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Revision 4: October 28, 2021
Revision 3: May 24, 2021
Revision 2: December 18, 2019
Revision 1: April 17, 2019
Original: October 17, 2017
File No. 129778

SUBJECT: Jeffrey Energy Center – Groundwater Monitoring Systems Certification
Existing Bottom Ash Settling Area/Bottom Ash Landfill, Fly Ash Landfill, Fly Ash Landfill Area 2, Flue Gas Desulfurization Landfill (Phase IA, IB, and IC), and Bottom Ash Pond
Evergy Kansas Central, Inc.

Evergy Kansas Central, Inc. (Evergy) operates the subject coal combustion residuals (CCR) management units referred to as the Bottom Ash Settling Area/Bottom Ash Landfill (BASA/BAL), Fly Ash Landfill (FAL), Fly Ash Landfill Area 2 (FAL2), Flue Gas Desulfurization (FGD) Landfill, and the Bottom Ash Pond (BAP; inactive) at the Jeffrey Energy Center (JEC; the Site) located in St. Marys, Kansas. These CCR units are considered subject to the CCR Rule since they are either active or identified as inactive with a notification of intent to close as of the effective and/or applicable dates of the CCR Rule.

This document addresses the requirements of § 257.91 *Groundwater Monitoring Systems*, specifically § 257.91(f), of the U.S. Environmental Protection Agency's (USEPA) Hazardous and Solid Waste Management System; Disposal of Coal Combustion Residuals from Electric Utilities, Code of Federal Regulations Title 40 (40 CFR) Part 257 (CCR Rule) effective October 19, 2015, and subsequent rulemaking revisions. In addition, this document revision provides narratives outlining the basis for the design and geospatial arrangements of the CCR well monitoring networks based on site-specific conditions, established hydrogeologic principles, and industry practice, with consideration for the geometry and physical characteristics of and material contents within the CCR unit(s) being monitored.

Evergy has determined, based upon the recommendations of Haley & Aldrich, Inc., that a multi-unit groundwater monitoring system is preferred for the BASA/BAL as allowed pursuant to § 257.91(d). This multi-unit monitoring system is as capable of detecting monitored constituents passing the combined unit waste boundary as individual groundwater monitoring systems.

The single-unit groundwater monitoring systems at the FAL, FAL2, FGD Landfill, and the BAP, and the multi-unit groundwater monitoring system at the BASA/BAL, have been designed to include at least a minimum of one upgradient and three downgradient monitoring wells pursuant to § 257.91(c). Each of the single-unit groundwater monitoring systems, except the FAL2, includes at least one side gradient piezometer used to support the groundwater elevations and flow direction. In 2020, Evergy submitted a revised sampling and analysis plan, which included the groundwater monitoring system design and construction information for each monitoring well network, to the Kansas Department of Health and

Environment (KDHE) for review under Kansas solid waste rules. Finding that the monitoring systems and associated sampling plan were adequate to monitor the groundwater associated with these units, KDHE approved the updated sampling and analysis plan on September 4, 2020. Table 1 below presents the wells in each of the groundwater monitoring systems as certified herein. This certification has been prepared based upon information available in the facility Operating Record pursuant to § 257.91(e)(1).

Table 1 – CCR Unit Groundwater Monitoring Well Networks

CCR UNIT	Upgradient Monitoring Wells		Downgradient Monitoring Wells				Piezometric Observation Monitoring Well		
Bottom Ash Settling Area/Bottom Ash Landfill	MW-BAA-6		MW-BAA-2	MW-BAA-3	MW-BAA-7		MW-BAA-1	MW-BAA-5	
Fly Ash Landfill	MW-FAA-5		MW-FAA-3	MW-FAA-4	MW-FAA-6		MW-FAA-1		
Fly Ash Landfill Area 2	MW-GR-4	MW-FAA-5	MW-FAA-7	MW-FAA-8	MW-FAA-9				
Flue Gas Desulfurization Landfill (Phase IA, IB, and IC)	MW-FGD-1	MW-FGD-6	MW-FGD-2	MW-FGD-3	MW-FGD-4	MW-FGD-9	MW-FGD-5	MW-FGD-7	MW-FGD-8
Bottom Ash Pond (inactive)	IBA-4		IBA-1	IBA-2	IBA-3		TPZ-GR-4		

BASA/BAL CCR MONITORING SYSTEM

The BASA/BAL monitoring network, as originally designed, includes one upgradient and three downgradient monitoring wells, along with two side gradient wells utilized for potentiometric observations. The number, spacing, and depths of monitoring wells was determined based upon site-specific technical information observed during drilling, installation, and testing of the monitoring wells, including stratigraphy, lithology, hydraulic conductivity, and porosity, along with site-specific data developed during previous characterization activities.

