2018 GROUNDWATER MONITORING & CORRECTIVE ACTION REPORT

COAL ASH PONDS
ELMER SMITH STATION
DAVIESS COUNTY
OWENSBORO, KENTUCKY

Prepared For:
OWENSBORO MUNICIPAL UTILITIES
OWENSBORO, KENTUCKY

Prepared By:
CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
PITTSBURGH, PENNSYLVANIA

CEC Project 164-014

JANUARY 31, 2019

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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 2018 Groundwater Monitoring and Corrective Action Report for the Coal Ash Ponds (aka the Site) at the Elmer Smith Station (ESS) as required by the CCR Rule. This document summarizes the monitoring activity conducted during 2018, including sampling events, statistical analyses, and modifications 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 Site 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, topographic 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 the

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

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 layer thickness 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 collected from the GMS monitoring well network during the 2018 sampling events ranged from 69.37 feet below top of casing (BTOC) at MW-7 to 34.75 feet BTOC at MW-1. Static groundwater elevations on-site during 2018 ranged from 351.74 feet above mean sea level (AMSL) at MW-7 to 370.29 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 0.006. The gradient is slightly steeper approaching the river and gradually flattens out moving away from the river to the south and east. This flow direction is contrary to what is typically observed in this type of hydrogeologic setting, where groundwater flow is towards the surface water body. 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

[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.

Plant A, which is located west of the Cavin Plant and draws from the same well field, OMU's total withdrawal capacity is 28 million gallons per day. Absent operation of the production wells, groundwater flow direction is likely to the 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

The GMS consists of eight 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, MW-7, and MW-8 are utilized to monitor both groundwater elevation and groundwater quality. Refer to the GMS Certification Report for lithologic descriptions and well construction diagrams. As noted above in Section 2.2.1, the groundwater pumping at the municipally-operated well field and proximity of the Ash 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) were 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 would have been situated 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 are used to monitor water quality of groundwater passing the boundary of the CCR unit. These wells were placed as close as possible to the CCR unit 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.

Monitoring well MW-8 was installed in December 2018 after one constituent (molybdenum) was quantified at a statistically significant level (SSL) in downgradient monitoring wells MW-5 and MW-6 (see Section 7.0) in an effort to characterize the nature and extent of the release, as required by §257.95(g)(1).

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
MW-8	Downgradient	4	63	15

4.0 STATISTICALLY SIGNIFICANT INCREASE EVALUATION

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 Sampling and Analysis Plan (SAP) for the Site, dated February 6, 2017, and were submitted to ALS Environmental Laboratory (ALS) in Cincinnati, Ohio. Laboratory analytical results for the initial Detection Monitoring sampling event were summarized in the Groundwater Monitoring and Corrective Action Report for the Site dated January 31, 2018.

Although results were provided, no Statistically Significant Increases (SSIs) of downgradient concentrations over background values were identified in 2017 as the rule allows for 90 days after completing analysis to determine SSIs (§ 257.93(h)(2)). The SSI determination was finalized in January 2018 and is summarized in the following sections.

4.1 FINAL UPL VALUES

The upper prediction limit (UPL) values were calculated in accordance with the statistical methodology described in the Detection Monitoring Statistical Methods Certification for the Site, dated October 17, 2017. Baseline groundwater data from the background wells were used to calculate the UPL for comparison to the downgradient locations. UPL values were calculated for each parameter based on the initial eight baseline sampling events conducted at the two background wells to establish background UPL values, which are summarized in the table provided below:

CCR RULE APPENDIX III BACKGROUND VALUES

Parameter	Units	UPL Value
Boron, Total	mg/L	0.33
Calcium, Total	mg/L	139.5
Chloride	mg/L	50
Fluoride	mg/L	NC
pH, laboratory	s.u.	8.01
Sulfate	mg/L	154.3
Total Dissolved Solids	mg/L	950.8

NC = not calculated because constituent was not quantified at concentrations exceeding laboratory detection limit.

4.2 FINAL SSI DETERMINATION

SSIs for Appendix III parameters were determined based upon comparison of the downgradient well results from the October 2017 Detection Monitoring event to the UPL of the mean concentration detected in the background wells from the eight rounds of baseline monitoring. Based upon the results, one or more SSIs were identified at MW-4, MW-5, and MW-6.

