APPENDIX I – SEEP INVESTIGATION

APPENDIX I.1

SEEP SAMPLING AND ANALYSIS REPORT

Cumberland Fossil Plant Seep Sampling and Analysis Report

TDEC Commissioner's Order:
Environmental Investigation Plan
Cumberland Fossil Plant
Cumberland City, Tennessee

April 9, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee

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Revision Record

Revision	Description	Date
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Sign-off Sheet

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Abbreviations

AOC	Area of Concern
AOI	Area of Interest
CUF Plant	Cumberland Fossil Plant
CCR	Coal Combustion Residuals
CCR Parameters	Constituents listed in Appendices III and IV of 40 CFR 257 and five inorganic constituents included in Appendix I of Tennessee Rule 0400-11-01-.04
CFR	Code of Federal Regulations
COC	Chain of Custody
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
EnvStds	Environmental Standards, Inc.
ENV	TVA's Environmental
FSP	Field Sampling Personnel
GPS	Global Positioning System
ID	Identification
IDW	Investigation Derived Waste
PPE	Personal Protective Equipment
QAPP	Quality Assurance Project Plan
QC	Quality Control
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order OGC15-0177
TI	Technical Instruction
TVA	Tennessee Valley Authority

1.0 INTRODUCTION

Stantec Consulting Services Inc. (Stantec) prepared this sampling and analysis report (SAR) on behalf of the Tennessee Valley Authority (TVA) to document the results of a seep investigation performed October 1, 2019 through March 18, 2020 at TVA's Cumberland Fossil Plant (CUF Plant) located in Cumberland City, Tennessee.

The purpose of the seep investigation was to collect information regarding the potential presence of active seeps at the CUF Plant in support of fulfilling the requirements for the Tennessee Department of Environment and Conservation (TDEC) Commissioner's Order No. OGC15-0177 (TDEC Order) issued to TVA (TDEC 2015). The TDEC Order sets forth a "process for the investigation, assessment, and remediation of unacceptable risks" at TVA's coal ash disposal sites in Tennessee.

The purpose of this SAR is to document the work completed during the seep investigation and to present the information and data collected during the execution of the Seep Sampling and Analysis Plan (SAP) (Stantec 2018a). This SAR includes a statistical evaluation of the water quality measurement data collected during the seep investigation at the CUF Plant. The results of this evaluation were used to determine whether additional investigation and/or sampling were warranted. This SAR is not intended to provide conclusions or evaluations of seep investigation soil or water analytical results when collected. The scope of the seep investigation represented herein was conducted pursuant to the SAP and is part of a larger environmental investigation at the CUF Plant. The evaluation of the results will consider other aspects of the environmental investigation, as well as data collected under other State and/or coal combustion residuals (CCR) programs and will be presented in the Environmental Assessment Report (EAR). The seep investigation activities were performed at the CUF Plant in general accordance with the following documents developed by TVA to support fulfilling the requirements of the TDEC Order:

- *Seep SAP* (Stantec 2018a)
- *Environmental Investigation Plan (EIP)* (Stantec 2018b)
- *Quality Assurance Project Plan (QAPP)* (Environmental Standards, Inc. 2018).

The seep investigation was implemented in accordance with TVA- and TDEC-approved Programmatic and Project-specific changes. Minor variances in scope and procedures from those outlined in the Seep SAP occurred during field activities due to field conditions and programmatic updates and are referenced in Section 3.9.

The seep investigation consisted of inspecting accessible areas by foot or vehicle; investigating inaccessible areas (i.e., structural mitigation areas covered by riprap) by boat; observing exposed shoreline in areas where historical seep locations could only be accessed by boat; collecting soil and water samples associated with potentially active seeps, referred to herein as areas of interest (AOIs); and conducting weekly inspections at one of the identified AOIs.

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Inspections of accessible areas allowed for the identification of potentially active seeps and additional monitoring and/or sampling as warranted. Investigation of inaccessible areas involved collection of water quality parameter measurements using a multi-parameter sonde and following protocols approved by TDEC. The sonde measurements were evaluated using statistical methods to identify potentially active seeps located in the riprap-covered areas. Additional Quality Assurance oversight on data acquisition protocols, sampling practices, and data validation or verification was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.

2.0 OBJECTIVE AND SCOPE

The primary objective of the seep investigation conducted pursuant to the Seep SAP at the CUF Plant in response to the TDEC Order was to identify and collect information regarding the potential presence of active seeps. The approach for the seep investigation was to:

- Identify active seeps/AOIs in accessible areas, if any
- Collect water and soil samples at the AOIs, if feasible, per TVA and TDEC onsite observations for analysis of CCR-related constituents
- Collect water quality parameters (pH, temperature, dissolved oxygen (DO), and specific conductance) in surface water in inaccessible areas (i.e., riprap covered) adjacent to historically identified seeps, area of concern (AOC), and a recently identified AOI where soil and water sampling to assess whether active seeps exist was not possible due to accessibility restrictions
- Conduct statistical analysis of the water quality parameter data to assess whether there was a potential for active seeps to exist in the inaccessible areas and whether additional investigation and/or sampling were warranted.

The scope of the seep investigation activities included:

- Visually inspecting accessible areas to identify AOIs and locations for additional investigation, if warranted
- Documenting the locations of identified AOIs using a sub-meter global positioning system (GPS) and plotting them on maps
- Collecting field measurements of water quality parameters (pH, temperature, DO, and specific conductance) in areas adjacent to historical seep locations/AOC/AOI below the perimeter ditch that were inaccessible due to riprap or dense vegetation. Measurements were collected by boat in Wells Creek and in two of a series of ponds (referred to as Ponds 3A and 3B for the seep investigation) of the Unnamed Tributary which occasionally discharges to Wells Creek during high flow
- Collecting water and soil samples at one of the identified AOIs for analysis of CCR-related constituents
- Conducting statistical analysis of the water quality parameter data to determine if there are statistically significant differences between monitoring results collected “adjacent to” and “upstream of” historical seep locations, AOCs or AOIs and to determine if additional investigation and/or sample collection were warranted in those areas
- Conducting weekly observations at one of the identified AOIs.

3.0 FIELD ACTIVITIES

Seep investigation field activities at the CUF Plant were conducted October 1, 2019 through March 18, 2020. Stantec performed field activities based on guidance and specifications in TVA's Environmental (ENV) Technical Instructions (TIs), the Seep SAP, and the QAPP except as noted in the Variations section of this report. As part of TVA's commitment to generate representative and reliable data, data validation and/or verification of laboratory analytical results were performed by EnvStds under direct contract with TVA. EnvStds also provided quality reviews of field documentation.

During the seep investigation, Stantec conducted the following field activities:

- Visually inspected areas accessible by foot or vehicle with TVA, TDEC, and Georgia Pacific (adjacent property owner) to identify AOI locations
- Documented the locations of AOIs and water quality parameter measurements using a sub-meter GPS and plotted them on maps
- Measured surface water quality parameters (pH, temperature, DO, and specific conductance) using a boat upstream, adjacent to, and downstream from historical seep/AOC locations below the perimeter ditch that were inaccessible due to structural mitigation (e.g., limestone riprap). Recorded field measurements of water quality parameters at 124 measurement locations
- Observed exposed shoreline between the riprap and water line by boat at inaccessible historical seep locations to visually identify active seeps/AOIs
- Collected one soil sample and one water sample for laboratory analysis at one of the AOIs identified during the accessible area inspection
- Collected field quality control (QC) samples, including: two duplicates (one soil sample and one water sample), two field blanks, one equipment blank, one tubing blank, and one filter blank
- Conducted weekly observations over approximately a six-month period at one of the AOIs.

