ATTACHMENT X – GROUNDWATER MONITORING PLAN

GROUNDWATER MONITORING PLAN

Bremo Bluff FFCP Management Facility
Solid Waste Permit 627
Fluvanna County, Virginia

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November 2024

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

1.0 INTRODUCTION

This Groundwater Monitoring Plan (GWMP) has been prepared for the Bremo Bluff Fossil Fuel Combustion Products (FFCP) Management Facility (Facility) located in Bremo Bluff, Virginia. The Facility will accept coal combustion residuals (CCR) previously generated at the Bremo Station (Station) and operate as a new, captive industrial landfill (CCR Unit) under the Virginia Department of Environmental Quality (DEQ) Solid Waste Permit (SWP) 627. Schnabel Engineering (Schnabel) has prepared this GWMP on behalf of the Virginia Electric and Power Company d/b/a Dominion Energy Virginia (Dominion Energy).

The Facility is subject to the requirements in the United States Environmental Protection Agency's "Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments" (CCR Rule, 40 CFR §257 Subpart D) as well as the DEQ's Virginia Solid Waste Management Regulations (VSWMR, 9VAC20-81).

This GWMP describes the procedures for installing monitoring wells; collecting, analyzing, and managing groundwater samples and data from the uppermost aquifer at the Facility; and reporting requirements and procedures. This initial GWMP is included within the Part B Permit Application to describe initial groundwater sampling activities and evaluation. The results of the Modified Detection/First Determination Monitoring Program, described herein, will be used to establish groundwater protection standards (GWPS). These results will be used to develop an updated GWMP that may be used for operation and post-closure periods. Revisions to this GWMP may be required in the future due to changes in the monitoring network, sampling action, or revisions to VSWMR or U.S. EPA regulations. Any revisions made to the GWMP will be posted to the operating record and will be submitted to the DEQ within 60 days of completion.

2.0 FACILITY LOCATION INFORMATION

The Facility will be located along State Route 656 at 2134 Bremo Road in Bremo Bluff, Virginia on an approximately 214-acre parcel that is owned by Dominion Energy and adjacent to the Station property (Tax Parcel 62-A-7). As shown in Figure 1, the Facility property is bounded by Bremo Road and wooded residential property to the north, wooded residential property to the east, the Station property to the west, and a CSX railroad right-of-way and agricultural property to the south. Additionally, the James River is approximately 800 feet south of the southern limits of the Facility property and flows west to east.

Approximately 125 acres of the 214-acre property will be dedicated for Facility activities, i.e., the Facility Boundary (FB), with approximately 73 of those acres designated for waste management activities, i.e., the Waste Management Boundary (WMB), and 47 of those acres lined for disposal activities, i.e., the Disposal Unit Boundary (DUB). The proposed Facility, FB, WMB, and DUB are depicted in Figure 2.

2.1 Land Use and Topography

The current land use for the proposed FB area is undeveloped and heavily wooded. As shown on Figure 1, the topography within the Facility property boundary ranges from approximately 230 to 400 feet above mean sea level (AMSL) and generally slopes inward to a valley with broad ridges and hilltops serving as topographical highs on either side. Surface flow in the vicinity of the Facility is characterized by an intermittent stream running through the valley towards the James River. The Facility is located outside the James River floodplain.

2.2 Facility History

The proposed Facility will be located on historically forested and undeveloped land. The former Station, located at 1038 Bremo Road, includes an existing CCR surface impoundment, the North Ash Pond (NAP), that will complete closure by removing CCR and disposing of it at a permitted disposal facility. This Facility is being proposed for the disposal of CCR materials removed from the Station.

3.0 FACILITY GEOLOGY AND HYDROGEOLOGY

The Facility geology and hydrogeology was previously explored and documented in the Part A Hydrogeologic and Geotechnical Report: Bremo Bluff Fossil Fuel Combustion Products (FFCP) Management Facility, Bremo Power Station, Rev. 1 dated August 19, 2022 (AECOM, 2022). Observations documented in this report as well as regional soils and geologic information specific to the Facility footprint have been used to summarize the Facility geology and hydrogeology in the following sections. Groundwater level elevation measurements/calculations and hydraulic conductivity measurements and analyses were previously performed by AECOM and form the basis of this GWMP. Once additional wells are installed at the Facility, additional clarification or information regarding site-specific data will be included in this GWMP as appropriate.

3.1 Soils

Surficial soils are predominantly Louisburg and Appling soils, which are well-drained soils on hilly areas with slopes ranging from 8 to 25 percent. The majority of soils in the valley are Louisburg soils, which are well-draining soils with a very low to moderately low capacity to transmit water. Appling soils, which tend to be located on hillslopes and have a moderately high to high capacity to transmit water, are located along the topographically highest part of the valley on either side of the intermittent stream. These soils are shown in Figure 3 (USDA, 2015).

The soil units underlying the surface soils may be subdivided into two primary hydrostratigraphic units, distributed from the ground surface downward toward the native bedrock:

- Mixtures of sands, silts, and clays; and,
- Saprolite.

Partially weathered granite above bedrock was also observed in the boreholes drilled for the Facility. These materials are chiefly derived from the native local parent bedrock material and include more clays than sands.

The shallow sands, silts, and clays are well distributed about the property, but absent in areas with steeper slopes in closer proximity to the intermittent stream that flows north to south through the valley. The thickness of this soil unit varied from 0 to approximately 20 feet based on site observations, data collected from drilling activities, and stratigraphic cross-section interpretations presented in the Part A Hydrogeologic and Geotechnical Report, and, where present, are assumed to be a relatively thin veneer of sediments overlying partially weathered rock (PWR) and bedrock.

Saprolite is present as the stratum overlying bedrock. Similar to other surface sediments, saprolite is interpreted as absent along steeper slopes toward the stream and the center of the valley. Based on boring log data and stratigraphic cross-section interpretations presented in the Part A Hydrogeologic and Geotechnical Report, the thickness of the saprolite unit ranges from 0 to approximately 50 feet and is

generally the thickest hydrostratigraphic unit across the Facility area, particularly on the topographically highest portions of the valley, away from the intermittent stream.

3.2 Geology

The Facility is located in the Piedmont Physiographic Province of Virginia (VDMR, 1993). The Piedmont Physiographic Province consists of late Proterozoic and Paleozoic igneous and metamorphic rocks and lower Mesozoic sedimentary rocks deposited in graben basins faulted into the igneous and metamorphic rocks (Smith et al., 1964), as shown on Figure 4. Rock is easily weathered in the humid climate, and bedrock is often buried under up to 65 feet of saprolite.

Within the Piedmont Physiographic Province, the Facility lies within the Chopawamsic terrane, which is a composite terrane of metamorphosed volcanic, plutonic, and sedimentary rocks that form part of an arc complex built upon continental crust (Bailey and Owens, 2012). Metamorphosed basin deposits of the Arvonia and Quantico formations unconformably overlie these rocks in the region. In central Virginia, the Chopawamsic Formation is interpreted as a suite of mafic to felsic metavolcanic rocks interlayered with metamorphosed volcaniclastic and clastic layers.

As previously interpreted in the Part A Hydrogeologic and Geotechnical Report, regional mapping and site observations indicate that portions of the Facility property near the James River, i.e., along and proximate to the floodplain for the James River and outside the area of the proposed FB, are underlain by unconsolidated Quaternary-aged alluvial sediments.

The overburden within the Facility Boundary consists of saprolitic material weathered from the parent bedrock below. Based on site observations, data collected from drilling activities, and stratigraphic cross-section interpretations presented in the Part A Hydrogeologic and Geotechnical Report, saprolite is well distributed across the property, and in steeply sloped areas close in proximity to the intermittent stream the saprolite becomes a relatively thin veneer of sediments overlying PWR and bedrock.

Once additional wells are installed, additional clarification or information regarding site-specific data will be included in this GWMP.

3.3 Hydrogeology

The horizontal contributing extent of the uppermost aquifer is constrained by either side of the valley to the east and west and by topography of the ground surface and bedrock to the north. The hydrogeologic system may be described as an unconfined system extending vertically from the ground surface to the top of bedrock. These materials consist almost entirely of saprolite, distributed in distinguishable layers of sands, silts, and clays. These distinguishable units do not represent specific hydrogeologic or geologic zones, but relatively consistent distributions of similarly weathered materials within the saprolite. The saprolite represents the single water-bearing/aquifer unit above the bedrock. The hydrostratigraphy is heterogeneous across the Facility property and is expected to be anisotropic based on native materials observed during drilling activities.

Groundwater flow is expected to be primarily in the saprolite materials above bedrock. Groundwater velocities may be higher in the horizon between the saprolite and competent bedrock, flowing through relict quartz veins and shallow fractured rock. Based on rock coring results in the Part A Hydrogeologic and Geotechnical Report, the underlying bedrock is competent. As such, the bedrock may be considered relatively impermeable in terms of flow through primary porosity, with relatively little significant exchange

of groundwater between the saprolite and underlying bedrock. Groundwater flow in the competent bedrock is expected to occur through secondary porosity via metamorphic foliation, fractures, and jointing. Groundwater flows consistently inward from the east and west flanks of the valley, toward the central intermittent stream feature and then southward, as depicted on Figure 5 (by others).

Groundwater data within the FB dating back to 2020, as collected and reviewed by AECOM, indicate that the saturated thickness of the saprolite water-bearing unit is on the order of 0 to 29 feet based on location and seasonal variation. Intermittent artesian or near-artesian conditions were observed in water level measurements and time series data for two piezometers, PZ-12 and PZ-31.

The recharge area is clearly defined by the topography of the valley, wherein precipitation may infiltrate and recharge groundwater, contribute to the intermittent stream via surface runoff, evaporate, or be taken up by plants via evapotranspiration. Vertical flow components are expected to generally be downward from the higher elevations in the valley that represent the recharge areas, with upward vertical hydraulic gradients near the intermittent stream and wetlands.

Based on the available time series data (April 2020 through November 2022), groundwater elevations decrease during the summer and increase in the winter and spring. This assessment is further corroborated by time series data available for other portions of the Station property, where groundwater monitoring has been ongoing. The intermittent stream is likely to receive less discharge from upgradient groundwater sources during the summer, as greater evapotranspiration and less rainfall produce less available groundwater for streamflow contribution.

3.4 Uppermost Aquifer Hydraulic Conductivity

Hydraulic testing using the rising and falling head slug test methods was performed on the newly installed piezometers at the proposed Facility and reported in the Part A Hydrogeologic and Geotechnical Report. Displacement of water in the piezometer was accomplished using a 4-foot-long solid slug, suddenly inserted or removed from the water column to create the rise/fall for each test. Piezometers PZ-18 and PZ-23 were not tested due to insufficient water in the piezometer at the time.

Slug test data were processed by AECOM using AqteSolv and the method described in Bouwer and Rice (Bouwer and Rice, 1976). A tabular summary of the hydraulic conductivity calculations is presented in Table 1. Average hydraulic conductivity beneath the Facility was determined to be 0.93 feet/day. Once additional wells are installed, the groundwater flow rate will be recalculated based on data obtained, with the use of geometric mean considered for determining hydraulic conductivity. This information will be included in this GWMP.

3.5 Groundwater Direction and Flow

Groundwater occurrence in the overburden is sporadic and not necessarily continuous in the overburden across the Facility property. Groundwater was not encountered in all boreholes within the proposed Facility footprint, as documented by AECOM (AECOM, 2022); however, using the available data, potentiometric surface mapping indicates the groundwater flows from the north and the upland directions on the eastern and western sides of the valley, toward the intermittent stream, and then southward toward the James River (Figure 5). Groundwater flow rates may be determined using the estimated hydraulic conductivity data and calculated hydraulic gradients from the potentiometric surface map. The average groundwater hydraulic gradient beneath the proposed Facility is approximately 0.055 feet/foot based on a

30-foot head change over 550 feet distance along the central portion of the valley. The effective porosity for the native material in the overburden was assumed to be 35% based on material type encountered during drilling (Fetter, 1988). As discussed in Section 3.4, the average hydraulic conductivity beneath the proposed Facility was determined to be 0.93 feet/day from slug testing results (Table 1). Groundwater flow rate, V, may be calculated using the simple formula:

$$V=Ki/n$$

Where:

K is the hydraulic conductivity (feet/day)
i is the hydraulic gradient (feet/feet)
n is the assumed porosity (unitless) (Fetter, 1988)
V = [[0.93 feet/day* (5.5E-0.2)] / 0.35] * 365 days/year = 53 feet/year

The average groundwater flow rate across the valley, i.e., from the sides of the valley toward the intermittent stream, is 53 feet per year.

3.6 Water Supply Wells

There are no known active drinking water or irrigation wells downgradient of the Facility or in the subwatershed that is defined by the topographic highs to the north, east, and west and by the James River to the south.

4.0 GROUNDWATER MONITORING SYSTEM DESIGN

The regional and Facility hydrogeological characteristics were evaluated to develop the groundwater monitoring system proposed herein. The design of the system considered the upper and lower boundaries of the uppermost aquifer, i.e., the saprolitic and Quaternary soils above bedrock, aquifer thickness, stratigraphy, lithology, hydraulic conductivities, and porosities. The proposed number, spacing, and depth of monitoring wells for the compliance network were selected to achieve representative upgradient and background data and to accurately monitor the DUB for potential contamination.

4.1 Special Considerations

The following special site conditions that may affect the design of the groundwater monitoring system were considered for waste management units located:

- Above a mounded groundwater table;
- Above aquifers with seasonally variable groundwater flow;
- In areas where surface water features or tidally influenced water bodies may influence groundwater level or flow direction;
- Near intermittently or continuously used groundwater production wells; and/or
- In karst or faulted areas where subsurface geologic features may modify expected groundwater flow.

Based on available information, these special conditions that would affect the design of the Facility's groundwater monitoring system are not known to exist.

4.2 Monitoring Well Placement

The compliance network will be located and constructed with a sufficient number of wells to yield groundwater samples that are representative of the groundwater quality in the uppermost aquifer. The compliance monitoring network is discussed in the following sections and shown on Figure 2.

4.2.1 Upgradient Wells

Background monitoring wells will be located hydraulically upgradient of the DUB where groundwater has not been affected by the CCR Unit. Two upgradient monitoring wells, FMW-01 and FMW-02, are proposed north and northeast of the DUB. Once installed, well construction logs for the proposed wells will be included within Appendix A of this document.

4.2.2 Sidegradient Wells

Two existing wells positioned hydraulically sidegradient to the Facility, OW-26S and OW-26D, will aid in understanding the water quality sidegradient to the adjacent NAP prior to any potential effect on the Facility. Well construction logs for these existing wells are included in Appendix A. An additional monitoring well (FWM-03) on the east side of the DUB is proposed to identify potential changes to groundwater flow direction and groundwater quality following the placement of CCR. Once installed, the well construction log for this proposed well will be included within Appendix A of this document.

4.2.3 Downgradient Wells

Wells will be installed hydraulically downgradient at the DUB to enable detection of potential groundwater contamination or degradation in quality related to the CCR Unit. Downgradient wells are spaced to intersect lateral/horizontal groundwater flow paths from the CCR Unit toward the James River.

Five locations are proposed for the monitoring well network, and are as follows:

- FMW-04
- FMW-05
- FMW-06
- FWM-07
- FWM-08

Once installed, the well construction logs for these proposed wells will be included within Appendix A of this document.

