Groundwater Monitoring System for the Winyah Generating Station's Class 3 Landfill Area 2

40 CFR Part 257
Groundwater Monitoring & Corrective Action
§257.91(f)

CONTENTS

Revision and Copy Control

Revision No.	Date	Reason for Change
0	December 16, 2021	Original document created to comply with CCR Rule
1	December 1, 2022	Adding monitoring wells to the compliance monitoring network to accommodate new cell construction in 2022. Expanding discussion of geology and hydrogeology in applicable sections.

1. INTRODUCTION

The United States Environmental Protection Agency (EPA) promulgated regulations (40 CFR Part 257) for coal combustion residuals (CCRs). The CCR rule was published in the Federal Register on April 17, 2015 and became effective on October 19, 2015. The Class 3 Landfill Area 2 is subject to the CCR Rule as a new landfill as defined in 40 CFR §257.53 and is being constructed within the footprint of Ash Pond A. Ash Pond A is an existing CCR surface impoundment as defined in 40 CFR §257.53 and is currently undergoing closure by removal. This document serves as certification that the Class 3 Landfill Area 2 ("CCR Unit") groundwater monitoring system at the Winyah Generating Station ("WGS") in Georgetown, South Carolina has been designed and constructed to meet the requirements of §257.91.

Ash Pond A is currently undergoing closure by removal of CCR material, specifically ash and CCR contact soil under a South Carolina Department of Health and Environmental Control (DHEC) approved closure plan and a Notification of Intent to Close was placed in the facility operating record on April 9, 2021. Ash Pond A in the footprint of landfill cells 4 & 5 was certified closed by DHEC on July 30, 2021. Ash Pond A in the footprint of landfill cells 6 & 7 was certified closed by DHEC on May 27, 2022.

DHEC approved the permit application for constructing the Class 3 Landfill on September 15, 2017. The Class 3 Landfill Area 2 is being constructed in a phased approach within the footprint of the Ash Pond A simultaneous to closure by removal. The Class 3 Landfill Area 2 received Approval to Operate on December 20, 2021 and began receiving waste on March 28, 2022. Additional cells are being constructed in 2022 and are anticipated to receive Approval to Operate on or before December 31, 2022.

The groundwater monitoring system is documented in the WGS Class 3 Landfill Permit Application prepared by Geosyntec Consultants and approved by DHEC on September 15, 2017 (Permit #LF3-00042). The groundwater monitoring system meets the design criteria requirements of 40 CFR §257.91 and the South Carolina solid waste management regulation R.61-107.19 and was designed under the direction of Scott M. Graves, P.E., Geosyntec Consultants, Inc., the design engineer-of-record. A permit modification was subsequently submitted to DHEC to adjust the location and number of wells based on a construction scope change and was designed under the direction of Aubree L. Decoteau, P.E., Santee Cooper. This permit modification was approved by DHEC on November 23, 2021. The date of installation was selected within the advance timeframe required by the CCR rule to establish

background water quality conditions at those wells. This certification has been prepared based upon a review of these documents.

Groundwater monitoring wells were installed in accordance with §257.91. Prior to the initial receipt of CCR by the CCR unit, the owner or operator must be in compliance with groundwater monitoring requirements as required by §257.90(b)(l)(i) and (b)(l)(ii).

2. DISCUSSION

Title 40 CFR §257.91 requires the owner or operator to design and install a groundwater monitoring system to meet the applicable requirements of this section. The applicable requirements for the groundwater monitoring system are listed below, with a description of how the system was designed and installed to satisfy each requirement.

§257.91(a) states *the owner or operator of a CCR unit must install a groundwater monitoring system that consists of a sufficient number of wells, installed at appropriate locations and depths, to yield groundwater samples from the uppermost aquifer that:*

(1) Accurately represent the quality of background groundwater that has not been affected by leakage from a CCR unit.

The background well locations were selected to yield representative groundwater samples from the uppermost aquifer that represent the quality of groundwater that has not been affected by any potential leakage from the landfill and is based on the groundwater flow directions at this site. The wells are located southwest and approximately 4,000 feet and 6,600 feet upgradient of the CCR Unit and are the same background wells that have been used to compare to monitoring data collected for Ash Pond A.

(2) Accurately represent the quality of groundwater passing the waste boundary of the CCR unit.