Details of each activity are presented in the following sections. Historical seep locations, water quality parameter measurement locations and AOI locations are provided in Appendix A, on Exhibits A.1 through A.3. Summaries of the water quality parameter measurement data, AOI soil and water sample information and results, and weekly AOI observations are tabulated in Appendix B and described further below. Photographs of site conditions are provided in Appendix C. Statistical analysis methods and results for the water quality parameter data are provided in Appendix D.

3.1 ACCESSIBLE AREA INSPECTION

An inspection of areas accessible by foot or vehicle was conducted on October 1, 2019 to identify AOIs and potential soil and water sample locations. Representatives from TDEC, TVA, Georgia Pacific, and TVA's subconsultants accompanied Stantec personnel during the visual walkdown. The following AOIs and observations were recorded and included:

- AOI1 – change in vegetation (common reed) at the southeastern toe of the Gypsum Storage Area; visual observations were obscured due to dense vegetation, but no signs of wetness or discoloration were noted. TDEC requested that water quality measurements be taken adjacent to this location
- AOI2 – change in vegetation (common reed) and clear flowing water approximately 50 feet downslope of riprap at historical seeps 2 and 15 south of the Gypsum Storage Area and adjacent to Wells Creek
- Historical Seeps 4 and 5 – change in vegetation (common reed) in the riprap area east of the Gypsum Storage Area, located below the perimeter ditch and adjacent to Ponds 3A and 3B of the "Unnamed Tributary" which occasionally discharges to Wells Creek during high flow; no signs of wetness or discoloration were noted
- Historical Seep 6 – riprap area south of the Gypsum Storage Area below the perimeter ditch and adjacent to Pond 1 of the unnamed tributary; no signs of wetness or discoloration were noted
- Historical Seep 14 – riprap area west of Dry Ash Stack, located below the perimeter ditch and adjacent to Wells Creek; no signs of wetness or discoloration were noted
- No other areas of wetness, vegetation change or discoloration were noted during the accessible area inspection or by boat at the other historical seep/AOC locations below the perimeter ditch and adjacent to the CCR units along Wells Creek or the unnamed tributary shown on Exhibits A.1 through A.3 in Appendix A.

AOI2 was identified during the accessible area inspection for collection of water and soil samples for laboratory analysis, per TVA and TDEC onsite observations. No samples were collected at AOI1 because of inaccessibility due to dense vegetation and no areas of wetness/flow or discoloration were observed by boat in this area.

3.2 INACCESSIBLE AREA INSPECTION AND WATER QUALITY PARAMETER MEASUREMENTS

To evaluate potential seeps not visible due to structural mitigation areas (e.g., riprap for shoreline scour protection) or not accessible due to steep terrain, a boat was used by TVA and Stantec field sampling personnel (FSP) to access locations near the banks of Wells Creek and a series of ponds (Ponds 3A and 3B) of the unnamed tributary to Wells Creek. Water quality parameters were measured by boat near the historical seeps/AOC 1 located below the perimeter ditch (historical seeps 4, 5, and 14) and AOI1 that

was identified during the accessible area inspection. The water quality parameters were measured in surface water upstream, adjacent to, and downstream of the historical seep/AOC/AOI locations defined below with a multi-parameter sonde. The locations of the water quality parameter measurements are shown on Exhibits A.1, A.2 and A.3 in Appendix A.

3.2.1 Water Quality Parameter Measurements and Locations

Water quality parameters (pH, specific conductance, temperature and DO) were recorded by Stantec FSP associated with one AOI location, one AOC location and three historical seep locations near the banks of Wells Creek and the unnamed tributary to Wells Creek. The measurement locations are shown on Exhibits A.1 through A.3 in Appendix A, and the water quality parameter results are included on Table B.1 in Appendix B.

Water quality parameter measurements associated with AOI1, AOC 2 and the three historical seep locations include the following locations:

Unnamed Tributary to Wells Creek (Ponds 3A and 3B):

- Historical Seep Locations 4 & 5 (HS45): Because of their close proximity, the areas for these historical seep locations were combined (referred to as a “cluster”) into a single dataset for the statistical evaluation following field activities. Parameter measurements #1 to #45 were taken at locations CUF-HS45-D-1 to CUF-HS45-U-45 downstream, adjacent, and upstream of cluster HS45
- AOI1: parameter measurements #46 to #60 were taken at locations CUF-AOI1-A-46 to CUF-AOI1-A-60 adjacent to AOI1. (Note that the downstream locations for HS45 described above represent upstream locations for AOI1.)

Wells Creek:

- Historical Seep Location 14 (HS14): parameter measurements #61 to #95 were taken at locations CUF-HS14-D-61 to CUF-HS14-U-95 downstream, adjacent, and upstream of HS14.
- AOC1: parameter measurements #96 to #124 were taken at locations CUF-AOC1-D-96 to CUF-AOC13-U-124 downstream, adjacent, and upstream of AOC1.

Water quality parameter measurements were not taken at historical seep locations A, 1, 3, 7, 8, 9, 10, 11, 12, and 13 because these locations are above the perimeter dike, and any seepage is captured by the perimeter drainage ditch and routed to the Bottom Ash Pond, which discharges via the NPDES outfall. Water quality parameter measurements were not taken at historical seep locations below the perimeter dike (historical seeps 6 and 15) because the banks in these areas were exposed between the riprap and waterline, and no active seeps were observed by boat. Historical seep locations 16 and 17 are not located adjacent to surface water. Upstream control and intermediate area water quality parameter measurements were not conducted for the CUF seep investigation because no suitable upstream areas were identified, and no intermediate areas were observed within the riprap areas, respectively.

3.3 DOCUMENTATION

Stantec planned the seep investigation activities per ENV-TI-05.08.01, *Planning Sampling Events* and maintained field documentation in general accordance with ENV-TI-05.80.03, *Field Record Keeping,* ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*, the SAP, and the QAPP. Field activities and data were recorded on program-specific field forms. Health and safety forms were completed in accordance with TVA and Stantec health and safety requirements. Additional information regarding field documentation is provided below.

3.3.1 Field Forms

Stantec FSP used program-specific field forms to record field observations and data for specific activities. Field forms used during the seep investigation included:

- *Daily Field Activity Log*
- *Seep Investigation Inspection Log*
- *Equipment Calibration Form*
- *Seep Investigation/Surface Stream Field Parameter Measurement Form*
- *Soil pH Calibration and Inspection Log*
- *Seep Investigation – Sample Collection Form*
- *Chain-of-Custody (COC)*
- *Area of Interest Observations – Weekly Field Log.*

3.3.1.1 Daily Field Activity Logs

Stantec FSP recorded field team members, field activities, observations, and data on a *Daily Field Activity Log* to chronologically document the field program. Deviations from the SAP, TIs, or QAPP were also documented on the Daily Field Activity Log.

3.3.1.2 Seep Investigation Inspection Log

Stantec staff used the *Seep Investigation Inspection Log* to document the presence of AOIs and field observations during the accessible area inspection. The form documented the AOI identification; latitude and longitude coordinates of the AOI recorded by GPS at the time of the inspection; size of the AOI; date and time of the AOI inspection; and general comments/observations.