Each downgradient location had at least one SSI that was identified. SSIs for boron, calcium, sulfate, and total dissolved solids (TDS) were the most common among the downgradient wells. Below is a tabular summary of the SSIs observed:

SUMMARY OF OBSERVED SSIs AT OMU ESS

	Appendix III Parameters						
Monitoring Point	**Boron**	**Calcium**	**Chloride**	**Fluoride**	**pH**	**Sulfate**	**Total Dissolved Solids (TDS)**
MW-4	X	X				X	X
MW-5	X					X	
MW-6	X	X				X	X

X – SSI Determined

4.3 TRANSITION TO ASSESSMENT MONITORING

As a result of the SSI evaluation, the Assessment Monitoring Program was initiated for the Site in March 2018. A notification for the transition into the Assessment Monitoring Program was placed in the facility's operating record in accordance with §257.105(h) on January 19, 2018.

5.0 2018 GROUNDWATER SAMPLING SUMMARY

In accordance with §257.95(b), the initial Assessment Monitoring event was performed on April 5, 2018. Groundwater samples were collected from the five GMS sampling locations and submitted to ALS for analysis of Appendix IV parameters. The Assessment Monitoring resample event was performed on June 5, 2018 in accordance with §257.95(d)(1), which included sampling of the five GMS locations and laboratory analysis for Appendix III parameters and the Appendix IV parameters that were quantified at concentrations exceeding their respective laboratory detection limits during the April sampling event. An analytical summary for the Assessment Monitoring sampling events is provided in Table 2.

An additional Assessment Monitoring event was performed on December 12, 2018. Groundwater samples were collected from the five GMS sampling locations and submitted to ALS for analysis of Appendix III and Appendix IV parameters. Analytical results are summarized in Table 2.

A summary of the 2018 sampling events is provided below. The Site remained in the Assessment Monitoring Program throughout 2018.

2018 CCR RULE GROUNDWATER SAMPLING EVENTS

Location	April 2018 Event	June 2018 Event	December 2018 Event
Downgradient Wells			
MW-4	4/5/2018	6/5/2018	12/12/2018
MW-5	4/5/2018	6/5/2018	12/12/2018
MW-6	4/5/2018	6/5/2018	12/12/2018
MW-8	Not Present	Not Present	12/27/2018
Background Wells			
MW-2	4/5/2018	6/5/2018	12/12/2018
MW-7	4/5/2018	6/5/2018	12/12/2018

6.0 GROUNDWATER PROTECTION STANDARDS

The CCR Rule requires that two Assessment Monitoring events be performed and analytical results obtained before establishing Groundwater Protection Standards (GWPS) for Appendix IV constituents (§257.95[h]). The GWPS are used to evaluate whether or not Appendix IV parameters are present in downgradient wells at concentrations exceeding the GWPS at Statistically Significant Levels (SSLs) that would prompt an Assessment of Corrective Measures in accordance with §257.96.

6.1 GWPS DETERMINATION

A GWPS may be determined as follows:

1. For Appendix IV constituents for which a maximum contaminant level (MCL) has already been established under 40 CFR §141.62 and §141.66, the GWPS is equal to the MCL;
2. For cobalt, lithium, and molybdenum, where a MCL has not been established, the GWPS is equal to the concentrations outlined in §257.95(h)(2).
3. For Appendix IV constituents for which the background groundwater concentration exceeds the MCL identified under option 1 or the standards identified under option 2, the GWPS is equal to the background concentration in accordance with §257.95(h)(3).

6.2 FINAL GWPS VALUES

GWPS values were established for the Site, consistent with §257.95(d)(2). The table below summarizes background concentrations, MCL values, and health-based values for detected constituents at the Site.