If any obstacles that prevent the installation of downgradient monitoring wells at the DUB are encountered during construction, the wells will be installed at the closest practicable distance that is hydraulically downgradient from the DUB in locations that ensure the detection of groundwater contamination in the uppermost aquifer, in accordance with 9VAC20-81-250.A.3.(3).

4.3 Monitoring Well Construction

Consistent with U.S. EPA guidance (USEPA, 1986 or most recent revision), the monitoring wells shall be constructed with 0.010-inch factory-slotted 2-inch inside diameter (ID) Schedule 40 PVC well screen and 2-inch ID Schedule 40 PVC riser casing. The well casing joints shall be threaded, and the bottom of the wells equipped with PVC end caps. The surface completions for the monitoring wells shall be completed

above grade. Monitoring wells should be drilled using hollow-stem auger, air rotary, and/or sonic drilling technology depending on the well depth and subsurface conditions.

Proposed monitoring wells will be installed in subsurface soils, saprolite, PWR, and/or bedrock. Wells will be constructed with nominally 10-foot screen lengths and conventional, industry-accepted backfill materials. Shorter or longer screen lengths, e.g., 5-, 10-, or 15-feet, may be considered depending on the specific location and setting. Final depths and screen intervals will be based upon specific conditions encountered during drilling. Any screen length variations will be documented and provided to the DEQ.

As required in Virginia for CCR facilities, wells will be screened solely within the saturated portion of the uppermost aquifer such that no portion of the well screen will be exposed to the unsaturated zone or capillary fringe zone. In addition, wells will be constructed in the uppermost aquifer, beneath the base of the CCR Unit, within the same aquifer unit, and screened in naturally occurring geologic formations as opposed to manmade layers. All monitoring wells shall be of a size adequate for sampling and shall be cased and grouted in a manner that maintains the integrity of the monitoring well borehole. This casing shall be screened or perforated, and packed with gravel or sand where necessary, to enable sample collection at depths where appropriate aquifer flow zones exist. The annular space above the sampling depth shall be sealed with a suitable material to prevent contamination of samples and the groundwater.

4.3.1 Drilling Methods

The installation of new monitoring wells shall be performed in general accordance with the specifications and procedures described herein. The wells may be drilled using the following common drilling methods; hollow-stem augering using either a 4.25-inch ID auger-equipped GeoProbe® rig or a conventional 4.25-inch or 6.25- inch hollow-stem auger-equipped rotary rig; pneumatic air hammer drilling using an air rotary rig with a tri-cone bit; mud, water, or air rotary drilling; or sonic drilling. Subsurface samples (e.g., soil samples, unconsolidated material samples, and rock cores) shall be collected and lithologically and geologically logged in a manner that includes soil types and their geologic origin (e.g., residual, depositional, etc.), hydrogeologic setting, and degree of weathering for rock samples. Borehole samples shall be collected by Shelby tube, split spoon sampler, rock corer, or other appropriate device.

For most applications, flush-threaded, 2-inch, Schedule 40 PVC will be used for well casings and screens, and well screens will be machine-slotted with 0.01-inch slots. In the event a Type III well is installed, a 6-inch diameter PVC outer casing will be filled with a Portland cement/bentonite slurry and left to set overnight. The boring will subsequently be advanced through the outer casing using air rotary drilling methods to the completion depth. A section of 0.010-inch machine-slotted, 2-inch Schedule 40 PVC well screen and 2-inch schedule 40 PVC riser will be placed in the boring. The annular space around the well screen will be filled with filter pack material, i.e., appropriately graded, inert gravel or silica sand. This filter pack will extend to a minimum of 2 feet above the top of the well screen and a minimum 2-foot-thick bentonite seal will be placed overtop and hydrated. The remaining annular space will be filled with a bentonite-cement grout to the ground surface. A tremie pipe shall be used when placing grout and, as feasible, used for placing the filter pack and bentonite seal.

4.3.2 Wellhead Completion

Well surface completion will consist of a lockable, steel protective stickup casing and a concrete pad, constructed in a manner that permits surface water to run off and drain away from the wellhead to prevent infiltration into the well annulus. The concrete pad will be approximately 4 feet by 4 feet by 3.5 inches,

centered with respect to the casing with at least half of the depth above the ground surface to promote drainage. As needed, protective bollards will be installed for aboveground well completions and painted with high-visibility paint to provide further wellhead protection.

4.3.3 Well Development

Newly constructed groundwater monitoring wells will be developed to remove any drilling fluids (water or mud) introduced into the aquifer during drilling, stabilize the filter pack, and remove sediments produced during well construction. Well development will be performed at least 24 hours after well construction. Methods for well development may include mechanical surging and bailing for pumping, or airlift pumping and jetting. These methods of well development require the application of sufficient energy to induce flow reversal or surges to break down particle bridges and to disturb the filter pack, thereby freeing the fines and allowing them to be drawn into the well. The coarser fraction settles and stabilizes the surrounding foundation. The well development method employed should be more vigorous than the proposed sampling method.

Investigative Derived Waste (IDW), including produced water from monitoring well development, will be managed in accordance with the DEQ policy on IDW entitled Department Policy on Investigation Derived Waste (document reference 20-80-004-1995, References Revised 09-2003; July 5, 1995).

If sampling activities reveal excessive turbidity and/or measurements that indicate sediment accumulation in the well itself, monitoring wells may require redevelopment. Should this occur, the wells will be redeveloped in a process similar for a new monitoring well.

4.3.4 Pump Installation

Dedicated bladder pumps or similar pump technology may be installed to facilitate low-flow sampling activities at compliance network monitoring wells. The pumps and associated tubing will be constructed of environmentally inert materials suitable for use in compliance and monitoring programs. Pumps shall be placed in the middle of the screened intervals for each well, and no closer than 2 feet from the bottom of the well.

4.3.5 Documentation

Monitoring well installations will be documented in accordance with the VSWMR and CCR Rule. Following the completion of well construction activities, each monitoring well will be surveyed by a Commonwealth of Virginia-licensed surveyor. Well locations will be surveyed to within +/- 0.05 foot horizontally and +/- 0.01 foot vertically, relative to mean sea level. Boring logs and well construction details will be prepared for each borehole and monitoring well.

The following information will be submitted to the DEQ within 14 days of completion of well construction and certification by a qualified scientist:

- Boring log
- Well construction log
- Groundwater monitoring network map, including survey data for each well
- Installation certification letter

A copy of these items will be incorporated into the Facility's operating record, as required by CCR Rule §257.105(h).

In accordance with the CCR Rule §257.91(f), as adopted in the VSWMR, a certification from a qualified Professional Engineer must be obtained stating that the groundwater monitoring system has been designed and constructed to meet the requirements of §257.91. Access to the well construction documents will be provided to the qualified Professional Engineer in accordance with §257.91I(1). Certification will be performed within 30 days of completing the well construction process and is subject to the recordkeeping requirements specified in §257.105(h), the notification requirements specified in §257.106(h), and the internet requirements specified in §257.107(h).

4.3.6 Monitoring Well Modification and Replacement

Should site construction activities result in changes to the ground surface elevation at monitoring well locations, monitoring well heights will be adjusted accordingly to ensure continued groundwater monitoring is feasible. Obstructions or accumulated materials should be removed prior to any well modifications. For well extensions, materials used will match those of the existing well and the additional riser will be added as an external joint. Annular space around the well casing will be grouted from the existing grout seal to the new ground surface. For well reductions, wells will be cut in a manner preventing material from entering the well. Wellhead completion and development steps outlined in Sections 4.3.2 and 4.3.3 will be implemented following modification of wells.

Monitoring wells that fail to perform as designed shall be replaced, as warranted and as practicable, prior to the next regularly scheduled groundwater sampling event. Non-performance of permitted groundwater monitoring wells in the approved compliance network will be reported to the DEQ within 30 days of recognition.

4.3.7 Documentation

Dominion Energy will submit a request to the DEQ for approval to decommission and replace any compliance monitoring wells. DEQ approval will be obtained prior to decommissioning or replacement activities.

4.4 Monitoring Well Decommissioning

If a monitoring well becomes unusable during the life of the groundwater monitoring program, reasonable efforts will be made to decommission and abandon the monitoring well. In addition, if a well that is not included in a regular monitoring program ceases to be used, the well will be decommissioned and documented in accordance with Virginia Department of Health requirements. Decommissioning activities will be performed in accordance with 12VAC5-630-450.

Prior to abandoning a decommissioned well, any obstructions or accumulated materials will be removed. In abandoning the well, the riser will be removed, and the well will be over drilled to a minimum of two feet past the original well depth, or to bedrock refusal, to remove the filter pack and annular seal. A bentonite/cement grout will be used to seal the well from the over-drilled depth to the ground surface through a tremie pipe.

4.4.1 Documentation

Dominion Energy will submit a request to the DEQ for approval to decommission and abandon any monitoring wells in the Facility's compliance monitoring (and, if necessary, corrective action) network. Following DEQ approval and completion of decommissioning activities, a report will be transmitted to the DEQ that documents the decommissioning process in accordance with 12VAC5-630-450.

4.5 Monitoring Well Operations and Maintenance

The monitoring wells, sampling, and analytical devices for the groundwater compliance network shall be operated and maintained in a manner that ensures performance to design specifications throughout the duration of the groundwater monitoring program, in accordance with the VSWMR and §257.91I(2). The following activities will be performed and documented:

- During routine monitoring events: Lock inspection, protective casing inspection, pad inspection, surface water infiltration inspection
- As needed: pump inspection and cleaning, measurement of depth to bottom, clearing of vegetation

5.0 GROUNDWATER MONITORING PROGRAM

This GWMP provides a framework for sampling and analysis procedures, designed to ensure monitoring results provide an accurate depiction of groundwater quality at the groundwater monitoring wells included in the program. The Facility is a proposed CCR unit, therefore, the monitoring program will meet VSWMR and CCR Rule requirements, and where the two differ, will utilize the more stringent requirement. The Facility's modified Detection Monitoring Program will meet both VSWMR's First Determination Monitoring Program and the CCR Rule's Detection Monitoring Program. The Facility's modified Assessment Monitoring Program is designed to meet the requirements of VSWMR's Phase II Monitoring Program and the CCR Rules Assessment Monitoring Program. Details on the modified Detection Monitoring and modified Assessment Monitoring Programs are included in the following sections.

5.1 Modified Detection Monitoring Program

The Facility's modified Detection Monitoring Program is designed to identify targeted presence and concentration of constituents in the uppermost aquifer beneath the Facility's DUB. The program will consist of sampling, analytical testing, and data evaluation.

5.1.1 Constituents

The modified Detection Monitoring Program will include sampling and analyzing for the inorganic constituents in VSWMR Table 3.1 Column A and Appendix III of the CCR Rule, as listed in Table 2. Analysis will be performed using methods from the *U.S. EPA Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846* and by a Virginia Environmental Laboratory Accreditation Program (VELAP)-accredited laboratory. All metals shall be analyzed for total recoverable metals.

5.1.2 Background Sampling

Eight discrete background sampling events, with each event spaced apart to allow for seasonal variation, will be performed to collect and analyze groundwater quality data that may be used to establish background concentrations for the Facility. Dominion Energy will submit a Facility Background Report to the DEQ within 30 days of completing the background calculations, as specified in 9VAC20-81-250.C.2.

The upgradient monitoring wells will be installed prior to construction activities. The remaining monitoring wells will be installed after the placement of structural fill to achieve final grades in these areas, which will occur after any potential blasting and installation of the underdrain. The eight discrete background sampling events will occur after all the wells have been installed and prior to the placement of waste.

5.1.3 Sampling Schedule

After background concentrations are established, the modified Detection Monitoring Program sampling will proceed on a semi-annual basis (once every 180 days, +/- 30 days).

5.1.4 Verification Sampling

Dominion Energy may conduct verification sampling to verify suspect analytical results. If verification sampling is performed, it will be completed within the 30-day statistical determination period.

5.1.5 Analytical Data Evaluation

After each modified Detection Monitoring Program event, results will be evaluated within 30 days to determine if a statistically significant increase (SSI) over background concentrations is present, and the following actions taken:

- If no constituent(s) are reported in the groundwater samples at statistically significant levels above background, modified detection monitoring and reporting will continue on a semi-annual schedule. Results will be reported in the semi-annual and annual reports.
- If constituent(s) are reported in the groundwater at statistically significant levels above background concentrations, Dominion Energy will notify the DEQ within 14 days of identifying the SSI. The notification will include a statement that Dominion Energy plans to initiate:
    - The modified assessment monitoring program; or
    - Prepare an Alternate Source Demonstration (ASD) within 90 days under 40 CFR 257.94(e)(2) and additionally, submit an ASD to the DEQ within 90 days of providing the SSI notification in accordance with 9VAC20-81-250.A.5.

5.1.6 Reporting

Recordkeeping and reporting will be performed in accordance with the requirements of the VSWMR and CCR Rule for data collection, storage, and reporting in accordance with the following regulations:

- Recordkeeping and reporting requirements specified in 40 CFR 257.105(h)
- Recordkeeping and reporting requirements specified in 9VAC20-81-250-E.1
- Reporting requirements specified in 9VAC20-81-250.E.2
- Notification requirements specified in 40 CFR 257.106(h)
- Publicly accessible Internet site requirements specified in 40 CFR 257.107(h)

Modified Detection Monitoring Program reporting requirements are described in the following sections.

5.1.6.1 Facility Background Determination Report

Within 30 days of establishing or re-establishing background concentrations, a Facility Background Determination Report will be submitted to the DEQ. The report will contain background sampling results, calculated background values, and statistical methods used. The report will be signed by a qualified groundwater scientist.

5.1.6.2 SSI Notification

Within 14 days of determining an SSI above background concentration, the DEQ will be notified. The notification will include the monitoring location, the constituent(s) and concentration(s), and the operator's plan for initiating the modified Assessment Monitoring Program or performing an ASD.

5.1.6.3 Semi-Annual Monitoring Report

A Semi-Annual Monitoring Report will be submitted to the DEQ no later than 120 days from completion of the first semi-annual monitoring event (including laboratory analysis). The report will include content as specified in 9VAC20-81-250.E.2.b and shall be submitted in a format consistent with the existing DEQ Submission Instructions. The semi-annual report will include the following information:

- Facility name and VSWMR Solid Waste Permit Number (627);
- Signature of a professional geologist, engineer, or qualified groundwater scientist;
- Description of the sampling and analysis activities;
- Statement that all monitoring points within the permitted network were sampled during the event, noting departures from the GWMP requirements where necessary;
- Calculated groundwater flow rate and groundwater flow direction during the sampling event;
- Dated laboratory analytical report(s); and
- Determination of SSIs over background, the supporting statistical calculations, and reference to the notification date to the DEQ pursuant to timeframes in the VSWMR, if applicable;

5.1.6.4 Annual Monitoring Report

An Annual Groundwater Monitoring Report will be submitted to the DEQ no later than January 31st of each year pursuant to §257.90(e) of the CCR Rule or 120 days from the date the second semi-annual sampling and analysis activities are complete pursuant to 9VAC20-81-250.E.2 of the VSWMR, whichever occurs first.