3.3.1.3 Equipment Calibration Form

Stantec FSP performed daily calibration of the water quality meter and documented the results on an *Equipment Calibration Log*. The form documented the calibration results for temperature, specific

conductance, pH, and DO and verified that the field instrument's sensors were operating within acceptance criteria. Refer to Section 3.4 for additional details on equipment calibration procedures.

3.3.1.4 Seep Investigation/Surface Stream Field Parameter Measurement Form

Stantec FSP recorded water quality parameters in accordance with ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde* on a *Seep Investigation/Surface Stream Field Parameter Measurement Form*. The form documented the AOI; location type (Historical Seep, AOC); measurement location (upstream, downstream, or adjacent); measurement identification; latitude and longitude coordinates recorded by GPS at the time of measurement; date; time; pH; temperature; specific conductance; DO; presence of riprap; and general comments/observations.

3.3.1.5 Soil pH Calibration and Inspection Log

Stantec FSP recorded daily soil pH meter calibration information on a *Soil pH Calibration and Inspection Log* on days that soil samples were collected. The log documented temperature, temperature verification, temperature-adjusted calibration values, post-calibration pH values, and calibration solution details. Additional information on equipment calibration is provided in Section 3.4.

3.3.1.6 Seep Investigation – Sample Collection Form

Stantec FSP recorded soil and water sample collection information on a *Seep Investigation – Sample Collection Form*. The form documented the AOI where the samples were collected; sample identification; sample latitude and longitude coordinates recorded by GPS at the time of sampling; sample type (soil or water); sample date and time; sample collection method; pH readings; and general comments and observations.

3.3.1.7 Chain of Custody

Stantec FSP completed *COC* documentation for each soil and water sample collected. The sample identification (ID), sample location, type of sample, sampling date and time, analyses requested, and sample custody record were recorded on the *COC*. The Field Team Leader reviewed the *COC* for completeness, and the FSP conducted a QC check of samples in each cooler compared to sample IDs on the corresponding *COC*. *COCs* were completed in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*.

3.3.1.8 Area of Interest Observations – Weekly Field Log

Stantec FSP recorded conditions at AOI2 on an *Area of Interest Observations – Weekly Field Log*, as requested by TVA and/or TDEC. The form documented the AOI identification; AOI latitude and longitude coordinates; date and time of observations; rainfall amount and intensity over the previous 24 hours; whether water had been applied in the area and when; water flow rate at the AOI (if present); photograph reference; and observations on the presence of shallow standing water, staining, and other general ground surface conditions.

3.4 EQUIPMENT CALIBRATION

The multi-parameter sonde used to collect, generate, or measure water quality parameters was calibrated each day prior to use as specified in the SAP, QAPP, and ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde.* Afternoon calibration verifications were performed to evaluate if the instrument remained within acceptance criteria during data collection. Temperature and barometric pressure instrument readings were verified using a calibrated National Institute of Standards and Technology traceable thermometer, and National Weather Service (via mesowest.utah.edu) barometric pressure readings for Clarksville Outlaw Field, Clarksville, Tennessee, respectively. Additional details regarding equipment calibration were recorded on the Equipment Calibration Form, as described in Section 3.3.1.3.

The soil pH meter was calibrated each day prior to use as specified by the SAP, QAPP, and Stantec Standard Operating Procedure – Rev 1 for the ExTech Exstik 110 meter (Stantec 2018c). Temperature was recorded using a calibrated National Institute of Standards and Technology traceable thermometer. Additional details regarding equipment calibration were recorded on the *Soil pH Calibration and Inspection Logs* as described in Section 3.3.1.5.

3.5 WATER QUALITY PARAMETER DATA COLLECTION

Stantec FSP collected field measurements of water quality parameters in Wells Creek, and in the unnamed tributary to Wells Creek including:

- pH (in Standard Units)
- Specific conductance (in microSiemens per centimeter)
- DO (in milligrams per Liter)
- Temperature (in degrees Celsius).

Stantec FSP collected the measurements using a water quality meter (YSI ProPlus) at 124 locations in Wells Creek, and the unnamed tributary (Ponds 3A and 3B) over a three-day period, October 1 through October 3, 2019. The measurement locations were identified using GIS coordinates on maps in advance of field activities. Water quality parameters were measured as close to the bank as possible immediately downstream, adjacent to, and upstream of each identified location as described in Section 3.2.1. Measurements were collected from a boat beginning at downstream locations and moving upstream for the targeted historical seep/AOC/AOI locations to minimize disturbance of water and sediment at the measurement location. Final measurement location coordinates were documented in the field using GPS.

Measurements, associated locations, field activities and notable observations were documented on electronic field forms described in Section 3.3.1. A summary of the water quality parameter results at the 124 measurement locations are provided in Table B.1 in Appendix B. Statistical analysis of the water quality parameter data is provided in Appendix D.

3.6 AREA OF INTEREST SAMPLE COLLECTION

As described in Section 3.1, two AOIs were identified during the accessible area inspection. After additional observations by boat, no soil or water samples were obtained from AOI1 because of inaccessibility due to dense vegetation and the lack of a visible active flow, wetness or discoloration in the area when observed by boat. Soil and water samples were collected on October 3, 2019 at AOI2. Soil and water sampling were conducted in accordance with the Seep SAP, QAPP, and applicable TVA TIs. Soil and water sampling information is provided in Appendix B, including a list of the samples collected at AOI2 in Table B.2, soil sample data results in Tables B.3 and B4, water sample data results in Table B.5, and soil and water field parameter results in Table B.6.

3.6.1 Soil Sampling

Soil samples were collected at AOI2 in accordance with ENV-TI-05.80.50, *Soil and Sediment Sampling* and ENV-TI-05.80.04, *Field Sampling Quality Control*. Soil samples were collected from saturated surface soils at the accessible location at AOI2. Each soil sample consisted of a five-point composite from locations spatially distributed within the saturated soil area. Soil samples were collected from depths about four inches below ground surface, with approximately equal amounts of soil collected from each of the five locations comprising the composite sample. The collected soil was placed in clean, resealable plastic bags and homogenized using gloved hands and when necessary clean, unused, disposable, or properly decontaminated sampling tools. Once the sample was sufficiently homogenized, an aliquot of the homogenized sample and deionized (DI) water was used to create a soil paste for measurement of the soil pH with the ExTech Exstik 110 pH meter according to Stantec Operating Procedure – Rev 1 (Stantec 2018c). The measurements were recorded on the *Seep Investigation – Sample Collection Form* within 15 minutes after creating the soil paste.

Afterwards, the soil sample was placed in an appropriate laboratory-supplied sample jar. Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*. FSP secured caps on each bottle and attached a custody seal across the cap before placing the sample container in a cooler with ice (within 15 minutes of sample collection) for shipment to the laboratory.

The samples were analyzed for CCR-related constituents listed in Appendices III and IV of Title 40 of the Code of Federal Regulations (CFR) Part 257 (40 CFR 257). In addition, five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04 and not included in the 40 CFR 257 Appendices III and IV were analyzed to maintain continuity with the TDEC environmental programs. These additional TDEC Appendix I constituents included copper, nickel, silver, vanadium, and zinc. The combined federal CCR Appendices III and IV constituents and TDEC Appendix I inorganic constituents are referred to as “CCR Parameters.” Summaries of the AOI soil sample laboratory results are provided in Tables B.3 and B.4. Field pH values for the soil samples are provided in Table B.6.