GWPS DETERMINATION FOR OMU ESS

Appendix IV Constituent	Units	UPL	MCL	Health-based Value	Final GWPS
Total Metals					
Antimony, Total	mg/L	ND/NC	0.006	--	0.006
Arsenic, Total	mg/L	ND/NC	0.010	--	0.010
Barium, Total	mg/L	0.18	2	--	2
Beryllium, Total	mg/L	0.00091	0.004	--	0.004
Cadmium, Total	mg/L	ND/NC	0.005	--	0.005
Chromium, Total	mg/L	4.1	0.1	--	4.1
Cobalt, Total	mg/L	0.098	--	0.006	0.006
Lead, Total	mg/L	0.015	0.015	0.015	0.015
Lithium, Total	mg/L	ND/NC	--	0.040	0.040
Mercury, Total	mg/L	ND/NC	0.002	--	0.002
Molybdenum, Total	mg/L	ND/NC	--	0.100	0.100
Selenium, Total	mg/L	ND/NC	0.05	--	0.05
Thallium, Total	mg/L	ND/NC	0.002	--	0.002
Non-Metals					
Fluoride	mg/L	1.0	4	--	4
Combined Radium-226/228	pCi/L	9.32	5	--	9.32

Notes:

- ND/NC = constituent was not detected at concentrations exceeding laboratory reporting limits in the background monitoring wells, and therefore UPL was not calculated.
- -- = No Value Established

7.0 STATISTICALLY SIGNIFICANT LEVEL DETERMINATION

The CCR Rule requires two Assessment Monitoring events be performed before GWPS are established as discussed in Section 6.0. Therefore, a SSL evaluation was performed after receipt of the laboratory results from the June 2018 Assessment Monitoring resample event.

7.1 FINAL SSL DETERMINATION

The final SSL determination was based on whether or not an exceedance of GWPSs occurred for an Appendix IV constituent at a downgradient GMS location in both the initial (March) and resample (June) sampling events. Based on the analytical results, one constituent (molybdenum) was quantified at a SSL at two locations (MW-5 and MW-6). A summary of the constituents quantified at a SSL are summarized below

	Appendix IV Parameters														
Downgradient GMS Location	**Antimony, Total**	**Arsenic, Total**	**Barium, Total**	**Beryllium, Total**	**Cadmium, Total**	**Chromium, Total**	**Cobalt, Total**	**Lead, Total**	**Lithium, Total**	**Mercury, Total**	**Molybdenum, Total**	**Selenium, Total**	**Thallium, Total**	**Fluoride**	**Combined Radium 226/228**
MW-4															
MW-5											X				
MW-6											X				

X – SSL Determined

In accordance with §257.105(h), a notification was placed into the facility's operating record on October 31, 2018 indicating that an SSL had been observed for molybdenum. The Site will remain in Assessment Monitoring unless concentrations of constituents in Appendix IV are quantified at levels equal to or less than the GWPS.

7.2 DECEMBER 2018 ANALYTICAL RESULTS

Statistical analysis of the laboratory data obtained from the December 2018 will be performed within 90 days of receiving the laboratory results to evaluate whether or not constituents are present at SSLs, consistent with §257.95(g).

8.0 RELEASE CHARACTERIZATION

The source of the observed SSLs in the downgradient GMS wells is attributable to the Ash Ponds. A Release Characterization was initiated in December 2018, consisting of the installation of one monitoring well (MW-8) in the southwest corner of the ESS property to delineate the extent of the molybdenum impact in groundwater downgradient from the Ash Ponds (refer to Figure 2). The location for this well was selected as close as possible to the Ash Ponds taking into consideration the inferred groundwater flow direction, the property boundary for the facility, and the ongoing construction project to expand the Cavin Water Treatment Plant.

Monitoring well installation and development activities were performed consistent with the procedures and materials utilized in the installation of the existing GMS monitoring well network. In accordance with §257.105(h), an amended GMS Certification will be placed in the facility's operating record to document the modification to the GMS monitoring well network.

Groundwater from the newly installed monitoring well was sampled for both Appendix III and Appendix IV parameters on December 27, 2018, and the sample was submitted to ALS for analysis. If molybdenum or any another Appendix IV constituent is quantified at a SSL, additional monitoring wells may be required to delineate the extent of groundwater impacts and support a complete and accurate assessment of the corrective measures necessary to effectively remediate releases from the CCR unit pursuant to §257.96. Findings from the Release Characterization will be summarized as part of the Assessment of Corrective Measures report in 2019.

9.0 PLANNED ACTIVITIES FOR 2019

This section discusses the groundwater monitoring and reporting activities anticipated for ESS in 2019. All dates are tentative and subject to change based on findings.

January 2019:

- Enter the *2018 Annual Groundwater Monitoring and Corrective Action Report* into the facility's operating record.
- Place notification indicating the initiation of an Assessment of Corrective Measures in operating record.