Additionally, the annual report will comply with CCR Rule recordkeeping requirements specified in §257.105(h)(1), notification requirements specified in §257.106(h)(1), and internet availability requirements specified in §257.107(h)(1). Contents of the Annual Groundwater Monitoring Report will include:

- Facility name, current owner/operator, and VSWMR Solid Waste Permit Number (627);
- Facility location on a United States Geological Survey (USGS) topographic survey map;
- Facility map showing the groundwater monitoring network and CCR Unit;
- Facility design information, size of the DUB, and history (operational and groundwater network);
- Description of the Facility topography, geology, hydrogeology, uppermost aquifer; and surface waters;
- Summary of the monitoring well network, any non-performance issues identified, identification of any wells that were installed, repaired, or decommissioned the preceding year and why, and a statement that the network meets the VSWMR performance requirements;
- Description of the sampling and analysis activities performed during the previous calendar year, including number of samples collected and whether the monitoring was performed under the modified detection or modified assessment monitoring programs;
- A narrative discussion of any transition between monitoring programs (e.g., the date and circumstances for transitioning from detection monitoring to assessment monitoring in addition to identifying the constituent(s) detected at a statistically significant increase over background levels, and any ASD completed);
- Calculated groundwater flow rate and groundwater flow direction during the second semi-annual sampling event;
- Dated laboratory analytical report(s) for the previous calendar year;

- Historical analytical results table listing detected constituents at each well;
- Determination of SSIs over background, the supporting statistical calculations, and reference to the notification date to the DEQ pursuant to timeframes in the VSWMR, if applicable;
- Signature of a professional geologist, engineer, or qualified groundwater scientist; and
- Completed QA/QC DEQ Form ARSC-01

5.1.6.5 Alternate Source Demonstration

An ASD may be made if a source other than the CCR Unit is expected to cause an SSI(s), such as an error in sampling, analysis, or evaluation or natural variation in groundwater quality. The demonstration will be submitted to the DEQ within 90 days of providing the SSI notification. Additionally, it must be certified by a qualified professional engineer and placed in the operating record within 90 days of noting the SSI as defined in 40 CFR 257.94(e)(2).

If the demonstration is approved by the DEQ, the modified Detection Monitoring Program will continue. If the ASD is not approved, the Assessment Monitoring Program will be initiated within 90 days of the SSI determination.

5.1.6.6 Well Installation Report

Well installation reports will be submitted to the DEQ within 44 days of completion of well construction activities. Well installation reports will be certified by a qualified groundwater scientist.

5.1.6.7 Well Decommissioning Report

Well decommissioning reports will be submitted to the DEQ within 44 days of completion of well decommissioning activities and will be certified by a qualified groundwater scientist.

5.1.6.8 Well Non-Performance Notification

Well non-performance reports shall be submitted to the DEQ within 30 days of recognizing a network well has a non-performance issue.

5.2 Modified Assessment Monitoring Program

The modified Assessment Monitoring Program is designed to identify and quantify potential CCR Unit-related constituents in the uppermost aquifer, and to determine if detected constituent concentrations require corrective action.

In accordance with the CCR Rule as adopted in the VSWMR, a notification will be placed in the Facility's operating record and on the publicly available website stating that a modified Assessment Monitoring Program has been established. Pursuant to §257.106 as adopted in the VSWMR, the DEQ must be notified when the notice has been placed.

Components of the modified Assessment Monitoring Program, including analytical requirements, sampling frequency, and data evaluation, are discussed in the following sections.

5.2.1 Constituents

Under the modified Assessment Monitoring Program, groundwater samples will be analyzed for the following constituents listed in Table 3:

- CCR Rule Appendix III;
- CCR Rule Appendix IV; and,
- VSWMR Table 3.1 Column B metals (copper, nickel, silver, tin, vanadium, and zinc) not included in the CCR Rule.

Analysis will be performed using methods from the U.S. EPA Test Methods for Evaluating Solid Waste - Physical/Chemical Methods, SW-846, if available, and by a VELAP-accredited laboratory.

Upon initiation of the modified Assessment Monitoring Program, an initial sampling event will take place for the constituents found in VSMWR Table 3.1 Column B, in accordance with 9VAC20-81-250.C.3 a. Any constituent detected will be added to the previously detected Table 3.1 Column B list of constituents.

5.2.2 Sampling Schedule

After the initial modified Assessment Monitoring event, sampling will continue on a semi-annual basis (once every 180 days +/- 30 days).

5.2.3 Verification Sampling

Dominion Energy may conduct verification sampling to verify suspect analytical results. If verification sampling is performed, it will be completed within the 30-day statistical determination period.

5.2.4 Establishing Groundwater Protection Standards

GWPS will be established in accordance with §257.95(h), as adopted in the VSWMR. The proposed GWPS will be developed based on the following requirements unless the requirements for establishing GWPS are revised by the U.S. EPA under future revisions to the CCR Rule, in which case the CCR Rule provisions will supersede these provisions:

- For constituents for which a U.S. EPA Maximum Contaminant Level (MCL) has been established, the MCL for that constituent will be used as GWPS.
- Established Federal GWPSs for cobalt, lead, lithium, and molybdenum as promulgated in the Federal Register dated July 30, 2018 [*Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals From Electric Utilities; Amendments to the National Minimum Criteria (Phase One, Part One)*].
- Proposed Federal GWPS for boron as proposed in the Federal Register dated March 15, 2018 [*Hazardous and Solid Waste Management System: Disposal of Coal Combustion Residuals from Electric Utilities; Amendments to the National Minimum Criteria (Phase One); Proposed Rule*].
- For constituents for which MCLs and Federal GWPSs have not been established, the site-specific background value established from the background wells will be used as GWPS.
- For constituents for which the site-specific background value is higher than the MCL or established Federal GWPS, the background value established from the background wells will be used as GWPS.

The established GWPS will be included in the annual monitoring report required by §257.90(e), as adopted by VSWMR. MCL-based GWPS will be updated based upon the U.S. EPA's promulgation of new or revised MCLs. Background-based GWPS will be updated every 2 years such that the eight most recent background well sampling results will replace the oldest eight background well sampling results. Following initiation of the modified Assessment Monitoring Program and the establishment of background

concentrations for the Table 3 constituents to be presented to the DEQ in a Facility Background Determination Report (see Section 5.1.6.1), proposed GWPS for applicable constituents (CCR Rule Appendix IV constituents and VSWMR Table 3.1 constituents) will be submitted to the DEQ consistent with VSWMR. GWPS based on MCLs will become effective immediately upon the report submittal. GWPS based on background levels will become effective upon written DEQ approval.

GWPS will be submitted to the operating record after completing the initial Modified Assessment Monitoring Program event and no later than 30 days following establishment of background concentrations for required monitoring constituents.

5.2.5 Analytical Data Evaluation

After each assessment monitoring event following establishment of GWPS, groundwater constituent concentrations will be statistically evaluated to Facility background concentrations and GWPS according to this GWMP. The evaluation will be conducted as follows:

- If groundwater concentrations are reported above background values, but below the established GWPS, groundwater sampling will continue modified assessment monitoring;
- If an SSI is identified over background concentrations and/or GWPS, Dominion Energy may:
  - Submit an ASD within 90 days of determining the SSI over GWPS; or
  - Begin initiation of corrective action as required under 9VAC20-81-260 and §257.96, §257.97, and §257.98 of the CCR Rule.

5.2.6 Data Validation

In accordance with 9VAC20-81-250.A.4.j, voluntary third-party data validation of laboratory data may be completed during the 30-day statistical determination period.

5.2.7 Reporting

Reports required under the modified Assessment Monitoring Program include GWPS exceedance notifications (as applicable), a semi-annual monitoring report, and an annual monitoring report. Modified Assessment Monitoring Program reporting requirements are described in the following sections.

5.2.7.1 GWPS Exceedance Notification

In accordance with §257.93(h)(2) of the CCR Rule and 9VAC20-81-250.C.3.e(3)(a) of the VSWMR, a GWPS exceedance notification will be submitted to the DEQ within 14 days of identifying a statistical exceedance of an established GWPS for monitoring program constituents, also within 44 days of issuance of the laboratory report.

The notification will include the constituent exceeding the GWPS, the well identification, and intent to either initiate a Corrective Action Program and proceed with a Nature and Extent Study and Assessment of Correction Measures within 90 days of noting the GWPS exceedance, or intent to perform an ASD.

5.2.7.2 Semi-Annual Monitoring Report

A Semi-Annual Monitoring Report will be submitted to the DEQ no later than 120 days from completion of the first semi-annual monitoring event (including laboratory analysis). The report will include content as specified in 9VAC20-81-250.E.2.b and shall be submitted in a format consistent with the existing DEQ Submission Instructions. The Semi-annual report will include information listed in Section 5.1.6.3.

5.2.7.3 Annual Monitoring Report

An Annual Groundwater Monitoring Report will be submitted to the DEQ no later than January 31st of each year pursuant to §257.90(e) of the CCR Rule or 120 days from the date the second semi-annual sampling and analysis activities are complete pursuant to 9VAC20-81-250.E.2 of the VSWMR, whichever occurs first.

Additionally, the annual report will comply with CCR Rule recordkeeping requirements specified in §257.105(h)(1), notification requirements specified in §257.106(h)(1), and internet availability requirements specified in §257.107(h)(1). Contents of the Annual Monitoring Report are listed in Section 5.1.6.4.

5.2.7.4 Alternate Source Demonstration

An ASD may be made if a source other than the CCR Unit is expected to cause a SSI(s), such as an error in sampling, analysis, or evaluation or natural variation in groundwater quality. The demonstration will be submitted to the DEQ within 90 days of providing the SSI notification. Additionally, it must be certified by a qualified professional engineer and placed in the operating record within 90 days of noting the SSI as defined in 40 CFR 257.94(e)(2).

If the demonstration is approved by the DEQ, the modified Assessment Monitoring Program will continue. If the 90-day period passes without demonstration approval, the owner or operator shall comply with the actions under 9VAC20-81-260 C within the timeframes specified unless the DEQ has granted an extension to those timeframes.

5.2.7.5 Well Installation Report

Well installation reports will be submitted to the DEQ within 44 days of completion of well construction activities. Well installation reports will be certified by a qualified groundwater scientist.

5.2.7.6 Well Decommissioning Report

Well decommissioning reports will be submitted to the DEQ within 44 days of completion of well decommissioning activities and will be certified by a qualified groundwater scientist.

5.2.7.7 Well Non-Performance Notification

Well non-performance reports shall be submitted to the DEQ within 30 days of recognizing a network well has a non-performance issue.

5.2.7.8 Groundwater Protection Standard Update Notifications

Notifications for GWPS updates due to changes in U.S. EPA MCLs or DEQ-approved background concentrations shall be submitted to the DEQ.

6.0 GROUNDWATER SAMPLING AND ANALYSIS REQUIREMENTS

The groundwater sampling program describes key information and procedures necessary for the successful execution of the groundwater monitoring program. The following sections describe the sampling program, which are consistent with VSWMR, U.S. EPA guidance, and the requirements of the CCR Rule.

6.1 Sampling Order

Compliance wells within the compliance monitoring network will be equipped with dedicated purging and sampling equipment to minimize the potential for cross-contamination during sampling events. The anticipated sampling order will, therefore, be determined in consideration of field conditions for each sampling event.

6.2 Water Level Gauging

Prior to purging and sampling, water level measurements (accurate to +/- 0.01 foot) will be collected using an electronic water level indicator and recorded on a field log. Prior to each use, the water level probe will be decontaminated to avoid cross-contamination. Water levels used in potentiometric surface mapping should be collected within an appropriate timeframe to reduce temporal variability (usually 24-hours).

6.3 Purging Procedure

Monitoring wells will be purged and sampled using low-flow techniques, using dedicated bladder pumps. For dedicated pumps, where a check valve is present, the volume in the dedicated discharge tubing should be purged prior to obtaining water quality readings. Each well will be purged at a rate between 100 and 500 milliliters per minute, collecting water quality parameters and water levels at 3-5 minutes intervals. Measurements will be recorded on a sampling log. Purging will continue until stabilization is reached for 3 consecutive readings. Stabilization guidelines are generally as follows but may vary with field conditions:

- pH +/- 0.1 standard unit
- Conductivity +/- 3%
- ORP +/- 10 mV
- DO +/- 10%
- Turbidity +/-10% or under 10 Nephelometric Turbidity Units (NTU)

In cases where low-flow rates are less than 50 milliliters per minute, the required samples may be collected prior to stabilization of the water column provided the water quality parameters have stabilized within acceptable limits. Water quality measurements and low-flow sampling rates will be recorded on the field sampling form and any deviations also be noted on the form.

Purge water generated during sampling activities will be containerized by the field sampling personnel. Purge water will be disposed in accordance with regulatory requirements.

In the event of equipment issues/malfunctions with dedicated sampling equipment, non-dedicated equipment may be used to sample the monitoring well(s) with similar low-flow sampling procedures. In such instances, the pump and supporting tubing will be decontaminated prior to use to avoid potential cross-contamination between wells. Decontamination will include use of a non-phosphate-based cleaning detergent and water mixture followed by a rinse with tap water, distilled water, or deionized water. Purging devices should be installed to withdraw water from the center of the screened interval. Use of non-dedicated equipment will be noted on the field sampling form and included in related reporting.

6.4 Sample Collection

Upon completion of purging activities, groundwater samples will be collected directly from the dedicated discharge tube (without an interruption in flow rate) into laboratory-supplied, pre-preserved sample

containers in a manner that minimizes agitation. Samples shall be collected at a flow rate equal to or lower than that of purging activities. Samples collected for analysis shall not be filtered in the field or at the laboratory. Once filled, sample containers will be placed in an iced cooler as outlined in the following section. Sample times will be recorded on sampling logs and chain-of-custody forms.

6.4.1 Sample Preservation and Shipment

Each sample will be collected in a laboratory-provided container appropriate for the sample type and size. Sample containers will be labeled with the sample source, date and time of collection, and analysis to be performed and stored in a cooler on ice. Recommended sample containers, preservation techniques, and holding times, as listed in Table 4, shall be used. The sampler will seal the cooler with a custody seal to prevent tampering during transport. Samples will be handled and transported in a manner consistent with the Chain of Custody (CoC) procedures described in Section 6.5.1.

6.5 Sample Documentation

Data pertaining to purging and sample collection activities will be recorded on field sampling logs. Log entries will be as detailed as possible and contain the following information:

- names of sampling personnel;
- project name;
- sampling date and time;
- weather conditions;
- field measurements;
- sample location;
- purging and sampling equipment used; and,
- sample description.

An example field sampling log is provided in Appendix B.

6.5.1 Chain of Custody

The field sampler will be responsible for the care and custody of the samples from the time of sampling until they are transferred or properly dispatched to the laboratory. A CoC form will be signed by the sampling personnel and maintained with the samples through transportation from the point of sampling to the lab. An example CoC form is provided in Appendix B. Upon arrival at the laboratory, samples will be inspected thoroughly to confirm that the integrity of the samples has not been compromised. The temperature of the cooler contents will be measured and recorded.

6.6 Field Quality Assurance / Quality Control

Field quality assurance (QA) and quality control (QC) samples will be collected concurrently with compliance samples. QA/QC samples will be analyzed at the laboratory alongside compliance samples, and the results evaluated to ensure sampling accuracy. QA/QC samples include blanks, duplicates, matrix spike (MS), and matrix spike duplicate (MSD) samples. When an analyte is detected in a blank, the appropriate validation flag may be applied to results from associated samples during the validation process, based on professional judgment. Each sample type is described in the following sections.

6.6.1 Trip Blanks

Trip blanks are a required part of the field sampling QA/QC program only when analytical parameters include volatile organic compounds (VOCs). As VOC is not a parameter under this groundwater monitoring program, trip blanks are not required.