3.6.2 Water Sampling

Water samples were collected in accordance with TDEC-approved methods in the SAP and ENV-TI-05.80.04, *Field Sampling Quality Control*. Water samples were collected at AOI2 for analysis of CCR Parameters. Due to insufficient sample volume, water samples were not collected for radiological analysis, in accordance with the water sampling prioritization in the SAP.

Water samples were collected by using a peristaltic pump with new tubing to collect the water samples into the laboratory-provided sample containers. Due to the expected high turbidity of the water samples, a second sample was field filtered using a peristaltic pump and a new, certified clean 0.45-micron filter and placed in an appropriate laboratory-supplied and preserved sampling container for analysis of dissolved metal constituents. A calibrated sonde meter was used to collect pH data for each water sample. The measurements were recorded on the *Seep Investigation – Sample Collection Form.*

Sample containers were labeled and handled in accordance with ENV-TI-05.80.02, *Sample Labeling and Custody*. FSP secured caps on each bottle and attached a custody seal across the cap before placing the sample container in a cooler with ice (within 15 minutes of sample collection) for shipment to the laboratory. The samples were analyzed for CCR Parameters, except as detailed above. A summary of the AOI water sample laboratory results is provided in Table B.5. Field parameter values for the water samples are provided in Table B.6.

3.6.3 Sample Shipment

Samples were packed and shipped under *COC* procedures as required by ENV-TI-05.80.06, *Handling and Shipping of Samples* and ENV-TI-05.80.02, *Sample Labeling and Custody*. The soil and water samples were shipped to TestAmerica, Inc. in Pittsburgh, Pennsylvania. The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.7 AOI OBSERVATIONS

Flowing water was observed at AOI2 during the October 1, 2019, Accessible Area Inspection. Subsequently, site conditions were observed approximately weekly at this location from October 15, 2019 through March 18, 2020. During the observations, the following items were documented:

- Rainfall amount and intensity over the previous 24-hour period
- Presence/absence of shallow standing water
- Presence/absence of soil staining
- Water flow rate (if present)
- General observations
- Weekly TVA rain gauge data.

Data from the *Area of Interest Observations – Weekly Field Log Form* are summarized on Table B.7 in Appendix B.

3.8 INVESTIGATION DERIVED WASTE

Investigation derived waste (IDW) generated during Seep Investigation activities included:

- Used calibration solutions
- Decontamination fluids
- Spent DI water
- Disposable personal protective equipment (PPE)
- General trash.

IDW was handled in accordance with ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*; the CUF Plant-specific waste management plan; and local, state, and federal regulations. Transportation and disposal of IDW was coordinated with TVA Plant personnel. Used calibration solution, spent DI water and decontamination fluids were containerized for later disposal as directed by the CUF Plant facility management. Used disposable PPE and general trash generated throughout the day were placed in garbage bags and disposed of in a general trash dumpster onsite at the end of each day.

3.9 VARIATIONS

The proposed scope and procedures for the seep investigation were outlined in the SAP, QAPP, and applicable TVA TIs, as detailed in the sections above. Variations in scope or procedures discussed with TDEC and/or TVA, and changes based on field conditions are described in the following sections. As discussed below, these variations do not impact the overall usability and representativeness of the dataset provided in this SAR for the seep investigation at the CUF Plant.

3.9.1 Variations in Scope

Variations in scope are provided below:

- TVA and TDEC agreed that the water quality measurements would be taken adjacent to AOI1 and soil and water samples would not be collected at this location because of dense vegetation and the lack of a visible flow/wetness/discoloration in the area.
- During the accessible area inspection, TDEC concurred that where the banks were exposed between the riprap and water line at historical seep locations below the perimeter dike and were inaccessible due to dense vegetation, historical seep locations 2, 6, and 15, could be assessed visually from the boat or shore rather than conducting water quality measurements.

- No upstream control water quality parameter measurements were collected as no suitable upstream areas with riprap were identified.

3.9.2 Variations in Procedures

The proposed methodology of the Seep Investigation was outlined in the SAP, QAPP, and applicable TVA TIs as detailed in the sections above. No deviations from these procedures were documented on the field forms.

4.0 STATISTICAL ANALYSIS OF WATER QUALITY PARAMETER MEASUREMENTS

A statistical analysis of water quality parameter data collected in surface water adjacent to the CUF Plant was conducted as part of the seep investigation. The statistical analysis was used to evaluate whether there are statistically significant differences between monitoring results collected adjacent to and upstream of historical seep, AOC, and AOI locations. The statistical methods used in this analysis and the analysis results are provided in Appendix D.

The statistical analysis results indicate that there were no locations where all four parameters (pH, temperature, DO, and specific conductance) indicated statistically significant differences when compared with upstream locations. Therefore, no additional AOIs associated with the historical seeps and AOC were identified in inaccessible (i.e., riprap-covered) areas at the CUF Plant for further investigation or data collection.

5.0 SUMMARY

The data presented in this report are from the seep investigation at the CUF Plant. The scope of the seep investigation included:

- Visually inspecting accessible areas to identify potential active seeps and locations for additional investigation, if warranted.
- Visually inspecting historical seep locations below the perimeter dike with exposed banks between the riprap and water to identify potential active seeps and locations for additional investigation, if warranted.
- Collecting water quality parameters in Wells Creek, and the unnamed tributary to Wells Creek (Ponds 3A and 3B) adjacent to identified historical seep/AOC locations and AOI1 that were inaccessible due to riprap or dense vegetation.
- Conducting statistical analysis of the water quality parameter data to assess whether there was a potential for AOIs to exist in the inaccessible areas, and whether additional investigation and/or sampling were warranted.

Two AOIs were identified during the visual walkdown inspection of accessible areas, based on TVA and TDEC onsite observations. Water quality parameter measurements (pH, specific conductance, DO, and temperature) were taken at 124 locations along the banks of Wells Creek and the unnamed tributary to Wells Creek (Ponds 3A and 3B) associated with three historical seeps, one AOC, and one AOI location. These water quality parameter results are presented in Table B.1 in Appendix B.

Based on statistical analysis of the water quality parameter data collected near the identified historical seep/AOC/AOI locations, there were no locations where all four parameters indicated statistically significant differences when compared with upstream locations. Therefore, no AOIs associated with historical seeps/AOC 1 were identified at the CUF Plant in the inaccessible areas or at AOI1 for further investigation or data collection.

One soil sample and one water sample were collected at AOI2 for analysis of CCR Parameters during the CUF Plant seep investigation, except as identified above. Soil and water sampling information is provided in Appendix B, including a list of the samples collected in Table B.2, soil sample data results in Tables B.3 and B.4, water sample data results in Table B.5, and field pH results in Table B.6.

Flowing water was observed at AOI2 during the October 1, 2019, Accessible Area Inspection. Subsequently, site conditions were observed approximately weekly at AOI2 from October 15, 2019 through March 18, 2020. A summary of the observations is presented in Table B.7 in Appendix B.

Stantec has completed the seep investigation at the CUF Plant in Cumberland City, Tennessee, in accordance with the Seep SAP as documented herein. The data collected during the investigation are usable for reporting and evaluation in the EAR and meet the objectives of the TDEC Order EIP. The complete dataset from this event will be evaluated along with data collected under other TDEC Order SAPs, as well as data collected under other State and CCR Programs. This evaluation will be provided in the EAR.

6.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Cumberland Fossil Plant Environmental Investigation*. Prepared for Tennessee Valley Authority. Revision 2. January 2018.