February 2019:

- Amend the *Groundwater Monitoring Certification* report to include the newly installed monitoring well MW-8.
- Evaluate analytical data from MW-8 against GWPS.
- Notify impacted landowners of SSL, if identified based on analytical data obtained. Document notice of landowners in operating record.
- Post to the public internet site and notify the Kentucky Department of Environmental Protection (KDEP) of the initiation of Assessment of Corrective Measures.

March 2019:

- Post to the public internet site and notify KDEP that landowners have been contacted regarding the SSL, if identified.
- Post the *2018 Annual Groundwater Monitoring and Corrective Action Report* to the public internet site and notify KDEP.
- The first semi-annual groundwater monitoring event in 2019 will be conducted. Assessment Monitoring samples (i.e., Appendix III and IV) will be collected during the event.

May 2019:

- Assuming 60-day extension is utilized, complete Assessment of Corrective Measures and place documentation in operating record.

June 2019:

- Post to the public internet site and notify KDEP of the Assessment of Corrective Measures report.
- Hold public meeting to discuss the results of the Assessment of Corrective Measures and place documentation of the meeting in the operating record.

July 2019:

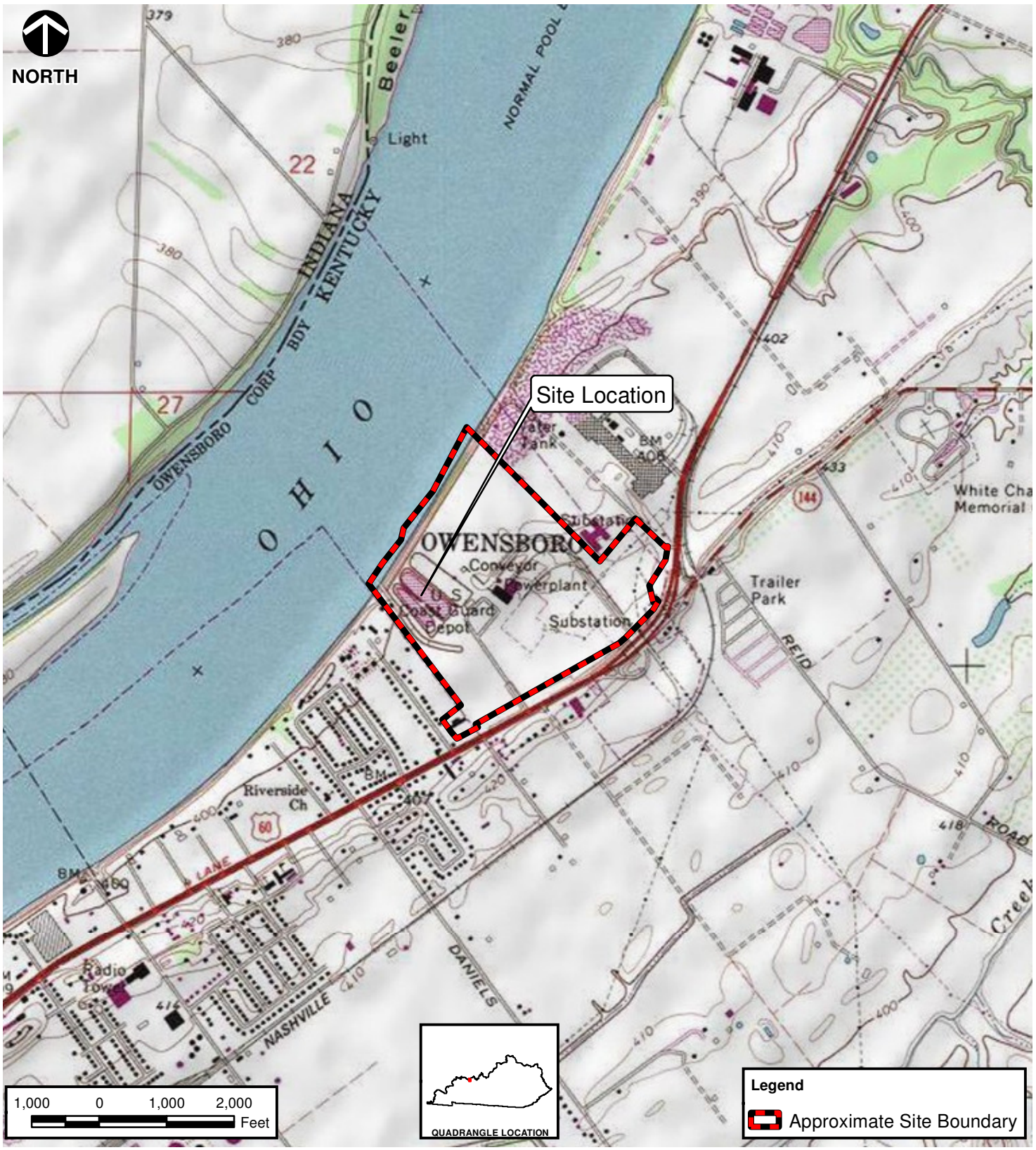
- Appendix IV sample results collected in March 2019 will be evaluated for a SSL over background.