6.6.2 Field Blanks

Field blanks test for contamination introduced through the sampling environment. One field blank per sampling event will be collected and analyzed. The field blank laboratory-supplied or distilled water will be opened to environmental conditions during sampling at a monitoring well location. The water will then be poured into sampling containers. The location where the field blank is sampled will be recorded on a sampling log.

6.6.3 Equipment Blanks

Equipment blanks test for contamination introduced through non-dedicated equipment. If non-dedicated equipment is used to purge and sample a well, one equipment blank per sampling event will be collected. Equipment blanks will be collected by pouring laboratory-supplied water or distilled water over or through the sampling equipment and collecting the rinsate in the sample containers.

6.6.4 Field Duplicates

A field duplicate is a duplicate sample collected from a source to test field precision. One duplicate sample will be collected for every 20 samples (5% frequency). The field duplicate sample container will be collected directly following the corresponding sample container for the original sample using the same procedure. The duplicate location will be recorded on a sampling log.

6.6.5 Matrix Spike/Matrix Spike Duplicate

MS/MSD samples are samples to which known amounts of compound are added in the laboratory before extraction/digestion and analysis. Facility samples collected in the field are to be used to assess how well the method used for laboratory analysis recovers target analytes in the site-specific sample matrix, a measure of accuracy. Additionally, the relative percent difference between the MS and MSD provides a measure of precision. One MS/MSD sample will be performed per 20 field samples or 1 per sampling event, whichever is greater.

6.7 Laboratory Quality Assurance / Quality Control

The quality assurance program for the selected VELAP-certified analytical laboratory will be documented in the laboratory's Quality Assurance Program Plan (QAPP). This document describes measures used by the laboratory to ensure that reported data meet or exceed applicable U.S. EPA and Commonwealth of Virginia requirements. The QAPP will include a description of the laboratory's experience, organizational structure, and procedures in place to ensure data quality. The QAPP will outline the sampling, analysis, and reporting procedures used by the laboratory, and the laboratory will be responsible for implementation and adherence to the QA/QC requirements described in the QAPP. The laboratory's QAPP will be available to DEQ or Facility personnel upon request.

Audits are conducted by the laboratory as part of their quality assurance program. Internal system and performance audits should be conducted periodically to ensure compliance with the QAPP. External audits may be conducted by accrediting agencies or by the state. Audit reports may be transmitted to department managers for review and response. Corrective measures must be taken for any noted deficiency or finding presented in the audit results.

Data Quality Reviews (DQRs) are conducted following any anomalous result. Requests for DQRs are submitted to the laboratory to formally review the results should they differ from historical results or

exceed certain permit requirements or QC criteria. The laboratory will provide a written response to DQRs to explain deficiencies.

6.7.1 Laboratory Analysis

Constituents for laboratory analysis are listed in Table 2 and Table 3 of this GWMP. The analytical methods to be used are U.S. EPA-approved SW-846 methods or Standard Methods as approved by the U.S. EPA, if available. Alternate methods may be used if they have the same or lower Practical Quantitation Limit (PQL). Methods with higher PQLs will be considered if the parameter concentration is such that an alternate test method with a higher PQL will provide the same result.

6.7.2 Limits of Quantitation (LOQs)

Laboratory-specific LOQs will be used as reporting limits for quantified detections of required monitoring constituents. Laboratory LOQs shall be reported with the sample results.

6.7.3 Limits of Detection (LODs)

Laboratory-specific LODs will be used as the reporting limits for estimated detections of required monitoring constituents. Constituents detected at concentrations above the LOD but below the LOQ will be reported as estimated with a qualifying “J” flag on the laboratory certificates of analysis. Estimated detections are not considered statistically significant and will not trigger the Corrective Action Program. Laboratory LODs shall be reported with the sample results.

6.8 Data Validation

The laboratory is responsible for verifying the accuracy of the reported analytical results. QA/QC data provided by the laboratory will be reviewed to ensure that the analytical results meet the project’s data quality objectives. The review process should be performed in general accordance with the procedures outlined in the *National Functional Guidelines for Inorganic Superfund Methods Data Review* (USEPA, 2017) and the *Multi-Agency Radiological Laboratory Analytical Protocols Manual* (USEPA, 2004).

7.0 DATA EVALUATION

Statistical data analysis will be completed as described below. Criteria used for this analysis represent a conservatively protective approach to groundwater analysis and incorporate statistical and evaluation methods.

7.1 Groundwater Data Evaluation

Inter-well statistical evaluation methods may be used to detect a release from the Facility by comparing downgradient well results to site-specific statistically calculated background values. During analysis of the background analytical results, it will be necessary to examine the data for outliers, anomalies, and trends that might be an indication of a sampling or analytical error. These must be considered and removed from further statistical analysis, as appropriate. The inclusion of such values for use in performing temporal water quality evaluations or inter-well statistical evaluations may cause misinterpretation of the data set and result in high false positives (an indication of a release where none exists) or false negatives (missing the indication of an actual release).

Background monitoring wells will be evaluated during background development for any new wells

constructed, once those wells have at least four measurements for a given constituent, using time versus concentration graphs. Should parameter concentrations appear anomalous (5 times or greater than previous results), they may be verified during the next sampling event or after a reasonable period of time to ensure sample independence (~3 months). If the anomalous result is not verified, the outlier value may be removed from the database to ensure accuracy of future evaluations. Detected systematic trends of verified outliers in the background database will be evaluated and reported to DEQ in a timely manner.

7.1.1 Correcting for Linear Trends

If a data series exhibits a linear trend, the sample will exhibit temporal dependence when tested via the sample autocorrelation function, the rank von Neumann ratio, or similar procedure (USEPA, 2009). These data can be de-trended, much like the data described in the example above. A linear regression may be performed on the data and then the regression residuals may be used in subsequent statistical analysis instead of the original measurements.

7.2 Statistical Methodology

In accordance with the CCR Rule §257.93(f)(6), as adopted in the VSWMR, a certification from a qualified Professional Engineer must be obtained stating that the selected statistical method is appropriate for evaluating the groundwater monitoring data for the CCR management area. The certification will include a narrative description of the statistical method selected to evaluate the groundwater monitoring data. As adopted in the VSWMR, this certification is subject to the recordkeeping requirements specified in §257.105(h), the notification requirements specified in §257.106(h), and the internet requirements specified in §257.107(h).

The statistical test used to evaluate the groundwater monitoring data will be selected based on the size of the data set, data distribution, and statistical level of significance requirements as allowed by VSWMR and the CCR Rule and associated state and federal guidance documents. An adequate number of that the level of significance for individual well comparison will be no less than 0.01 and no less than 0.05 for multiple comparisons for any statistical test. Possible additional/alternate statistical test methods may include:

- A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method will include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.
- An ANOVA based on ranks followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.
- A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.
- A control chart approach that gives control limits for each constituent.
- Another statistical test method that meets the performance standards specified below. In this event, justification will be submitted to DEQ for approval.

The statistical analysis method chosen to evaluate the groundwater data will meet the following performance standards, consistent with 9VAC20-81-250.D.2 and with the U.S. EPA's *Statistical Analysis*

of Groundwater Monitoring Data at RCRA Facilities, Unified Guidance (USEPA, 2009) performance standards, consistent with 9VAC20-81-250.D.2:

- The statistical method used to evaluate groundwater monitoring data shall be appropriate for the distribution of monitoring parameters or constituents. If the distribution is shown by Dominion Energy to be inappropriate for a normal theory test, then the data shall be transformed or a distribution-free theory test shall be used. If the distributions for the constituents differ, more than one statistical method may be needed.
- If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a GWPS, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparisons procedure is used, the Type I experiment-wise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained.
- If a control chart approach is used to evaluate groundwater monitoring data, the specific type of control chart and its associated parameter values shall be protective of human health and the environment. The parameters shall be determined after considering the number of samples in the background database, the data distribution, and the range of the concentration values for each constituent of concern.
- If a tolerance interval or a predictional interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be protective of human health and the environment. These parameters shall be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern.
- The statistical method shall account for data below the limit of detection with one or more statistical procedures that are protective of human health and the environment. Any LOQ that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the Facility.
- If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.

7.2.1 Reporting of Low and Zero Values

Not detected (ND) results are reported when chemical constituent concentrations are below the LOD of the analytical procedure. This does not imply that the concentration is zero or not present, and the laboratory's LOD is provided in the analytical report. Method(s) for addressing data that include values below detection will be consistent with U.S. EPA's Unified Guidance (USEPA, 2009).

7.2.2 Normality Testing

Original data must be tested for normality using an appropriate method consistent with U.S. EPA's Unified Guidance (USEPA, 2009). The following guidelines should be considered for normality testing decisions:

- If the original data show that they are not normally distributed, then the data must be natural log transformed and tested for normality using the above methods.
- If the original or natural log-transformed data confirm that the data are normally distributed, then a normal distribution test shall be applied.

- If neither the original nor the natural log-transformed data fit a normal distribution, then a distribution-free test shall be applied.

7.2.3 Missing Data Values

Missing data may result in incomplete measures of concentration variability and increases the potential for false contamination detections. Resampling will occur within 30 days to remove the missing data gap unless an alternative schedule is approved by DEQ.

7.2.4 Outliers

Outlier concentrations are values that are markedly different from previous measurements for a single location and/or markedly different from other values in the overall data set for a network-wide measurement event. This may occur for several reasons, such as sampling error, field contamination, analytical error, laboratory contamination, transcription errors, etc.

Additional testing may be performed only if an observation seems particularly high (more than one order of magnitude from previous events) compared to the rest of the data set. The suspected outlier value will be evaluated using the appropriate outlier test described in the U.S. EPA's Unified Guidance (USEPA, 2009).

Background concentrations which are considered to be outliers will not be included in the statistical analysis.

7.3 Verification Procedure

Results must be verified in accordance with the objectives of the VSWMR for groundwater monitoring once the groundwater analysis results have been collected, checked for accuracy, and determined to be above the appropriate statistical level. Verification sampling should be performed for each constituent when it is initially determined to be measured above its statistical limit. Consistent with the VSWMR, verification samples must be collected within the 30-day SSI determination period defined in 9VAC20-81-250.A.4 h(2).

7.4 Comparison to Groundwater Protection Standards

Following establishment of GWPS under the modified Assessment Monitoring Program, detected constituents will be statistically compared to the approved GWPS using one of the following methods described below.

- For constituents where the GWPS is derived from the background concentration, then the groundwater monitoring data shall be compared directly to the GWPS using a value-to-value comparison.
- For constituents where the GWPS is derived from a MCL (or other reference standard concentration), then the groundwater monitoring data may be compared to the GWPS statistically and/or using a value-to-value procedure.
- For constituents where the GWPS was derived from background concentrations and are not detected (100% non-detects) in upgradient monitoring wells, the double quantification rule shall be used to determine downgradient exceedances. Whereas, if the constituent concentration in a compliance well exceeds the highest historical laboratory reporting limit for two consecutive events, an exceedance of GWPS shall be confirmed. If an exceedance

occurs, the Facility will collect a second sample during the compliance period.

Based on the above criteria, groundwater monitoring data will initially be compared to established GWPS via a value-to-value comparison. If a GWPS is exceeded during the value-to-value comparison for any parameter, a verification sample may be collected. The results from the verification sample will be compared to the GWPS via a value-to-value comparison. If that comparison indicates a GWPS exceedance, the source of the GWPS will be determined. If the GWPS is derived from an MCL, two additional groundwater samples for the suspect constituent(s) may be collected to allow a statistical comparison to the GWPS. Verification sampling and/or additional sampling needed to perform the statistical evaluation must be performed within the same compliance monitoring period during which the original samples were collected. The compliance monitoring period begins on the day of sampling and expires six months later, or the date of the next compliance sampling event, whichever occurs first. A minimum of four samples must be collected within the compliance monitoring period to perform a statistical comparison. Using those data, the lower confidence interval may be calculated and compared to the GWPS. The lower limit should be calculated initially by using a 95% confidence level. If the lower limit exceeds the GWPS, DEQ may be contacted regarding the use of a confidence level greater than 95%.

8.0 HYDROGEOLOGIC ASSESSMENT

Groundwater direction and flow rate shall be determined each time groundwater is sampled pursuant to 9VAC20-81-260. Groundwater elevation at each monitoring well shall be measured prior to purging and within enough time to avoid temporal variations (*e.g.* 24 hours) when performing calculations for groundwater rate and flow for the Facility. Deviations from the understood groundwater rate and flow directions will be documented and reviewed, as appropriate. A groundwater elevation contour map will be prepared, at least annually, from monitoring well groundwater measurements collected for each sampling event. The following calculation will be used to determine groundwater flow rate:

$$\mathbf{V = K \mathit{i} (1/n)}$$

Where:

V is groundwater velocity
K is hydraulic conductivity
i is the hydraulic gradient
n is the effective porosity

If the evaluation shows that the groundwater monitoring compliance well placement does not satisfy the requirements of VSWMR, the monitoring system will need to be modified to comply with those regulations, after obtaining DEQ approval. In this event, a permit amendment action will be requested related to any revisions to the monitoring well network that is deemed needed due to calculated changes in the groundwater flow pattern or functionality of any monitoring well. Proposed revisions will be submitted to DEQ within 30 days of determining the requirements are no longer met. Proposed modifications may include a change in the number, location, or depth of the monitoring wells in the compliance network.