There are six (6) downgradient compliance wells. The locations were selected to yield representative groundwater samples from the uppermost aquifer that represent the quality of groundwater passing the relevant point of compliance. The downgradient compliance wells are installed along three sides of the CCR Unit at the closest practicable distance hydraulically downgradient from the relevant point of compliance, but no greater than 150 feet away from the boundary of the CCR Unit. WAP-19 is installed in the top of the dike of Ash Pond A, which will serve as the side slope of the new Class 3 Landfill Area 2 cells. The remaining wells are installed at the outside toe of the slopes. Additional downgradient wells may be installed on an as needed basis.

The six (6) downgradient wells are installed at appropriate depths to monitor the uppermost aquifer. The water table elevation in the vicinity of the Class 3 Landfill Area 2 ranges from approximately 19-22 feet above mean sea level (msl). Details of the screen placement and distance from the CCR Unit are provided in Table 1 below.

Table 1: Summary of Class 3 Landfill Area 2 Monitoring Wells

Well ID	Purpose	Ground Surface Elevation (ft above msl)	Screen Zone (ft bgs)	Screen Zone Elevation (ft above msl)	Distance from CCR Unit (ft)
WAP-1	Background	27.05	4-24	3.05-23.05	4,000
WBW-1	Background	29.08	7-17	12.08-22.08	6,600
WAP-17	Waste Boundary	23.98	9-19	4.98-14.98	50
WAP-18	Waste Boundary	27.69	7.5-17.5	10.19-20.19	50
WAP-19	Waste Boundary	40.77	14-24	16.77-26.77	0
WLF-A2-1	Waste Boundary	27.25	8.5-18.5	8.75-18.75	50
WLF-A2-2	Waste Boundary	24.65	8.5-18.5	6.15-16.15	50
WLF-A2-6	Waste Boundary	32.11	14-24	8.11-18.11	50

§257.91(b) states *the number, spacing, and depths of monitoring systems shall be determined based upon site-specific technical information that must include thorough characterization of*

(1) Aquifer thickness, groundwater flow rate, groundwater flow direction including seasonal and temporal fluctuations in groundwater flow:

The surficial aquifer consists of mixtures of predominantly well-sorted sand with minor amounts of silt and clay and ranges from approximately 10 to 55 feet thick across the site.

Hydrogeologic conditions at WGS indicate water within the surficial aquifer will not migrate downward into the next water bearing zone used for potable supply within a reasonable timeframe. The range of horizontal groundwater flow velocities at WGS is between 0.2 and 268 feet per year (ft/yr) with an average of 13.2 ft/yr. This velocity range was originally calculated for the hydrogeologic characterization study based on elevation data collected between February 2013 and May 2015. During this period, all surface impoundments were unlined, elevated, and contained wastewater, which provided hydraulic head on the potentiometric surface. Groundwater flow velocities directly in the vicinity of the Class 3 Landfill Area 2 are calculated now to be even less, typically ranging at less than 4 ft/yr. This current velocity is based on 2021-2022 groundwater elevation measurements that reflect dewatering activities to close Ash Pond A and the landfill cells that are lined which reduce or remove hydraulic head.

Groundwater flow direction at the CCR Unit is predominantly radial beneath the existing

Ash Pond A and new Class 3 Landfill Area 2. This is due to the area being encompassed by the cooling pond to the east, the intake canal to the north, and discharge canal to the west. There are currently no seasonal or temporal fluctuations in groundwater flow directions. However, this may change over time as hydraulic head in the remainder of Ash Ponds A & B is reduced during closure by removal. The groundwater flow direction will continue to be evaluated and the monitoring network may be supplemented to address any changes.

(2) *Saturated and unsaturated geologic units and fill materials overlying the uppermost aquifer, materials comprising the uppermost aquifer, and materials comprising the confining unit defining the lower boundary of the uppermost aquifer, including, but not limited to, thicknesses, stratigraphy, lithology, hydraulic conductivities, porosities and effective porosities:*

WGS is located within the Atlantic Coastal Plain of South Carolina, which is a wedge of unconsolidated to well consolidated sediments. The regional aquifers of relevance to this CCR unit are the surficial aquifer and Gordon Aquifer. The surficial aquifer consists mainly of terrace sediments that were deposited during transgressions and regressions of a post-Miocene sea. The surficial aquifer is lithologically heterogeneous but generally consists of quartz gravel and sand, silt, clay, and shelly sand which unconformably overlies the Gordon aquifer, the lowermost aquifer of the Floridan Aquifer system. The Gordon Aquifer represents the permeable portion of the Williamsburg Formation (upper Chicora Member) in the vicinity of the WGS. The Gordon Aquifer, as noted by Campbell and Coes (2010), pinches out just to the northeast of the WGS. The regional confining unit between the Gordon Aquifer and the surficial aquifer is not present at WGS.