September 2019: The second semi-annual groundwater monitoring event in 2019 will be conducted. Assessment Monitoring samples (i.e., Appendix III and IV) will be collected during the event. Note SSLs for the September 2019 will be determined by January 2020.

December 2019:

- Preparation of the *2019 Annual Groundwater Monitoring and Corrective Action Report* will begin.
- Prepare semi-annual report describing the progress in selecting and designing the remedy.

FIGURES



SOURCE: PORTION OF THE USGS 7.5-MINUTE SERIES TOPOGRAPHIC QUADRANGLE MAP - OWENSBORO EAST, KY - 1983

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OWENSBORO, DAVIESS COUNTY, KY

SITE LOCATION MAP

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NORTH

Ohio River

MW-3
MW-2
MW-1
Pond 1
Pond 2
Pond 3
MW-4
MW-6
MW-5
MW-7
MW-8
49
48
50
61
63
66
65
69
64
68
67

Cooling Water Discharge Canal (channelized)

Cavin Water Treatment Plant

Coast Guard Lane

Ellis Sneathers Road

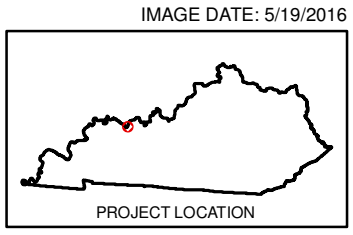
State Route 2380

E 4th Street (State Route 144)

SOURCE: ESRI WORLD IMAGERY / ARCGIS MAP SERVICE: HTTP://GOTO.ARCGISONLINE.COM/MAPS/WORLD_IMAGERY. LAST ACCESSED: 1/31/2019
IMAGE DATE: 5/19/2016

Legend

- Approximate Site Boundary
- GMS Monitoring Well
- OMU Municipal Production Well



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SITE AND VICINITY AERIAL MAP
WITH GMS WELLS

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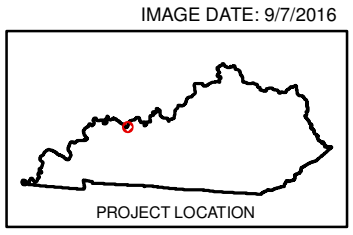
SOURCE: ESRI WORLD IMAGERY / ARCGIS MAP SERVICE: HTTP://GOTO.ARCGISONLINE.COM/MAPS/WORLD_IMAGERY. LAST ACCESSED: 1/31/2019
IMAGE DATE: 9/7/2016

Legend

- Approximate Site Boundary
- OMU Municipal Production Well
- MW-1 / 579.45 — GMS Monitoring Well; Groundwater Elevation (feet above mean sea level)



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POTENTIOMETRIC SURFACE MAP
DECEMBER 27, 2018

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TABLES

TABLE 1
Groundwater Elevation Summary
OMU Elmer Smith Station Ash Ponds
Owensboro, KY
(all measurements are in feet)