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Stantec. 2018c. Standard Operating Procedures (SOP) - Rev 1 for the ExTech Exstik 110 meter. September 5, 2018.

Tennessee Department of Environment and Conservation. 2015. *Commissioner's Order No. OGC15-0177.*

Tennessee Valley Authority (TVA). ENV-TI-05.08.01, *Planning Sampling Events*.

TVA. ENV-TI-05.80.02, *Sample Labeling and Custody*.

TVA. ENV-TI-05.80.03, *Field Record Keeping*.

TVA. ENV-TI-05.80.04, *Field Sampling Quality Control.*

TVA. ENV-TI-05.80.05, *Field Sampling Equipment Cleaning and Decontamination*.

TVA. ENV-TI-05.80.06, *Handling and Shipping of Samples.*

TVA. ENV-TI-05.80.46, *Field Measurement Using a Multi-Parameter Sonde*.

TVA. ENV-TI-05.80.50, *Soil and Sediment Sampling.*

APPENDIX A - EXHIBITS

Exhibit No.

A.1

Title

Water Quality Parameter Measurement Locations - Overview

Client/Project

Tennessee Valley Authority
Cumberland Fossil (CUF) Plant TDEC Order

Project Location

Stewart County, Tennessee

175568209

Prepared by MB on 2021-04-05
Technical Review by HW on 2021-04-05

0 300 600 900 1,200 Feet

1:3,600 (At original document size of 22x34)

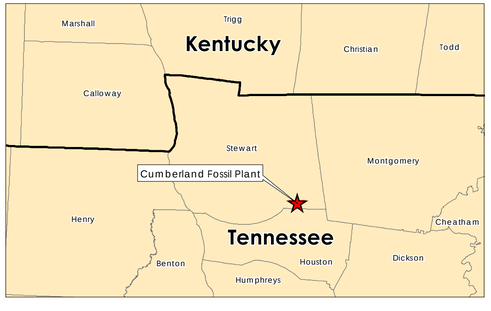
Legend

Measurement Locations

- Adjacent (A)
- Downstream (D)
- Upstream (U)
- Area of Interest (AOI)/Area of Concern (AOC) Location
- Seepage Area Above Perimeter Ditch
- Seepage Area Below Perimeter Ditch
- 2019 Imagery Boundary
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (c. 2017) and TVA (3/6/2019 and 12/11/2019)



Stantec TVA

Exhibit No.

A.2

Title

Water Quality Parameter Measurement Locations - Western Detail

Client/Project

Tennessee Valley Authority
Cumberland Fossil (CUF) Plant TDEC Order

Project Location

Stewart County, Tennessee

175568209

Prepared by MB on 2021-01-06
Technical Review by HW on 2021-01-06

0 100 200 300 400 Feet

1:1,200 (At original document size of 22x34)

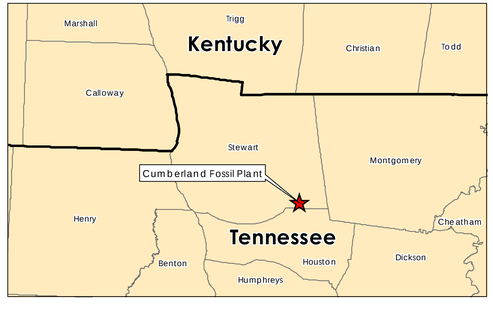
Legend

Measurement Locations

- Adjacent (A)
- Downstream (D)
- Upstream (U)
- Area of Interest (AOI)/Area of Concern (AOC)
- Seepage Area Below Perimeter
- 2019 Imagery Boundary
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (c. 2017) and TVA (3/6/2019 and 12/11/2019)



Stantec TVA

Exhibit No.

A.3

Title

Water Quality Parameter Measurement Locations - Eastern Detail

Client/Project

Tennessee Valley Authority
Cumberland Fossil (CUF) Plant TDEC Order

Project Location

Stewart County, Tennessee

175568209

Prepared by MB on 2021-04-05
Technical Review by HW on 2021-04-05

0 100 200 300 400 Feet

1:1,200 (At original document size of 22x34)

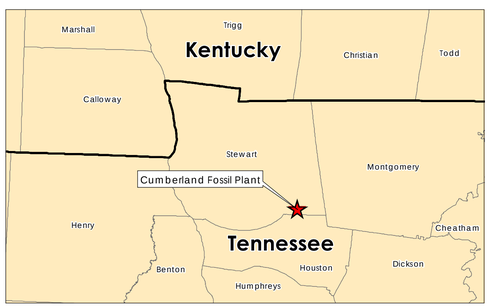
Legend

Measurement Locations

- Adjacent (A)
- Downstream (D)
- Upstream (U)
- Area of Interest (AOI)/Area of Concern (AOC) Location
- Seepage Area Above Perimeter Ditch
- Seepage Area Below Perimeter Ditch
- 2019 Imagery Boundary
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (c. 2017) and TVA (3/6/2019 and 12/11/2019)



Stantec TVA

APPENDIX B - TABLES

TABLE B.1 - Summary of Water Quality Parameter Results
Cumberland Fossil Plant
October 2019