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TABLES

Table 1.Summary of Estimated Hydraulic Conductivities.
Bremo Bluff FFCP Management Facility
Solid Waste Permit No. 627

Well ID	Total Depth (ft)	Depth to Water (ft bgs)	Screen Interval (ft bgs)	L (Screen Length in water) (feet)	Top of Well Screen (ft bgs)	d	Water Column (H) & (b)* (feet)	Max displacement (H0) (feet)	Top of water in Screen?	T (ft)	r(c)	r(eq)	r(p)	r(w)	r(sk)	Slug In/Out	Initial K (feet/day)	Initial Y0	Notes
PZ-7	57	47.98	47-57	10	47	-0.98	9.02	1.74	Y	8	0.083	0.03	0	0.083	0.344	Slug In	0.0731	0.2914	(SM) Saprolite
								1.361								Slug Out	0.2072	0.2873	(SM) Saprolite
								1.638								Slug Out	0.0917	0.3085	(SM) Saprolite
								1.176								Slug In	0.1101	0.2863	(SM) Saprolite
								1.306								Slug Out	0.125	0.4622	(SM) Saprolite
PZ-12	28	0.36	18-28	10	18	17.64	27.64	1.902	N	20	0.083	0.03	0	0.083	0.344	Slug In	0.5985	1.348	(SM) Saprolite
								1.419								Slug Out	0.7054	1.434	(SM) Saprolite
								2.257								Slug In	0.5798	1.329	(SM) Saprolite
								1.557								Slug Out	0.68	1.392	(SM) Saprolite
								1.918								Slug In	0.536	1.298	(SM) Saprolite
								1.592								Slug Out	0.7109	1.47	(SM) Saprolite
PZ-15	40	19	30-40	10	30	11	21	0.687	N	5	0.083	0.03	0	0.083	0.344	Slug Out	1.853	0.2743	(SM) Saprolite
								0.678								Slug In	1.86	0.3195	(SM) Saprolite
								0.790								Slug Out	1.761	0.3059	(SM) Saprolite
								0.708								Slug Out	1.6260	0.2591	(SM) Saprolite
PZ-16	70	44.26	60-70	10	60	15.74	25.74	2.43	N	12	0.083	0.03	0	0.083	0.344	Slug In	1.958	1.542	(SM) Saprolite/PWR
								2.573								Slug In	1.967	1.629	(SM) Saprolite/PWR
								1.696								Slug Out	1.715	1.438	(SM) Saprolite/PWR
								2.516								Slug In	1.922	1.54	(SM) Saprolite/PWR
								1.896								Slug Out	1.021	1.021	(SM) Saprolite/PWR
PZ-19	36	27.75	31-36	5	31	3.25	8.25	2.133	N	5	0.083	0.03	0	0.083	0.344	Slug In	0.7416	0.7704	(SM) Saprolite
								1.911								Slug Out	0.4018	1.0440	(SM) Saprolite
								2.231								Slug In	0.6628	0.7545	(SM) Saprolite
								1.711								Slug Out	0.6755	0.9162	(SM) Saprolite
								2.378								Slug In	0.6371	0.7737	(SM) Saprolite
								1.712								Slug Out	0.6755	0.9162	(SM) Saprolite
PZ-31	20	-0.91	10-20	10	10	10.91	20.91	2.198	N	11	0.083	0.03	0	0.083	0.344	Slug Out	1.019	0.5332	(SM) Saprolite/PWR
								1.793								Slug In	1.315	0.6842	(SM) Saprolite/PWR
								2.092								Slug Out	0.7564	0.5043	(SM) Saprolite/PWR
								1.712								Slug In	1.04	0.5084	(SM) Saprolite/PWR
																Average:	0.93		

Notes
ft- feet
ft BTOC - feet below top of casing
ft bgs- feet below ground surface
L - length of screen in water
H- total length of water column
b- aquifer thickness
T- depth of transducer in the water column
r(c) - radius of well casing
r(eq) - radius of downwell equipment (transducer)
r(w) - radius of the well screen
r(sk) - radius of disturbed material around well screen
BR-UC - Bouwer Rice Solution for an Unconfined Aquifer
K- hydraulic conductivity
Y0 - Initial displacement

Table 2: Summary of Detection Monitoring Program Parameters

	Parameter	Class	CAS RN[1]	Typical Method[2]	Units	Typical LOQ[3]/QL[4]
CCR Appendix III	Boron	metal	7440-42-8	6010D/6020B	µg/L[5]	50
	Calcium	metal	7440-70-2	6010D/6020B	mg/L[6]	5
	Chloride	anion	16887-00-6	9056A	mg/L	1
	Fluoride	anion	16984-48-8	9056A	mg/L	0.1
	pH	field parameter	N/A[7]	9040C	S.U.	N/A
	Sulfate	anion	18785-72-3	9056A	mg/L	1
	Total Dissolved Solids (TDS)	dissolved cations/anions	Total[8]	SM2540C	mg/L	50
VSWMR Table 3.1 Column A Metals	Antimony	metal	Total	6010D/6020B	µg/L	5
	Arsenic	metal	Total	6010D/6020B	µg/L	1
	Barium	metal	Total	6010D/6020B	µg/L	5
	Beryllium	metal	Total	6010D/6020B	µg/L	1
	Cadmium	metal	Total	6010D/6020B	µg/L	1
	Chromium	metal	Total	6010D/6020B	µg/L	5
	Cobalt	metal	Total	6010D/6020B	µg/L	1
	Copper	metal	Total	6010D/6020B	µg/L	5
	Lead	metal	Total	6010D/6020B	µg/L	1
	Nickel	metal	Total	6010D/6020B	µg/L	5
	Selenium	metal	Total	6010D/6020B	µg/L	5
	Silver	metal	Total	6010D/6020B	µg/L	5
	Thallium	metal	Total	6010D/6020B	µg/L	1
	Vanadium	metal	Total	6010D/6020B	µg/L	5
	Zinc	metal	Total	6010D/6020B	µg/L	20

Notes:

[1] Chemical Abstracts Service Registry Number (CAS RN)

[2] U.S. EPA SW-846 analytical methods, if available, will be used for monitoring constituents. Typical methods shall be as equivalent or most current version, depending on laboratory's VELAP certification for the method.

[3] Limit of Quantitation (LOQ)

[4] Quantitation Limit (QL)

[5] Micrograms per liter (µg/L)

[6] Milligrams per liter (mg/L)

[7] Not applicable (N/A)

[8] All species that contain the element are included.

Table 3: Summary of Assessment Monitoring Program Parameters

	Parameter	Class	CAS RN[1]	Typical Method[2]	Units	Typical LOQ[3]/QL[4]
CCR Appendix III	Boron	metal	7440-42-8	6010D/6020B	µg/L[5]	50
	Calcium	metal	7440-70-2	6010D/6020B	mg/L[6]	5
	Chloride	anion	16887-00-6	9056A	mg/L	1
	Fluoride	anion	16984-48-8	9056A	mg/L	0.1
	pH	field parameter	N/A[7]	9040C	S.U.	N/A
	Sulfate	anion	18785-72-3	9056A	mg/L	1
	Total Dissolved Solids (TDS)	dissolved cations/anions	Total[8]	SM2540C	mg/L	50
CCR Appendix IV	Antimony	metal	Total	6010D/6020B	µg/L	5
	Arsenic	metal	Total	6010D/6020B	µg/L	1
	Barium	metal	Total	6010D/6020B	µg/L	5
	Beryllium	metal	Total	6010D/6020B	µg/L	1
	Cadmium	metal	Total	6010D/6020B	µg/L	1
	Chromium	metal	Total	6010D/6020B	µg/L	5
	Cobalt	metal	Total	6010D/6020B	µg/L	1
	Fluoride	anion	Total	9056A	µg/L	300
	Lead	metal	Total	6010D/6020B	µg/L	1
	Lithium	metal	Total	6010D/6020B	µg/L	40
	Mercury	metal	Total	7470A	µg/L	2
	Molybdenum	metal	Total	6010D	µg/L	10
	Selenium	metal	Total	6010D/6020B	µg/L	5
	Thallium	metal	Total	6010D/6020B	µg/L	1
	Radium 226 & 228 combined	radionuclide	13982-63-3 &15262-20-1	9315/9320	pCi/L[9]	1
VSWMR Table 3.1 Column A, B	Copper	metal	Total	6010D/6020B	µg/L	5
	Nickel	metal	Total	6010D/6020B	µg/L	5
	Silver	metal	Total	6010D/6020B	µg/L	5
	Tin	metal	Total	6010D, 6020B	µg/L	10
	Vanadium	metal	Total	6010D/6020B	µg/L	5
	Zinc	metal	Total	6010D/6020B	µg/L	20

Notes:

[1] Chemical Abstracts Service Registry Number (CAS RN)

[2] U.S. EPA SW-846 analytical methods, if available, will be used for monitoring constituents. Typical methods shall be as equivalent or most current version, depending on laboratory's VELAP certification for the method.

[3] Limit of Quantitation (LOQ)

[4] Quantitation Limit (QL)

[5] Micrograms per liter (µg/L)

[6] Milligrams per liter (mg/L)

[7] Not applicable (N/A)

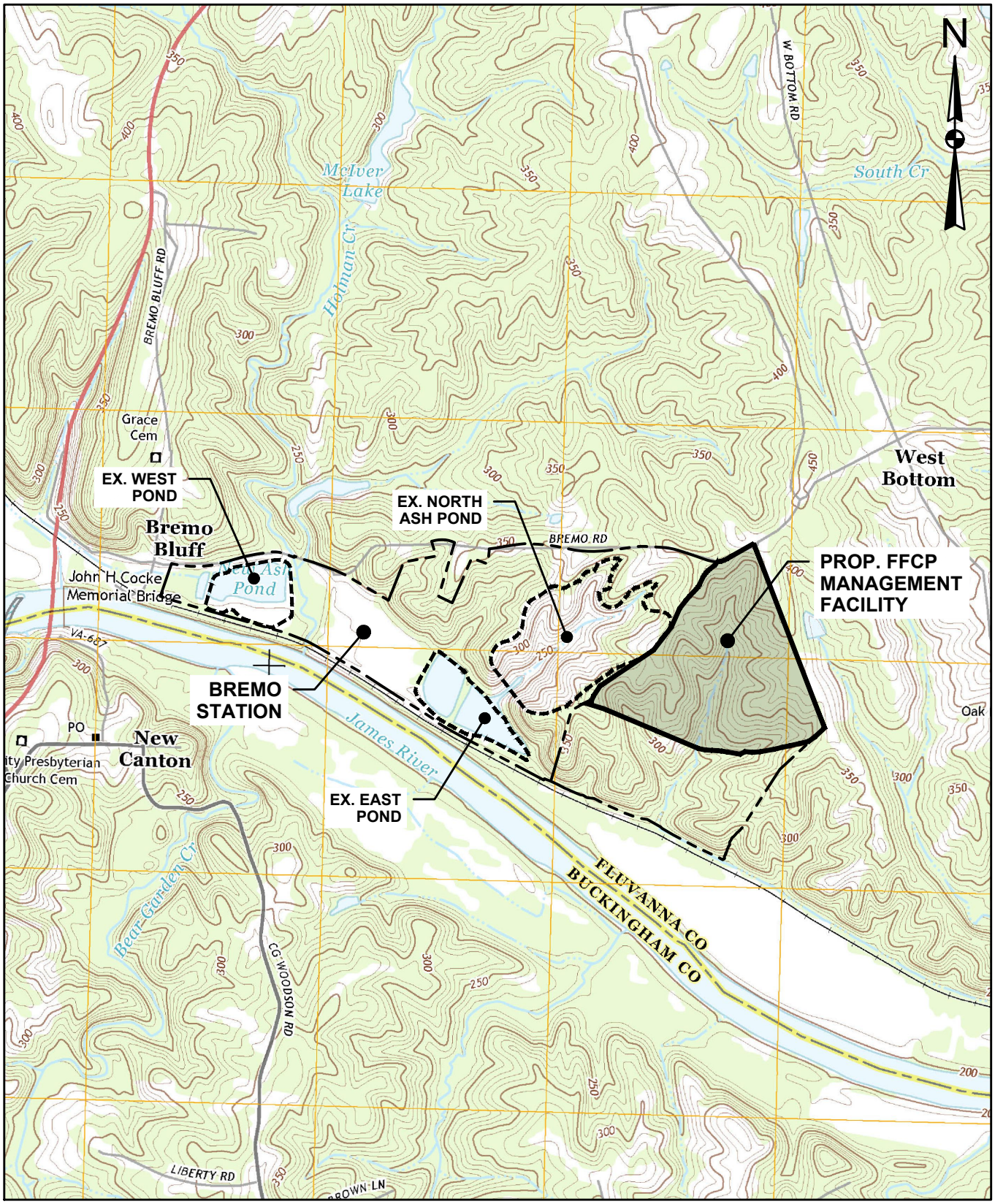
[8] All species that contain the element are included.

[9] Picocuries per liter (pCi/L)

Table 4: Summary of Sample Container Information and Hold Times

Parameter	Container & Volume	Preservative	Maximum Holding Time
pH	Flow-through cell or plastic, 500 milliliter (mL)	None	15 minutes (field analysis)
Specific Conductance	Flow-through cell or plastic, 500 mL	None	15 minutes (field analysis)
Temperature	Flow-through cell or plastic, 500 mL	None	15 minutes (field analysis)
Mercury (total)	Plastic, 250 mL	Nitric Acid to pH <2	28 days
Metals (total) except mercury	Plastic, 250 mL	Nitric Acid to pH <2	6 months
Total Dissolved Solids (TDS)	Plastic, 250 mL	None	7 days
Fluoride, Chloride, Sulfate	Plastic, 250 mL	None	28 days
Radium 223 & 228	Plastic, ½ gallon (2 Liter)	Preserved upon receipt at laboratory	6 months

FIGURES



MAP SOURCE

BASE MAP CONSISTS OF 7.5-MINUTE USGS TOPOGRAPHIC QUADRANGLE NAMED ARVONIA, VIRGINIA, DATED 2013.

SCALE: 1"=2000'

0 2000' 4000'

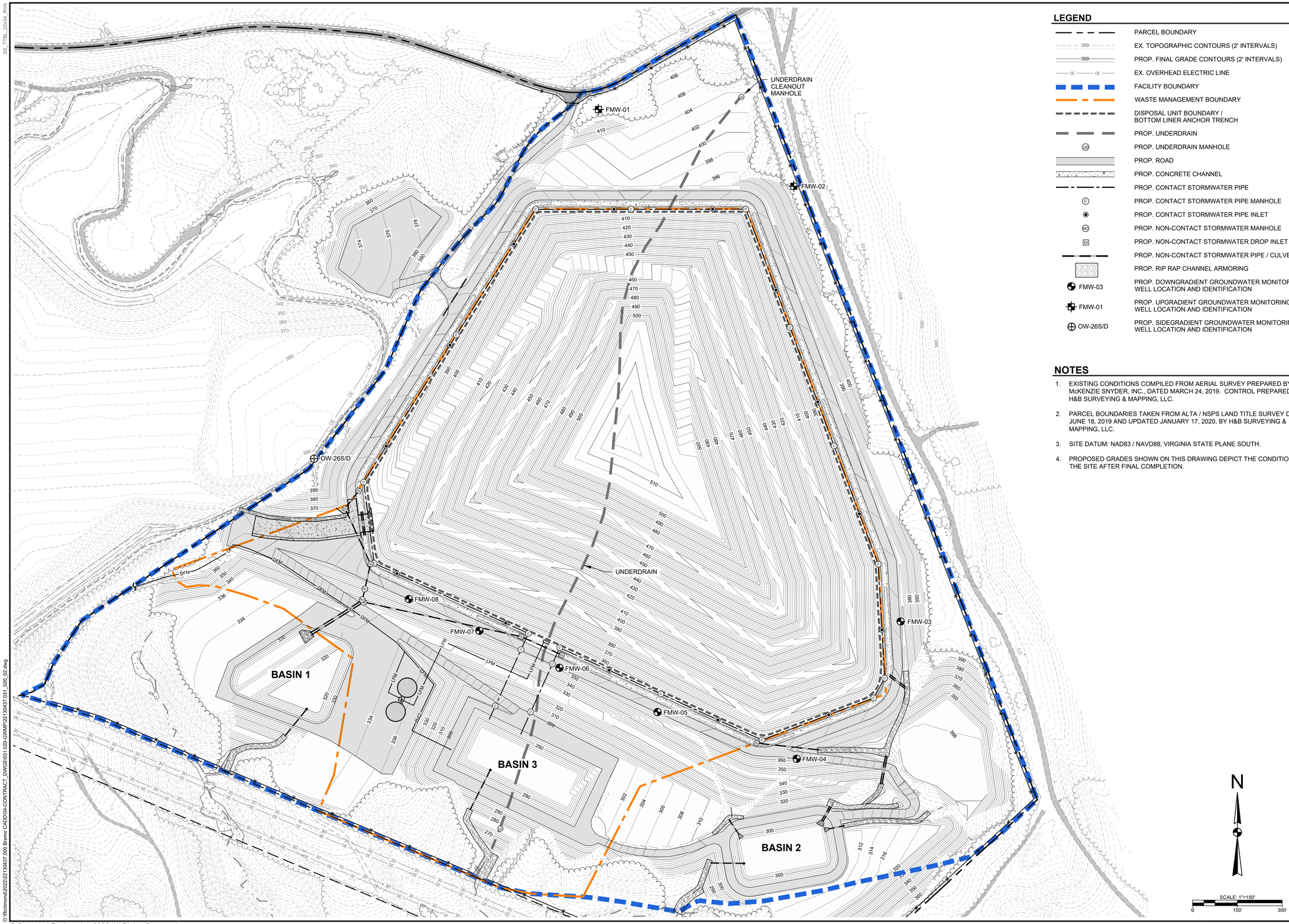
Schnabel ENGINEERING

BREMO BLUFF
FFCP MANAGEMENT FACILITY
SOLID WASTE PERMIT No. 627
FLUVANNA COUNTY, VIRGINIA

FACILITY LOCATION MAP

FIGURE 1

O:\RICHMOND\2022\22130437.000 BREMO CADD\04-CONTRACT_DWGS\031.020-GWMP\22130437.031_020_01.DWG



LEGEND

- PARCEL BOUNDARY
- EX. TOPOGRAPHIC CONTOURS (2' INTERVALS)
- PROP. FINAL GRADE CONTOURS (2' INTERVALS)
- EX. OVERHEAD ELECTRIC LINE
- FACILITY BOUNDARY
- WASTE MANAGEMENT BOUNDARY
- DISPOSAL UNIT BOUNDARY / BOTTOM LINER ANCHOR TRENCH
- PROP. UNDERDRAIN
- PROP. UNDERDRAIN MANHOLE
- PROP. ROAD
- PROP. CONCRETE CHANNEL
- PROP. CONTACT STORMWATER PIPE
- PROP. CONTACT STORMWATER PIPE MANHOLE
- PROP. CONTACT STORMWATER PIPE INLET
- PROP. NON-CONTACT STORMWATER MANHOLE
- PROP. NON-CONTACT STORMWATER DROP INLET
- PROP. NON-CONTACT STORMWATER PIPE / CULVERT
- PROP. RIP RAP CHANNEL ARMORING
- FMW-03 — PROP. DOWNGRADIENT GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION
- FMW-01 — PROP. UPGRADIENT GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION
- OW-26S/D — PROP. SIDEGRADIENT GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION

NOTES

1. EXISTING CONDITIONS COMPILED FROM AERIAL SURVEY PREPARED BY McKENZIE SNYDER, INC., DATED MARCH 24, 2019. CONTROL PREPARED BY H&B SURVEYING & MAPPING, LLC.
2. PARCEL BOUNDARIES TAKEN FROM ALTA / NSPS LAND TITLE SURVEY DATED JUNE 18, 2019 AND UPDATED JANUARY 17, 2020, BY H&B SURVEYING & MAPPING, LLC.
3. SITE DATUM: NAD83 / NAVD88, VIRGINIA STATE PLANE SOUTH.
4. PROPOSED GRADES SHOWN ON THIS DRAWING DEPICT THE CONDITION OF THE SITE AFTER FINAL COMPLETION.

REV	DESCRIPTION	DES. BY	CAD BY	CHK. BY	DATE
1	RESPONSE TO COMMENTS	MEO	BPG	JRD	02/16/24
0	ORIGINAL ISSUE	MEO	BPG	JRD	07/10/23

Schnabel ENGINEERING
9800 JEB Stuart Parkway, Suite 100
Glen Allen, VA 23059
Phone: 804-264-3205
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schnabel-eng.com

BREMO BLUFF FFCP MANAGEMENT FACILITY
SOLID WASTE PERMIT No. 627
FLUVANNA COUNTY, VIRGINIA

GROUNDWATER MONITORING PLAN

PREPARED FOR: Dominion Energy

PROJECT: 22130437.031
DATE: 02/16/24
FIGURE 2
SHEET 2 OF 5

SE_TTBL_22x34_RVA

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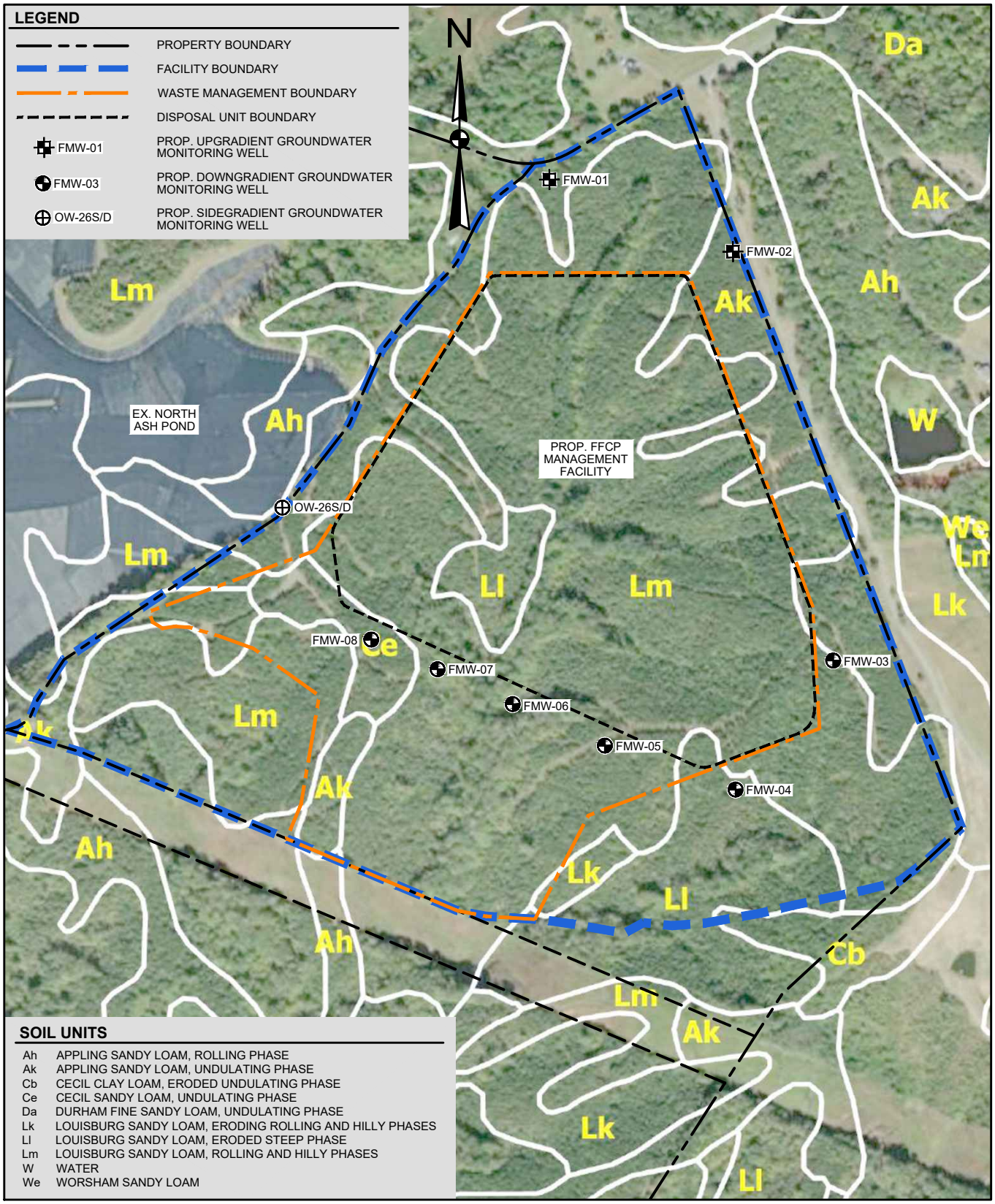


MAP SOURCE

SOIL UNIT BOUNDARIES AND IDENTIFICATIONS TAKEN FROM NRCS WEB SOIL SURVEY

SCALE: 1"=500'

0 500' 1000'

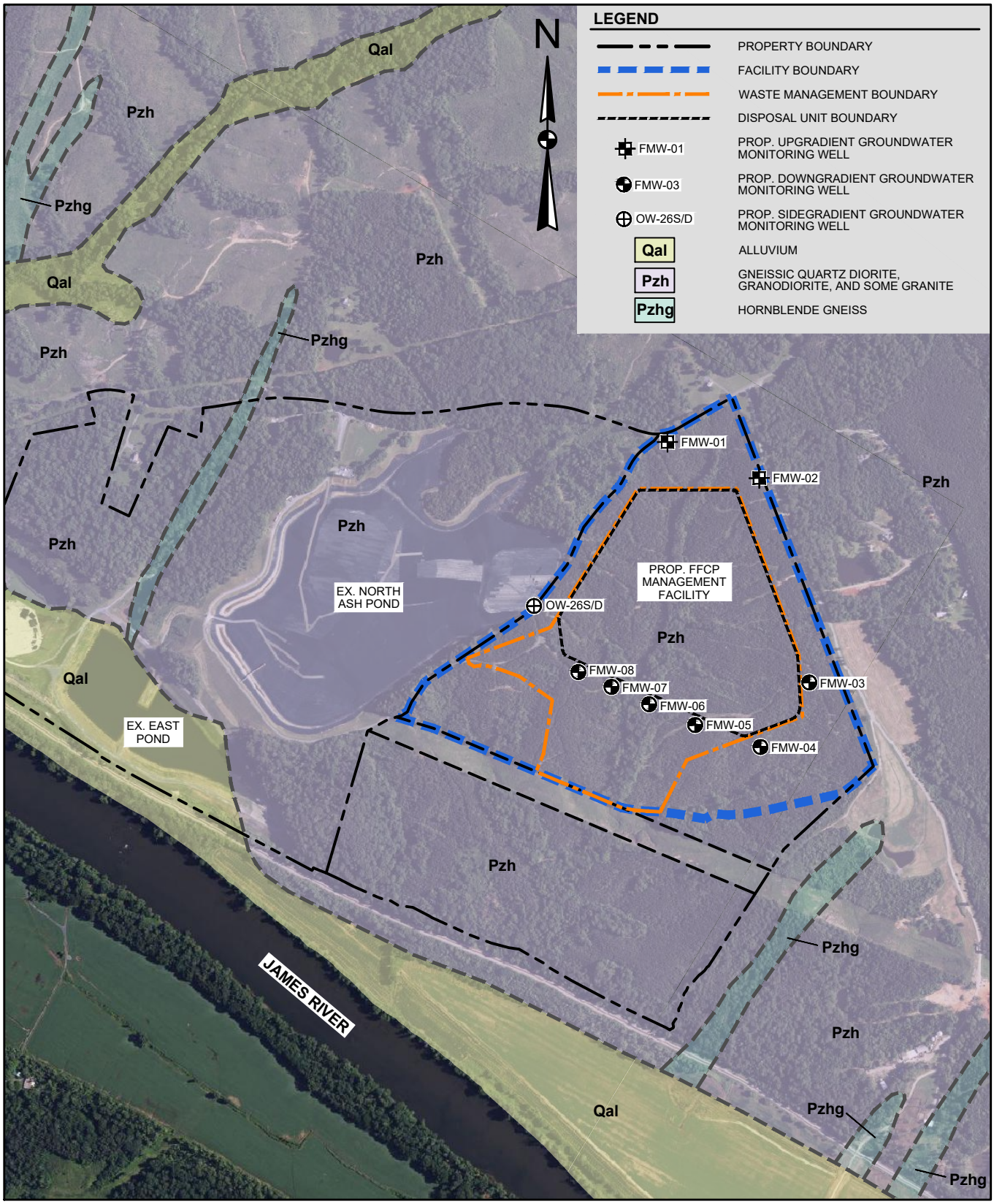
Schnabel ENGINEERING

BREMO BLUFF
FFCP MANAGEMENT FACILITY
SOLID WASTE PERMIT No. 627
FLUVANNA COUNTY, VIRGINIA

FACILITY SOILS MAP

FIGURE 3

O:\RICHMOND\2022\22130437.000 BREMO CADD\04-CONTRACT_DWGS\031.020-GWMP\22130437.031_020_03.DWG



MAP SOURCE

GEOLOGIC UNITS AND IDENTIFICATIONS TAKEN FROM ONLINE U.S. GEOLOGIC SURVEY MAP VIEWER

SCALE: 1"=1000'

0 1000' 2000'

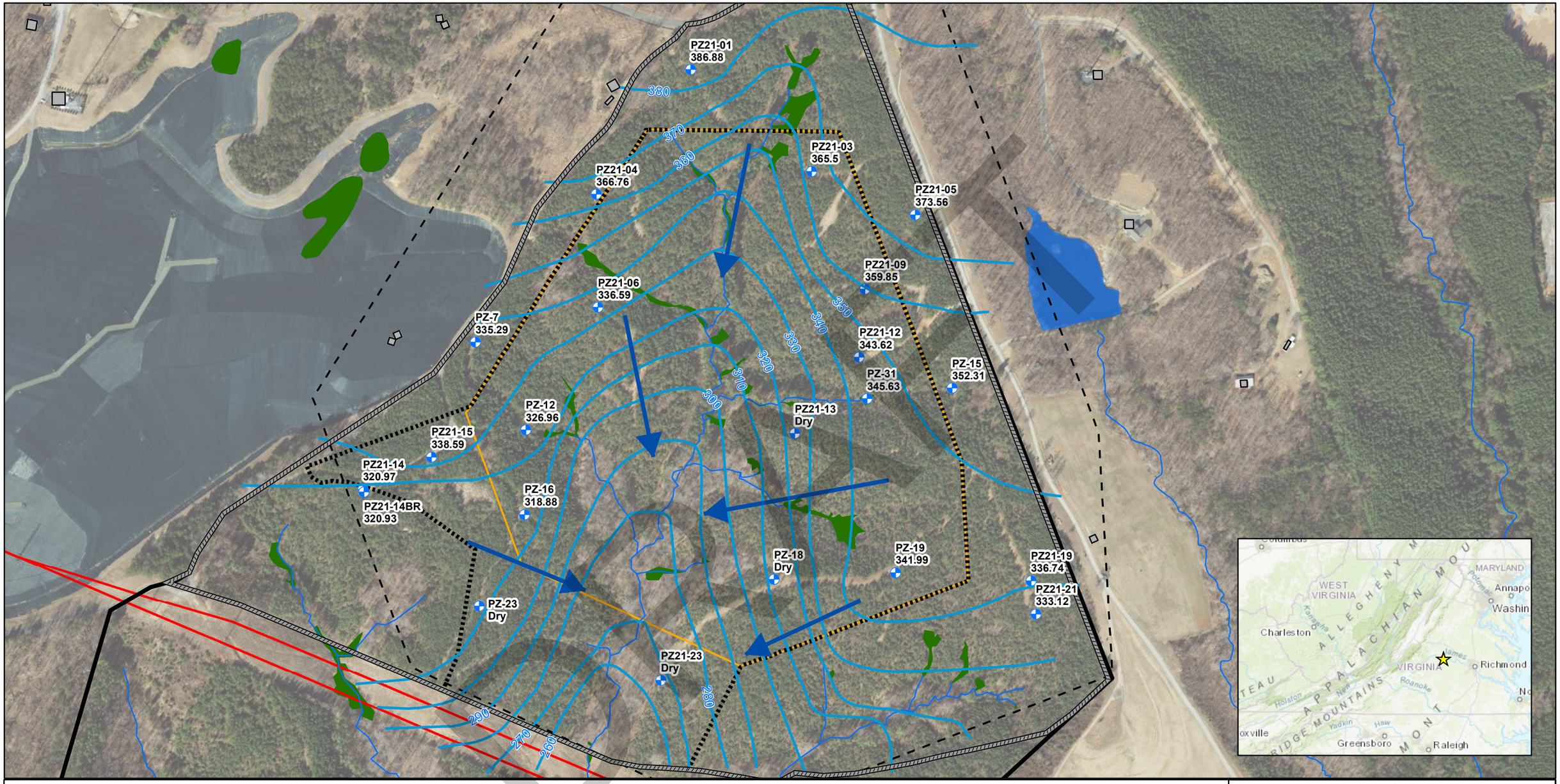
Schnabel ENGINEERING

BREMO BLUFF
FFCP MANAGEMENT FACILITY
SOLID WASTE PERMIT No. 627
FLUVANNA COUNTY, VIRGINIA

FACILITY GEOLOGIC MAP

FIGURE 4

O:\RICHMOND\2022\22130437.000 BREMO CADD\04-CONTRACT_DWGS\031.020-GWMP\22130437.031_020_04.DWG



LEGEND

- Facility Boundary
- GW Contour CI=10 ft (Jan 2022)
- Disposal Unit Boundary 500 ft Buffer
- Piezometer Locations
- Disposal Unit Boundary
- Waste Management Boundary
- Property Boundary
- Stream Centerline
- Utility Lines
- Building Footprint
- Wetlands
- Waterbody
- PZ-7 335.29 Piezometer ID and Groundwater Elevation
- Groundwater Flow Direction