Well ID (AKGWA #)	Location Relative to Ash Ponds	Ground Surface Elevation (AMSL)	TOC Elevation (AMSL)	Measurement Date	Depth to Water Measurement (ft BTOC)	Groundwater Elevation (AMSL)
MW-1 (8006-9522)	Upgradient	402.00	404.53	12/8/2016	48.51	356.02
				12/13/2016	48.07	356.46
				2/8/2017	45.69	358.84
				3/8/2017	40.68	363.85
				4/6/2017	43.51	361.02
				5/3/2017	45.91	358.62
				5/15/2017	43.46	361.07
				6/16/2017	49.94	354.59
				6/29/2017	46.72	357.81
				7/13/2017	49.81	354.72
				7/27/2017	49.99	354.54
				8/9/2017	49.15	355.38
				8/23/2017	50.38	354.15
				9/6/2017	50.31	354.22
				9/20/2017	50.04	354.49
				10/10/2017	49.55	354.98
				4/5/2018	34.75	369.78
				6/5/2018	46.61	357.92
				12/12/2018	43.97	360.56
				12/27/2018	35.66	368.87
MW-2 (8006-9523)	Upgradient (Background)	402.75	405.55	12/8/2016	49.21	356.34
				12/13/2016	48.74	356.81
				2/8/2017	46.29	359.26
				3/8/2017	41.24	364.31
				4/6/2017	44.16	361.39
				5/3/2017	45.48	360.07
				5/15/2017	44.02	361.53
				6/16/2017	50.02	355.53
				6/29/2017	47.17	358.38
				7/13/2017	50.16	355.39
				7/27/2017	50.23	355.32
				8/9/2017	50.75	354.80
				8/23/2017	50.97	354.58
				9/6/2017	50.95	354.60
				9/20/2017	50.69	354.86
				10/10/2017	50.20	355.35
				4/5/2018	35.70	369.85
				6/5/2018	47.22	358.33
				12/12/2018	44.51	361.04
				12/27/2018	36.85	368.70
MW-3 (8006-9524)	Upgradient	403.78	406.39	12/8/2016	49.88	356.51
				12/13/2016	49.43	356.96
				2/8/2017	46.95	359.44
				3/8/2017	41.64	364.75
				4/6/2017	44.56	361.83
				5/3/2017	45.90	360.49
				5/15/2017	44.51	361.88
				6/16/2017	50.06	356.33
				6/29/2017	47.29	359.10
				7/13/2017	50.64	355.75
				7/27/2017	50.69	355.70
				8/9/2017	51.35	355.04
				8/23/2017	51.65	354.74
				9/6/2017	51.43	354.96
				9/20/2017	51.25	355.14
				10/10/2017	50.82	355.57
				4/5/2018	36.10	370.29
				6/5/2018	47.84	358.55
				12/12/2018	45.16	361.23
				12/27/2018	37.61	368.78

Notes: AMSL = Above Mean Sea Level
TOC = Top of Casing
Ft BTOC = Feet Below Top of Casing

TABLE 1
Groundwater Elevation Summary
OMU Elmer Smith Station Ash Ponds
Owensboro, KY
(all measurements are in feet)

Well ID (AKGWA #)	Location Relative to Ash Ponds	Ground Surface Elevation (AMSL)	TOC Elevation (AMSL)	Measurement Date	Depth to Water Measurement (ft BTOC)	Groundwater Elevation (AMSL)
MW-4 (8006-9525)	Downgradient	406.44	408.02	12/8/2016	54.44	353.58
				12/13/2016	54.06	353.96
				2/8/2017	51.22	356.80
				3/8/2017	52.97	355.05
				4/6/2017	54.99	353.03
				5/3/2017	55.75	352.27
				5/15/2017	53.95	354.07
				6/16/2017	58.65	349.37
				6/29/2017	57.60	350.42
				7/13/2017	58.20	349.82
				7/27/2017	58.73	349.29
				8/9/2017	58.97	349.05
				8/23/2017	59.48	348.54
				9/6/2017	58.73	349.29
				9/20/2017	57.75	350.27
				10/10/2017	57.15	350.87
				4/5/2018	48.85	359.17
				6/5/2018	51.97	356.05
				12/12/2018	50.92	357.10
				12/27/2018	48.87	359.15
MW-5 (8005-9530)	Downgradient	403.56	406.16	6/16/2017	56.37	349.79
				6/29/2017	56.66	349.50
				7/13/2017	56.62	349.54
				7/27/2017	57.03	349.13
				8/9/2017	57.05	349.11
				8/23/2017	57.45	348.71
				9/6/2017	57.11	349.05
				9/20/2017	56.12	350.04
				10/10/2017	55.51	350.65
				4/5/2018	45.14	361.02
				6/5/2018	50.11	356.05
				12/12/2018	49.16	357.00
				12/27/2018	46.58	359.58
MW-6 (8006-9531)	Downgradient	405.23	407.35	6/16/2017	57.96	349.39
				6/29/2017	57.40	349.95
				7/13/2017	57.96	349.39
				7/27/2017	58.16	349.19
				8/9/2017	58.55	348.80
				8/23/2017	58.82	348.53
				9/6/2017	58.65	348.70
				9/20/2017	57.41	349.94
				10/10/2017	56.84	350.51
				4/5/2018	46.53	360.82
				6/5/2018	51.56	355.79
				12/12/2018	50.53	356.82
				12/27/2018	48.35	359.00
MW-7 (8006-9532)	Downgradient (Background)	418.26	421.11	6/16/2017	72.90	348.21
				6/29/2017	73.25	347.86
				7/13/2017	72.87	348.24
				7/27/2017	73.81	347.30
				8/9/2017	74.31	346.80
				8/23/2017	74.31	346.80
				9/6/2017	73.71	347.40
				9/20/2017	73.79	347.32
				10/10/2017	73.70	347.41
				4/5/2018	67.61	353.50
				6/5/2018	69.37	351.74
				12/12/2018	66.12	354.99
				12/27/2018	65.11	356.00
MW-8 (8007-1801)	Downgradient	402.97	405.82	12/27/2018	49.51	356.31