Measurement ID	Measurement Date	Dissolved Oxygen	pH (field)	Specific Cond (Field)	Temperature, Water (C)
		mg/L	SU	uS/cm	DEG C
CUF-HS45-D-1	1-Oct-19	5.6	7.97	2020	23.8
CUF-HS45-D-2	1-Oct-19	6.8	7.48	2015	23.8
CUF-HS45-D-3	1-Oct-19	5.8	7.17	2092	23.3
CUF-HS45-D-4	1-Oct-19	4.2	7.15	2068	23.4
CUF-HS45-D-5	1-Oct-19	4.8	7.27	2091	23.9
CUF-HS45-D-6	1-Oct-19	5.2	7.30	1988	23.2
CUF-HS45-D-7	1-Oct-19	4.0	7.19	2048	23.4
CUF-HS45-D-8	1-Oct-19	5.6	7.23	2068	23.3
CUF-HS45-D-9	1-Oct-19	5.5	7.12	1925	23.1
CUF-HS45-D-10	1-Oct-19	3.7	7.15	2063	23.1
CUF-HS45-D-11	1-Oct-19	6.0	7.29	2053	23.8
CUF-HS45-D-12	1-Oct-19	5.9	7.20	2070	23.2
CUF-HS45-D-13	1-Oct-19	5.4	7.13	2297	24.4
CUF-HS45-D-14	1-Oct-19	6.1	7.31	1903	24.7
CUF-HS45-D-15	1-Oct-19	0.5	7.00	2079	23.5
CUF-HS45-D-16	1-Oct-19	0.8	6.92	2092	24.2
CUF-HS45-A-17	1-Oct-19	3.9	7.05	2073	23.8
CUF-HS45-A-18	1-Oct-19	0.1	6.97	2074	24.6
CUF-HS45-A-19	1-Oct-19	0.1	6.93	1969	24.0
CUF-HS45-A-20	1-Oct-19	0.0	6.88	2069	24.2
CUF-HS45-A-21	1-Oct-19	0.1	6.92	2090	24.1
CUF-HS45-A-22	1-Oct-19	0.6	6.93	2072	24.1
CUF-HS45-A-23	1-Oct-19	0.0	6.93	2099	24.7
CUF-HS45-A-24	1-Oct-19	0.2	6.99	2072	24.1
CUF-HS45-A-25	1-Oct-19	0.0	6.86	2397	25.2
CUF-HS45-A-26	1-Oct-19	9.0	7.86	2041	26.9
CUF-HS45-A-27	1-Oct-19	10.8	7.81	2051	26.0
CUF-HS45-A-28	1-Oct-19	6.6	7.70	2057	25.7
CUF-HS45-A-29	1-Oct-19	6.6	7.73	2059	25.7
CUF-HS45-A-30	1-Oct-19	4.8	7.48	2053	25.3
CUF-HS45-A-31	2-Oct-19	0.2	6.61	2090	23.8
CUF-HS45-A-32	2-Oct-19	0.2	6.90	2083	23.8
CUF-HS45-A-33	2-Oct-19	0.2	7.02	2089	23.9
CUF-HS45-A-34	2-Oct-19	0.2	7.01	2086	24.1
CUF-HS45-A-35	2-Oct-19	0.1	7.08	2087	24.0
CUF-HS45-U-36	2-Oct-19	0.4	7.09	2080	24.1
CUF-HS45-U-37	2-Oct-19	0.3	7.13	2074	24.1
CUF-HS45-U-38	2-Oct-19	0.6	7.16	2080	24.3
CUF-HS45-U-39	2-Oct-19	0.3	7.17	2087	24.2
CUF-HS45-U-40	2-Oct-19	0.1	7.14	2089	24.0
CUF-HS45-U-41	2-Oct-19	0.1	7.08	2089	24.2
CUF-HS45-U-42	2-Oct-19	0.0	7.01	2097	24.2
CUF-HS45-U-43	2-Oct-19	0.2	7.05	2068	24.3
CUF-HS45-U-44	2-Oct-19	0.1	7.03	2091	24.3
CUF-HS45-U-45	2-Oct-19	0.3	7.09	2092	25.2
CUF-AOI1-A-46	2-Oct-19	2.5	7.10	2068	22.6
CUF-AOI1-A-47	2-Oct-19	2.8	7.04	2064	22.5
CUF-AOI1-A-48	2-Oct-19	1.8	6.96	2075	22.4
CUF-AOI1-A-49	2-Oct-19	1.9	7.02	2069	22.6
CUF-AOI1-A-50	2-Oct-19	2.0	7.01	2068	22.4
CUF-AOI1-A-51	2-Oct-19	1.0	6.98	2066	22.4
CUF-AOI1-A-52	2-Oct-19	3.4	7.00	2063	22.7
CUF-AOI1-A-53	2-Oct-19	3.6	7.01	2064	22.5
CUF-AOI1-A-54	2-Oct-19	2.9	6.95	2066	22.4
CUF-AOI1-A-55	2-Oct-19	3.3	6.99	2065	22.7
CUF-AOI1-A-56	2-Oct-19	2.8	6.97	2065	22.4
CUF-AOI1-A-57	2-Oct-19	2.3	6.96	2064	22.4
CUF-AOI1-A-58	2-Oct-19	2.2	7.02	2066	22.4
CUF-AOI1-A-59	2-Oct-19	2.2	6.96	2072	22.5
CUF-AOI1-A-60	2-Oct-19	0.5	6.90	2067	22.5
CUF-HS14-D-61	2-Oct-19	5.2	7.44	347.5	25.7
CUF-HS14-D-62	2-Oct-19	5.2	7.43	347.8	26.0
CUF-HS14-D-63	2-Oct-19	5.4	7.39	349.2	25.8
CUF-HS14-D-64	2-Oct-19	5.3	7.42	348.2	26.1
CUF-HS14-D-65	2-Oct-19	6.1	7.46	348.6	26.4
CUF-HS14-D-66	2-Oct-19	5.6	7.45	351.8	26.1

See notes on last page.

TABLE B.1 - Summary of Water Quality Parameter Results
Cumberland Fossil Plant
October 2019

Measurement ID	Measurement Date	Dissolved Oxygen	pH (field)	Specific Cond (Field)	Temperature, Water (C)
		mg/L	SU	uS/cm	DEG C
CUF-HS14-D-67	2-Oct-19	5.6	7.47	352.0	26.1
CUF-HS14-D-68	2-Oct-19	5.2	7.48	350.2	26.3
CUF-HS14-D-69	2-Oct-19	5.8	7.49	352.3	26.2
CUF-HS14-D-70	2-Oct-19	5.2	7.49	349.6	26.3
CUF-HS14-D-71	2-Oct-19	6.0	7.50	350.9	26.3
CUF-HS14-D-72	2-Oct-19	5.3	7.52	352.0	26.5
CUF-HS14-D-73	2-Oct-19	6.4	7.52	350.0	26.4
CUF-HS14-D-74	2-Oct-19	6.3	7.51	351.1	26.2
CUF-HS14-D-75	2-Oct-19	5.9	7.53	350.4	26.3
CUF-HS14-D-76	2-Oct-19	5.1	7.52	351.0	26.3
CUF-HS14-A-77	2-Oct-19	5.5	7.55	350.5	26.6
CUF-HS14-A-78	2-Oct-19	5.2	7.55	351.1	26.7
CUF-HS14-A-79	2-Oct-19	6.1	7.55	352.6	26.6
CUF-HS14-A-80	2-Oct-19	5.3	7.54	355.0	26.5
CUF-HS14-A-81	2-Oct-19	6.4	7.56	356.2	26.9
CUF-HS14-A-82	2-Oct-19	6.3	7.56	356.3	26.7
CUF-HS14-A-83	2-Oct-19	5.6	7.55	356.8	26.8
CUF-HS14-A-84	2-Oct-19	6.2	7.57	355.8	26.9
CUF-HS14-A-85	2-Oct-19	5.6	7.58	359.4	27.0
CUF-HS14-U-86	2-Oct-19	5.8	7.58	360.2	27.0
CUF-HS14-U-87	2-Oct-19	5.7	7.55	358.3	26.8
CUF-HS14-U-88	2-Oct-19	5.9	7.56	357.6	26.7
CUF-HS14-U-89	2-Oct-19	5.6	7.60	356.2	26.9
CUF-HS14-U-90	2-Oct-19	5.6	7.58	357.7	26.9
CUF-HS14-U-91	2-Oct-19	5.7	7.58	354.5	26.9
CUF-HS14-U-92	2-Oct-19	6.0	7.59	355.9	27.1
CUF-HS14-U-93	2-Oct-19	5.3	7.60	354.4	27.2
CUF-HS14-U-94	2-Oct-19	6.0	7.60	352.8	27.2
CUF-HS14-U-95	2-Oct-19	5.8	7.57	354.4	26.6
CUF-AOC1-D-96	2-Oct-19	6.3	7.58	354.2	26.5
CUF-AOC1-D-97	2-Oct-19	4.9	7.60	357.6	26.8
CUF-AOC1-D-98	2-Oct-19	5.2	7.60	357.8	26.6
CUF-AOC1-D-99	2-Oct-19	4.9	7.60	357.2	26.7
CUF-AOC1-D-100	2-Oct-19	4.9	7.59	356.5	26.6
CUF-AOC1-D-101	2-Oct-19	4.7	7.57	357.9	26.4
CUF-AOC1-D-102	2-Oct-19	4.8	7.56	356.6	26.5
CUF-AOC1-D-103	2-Oct-19	4.8	7.56	355.7	26.4
CUF-AOC1-D-104	2-Oct-19	4.6	7.58	354.8	26.5
CUF-AOC1-D-105	2-Oct-19	4.5	7.57	362.8	26.6
CUF-AOC1-A-106	2-Oct-19	4.7	7.60	355.6	26.8
CUF-AOC1-A-107	2-Oct-19	5.1	7.59	356.4	26.9
CUF-AOC1-A-108	2-Oct-19	5.1	7.58	353.6	26.6
CUF-AOC1-A-109	2-Oct-19	5.2	7.61	352.3	26.8
CUF-AOC1-A-110	2-Oct-19	5.5	7.58	352.5	26.5
CUF-AOC1-A-111	2-Oct-19	5.1	7.54	352.9	26.6
CUF-AOC1-A-112	2-Oct-19	5.2	7.57	352.8	26.7
CUF-AOC1-A-113	2-Oct-19	4.9	7.59	351.6	26.9
CUF-AOC1-A-114	2-Oct-19	5.6	7.57	351.8	26.7
CUF-AOC1-U-115	2-Oct-19	4.9	7.60	351.7	26.8
CUF-AOC1-U-116	2-Oct-19	5.3	7.57	350.5	26.8
CUF-AOC1-U-117	2-Oct-19	5.4	7.59	351.2	26.8
CUF-AOC1-U-118	2-Oct-19	5.9	7.57	350.5	26.6
CUF-AOC1-U-119	2-Oct-19	5.5	7.58	351.8	26.5
CUF-AOC1-U-120	2-Oct-19	5.5	7.59	350.5	26.5
CUF-AOC1-U-121	2-Oct-19	5.0	7.61	350.9	26.6
CUF-AOC1-U-122	2-Oct-19	4.8	7.59	350.3	26.6
CUF-AOC1-U-123	2-Oct-19	5.5	7.63	326.6	26.8
CUF-AOC1-U-124	2-Oct-19	5.3	7.63	326.1	26.7

