneer of topsoil, crushed stone fill, or other fill material. The near-surface fine-grained deposits are thicker near

[1] Drawing No. S-7 "Structural Finish Grading", prepared by Black & Veatch, dated August 28, 1962.

the Ohio River, and decrease in thickness away from the river towards the southeast, where sand becomes the predominant soil type. A low permeability clay layer was encountered at depths ranging from 26 to 43 feet bgs, varying in thickness from approximately 1 foot to over 16 feet, with an increasing trend in the thickness of this layer towards the south/southeast. The clay layer is underlain by saturated, coarse-grained deposits that comprise the uppermost aquifer at the site. Aquifer saturated thickness in the vicinity of the site ranges from approximately 60 to 100 feet[2]. Based on the depth to groundwater and the depth of the Ash Ponds, it does not appear that groundwater is in direct communication with the Ash Ponds. Refer to the GMS Certification Report for a geologic cross-section and boring logs for the site.

2.2.1 Hydrogeologic Characteristics

Groundwater occurs within the coarse-grained deposits that constitute the uppermost aquifer at the site. Depth to water measurements ranged from 74.31 feet below top of casing (BTOC) at MW-7 to 40.68 feet BTOC at MW-1 over the monitoring period. Static groundwater elevations on-site ranged from 346.80 feet above mean sea level (AMSL) at MW-7 to 364.75 feet AMSL at MW-3. The normal pool elevation of the adjacent Ohio River in the vicinity of ESS is approximately 358 feet AMSL[3]. Potentiometric data are summarized on Table 1 and shown on Figure 3.

Groundwater elevation measurements indicate that the groundwater flow direction is to the southeast at an approximate average hydraulic gradient of 0.004. This flow direction is contrary to the hydrogeologic setting where groundwater flow is typically towards the Ohio River. The southeasterly flow direction is interpreted to be a result of the pumping influence from the 11 nearby water production wells (Figure 2) associated with municipal water production operations at OMU's Cavin Water Treatment Plant, which has a capacity of up to 10 million gallons per day. Between the Cavin Plant and Water Plant A, which is located west of the Cavin Plant and draws from the same well field, OMU's total treatment capacity is 28 million gallons per day. Absent operation of the production wells, groundwater flow direction is likely to the

[2] *Geohydrology and Simulation of Ground-Water Flow for the Ohio River Alluvial Aquifer near Owensboro, Northwestern Kentucky.* U.S. Geological Survey Water-Resources Investigation Report 96-4274. 1997. Figure 7.

[3]Ohio River Navigation Charts from Cairo, Illinois to Foster, Kentucky (June 2010). U.S. Army Corps of Engineers, Louisville District. Chart No. 53.

northwest towards the Ohio River; however, some combination of pumping wells is always in operation and the observed groundwater levels measured since the installation of the GMS (Table 1) indicate a southeasterly groundwater flow direction.

Hydraulic conductivity of the uppermost aquifer was not evaluated as part of the GMS installation process; however, based on published scientific reports, the site is located in an area where horizontal hydraulic conductivity values are estimated to range from 126 to 157 feet per day[4].

[4]*Geohydrology and Simulation of Ground-Water Flow for the Ohio River Alluvial Aquifer near Owensboro, Northwestern Kentucky.* U.S. Geological Survey Water-Resources Investigation Report 96-4274. 1997. Figure 11.

3.0 GROUNDWATER MONITORING SYSTEM

3.1 MONITORING WELL SELECTION

The GMS consists of seven monitoring wells. Monitoring wells MW-1 and MW-3 are used to monitor groundwater elevation, and monitoring wells MW-2, MW-4, MW-5, MW-6, and MW-7 are utilized to monitor both groundwater elevation and quality. Refer to the GMS Certification Report for lithologic descriptions and well construction diagrams. As noted above in Section 2.2.1, the well field pumping influence and proximity of the ponds to the Ohio River create a unique hydrogeologic setting where there is not an ideal location to establish background groundwater quality conditions (i.e., groundwater that does not have the potential to be affected by leakage from a CCR unit). Two monitoring wells (MW-2 and MW-7) will be used to establish and monitor background groundwater conditions.