Notes: AMSL = Above Mean Sea Level
TOC = Top of Casing
Ft BTOC = Feet Below Top of Casing

TABLE 2

Groundwater Analytical Summary - CCR Rule Assessment Monitoring (2018)

OMU Elmer Smith Station

Owensboro, KY

Sample ID		MW-2			MW-4			MW-5			MW-6			MW-7			Duplicate[1]			Equipment Blank			Groundwater Protection Standard
Collection Date		4/5/18	6/5/18	12/12/18	4/5/18	6/5/18	12/12/18	4/5/18	6/5/18	12/12/18	4/5/18	6/5/18	12/12/18	4/5/18	6/5/18	12/12/18	4/5/18	6/5/18	12/12/18	4/5/18	6/5/18	12/12/18	
Total Metals	**Units**																						
Antimony	mg/L	<0.0060	NA	NA	<0.0060	NA	NA	<0.0060	NA	NA	<0.0060	NA	NA	<0.0060	NA	NA	<0.0060	NA	NA	<0.0060	NA	NA	0.006
Arsenic	mg/L	<0.010	NA	NA	<0.010	NA	NA	<0.010	NA	NA	<0.010	NA	NA	<0.010	NA	NA	<0.010	NA	NA	<0.010	NA	NA	0.010
Barium	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.11**	**0.12**	<0.10	<0.10	<0.10	<0.10	**0.13**	**0.12**	**0.13**	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	2
Beryllium	mg/L	<0.00040	NA	NA	<0.00040	NA	NA	<0.00040	NA	NA	<0.00040	NA	NA	<0.00040	NA	NA	<0.00040	NA	NA	<0.00040	NA	NA	0.004
Boron	mg/L	NA	<0.10	**0.11**	NA	**11**	**5.6**	NA	**12**	**10**	NA	**10**	**11**	NA	<0.10	<0.10	NA	**10**	0.14	NA	<0.10	<0.10	0.33
Cadmium	mg/L	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	0.005
Calcium	mg/L	NA	**53**	**100**	NA	**180**	**100**	NA	**150**	**120**	NA	**180**	**170**	NA	**100**	**99**	NA	**180**	**100**	NA	<0.20	**0.36**	139.5
Chromium	mg/L	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	**0.021**	<0.020	<0.020	<0.020	**0.22**	<0.020	**0.020**	<0.020	<0.020	<0.020	<0.020	<0.020	4.10
Cobalt	mg/L	<0.0040	NA	NA	<0.0040	NA	NA	<0.0040	NA	NA	<0.0040	NA	NA	<0.0040	NA	NA	<0.0040	NA	NA	<0.0040	NA	NA	0.098
Lead	mg/L	<0.015	NA	NA	<0.015	NA	NA	<0.015	NA	NA	<0.015	NA	NA	<0.015	NA	NA	<0.015	NA	NA	<0.015	NA	NA	0.015
Lithium	mg/L	<0.10	NA	NA	<0.10	NA	NA	<0.10	NA	NA	<0.10	NA	NA	<0.10	NA	NA	<0.10	NA	NA	<0.10	NA	NA	0.040
Mercury	mg/L	<0.00020	NA	NA	<0.00020	NA	NA	<0.00020	NA	NA	<0.00020	NA	NA	<0.00020	NA	NA	<0.00020	NA	NA	<0.00020	NA	NA	0.002
Molybdenum	mg/L	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	**0.34**	**0.41**	**0.36**	**1.7**	**1.8**	**2.1**	<0.10	<0.10	<0.10	**1.7**	<0.10	<0.10	<0.10	<0.10	<0.10	0.10