N

1 inch = 350 feet

0 350 700 Feet

Data Source: AECOM, Fluvanna GIS, ESRI, USFWS and VITA Imagery

AECOM

POTENTIOMETRIC SURFACE MAP JANUARY 2022 MEASUREMENTS

DRAWN BY:	REVIEWED BY:	APPROVED BY:	REVISION NUMBER:
H.RIETHER	PMT	JAB	REV. 0

DRAWING 4

DATE:	DEPT:
2/16/2024	DOMINION POWER - BREMO POWER STATION

Document Path: Z:\Raleigh-USRAL3\DCS\Projects\L-URS\Jobs4_Projects\Dominion CCP\Bremo OE Services\900_CAD_GIS\920_GIS\Part B Application\Drawing 4_Potentiometric_surfaceMap_Jan2022.mxd

Figure 5

APPENDIX A

MONITORING WELL CONSTRUCTION LOGS

RECORD OF BOREHOLE MW-26D (OW-26D)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 138.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/22/16
DATE COMPLETED: 9/23/16

NORTHING: 3,781,789.70
EASTING: 11,548,685.31
GS ELEVATION: 391.50 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	390	0.00 - 8.00 (CL) silty CLAY bright reddish orange; highly micaceous; dry, soft - firm.	CL				**WELL CASING** Interval: 0.0-128.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread **WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4" Aluminum **ANNULUS SEAL** Interval: 0.0-118.7 feet BGS Type: Bentonite Grout **FILTER PACK SEAL** Interval: 118.7-122.0 feet BGS Type: Bentonite Chips **FILTER PACK** Interval: 122.0-138.0 feet BGS Type: No. 2 filter Sand **WELL SCREEN** Interval: 128.0-138.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 138 feet BGS
5	385				383.50		
		8.00 - 17.00 (CL) silty CLAY; reddish orange, bright tan mottles; highly micaceous; moist, soft.	CL		8.00		
10	380						
15	375				374.50		
		17.00 - 18.00 (CL) silty CLAY; dull tan; highly micaceous; moist, soft.	CL		17.00 373.50		
		18.00 - 23.00 (CL) silty CLAY trace sand; dull golden brown, red mottles; highly micaceous; moist, very soft.	CL		18.00		
20	370						
		23.00 - 26.75 (CL) silty CLAY, trace sand; fine; reddish orange, dull golden brown mottles; highly micaceous; moist, very soft.	CL		368.50 23.00		
25		Log continued on next page					

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26D (OW-26D)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 138.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/22/16
DATE COMPLETED: 9/23/16

NORTHING: 3,781,789.70
EASTING: 11,548,685.31
GS ELEVATION: 391.50 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
25		23.00 - 26.75 (CL) silty CLAY, trace sand; fine; reddish orange, dull golden brown mottles; highly micaceous; moist, very soft. *(Continued)*	CL				**WELL CASING** Interval: 0.0-128.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread
	365				364.75		
		26.75 - 27.00 (CL) silty CLAY; black - dark brown; moist, soft.	CL		27.00		**WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4" Aluminum
		27.00 - 42.00 (CL-ML) silty CLAY; dull golden brown; highly micaceous; low plasticity; dry - moist, soft.					**ANNULUS SEAL** Interval: 0.0-118.7 feet BGS Type: Bentonite Grout
30							**FILTER PACK SEAL** Interval: 118.7-122.0 feet BGS Type: Bentonite Chips
	360						**FILTER PACK** Interval: 122.0-138.0 feet BGS Type: No. 2 filter Sand
							WELL SCREEN Interval: 128.0-138.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 138 feet BGS
35			CL-ML				
	355						
40							
	350				349.50		
		42.00 - 47.00 (CL-ML) silty CLAY trace sand; dull golden brown; highly micaceous; low plasticity; dry - moist, soft.			42.00		
45			CL-ML				
	345				344.50		
		47.00 - 50.00 PHYLLITE; severely weathered; sandy silt matrix; fine, well sorted; tan; moist - dry, soft			47.00		
50					341.50		
		Log continued on next page					

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus
PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26D (OW-26D)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 138.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/22/16
DATE COMPLETED: 9/23/16

NORTHING: 3,781,789.70
EASTING: 11,548,685.31
GS ELEVATION: 391.50 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
50		50.00 - 56.00 (CL-ML) silty CLAY trace sand; dull brown, occasional white mottles; highly micaceous; moist, soft.	CL-ML		50.00		**WELL CASING** Interval: 0.0-128.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread **WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4" Aluminum **ANNULUS SEAL** Interval: 0.0-118.7 feet BGS Type: Bentonite Grout **FILTER PACK SEAL** Interval: 118.7-122.0 feet BGS Type: Bentonite Chips **FILTER PACK** Interval: 122.0-138.0 feet BGS Type: No. 2 filter Sand **WELL SCREEN** Interval: 128.0-138.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 138 feet BGS
	340						
55					335.50		
	335	56.00 - 60.00 (CL-ML) silty CLAY; dull brown; highly micaceous; moist, soft.	CL-ML		56.00	Bentonite Grout	
60					331.50		
	330	60.00 - 65.00 (CL-ML) silty CLAY; dull brown; highly micaceous; wet - moist, soft.	CL-ML		60.00		
65					326.50		
	325	65.00 - 73.00 (CL-ML) silty CLAY; dull brown; highly micaceous; moist, soft.	CL-ML		65.00		
70							
	320				318.50		
		73.00 - 79.00 PHYLLITE and QUARTZ; severely weathered; silt matrix; dull brown; dry.			73.00		
75		Log continued on next page					

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26D (OW-26D)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 138.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/22/16
DATE COMPLETED: 9/23/16

NORTHING: 3,781,789.70
EASTING: 11,548,685.31
GS ELEVATION: 391.50 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
75		73.00 - 79.00 PHYLLITE and QUARTZ; severely weathered; silt matrix; dull brown; dry. *(Continued)*					**WELL CASING** Interval: 0.0-128.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread
	315						
					312.50		
		79.00 - 82.00 PHYLLITE; severely weathered; silt matrix; dull brown; dry.			79.00		**WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4" Aluminum
80							**ANNULUS SEAL** Interval: 0.0-118.7 feet BGS Type: Bentonite Grout
	310						**FILTER PACK SEAL** Interval: 118.7-122.0 feet BGS Type: Bentonite Chips
					309.50		**FILTER PACK** Interval: 122.0-138.0 feet BGS Type: No. 2 filter Sand
		82.00 - 88.00 PHYLLITE; severely - heavily weathered, orange staining penetrates rock mass; tan; soft.			82.00		**WELL SCREEN** Interval: 128.0-138.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 138 feet BGS
85							
	305						
					303.50		
		88.00 - 95.00 No recovery			88.00		
90							
	300						
					296.50		
95		95.00 - 104.00 quartzofeldspathic - biotite SCHIST; highly weathered, orange staining penetrates rock mass; white and black; apparent fracture dip angle ~45-degrees; moderately hard. vertical foliations.			95.00		
	295						
100		Log continued on next page					

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus
PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26D (OW-26D)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 138.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/22/16
DATE COMPLETED: 9/23/16

NORTHING: 3,781,789.70
EASTING: 11,548,685.31
GS ELEVATION: 391.50 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
100		95.00 - 104.00 quartzofeldspathic - biotite SCHIST; highly weathered, orange staining penetrates rock mass; white and black; apparent fracture dip angle ~45-degrees; moderately hard. vertical foliations. *(Continued)*			287.50		**WELL CASING** Interval: 0.0-128.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread
	290						
		104.00 - 106.50 QUARTZ; cloudy white; some iron oxidation inclusions.			104.00 285.00		**WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4" Aluminum **ANNULUS SEAL** Interval: 0.0-118.7 feet BGS Type: Bentonite Grout
105							
	285	106.50 - 111.00 quartzofeldpathic - biotite SCHIST; heavily weathered, orange staining at fractures; white - black; vertical foliations; moderately hard.			106.50		**FILTER PACK SEAL** Interval: 118.7-122.0 feet BGS Type: Bentonite Chips **FILTER PACK** Interval: 122.0-138.0 feet BGS Type: No. 2 filter Sand
110					280.50		**WELL SCREEN** Interval: 128.0-138.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 138 feet BGS
	280	111.00 - 113.00 quartzofeldpathic - biotite SCHIST; heavily weathered, orange staining at fractures; white - black; vertical foliations; soft.			111.00 278.50		
		113.00 - 124.00 quartzofeldpathic - biotite SCHIST; heavily weathered, orange staining around mafic porphory; white - black; vertical foliations; soft.			113.00		
115							
	275						
120						Bentonite Chips	
	270						
		124.00 - 127.00 quartzofeldpathic - biotite - chlorite SCHIST; slightly weathered, some orange staining; white - black; vertical foliations; hard - moderately hard.			267.50 124.00		
125		Log continued on next page					

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26D (OW-26D)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 138.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/22/16
DATE COMPLETED: 9/23/16

NORTHING: 3,781,789.70
EASTING: 11,548,685.31
GS ELEVATION: 391.50 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
125		124.00 - 127.00 quartzofeldpathic - biotite - chlorite SCHIST; slightly weathered, some orange staining; white - black; vertical foliations; hard - moderately hard. *(Continued)*					
	265				264.50		
		127.00 - 130.00 quartzofeldpathic - biotite SCHIST; moderately weathered, orange staining penetrates rock mass; white - black; vertical foliations; soft - moderately hard.			127.00		
130					261.50	No. 2 Filter Sand	**WELL CASING** Interval: 0.0-128.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread **WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4" Aluminum **ANNULUS SEAL** Interval: 0.0-118.7 feet BGS Type: Bentonite Grout **FILTER PACK SEAL** Interval: 118.7-122.0 feet BGS Type: Bentonite Chips **FILTER PACK** Interval: 122.0-138.0 feet BGS Type: No. 2 filter Sand **WELL SCREEN** Interval: 128.0-138.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 138 feet BGS
	260	130.00 - 136.00 quartzofeldpathic - biotite SCHIST; heavily weathered, orange staining at fractures; white - black; vertical foliations; moderately hard.			130.00		
135					255.50	0.010-inch Slot	
	255	136.00 - 138.00 quartzofeldpathic - biotite SCHIST; moderately weathered, some orange staining; white - black; vertical foliations; hard.			136.00		
					253.50		
		Boring completed at 138.00 ft					
140	250						
145	245						
150							

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26S (OW-26S)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 108.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/24/26
DATE COMPLETED: 9/24/16

NORTHING: 3,781,781.03
EASTING: 11,548,679.74
GS ELEVATION: 326.70 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)
0		0.00 - 0.30 (CL) silty CLAY; udark brown; numerous roots; wet, soft.	CL		326.40
		0.30 - 1.00 (CH - CL) silty CLAY trace sand; fine; bright reddish orange; wet, soft.	CH-CL		0.30 325.70
	325	1.00 - 2.50 (CH - CL) silty CLAY trace sand; fine; bright reddish orange; moist - dry, soft.	CH-CL		1.00 324.20
		2.50 - 4.00 (CL) silty CLAY trace sand; fine; bright reddish orange; micaceous; moist - dry, soft.	CL		2.50 322.70
5		4.00 - 9.00 (CL) silty CLAY trace sand; fine; bright reddish orange; micaceous; dry, soft.	CL		4.00 317.70
	320				
		9.00 - 12.00 (CL) silty CLAY; reddish brown, dull tan mottles; highly micaceous; moist, soft - firm.	CL		9.00 314.70
10					
	315	12.00 - 13.50 (CL) silty CLAY trace sand; reddish orange, reddish brown mottles; moist - dry, soft.	CL		12.00 313.20
		13.50 - 18.00 (CL) silty CLAY; tan, occasional reddish brown mottles; moist - dry, soft.	CL		13.50 308.70
15					
	310	18.00 - 19.00 (CL) silty CLAY trace sand; tan, red mottles; moist, soft - very soft.	CL		18.00 307.70
		19.00 - 19.25 (CL) silty CLAY trace sand; thin black lamination (~ 0.25"); moist, soft - very soft.	CL		19.25
		19.25 - 20.00 (CL) silty CLAY trace sand; tan, red mottles; moist, soft - very soft.	CL		306.70 20.00
20		20.00 - 20.50 (CL) silty CLAY trace sand; thin black lamination (~ 0.50"); moist, soft - very soft.	CL		306.20
		20.50 - 20.75 (CL) silty CLAY trace sand; tan, red mottles; moist, soft - very soft.	CL		21.00
	305	20.75 - 21.00 (CL) silty CLAY trace sand; thin black lamination (~ 0.25"); moist, soft - very soft.	CL		
		21.00 - 23.00 (CL) silty CLAY trace sand; tan, red mottles; moist, soft - very soft.			303.70
		23.00 - 27.00 (CL) silty CLAY; reddish brown, tan mottles; highly micaceous; dry - moist, soft.	CL		23.00
25		Log continued on next page			

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0-98.0 feet BGS
Material: Sch. 40 PVC
Diameter: 2-inch
Joint Type: Thread

WELL COMPLETION
Pad: 2'x2' Concrete
Protective Casing: 4"x4' Aluminum

ANNULUS SEAL
Interval: 0.0-89.6 feet BGS
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 89.6-93.1 feet BGS
Type: Bentonite Chips

FILTER PACK
Interval: 93.1-108.0 feet BGS
Type: No. 2 Fitler Sand

WELL SCREEN
Interval: 98.0-108.0 feet BGS
Material: Sch. 40 PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: 108.0 feet BGS

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26S (OW-26S)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 108.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/24/26
DATE COMPLETED: 9/24/16