The monitoring network was designed to monitor the Beattie Limestone, which constitutes the uppermost aquifer beneath the CCR unit and has a saturated thickness of approximately 20 to 33 feet based on observations made during drilling at JEC. The hydraulic conductivity of the uppermost aquifer was calculated using data generated from slug tests conducted after monitoring well installation and development and calculated between 2.90 $x10^{-3}$ centimeters per second (cm/sec) and $3.07x10^{-4}$ cm/sec. Based on slug test results, effective porosity of the uppermost aquifer is estimated to be 6 percent. The groundwater flow velocity was calculated to be approximately 139 feet per year (feet/year) toward the west/southwest. Groundwater flowing at this velocity and direction would be expected to convey impacted groundwater from beneath the unit and past the waste boundary within the monitoring timeframe. The monitoring wells have been constructed at locations on the west and southwest sides of the unit that allow them to intercept representative groundwater flow paths passing beneath the unit, at the waste boundary. The number and placement of monitoring wells at BASA/BAL is appropriate based on the consistent groundwater flow direction and groundwater flow velocity to detect groundwater constituents present in representative groundwater flow paths within the uppermost aquifer and passing the waste boundary.

FAL CCR MONITORING SYSTEM

The FAL monitoring network includes one upgradient and three downgradient monitoring wells, along with one side gradient well utilized for potentiometric observation. Prior to the certification of the current monitoring system, three downgradient monitoring wells were installed and sampled at the unit, which assisted in defining the groundwater flow direction. The number, spacing, and depths of monitoring wells was determined based upon site-specific technical information observed during drilling, installation, and testing of the monitoring wells, including stratigraphy, lithology, hydraulic conductivity, and porosity, along with site-specific data developed during previous characterization activities. The monitoring network was designed to monitor the Grenola Limestone, which constitutes the uppermost aquifer beneath the CCR unit and has a saturated thickness of approximately 12 to 42 feet based on observations made during drilling at the FAL. The hydraulic conductivity of the uppermost aquifer beneath the FAL was calculated using data generated from slug tests conducted after monitoring well installation and development and calculated between $3.97x10^{-3}$ cm/sec and $2.33x10^{-3}$ cm/sec. Based on slug test results, effective porosity of the uppermost aquifer is estimated to be 5 percent. The groundwater flow velocity was calculated to be approximately 320 feet/year toward the south/southeast. Groundwater flowing at this velocity and direction would be expected to convey impacted groundwater from beneath the unit and past the waste boundary within the monitoring timeframe. The monitoring wells have been constructed at locations on the south and southeast sides of the unit that allow them to intercept representative groundwater flow paths passing beneath the unit, at the waste boundary. The number and placement of monitoring wells at FAL is appropriate based on the consistent groundwater flow direction and groundwater flow velocity to detect groundwater constituents present in representative groundwater flow paths within the uppermost aquifer and passing the waste boundary.

FAL2 CCR MONITORING SYSTEM

The FAL2 monitoring network includes two upgradient and four downgradient monitoring wells. The number, spacing, and depths of monitoring wells was determined based upon site-specific technical information observed during drilling, installation, and testing of the monitoring wells, including stratigraphy, lithology, hydraulic conductivity, and porosity, along with site-specific data developed during previous characterization activities. The monitoring network was designed to monitor the Grenola Limestone, which constitutes the uppermost aquifer beneath the CCR unit and has a saturated thickness of approximately 20 to 50 feet based on observations made during drilling at the FAL2. The hydraulic conductivity of the uppermost aquifer beneath the FAL2 was calculated using data generated from slug tests conducted after monitoring well installation and development and calculated between $3.97x10^{-3}$ cm/sec and $2.33x10^{-3}$ cm/sec. Based on slug test results, effective porosity of the uppermost aquifer is estimated to be 5 percent. The groundwater flow velocity was calculated to be approximately 320 feet/year to the south. Groundwater flowing at this velocity and direction would be expected to convey impacted groundwater from beneath the unit and past the waste boundary within the monitoring timeframe. The monitoring wells have been constructed at locations on the south and southeastern sides of the unit that allow them to intercept representative groundwater flow paths passing beneath the unit, at the waste boundary. Upgradient monitoring well MW-FAA-5 is not used for groundwater contours, as it is not located directly upgradient of the FAL2 but is utilized for representative water quality data within the Grenola Limestone upgradient of FAL2. The number and placement of monitoring wells at the FAL2 is appropriate based on the consistent groundwater flow direction and groundwater flow velocity to detect groundwater constituents present in representative groundwater flow paths within the uppermost aquifer and passing the waste boundary.