Notes:

Cond.	conductance
DEG C	degrees Celsius
ID	identification
mg/L	milligrams per Liter
SU	Standard Units
uS/cm	microSiemens per centimeter

TABLE B.2 Summary of AOI Soil and Water Sample Analysis
Cumberland Fossil Plant
October 2019

				Analysis Type										
Location ID	**Sample ID**	**Sample Type**	**Medium**	Field Parameters	Total Metals	Dissolved Metals	Total Mercury	Dissolved Mercury	Anions	pH (laboratory)	pH (field)	Radium-226, Radium-228, Radium-226+228	Total Dissolved Solids	Total Suspended Solids
AOI2	CUF-SeS-02-20191003	Normal Environmental Sample	AOI Soil		x		x		x	x	x	x		
	CUF-SeS-DUP01-20191003	Field Duplicate Sample	AOI Soil		x		x		x	x		x		
	CUF-SeW-02-20191003	Normal Environmental Sample	AOI Water	x	x	x	x	x	x				x	x
	CUF-SeW-DUP01-20191003	Field Duplicate Sample	AOI Water		x	x	x	x	x				x	x

Notes:

Total and Dissolved Metals	SW-846 6020A
Total Metals	SW-846 6020A
Total Mercury	SW-846 7471B
Total and Dissolved Mercury	SW-846 7470A
Anions	SW-846 9056A
pH (laboratory)	SW-846 9045D
Radium-226, Radium-228, Radium-226+228	EPA 901.1
Total Dissolved Solids	SM2540C
Total Suspended Solids	SM2540D
ID	identification
AOI	Area of Interest

1. Field and laboratory quality control sample results except for field duplicates are not included in report tables but were used for data validation.

Table B.3 - Summary of AOI Soil Analytical Results for Metals, Anions, and General Chemistry
Cumberland Fossil Plant
October 2019

Sample Location		AOI2	
Sample Date		3-Oct-19	3-Oct-19
Sample ID		CUF-SeS-02-20191003	CUF-SeS-DUP01-20191003
Sample Depth		0 - 0.3 ft	0 - 0.3 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	Final-Verified	Final-Verified
Total Metals			
Antimony	mg/kg	0.209 J	0.324 J
Arsenic	mg/kg	2.56 J	2.52 J
Barium	mg/kg	35.5 J	36.6 J
Beryllium	mg/kg	0.710 J	0.711 J
Boron	mg/kg	39.7 J	38.9 J
Cadmium	mg/kg	0.453 J	0.620 J
Calcium	mg/kg	5,920 J	5,290 J
Chromium	mg/kg	16.2 J	15.7 J
Cobalt	mg/kg	6.98 J	6.90 J
Copper	mg/kg	12.4 J	11.0 J
Lead	mg/kg	14.3 J	11.9 J
Lithium	mg/kg	8.02 J	7.82 J
Mercury	mg/kg	0.0445 J	0.0461 J
Molybdenum	mg/kg	7.63 J	11.2 J
Nickel	mg/kg	13.8 J	13.5 J
Selenium	mg/kg	0.551 J	0.599 J
Silver	mg/kg	0.0565 J	0.0643 J
Sodium	mg/kg	38.8 UJ	40.1 UJ
Thallium	mg/kg	0.159 J	0.472 J
Vanadium	mg/kg	20.3 J	21.1 J
Zinc	mg/kg	55.1 J	55.4 J
Anions			
Chloride	mg/kg	192 J	170 J
Fluoride	mg/kg	35.7 J	34.1 J
Sulfate	mg/kg	2,040 J	2,240 J
General Chemistry			
pH (lab)	SU	7.4	7.3

Notes:

AOI	Area of Interest
ft	feet
ID	identification
J	quantitation is approximate due to limitations identified during data validation
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.
mg/kg	milligrams per kilogram
SU	standard unit

1. Level of review is defined in the Quality Assurance Project Plan.

TABLE B.4 Summary of AOI Soil Analytical Results for Radiological Parameters
Cumberland Fossil Plant
October 2019

Sample Location		AOI2	
Sample Date		3-Oct-19	3-Oct-19
Sample ID		CUF-SeS-02-20191003	CUF-SeS-DUP01-20191003
Sample Depth		0 - 0.3 ft	0 - 0.3 ft
Sample Type		Normal Environmental Sample	Field Duplicate Sample
Level of Review	Units	Final-Verified	Final-Verified
Radiological Parameters			
Radium-226	pCi/g	1.00 +/-(0.306)J	1.66 +/-(0.389)J
Radium-228	pCi/g	0.765 +/-(0.596)	1.11 +/-(0.359)
Radium-226+228	pCi/g	1.77 +/-(0.670)J	2.77 +/-(0.529)J

Notes:

AOI	Area of Interest
ft	feet
ID	identification
J	quantitation is approximate due to limitations identified during data validation
pCi/g	picoCurie per gram

1. Level of review is defined in the Quality Assurance Project Plan.

Table B.5 - Summary of AOI Water Analytical Results for Metals, Anions, and General Chemistry
Cumberland Fossil Plant
October 2019