NORTHING: 3,781,781.03
EASTING: 11,548,679.74
GS ELEVATION: 326.70 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
25		23.00 - 27.00 (CL) silty CLAY; reddish brown, tan mottles; highly micaceous; dry - moist, soft. *(Continued)*	CL				**WELL CASING** Interval: 0.0-98.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread
	300				299.70		
		27.00 - 28.50 (CL - ML) silty CLAY; dark tan; moist - dry, soft.	CL-ML		27.00 298.20		**WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4' Aluminum
		28.50 - 30.00 (CL - ML) silty CLAY; bright reddish orange; highly micaceous; moist, soft.	CL-ML		28.50 296.70		**ANNULUS SEAL** Interval: 0.0-89.6 feet BGS Type: Bentonite Grout
30		30.00 - 35.00 (ML) SILT some clay, some sand; reddish brown, tan mottles; moist, soft.			30.00		**FILTER PACK SEAL** Interval: 89.6-93.1 feet BGS Type: Bentonite Chips
	295		ML				**FILTER PACK** Interval: 93.1-108.0 feet BGS Type: No. 2 Fitler Sand
							WELL SCREEN Interval: 98.0-108.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 108.0 feet BGS
35					291.70		
		35.00 - 37.75 (ML) SILT some clay, some sand; tan, reddish brown mottles; moist, soft.	ML		35.00		
	290						
					288.95		
		37.75 - 38.00 (ML) sandy SILT, trace clay; fine, well sorted; white - tan; moist, non-cohesive, loose.	ML		38.00		
40		38.00 - 43.00 (CL) silty CLAY, some sand; fine, well sorted; dark tan, occassional black laminations; highly micaceous; wet, soft - very soft.	CL				
	285						
					283.70		
		43.00 - 58.00 (CL) silty CLAY, trace sand; fine, well sorted; dark tan; highly micaceous; moist.			43.00		
45						Bentonite Grout	
	280		CL				
50							

Log continued on next page

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26S (OW-26S)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 108.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/24/26
DATE COMPLETED: 9/24/16

NORTHING: 3,781,781.03
EASTING: 11,548,679.74
GS ELEVATION: 326.70 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
50		43.00 - 58.00 (CL) silty CLAY, trace sand; fine, well sorted; dark tan; highly micaceous; moist. *(Continued)*	CL				**WELL CASING** Interval: 0.0-98.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread **WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4' Aluminum **ANNULUS SEAL** Interval: 0.0-89.6 feet BGS Type: Bentonite Grout **FILTER PACK SEAL** Interval: 89.6-93.1 feet BGS Type: Bentonite Chips **FILTER PACK** Interval: 93.1-108.0 feet BGS Type: No. 2 Fitler Sand **WELL SCREEN** Interval: 98.0-108.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 108.0 feet BGS
	275						
55							
	270				268.70		
		58.00 - 64.00 (CL) silty CLAY; fine, well sorted; dark tan; highly micaceous; moist.	CL		58.00		
60							
	265				262.70		
		64.00 - 68.00 (ML) SILT some clay; dull tannish gray; relict foliation features; moist, soft.	ML		64.00		
65							
	260				258.70		
		68.00 - 75.00 (ML) clayey SILT; brown, some tan and white; relict foliation features; moist, soft.	ML		68.00		
70							
	255						
75					251.70		

Log continued on next page

LOG SCALE: 1 in = 3.13 ft
DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus
PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26S (OW-26S)

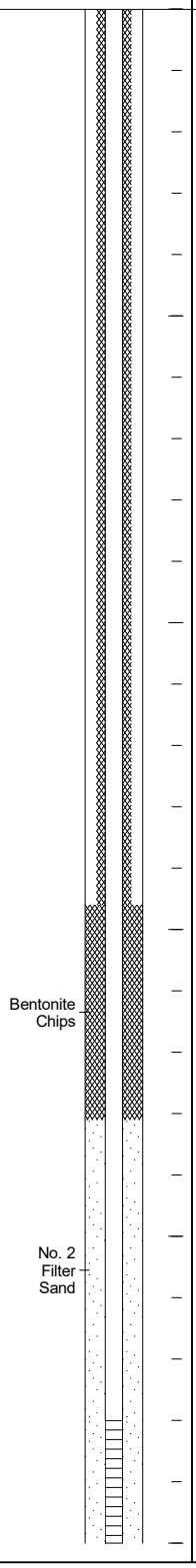
PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 108.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/24/26
DATE COMPLETED: 9/24/16

NORTHING: 3,781,781.03
EASTING: 11,548,679.74
GS ELEVATION: 326.70 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)
75		75.00 - 82.00 (ML) clayey SILT some sand; fine; brown, some tan and white; relict foliation features; moist, soft.	ML		75.00
	250				
80					
	245				244.70
		82.00 - 85.00 PHYLLITE; severely weathered; dull gray; silt matrix; moist - wet.			82.00
85					241.70
		85.00 - 85.50 QUARTZ; light gray; severely weathered; dry.			85.00 241.20
		85.50 - 86.00 PHYLLITE; severely weathered; greenish tan; silt matrix; moist - wet.			85.50 240.70
		86.00 - 87.00 PHYLLITE; severely weathered; greenish tan; silt matrix; dry.			86.00 239.70
	240	87.00 - 98.00 quartzofeldspathic - biotite SCHIST; white and black; heavily weathered, orange staining;			87.00
90					
	235				
95					
	230				
					228.70
		98.00 - 106.00 quartzofeldspathic - biotite SCHIST; white and black; moderately weathered;			98.00
100		Log continued on next page			

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

WELL CASING
Interval: 0.0-98.0 feet BGS
Material: Sch. 40 PVC
Diameter: 2-inch
Joint Type: Thread

WELL COMPLETION
Pad: 2'x2' Concrete
Protective Casing: 4"x4' Aluminum

ANNULUS SEAL
Interval: 0.0-89.6 feet BGS
Type: Bentonite Grout

FILTER PACK SEAL
Interval: 89.6-93.1 feet BGS
Type: Bentonite Chips

FILTER PACK
Interval: 93.1-108.0 feet BGS
Type: No. 2 Fitler Sand

WELL SCREEN
Interval: 98.0-108.0 feet BGS
Material: Sch. 40 PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: 108.0 feet BGS

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

RECORD OF BOREHOLE MW-26S (OW-26S)

PROJECT: Dominion - Bremo Power Station
PROJECT NUMBER: 15-20347.230.001
DRILLED DEPTH: 108.00 ft
DRILL METHOD: Sonic

DRILL RIG: Bort T-300
DATE STARTED: 9/24/26
DATE COMPLETED: 9/24/16

NORTHING: 3,781,781.03
EASTING: 11,548,679.74
GS ELEVATION: 326.70 ft

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
100		98.00 - 106.00 quartzofeldspathic - biotite SCHIST; white and black; moderately weathered; *(Continued)*					**WELL CASING** Interval: 0.0-98.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Joint Type: Thread
	225						
						0.010-inch Slot	**WELL COMPLETION** Pad: 2'x2' Concrete Protective Casing: 4"x4' Aluminum
105							**ANNULUS SEAL** Interval: 0.0-89.6 feet BGS Type: Bentonite Grout
					220.70		**FILTER PACK SEAL** Interval: 89.6-93.1 feet BGS Type: Bentonite Chips
		106.00 - 108.00 quartzofeldspathic - biotite SCHIST; white and black; heavily weathered, orange staining;			106.00		**FILTER PACK** Interval: 93.1-108.0 feet BGS Type: No. 2 Fitler Sand
	220						
					218.70		**WELL SCREEN** Interval: 98.0-108.0 feet BGS Material: Sch. 40 PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: 108.0 feet BGS
		Boring completed at 108.00 ft					
110							
	215						
115							
	210						
120							
	205						
125							

LOG SCALE: 1 in = 3.13 ft

DRILLING COMPANY: Cascade Drilling, L.P.
DRILLER: Fred Kraus

PREPARED: J. Kasperski
REVIEWED: Craig LaCosse, C.P.G.
DATE: 2/15/17

Golder Associates

APPENDIX B

EXAMPLE FORMS

Schnabel ENGINEERING

GROUNDWATER SAMPLING FIELD FORM

Site Name:	File Number:
Monitoring Well I.D.:	Date:

Well Information

Initial Water Level (TOC-ft):	Riser Pipe Diameter (in):
Well Depth (TOC-ft):	Well Volume (gal):

Equipment

	Dedicated		Nondedicated		Bladder Pump		Peristaltic Pump		Grundfos Pump		Bailer
	Other		WL Indicator		Controller Box		WQ Meter Model/SN:				

Decontamination for non-dedicated equipment:		Alconox + DI rinse		Isopropyl + DI rinse		Other:	

Purge Information

Purging Cycle Notes (flow, pressure, controller settings):

Time (3-5 min)	Temp (C)	pH (SU)	Conductivity (µS/cm)	DO (mg/L)	ORP (mV)	Turbidity (NTU)	DTW	Flow
Stabilization	*+/-0.1*	*+/- 0.1*	*+/- 3%*	*+/- 10% >0.5*	*+/- 10%*	*'+/- 10% < 10*	*+/- 0.3*	*ml/min*

Purge water volume and handling:

Date Sampled:	Time Sampled:	Field Filtered:		Yes		No

Sample Parameters:

QA/QC Samples Taken:

Comments:

Signature

Sampler (Print):	Sampler (signature):	Date:
QC Name (Print):	QC (signature):	Date:

Schnabel ENGINEERING

WELL GAUGING AND CONDITION FORM

Site Name and Location:	Project Number:
Field Personnel:	Date:

Well Information

Well ID	Time	DTW	DTB	Protective Casing	Inner Casing	Label	Lock	Pad
				☐ Acceptable ☐ Damaged	☐ Acceptable ☐ Damaged	☐ Acceptable ☐ Damaged	☐ Acceptable ☐ Damaged	☐ Acceptable ☐ Damaged
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Notes:

Signature

Sampler (Print):	Sampler (signature):	Date:
QC Name (Print):	QC (signature):	Date:

WATER QUALITY METER CALIBRATION LOG

File Number:	**Project Name:**
Instrument Make/Model:	**Serial Number:**

Well Information	Time	Calibration Standard	Concentration	Lot No.	Expire Date	Pre-Cal Reading	Post-Cal Reading	Calibration Technician Initials
		pH 7.0 (SU)						
		pH 4.0 (SU)						
		pH 10.0 (SU)						
		pH 7.0 (SU) Check Std					Reading is ± 0.1 ☐	
		Conductivity (µS/cm)						
		ORP (mV)						
		DO (mg/L)						
		Turb (NTU)						
Date	**Time**	**Calibration Standard**	**Concentration**	**Lot No.**	**Expire Date**	**Pre-Cal Reading**	**Post-Cal Reading**	**Calibration Technician Initials**
		pH 7.0 (SU)						
		pH 4.0 (SU)						
		pH 10.0 (SU)						
		pH 7.0 (SU) Check Std					Reading is ± 0.1 ☐	
		Conductivity (µS/cm)						
		ORP (mV)						
		DO (mg/L)						
		Turb (NTU)						
Date	**Time**	**Calibration Standard**	**Concentration**	**Lot No.**	**Expire Date**	**Pre-Cal Reading**	**Post-Cal Reading**	**Calibration Technician Initials**
		pH 7.0 (SU)						
		pH 4.0 (SU)						
		pH 10.0 (SU)						
		pH 7.0 (SU) Check Std					Reading is ± 0.1 ☐	
		Conductivity (µS/cm)						
		ORP (mV)						
		DO (mg/L)						
		Turb (NTU)						
Date	**Time**	**Calibration Standard**	**Concentration**	**Lot No.**	**Expire Date**	**Pre-Cal Reading**	**Post-Cal Reading**	**Calibration Technician Initials**
		pH 7.0 (SU)						
		pH 4.0 (SU)						
		pH 10.0 (SU)						
		pH 7.0 (SU) Check Std					Reading is ± 0.1 ☐	
		Conductivity (µS/cm)						
		ORP (mV)						
		DO (mg/L)						
		Turb (NTU)						
Date	**Time**	**Calibration Standard**	**Concentration**	**Lot No.**	**Expire Date**	**Pre-Cal Reading**	**Post-Cal Reading**	**Calibration Technician Initials**
		pH 7.0 (SU)						
		pH 4.0 (SU)						
		pH 10.0 (SU)						
		pH 7.0 (SU) Check Std					Reading is ± 0.1 ☐	
		Conductivity (µS/cm)						
		ORP (mV)						
		DO (mg/L)						
		Turb (NTU)						

Notes:
1. One duplicate analysis of a pH standard (typically 7.0) required per event; duplicate must be within 0.1 pH standard unit of calibrated reading;
2. pH calibrations must be performed in accordance with the 21st edition of the EPA Standard Method (SM) 4500-H+ B;
3. The temperature compensating thermometer for the pH meter must be verified annually in accordance with EPA SM 2550 B.1.

Pace® Location Requested (City/State):

CHAIN-OF-CUSTODY Analytical Request Document

Chain-of-Custody is a LEGAL DOCUMENT - Complete all relevant fields

LAB USE ONLY- Affix Workorder/Login Label Here

Scan QR Code for instructions

Company Name:	Contact/Report To:
Street Address:	Phone #:
	E-Mail:
	Cc E-Mail:
Customer Project #:	
Project Name:	Invoice To:
	Invoice E-Mail:
Site Collection Info/Facility ID (as applicable):	Purchase Order # (if applicable):
	Quote #:
Time Zone Collected: [ ] AK [ ] PT [ ] MT [ ] CT [ ] ET	County / State origin of sample(s): VA

Data Deliverables:

[ ] Level II [ ] Level III [ ] Level IV

[ ] EQUIS

[ ] Other _____

Regulatory Program (DW, RCRA, etc.) as applicable: Reportable [ ] Yes [ ] No

Rush (Pre-approval required):

[ ] Same Day [ ] 1 Day [ ] 2 Day [ ] 3 Day [ ] Other Normal_

DW PWSID # or WW Permit # as applicable:

Date Results Requested:

Field Filtered (if applicable): [ ] Yes [ ] No

Analysis:

* Matrix Codes (Insert in Matrix box below): Drinking Water (DW), Ground Water (GW), Waste Water (WW), Product (P), Soil/Solid (SS), Oil (OL), Wipe (WP), Tissue (TS), Bioassay (B), Vapor (V), Surface Water (SW),Sediment (SED), Sludge (SL), Caulk (CK), Leachate (LL), Biosolid (BS), Other (OT)

Specify Container Size **

Identify Container Preservative Type***

Analysis Requested

**Container Size: (1) 1L, (2) 500mL, (3) 250mL, (4) 125mL, (5) 100mL, (6) 40mL vial, (7) EnCore, (8) TerraCore, (9) 90mL, (10) Other

*** Preservative Types: (1) None, (2) HNO3, (3) H2SO4, (4) HCl, (5) NaOH, (6) Zn Acetate, (7) NaHSO4, (8) Sod. Thiosulfate, (9) Ascorbic Acid, (10) MeOH, (11) Other

Lab Use Only

Proj. Mgr:

AcctNum / Client ID:

Table #:

Profile / Template:

Prelog / Bottle Ord. ID:

Preservation non-conformance identified for sample.

Customer Sample ID	Matrix *	Comp / Grab	Composite Start Date	Composite Start Time	Collected or Composite End Date	Collected or Composite End Time	# Cont.	Res. Chlorine Results	Res. Chlorine Units	Sample Comment

Additional Instructions from Pace®:

Collected By: (Printed Name)

Signature:

Customer Remarks / Special Conditions / Possible Hazards:

# Coolers:	Thermometer ID:	Correction Factor (°C):	Obs. Temp. (°C)	Corrected Temp. (°C)	On Ice:

Relinquished by/Company: (Signature)	Date/Time:	Received by/Company: (Signature)	Date/Time:

Tracking Number:

Delivered by: [ ] In- Person [ ] Courier

[ ] FedEX [ ] UPS [ ] Other

Page: **of**