FGD LANDFILL CCR MONITORING SYSTEM

The current FGD Landfill monitoring network includes two upgradient and four downgradient monitoring wells, along with three side gradient wells utilized for potentiometric observations. The monitoring network was expanded by two monitoring wells to the current size in 2019 to provide additional groundwater monitoring coverage for the future lateral expansion of the FGD Landfill CCR Management Unit. The original monitoring network included one upgradient and three downgradient monitoring wells, along with one side gradient well utilized for potentiometric observation. The number, spacing, and depths of monitoring wells was determined based upon site-specific technical information observed during drilling, installation, and testing of the monitoring wells, including stratigraphy, lithology, hydraulic conductivity, and porosity, along with site-specific data developed during previous characterization activities. The monitoring network was designed to monitor the Grenola Limestone, which constitutes the uppermost aquifer beneath the CCR unit and has a saturated thickness of approximately 17 to 29 feet based on observations made during drilling at the FGD Landfill. The hydraulic conductivity of the uppermost aquifer beneath the FGD Landfill was calculated using data generated from slug tests conducted after monitoring well installation and development and calculated between 9.26×10^{-3} cm/sec and 4.97×10^{-4} cm/sec. Based on slug test results, effective porosity of the uppermost aquifer is estimated to be 5 percent. The groundwater flow velocity was calculated to be approximately 320 feet/year toward the west. Groundwater flowing at this velocity and direction would be expected to convey impacted groundwater from beneath the unit and past the waste boundary, within the monitoring timeframe. The monitoring wells have been constructed at locations on the west side of the unit that allow them to intercept representative groundwater flow paths passing beneath the unit, at the waste boundary. The number and placement of monitoring wells at the FGD Landfill is appropriate based on the consistent groundwater flow direction and groundwater flow velocity to detect groundwater constituents present in representative groundwater flow paths within the uppermost aquifer and passing the waste boundary.

BAP CCR MONITORING SYSTEM

The BAP monitoring network includes one upgradient and three downgradient monitoring wells, along with one side gradient well utilized for potentiometric observation. The number, spacing, and depths of monitoring wells was determined based upon site-specific technical information observed during drilling, installation, and testing of the monitoring wells, including stratigraphy, lithology, hydraulic conductivity, and porosity, along with site-specific data developed during previous characterization activities. The monitoring network was designed to monitor the Red Eagle Limestone, which constitutes the uppermost aquifer beneath the CCR unit and has a saturated thickness of approximately 17 to 26 feet. The hydraulic conductivity of the uppermost aquifer beneath the BAP is reported to be similar to the Beattie Limestone which ranges from 2.90 x 10-3 cm/sec and 3.07 x 10 4 cm/sec based on data generated from slug tests conducted after monitoring well installation and development at the

BASA/BAL. Based on reported similarities between the Beattie and Red Eagle Limestones, the effective porosity of the uppermost aquifer is estimated to be 6 percent. The groundwater flow velocity was calculated to be approximately 139 feet/year to the west. Groundwater flowing at this velocity and direction would be expected to convey impacted groundwater from beneath the unit and past the waste boundary within the monitoring timeframe. The monitoring wells have been constructed at locations on the west side of the unit that allow them to intercept representative groundwater flow paths passing beneath the unit, at the waste boundary. The number and placement of monitoring wells at the BAP is appropriate based on the consistent groundwater flow direction and groundwater flow velocity to detect groundwater constituents present in representative groundwater flow paths within the uppermost aquifer and passing the waste boundary.

CERTIFICATION STATEMENT

Pursuant to 40 CFR Chapter I Subchapter I Part 257 Subpart D §257.91(f), I certify that the groundwater monitoring systems for the subject units have been designed and constructed to meet the requirements of § 257.91. The certification submitted is, to the best of my knowledge, accurate and complete.

Signed: ______________________

Certifying Engineer

Print Name: Steven F. Putrich, P.E.
Kansas License No.: PE24363
Title: Principal Consultant
Company: Haley & Aldrich, Inc.

Signed: ______________________

Professional Geologist

Print Name: Mark D. Nicholls, P.G.
Kansas License No.: 881
Title: Lead Hydrogeologist
Company: Haley & Aldrich, Inc.

Revision No.	Date	Notes
0	October 17, 2017	Original
1	April 17, 2019	Revised to clarify names of CCR Units and to include the inactive Bottom Ash Pond in subject certification.
2	December 18, 2019	Inclusion of additional lateral expansion up gradient and down gradient monitoring wells into the FGD Landfill CCR Management Unit.
3	May 24, 2021	Provide additional information supporting the rationale for the originally certified CCR monitoring well networks at BASA/BAL, FAL, FGD Landfill, and BAP.
4	October 28, 2021	Revised to include the Fly Ash Landfill Area 2 (FAL2) in subject certification.
5	March 13, 2023	Provide additional information supporting the performance standards for the CCR monitoring well networks in accordance with § 257.91(f) of the CCR Rule.