Selenium	mg/L	<0.030	NA	NA	<0.030	NA	NA	<0.030	NA	NA	<0.030	NA	NA	<0.030	NA	NA	<0.030	NA	NA	<0.030	NA	NA	0.050
Thallium	mg/L	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	<0.0050	NA	NA	0.002
Anions																							
Chloride	mg/L	NA	**18**	**18**	NA	**37**	**27**	NA	**62**	**49**	NA	**130**	**37**	NA	**21**	**19**	NA	**37**	**18**	NA	<1.0	<2.0	50
Fluoride	mg/L	<2.0	**0.30**	<2.0	<2.0	<0.50	<2.0	**2.3**	**1.9**	<2.0	<2.0	<0.50	<2.0	<2.0	**0.22**	<2.0	<2.0	<0.50	<2.0	<2.0	<0.10	<2.0	4
Sulfate	mg/L	NA	**36**	**19**	NA	**370**	**140**	NA	**390**	**260**	NA	**400**	**550**	NA	**84**	**91**	NA	**370**	**19**	NA	<1.0	<5.0	154.3
Radium																							
Radium-226	pCi/L	<0.25 (+/-0.13)	<0.193 (+/-0.098)	<0.28 (+/-0.17)	**0.49 (+/-0.23)**	**0.32 (+/-0.18)**	<0.23 (+/-0.15)	<0.13 (+/-0.11)	**0.2 (+/-0.13)**	<0.61 (+/-0.35)	<0.19 (+/-0.13)	**0.29 (+/-0.16)**	<0.27 (+/-0.2)	**0.21 (+/-0.16)**	**0.32(+/-0.15)**	<0.21 (+/-0.14)	**0.25 (+/-0.16)**	**0.32 (+/-0.17)**	<0.25 (+/-0.15)	<0.18 (+/-0.11)	<0.16 (+/-0.12)	<0.38 (+/-0.16)	9.32
Radium-228	pCi/L	<0.94 (+/-0.4)	NA	<0.84 (+/-0.42)	<0.98 (+/-0.48)	NA	<0.82 (+/-0.39)	<1.01 (+/-0.45)	NA	<0.76 (+/-0.36)	<0.98 (+/-0.45)	NA	<0.72 (+/-0.34)	<0.97 (+/-0.48)	NA	<0.73 (+/-0.36)	<0.98 (+/-0.43)	NA	<0.81 (+/-0.41)	<1.17 (+/-0.54)	NA	<0.7 (+/-0.31)	
pH																							
pH	s.u.	NA	**7.7**	**7.6**	NA	**7.5**	**7.8**	NA	**7.5**	**8.0**	NA	**7.3**	**7.8**	NA	**7.0**	**7.6**	NA	**7.4**	**6.1**	NA	**6.6**	**7.4**	8.01
Total Dissolved Solids																							
Total Dissolved Solids	mg/L	NA	**260**	**420**	NA	**1,100**	**570**	NA	**1,200**	**840**	NA	**1,500**	**1,100**	NA	**570**	**490**	NA	**1,100**	**420**	NA	**44**	**30**	950.80

= Appendix III constituent (fluoride is included on both Appendix III & IV lists)

= Appendix IV constituent (fluoride is included on both Appendix III & IV lists)

Bold indicates result detected above laboratory reporting limit

1.8 = Appendix IV constituent quantified at Statistically Significant Level (exceeding Groundwater Protection Standard)

NA = Not analyzed for this constituent

[1]Duplicate sample collected at MW-6 (4/5/18), MW-4 (6/5/18), MW-2 (12/12/18)