While MW-2 is currently hydraulically upgradient, this is an artificial condition created by the operation of the production wells. Prior to the operation of the production wells (ca. 1998) this well was in a downgradient location. Also, should the production wells cease to operate in the future, groundwater flow direction would likely be reversed toward the river and MW-2 would be in a downgradient location. Because of this unique and artificial condition, the MW-7 location was also selected to accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit. MW-7, while located hydraulically downgradient from the ash ponds, is placed in a location so as not to be on a direct flow path from the ponds. MW-7 is also at a sufficient distance from the ponds to be representative of background conditions for the well field aquifer.

Downgradient monitoring wells MW-4, MW-5 and MW-6 will be used to monitor water quality of groundwater passing the waste boundary of the CCR unit. These wells were placed as close as possible to the waste boundary to provide for detection of groundwater contamination in the uppermost aquifer. Additionally, in the event that the well field should cease pumping operations for an extended period of time and the groundwater flow direction reverts back toward the river, monitoring wells MW-1 and MW-3 (currently used only for water level monitoring) can serve as

future downgradient wells along with MW-2. A summary of the GMS wells is provided in the table below.

CCR RULE GROUNDWATER MONITORING SYSTEM

Location	Relative Location	Well Diameter (in.)	Total Depth (ft-bgs)	Screen Length (ft)
MW 1	Upgradient	4	57	10
MW-2	Upgradient (Background)	4	57	10
MW-3	Upgradient	4	57	10
MW-4	Downgradient	4	59	10
MW-5	Downgradient	4	59	10
MW-6	Downgradient	4	59	10
MW-7	Downgradient (Background)	4	72	10

4.0 2017 GROUNDWATER MONITORING SUMMARY

4.1 BASELINE SAMPLING EVENTS

Baseline groundwater sampling was performed between February 8, 2017 and September 6, 2017 (refer to table below). Samples were collected from GMS wells MW-2, MW-4, MW-5, MW-6 and MW-7 during each of the eight baseline sampling events, with the exception of the June 16, 2017 sampling event where insufficient groundwater was available for the collection of a representative sample from MW-7. These baseline samples were analyzed for both Appendix III and Appendix IV parameters. Samples were collected per the facility Sampling and Analysis Plan (SAP) and submitted to ALS Environmental Laboratory (ALS), an American Association for Laboratory Accreditation (A2LA) accredited laboratory. A summary of the laboratory analytical data for the baseline sampling events is provided in Table 2.

4.2 DETECTION MONITORING EVENT

The initial Detection Monitoring sampling event was performed on October 10, 2017, with samples being collected from GMS wells MW-2, MW-4, MW-5, MW-6 and MW-7 and analyzed for Appendix III parameters. Samples were collected in accordance with the facility SAP and submitted to ALS. The laboratory results were finalized on October 27, 2017. Laboratory analytical results for the initial Detection Monitoring sampling event are summarized in Table 3.

A summary of 2017 sampling events is listed below. No transition between CCR Rule groundwater monitoring programs occurred in 2017.

Location	Baseline Monitoring Events – Appendix III and IV								Detection Monitoring Event – Appendix III
Event No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Background Wells									
MW-2	02/08/17	3/8/17	4/6/17	5/3/17	6/16/17	7/13/17	8/9/17	9/6/17	10/10/17
MW-7	NS	6/29/17	7/13/17	7/27/17	8/9/17	8/23/17	9/6/17	9/20/17	10/10/17
Downgradient Wells									
MW-4	02/08/17	3/8/17	4/6/17	5/3/17	6/16/17	7/13/17	8/9/17	9/6/17	10/10/17
MW-5	6/16/17	6/29/17	7/13/17	7/27/17	8/9/17	8/23/17	9/6/17	9/20/17	10/10/17
MW-6	6/16/17	6/29/17	7/13/17	7/27/17	8/9/17	8/23/17	9/6/17	9/20/17	10/10/17

Notes:

= Background Well
= Downgradient Well

NS = Not sampled due to insufficient water

4.3 RECORD KEEPING REQUIREMENTS

In accordance with §257.105(h) this document has been placed in OMU's Operating Record. A copy will also be placed on the publicly accessible website and a notification will be submitted to the Kentucky Department for Environmental Protection to comply with §257.107(h) and §257.106(h) of the CCR Rule.

FIGURES

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