The surficial aquifer and Gordon Aquifer exhibit similar hydrogeologic properties and are collectively considered the surficial aquifer for groundwater monitoring at WGS. The surficial aquifer consists of mixtures of predominantly well-sorted sand with minor amounts of silt and clay. The surficial aquifer is underlain by a confining unit comprised of dense, low permeability clay locally termed "Black Mingo" clay in the Crouch Branch confining unit and the Crouch Branch Aquifer. As noted by Campbell and Coes (2010), between 185 to 378 ft (summed thickness of the Lang Syne, Rhems and Upper/Middle Pee Dee Members) of low permeability materials comprise the Crouch Branch confining unit which separates the base of the surficial aquifer from the underlying middle zone of the Crouch Branch Aquifer. The 50 ft of Williamsburg clay was added to the Crouch Branch confining unit thickness which established a conservative collective confining unit thickness range of 235 to 428 ft. This thickness is likely greater if the full thickness of the Williamsburg Formation clay is included.

The range of average linear velocity through the collective confining units (the clay of the Williamsburg Formation and the Crouch Branch confining unit) is between 0.15 and 0.62 ft per year. Assuming a continuous thickness range of between 235 and 428 ft, the time of travel through the collective confining units ranges between 381 and 2,767 years. The timeframes presented assume steady state conditions and represent conservative conditions

(e.g., confining unit thickness, use of Darcy equation). Therefore, actual travel times are most likely much longer than presented. Hydrogeologic conditions at WGS indicate water within the surficial aquifer will not migrate downward into the next water bearing zone (Crouch Branch Aquifer) used for potable supply within a reasonable timeframe.

The horizontal hydraulic conductivity (K_h) of the upper surficial aquifer ranged from 7.80E-5 centimeters per second (cm/s) to 2.47E-3 cm/s with a geometric mean of 9.10E-4 cm/s and the K_h of the lower surficial aquifer ranges from 1.43E-4 cm/s to 8.26 E-3 cm/s with a geometric mean of 8.21E-4 cm/s. These results show a comparable K_h in the upper and lower zones of the surficial aquifer.

The observed and documented vertical hydraulic conductivity (K_v) of the clay materials within the Williamsburg Formation and the Crouch Branch confining unit provide significant confinement to the Crouch Branch Aquifer. The K_v of the clay within the Williamsburg Formation ranges from 1.40E-8 cm/s to 9.50E-6 cm/s with a geometric mean of 1.03E-7 cm/s. Referenced K_v values for the Crouch Branch confining unit range from 1.20E-9 cm/s to 6.00E-6 cm/s with a mean of 4.59E-8 cm/s (Aadland, 1995).

A porosity value of 10 percent was used for the site as referenced in Domenico and Schwarz (1990).

The preceding information provided to demonstrate compliance with the requirements of §257.91(b)(1) and (b)(2) was based on the detailed site hydrogeologic characterization study conducted by Geosyntec Consultants during the period 2013 to 2016. The hydrogeological characterization study was used to design the new Class 3 Landfill and its groundwater monitoring system.

§257.91(c) states *the groundwater monitoring system must include the minimum number of monitoring wells necessary to meet the performance standards specified in paragraph (a) of this section, based on the site-specific information specified in paragraph (b) of this section. The groundwater monitoring system must contain:*

(1) A minimum of one upgradient and three downgradient monitoring wells.

The groundwater monitoring system exceeds the minimum requirement for one upgradient and three downgradient monitoring wells pursuant to §257.91(c). The actual number of wells used in the groundwater monitoring system includes two (2) upgradient and six (6) downgradient wells.

(2) Additional monitoring wells may be installed as necessary to accurately represent the quality of background groundwater that has not been affected by leakage from the CCR unit and the quality of groundwater passing the waste boundary of the CCR unit.

This number of wells is sufficient and appropriate to characterize the quality of groundwater, in the uppermost aquifer, from background groundwater not affected by leakage from the CCR Unit and groundwater passing the waste boundary of the CCR Unit based on site specific conditions. Additional downgradient wells may be installed as the remaining cells of the CCR Unit are constructed to meet this requirement. In 2023, two piezometers will be installed on the southern portion of the Class 3 Landfill Area 2 to determine if there are any shifts in groundwater flow direction after the landfill construction is completed. Wells could not previously be installed and feasibly protected along the southern border of the landfill due to landfill construction and ash pond closure traffic, material stockpiling, and existence of a natural gas transmission line in the subsurface of Ash Pond A.

§257.91(d) states *the owner or operator of multiple CCR units may install a multiunit groundwater monitoring system instead of separate groundwater monitoring systems for each CCR unit.*

Santee Cooper has installed a separate groundwater monitoring system for the new Class 3 Landfill Area 2; however, some wells may also be used to monitor the existing Ash Pond A as these CCR units share the same footprint. Ash Pond A and the Class 3 Landfill Area 2 are not operated as a multiunit system. This CCR Unit has a separate groundwater monitoring system installed from other site CCR units.

§257.91(e) states *monitoring wells must be cased in a manner that maintains the integrity of the monitoring wells borehole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of groundwater samples. The annular space (i.e., the space between the borehole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the groundwater:*

(1) The owner or operator of the CCR unit must document and include in the operating record the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices.

Santee Cooper has documented the design, installation, development, and decommissioning of any monitoring wells, piezometers and other measurement, sampling, and analytical devices. The documentation was reviewed prior to completing this certification.

The monitoring wells were installed by a South Carolina certified well driller under the direction of a qualified professional geologist and/or engineer. Details for construction of the monitoring wells were approved and permitted by DHEC prior to installation.

During installation, the geologist and/or engineer visually inspected the drill cutting directly from the auger flights to ensure the screened portion of the well was installed at the appropriate interval. The annular space above the sampling depth was sealed by using bentonite clay or grout to prevent contamination of samples and the groundwater. The soil boring descriptions and well construction information was documented by the certified well driller and the records are retained in the facility operating record. The location of the wells, the elevation of the ground surface, and the measuring reference point on the top of the inner PVC well casing was determined by a State of South Carolina registered land surveyor.

(2) The monitoring wells, piezometers, and other measurement, sampling, and analytical devices must be operated and maintained so that they perform to the design specifications throughout the life of the monitoring program.

Monitoring wells are and will be maintained in accordance with the design specifications throughout the life of the monitoring program. Routine well maintenance will include inspection and correction or repair of, as necessary, identification labels, concrete aprons, locking caps and locks, and access to the wells. If it is determined that background or detection monitoring wells no longer provide samples representative of the quality of groundwater passing the relevant point of compliance Santee Cooper will re-evaluate and prepare a plan to modify, rehabilitate, decommission, or replace monitoring wells as appropriate. Any changes will be documented in the Annual Groundwater Monitoring and Corrective Action Report.

This document satisfies the requirements of §257.9l(f) by providing a certification from a qualified professional engineer stating that the groundwater monitoring system has been designed and constructed to meet the requirements of this section. The groundwater monitoring system for the new Class 3 Landfill Area 2 at WGS includes more than the minimum number of wells and has been designed and installed to meet the applicable requirements of this section and state regulations.

3. CONCLUSIONS

The groundwater monitoring system has been developed to monitor the uppermost aquifer during the active life and the post-closure period. It was designed to detect changes in groundwater quality, if any, resulting from landfilling activities at the Class 3 Landfill Area 2 or previous activities that occurred during the operation of the Ash Pond A. This document serves as certification that the groundwater monitoring system for the new CCR Landfill Area 2 at Winyah Generating Station in Georgetown, South Carolina has been designed and installed to meet the requirements of Title 40 CFR §257.91.

4. CERTIFICATION

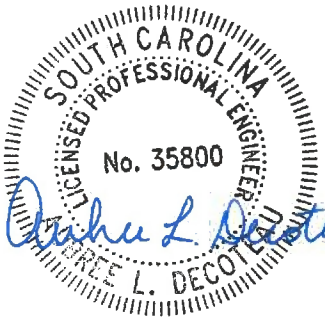
Certification for Groundwater Monitoring System

Federal CCR Rule: 40 CFR §257.91

CCR Unit: WGS Class 3 Landfill Area 2

I, the undersigned Professional Engineer registered in good standing in the State of South Carolina, do hereby certify under penalty of law that I have personally examined and am familiar with the information submitted in this demonstration, and that, based on my inquiry of the individuals responsible for obtaining the information, I believe that the submitted information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I certify, for the above-referenced CCR Unit, that the groundwater monitoring system meets the requirements of Title 40 CFR §257.91.

Seal and Signature:



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Printed Name: Aubree L. Decoteau

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5. REFERENCES

1. Geosyntec Consultants (2016). Site Hydrogeologic Characterization Study Report. Winyah Generating Station, Georgetown, South Carolina. August 5, 2016.