Sample Location		AOI2	
Sample Date		3-Oct-19	3-Oct-19
Sample ID		CUF-SeW-02-20191003	CUF-SeW-DUP01-20191003
Sample Type		Normal Environmental Sample	Field Duplicate Sample
Level of Review		Final-Verified	Final-Verified
	Units		
Total Metals			
Mercury	ug/L	<0.101	<0.101
Antimony	ug/L	<0.378	<0.378
Arsenic	ug/L	0.561 J	0.570 J
Barium	ug/L	30.3	30.6
Beryllium	ug/L	0.424 U*	0.436 U*
Boron	ug/L	9,680	10,000
Cadmium	ug/L	<0.125	<0.125
Calcium	ug/L	592,000	625,000
Chromium	ug/L	<1.53	<1.53
Cobalt	ug/L	0.310 J	0.289 J
Copper	ug/L	3.24 U*	4.21 U*
Lead	ug/L	0.270 J	0.282 J
Lithium	ug/L	23.6	23.6
Molybdenum	ug/L	121	127
Nickel	ug/L	0.512 U*	1.13 U*
Selenium	ug/L	<1.51	<1.51
Silver	ug/L	<0.177	<0.177
Sodium	ug/L	9,730	10,300
Thallium	ug/L	<0.148	<0.148
Vanadium	ug/L	2.53 U*	3.21 U*
Zinc	ug/L	4.90 J	5.28
Dissolved Metals			
Mercury	ug/L	<0.101	<0.101
Antimony	ug/L	0.677 J	<0.378
Arsenic	ug/L	0.629 U*	0.537 U*
Barium	ug/L	27.8	28.2
Beryllium	ug/L	0.661 U*	0.360 U*
Boron	ug/L	9,770	9,930
Cadmium	ug/L	<0.125	<0.125
Calcium	ug/L	614,000	599,000
Chromium	ug/L	<1.53	<1.53
Cobalt	ug/L	0.168 J	0.241 J
Copper	ug/L	3.94 U*	3.56 U*
Lead	ug/L	<0.128	<0.128
Lithium	ug/L	23.3	23.7
Molybdenum	ug/L	123	124
Nickel	ug/L	3.69 J	4.85 J
Selenium	ug/L	<1.51	<1.51
Silver	ug/L	<0.177	<0.177
Sodium	ug/L	10,000	9,820
Thallium	ug/L	<0.148	<0.148
Vanadium	ug/L	2.40 U*	2.48 U*
Zinc	ug/L	3.35 J	6.08
Anions			
Chloride	mg/L	168	186
Fluoride	mg/L	2.02	2.48
Sulfate	mg/L	1,610	1,710
General Chemistry			
Total Dissolved Solids	mg/L	2,890	2,530
Total Suspended Solids	mg/L	10.3 J	8.10 J

Notes:

AOI	Area of Interest
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
-	parameter not analyzed / not available
ft	feet below top of casing
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter

1. Level of review is defined in the Quality Assurance Project Plan.

Stantec

TABLE B.6 - Summary of AOI Soil and Water Field Parameter Results
Cumberland Fossil Plant
October 2019

Measurement ID	Measurement Date	Depth	Dissolved Oxygen	pH (field)	Specific Cond (Field)	Temperature, Water (C)
			mg/L	SU	uS/cm	DEG C
CUF-SeS-02-20191003	10/3/2019 9:50:00 AM	0 - 4 in	-	7.48	-	-
CUF-SeW-02-20191003	10/3/2019 10:33:00 AM	-	-	6.65	-	-

Notes:

-	parameter not analyzed / not available
Cond.	conductance
DEG C	degrees Celsius
ID	identification
in	inches
mg/L	milligrams per Liter
SU	Standard Units
uS/cm	microSiemens per centimeter

TABLE B.7 - SUMMARY OF WEEKLY AOI OBSERVATIONS
CUMBERLAND FOSSIL PLANT

Area of Interest (AOI) ID	Date	Rainfall Total Since Last Observation (inches)	Surface Water	Pooled Water Evident?		Staining Evident?		Comments
			Non/Damp/Flow Rate	Yes / No	Estimated size - width (feet) x length (feet) x depth (inches)	Yes/No	Color	
AOI2	10/15/2019	0.72	Flow rate constant into Wells Creek	Yes	Pooled water present and flowing into Wells Creek	No	NA	None
	10/22/2019	0.56	Flow rate constant into Wells Creek	Yes	Pooled water present and flowing into Wells Creek	No	None	No change from previous week
	10/29/2019	1.04	Flow rate constant into Wells Creek	Yes	Pooled water present and flowing into Wells Creek	Yes	A couple of puddles appeared to have an oil sheen	No change from previous week
	11/06/2019	0.69	Flow rate constant into Wells Creek	Yes	Pooled water present and trickling into Wells Creek	No	No sheen observed	None
	11/13/2019	0.00	Flow rate constant into Wells Creek	Yes	Pooled water present and trickling into Wells Creek	No	None	None
	11/20/2019	0.08	Flow rate constant into Wells Creek	Yes	Pooled water present and trickling into Wells Creek	No	None	None
	12/02/2019	4.86	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	12/19/2019	2.37	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	01/08/2020	3.51	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	01/13/2020	1.70	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	01/22/2020	0.68	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	01/29/2020	0.39	Seep flowing into Wells Creek	No	NA	No	None	Water level lowest since 11/2019. Seep flowing and accessible
	02/05/2020	1.15	Seep flowing into Wells Creek	No	NA	No	None	Water level in Wells Creek higher but seep is still apparent
	02/12/2020	2.82	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	02/19/2020	0.41	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	02/26/2020	0.87	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	03/04/2020	1.68	Elevated water level in Wells Creek	No	NA	No	None	Elevated water levels in Wells Creek made seep observation impossible.
	03/11/2020	0.10	NA	No	NA	No	None	NA
	03/18/2020	2.25	NA	No	NA	No	None	NA

Notes:
NA Not Applicable

1. Rainfall measured at CKVT1 -Cumberland at Clarksville, TN. Precipitation data for October 30 and 31, 2019 were obtained from the National Oceanic and Atmospheric Administration, National Centers for Environmental Information climate information website for Cumberland City, TN.

APPENDIX C - PHOTOGRAPHS OF SITE CONDITIONS

Exhibit No.

C.1

Title

Photographs of Site Conditions

Client/Project

Tennessee Valley Authority
Cumberland Fossil (CUF) Plant TDEC Order

Project Location

Stewart County, Tennessee

175568209

Prepared by MB on 2021-04-05
Technical Review by HW on 2021-04-05

0 300 600 900 1,200 Feet

1:3,600 (At original document size of 22x34)

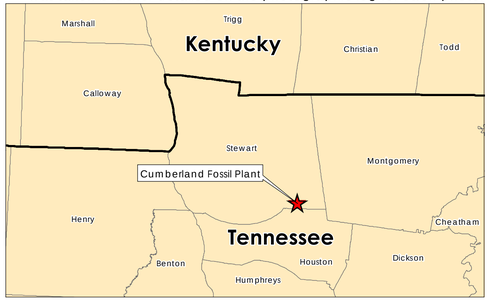
Legend

Measurement Locations

- Adjacent (A)
- Downstream (D)
- Upstream (U)
- Area of Interest (AOI)/Area of Concern (AOC) Location
- Seepage Area Above Perimeter Ditch
- Seepage Area Below Perimeter Ditch
- Photo Location
- 2019 Imagery Boundary
- CCR Unit Area (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by Tuck Mapping (c. 2017) and TVA (3/6/2019 and 12/11/2019)
3. Photo location arrows with multiple photos identified depict the area and general direction the photos were taken. The direction each photo was taken is further detailed on the photographic log for each photo.



Stantec TVA

Stantec

Photographic Log

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 1 **Photo Location:** Gypsum Storage Area **Direction:** Southeast **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: View below perimeter ditch, southwest side of Gypsum Storage Area	
Photograph ID: 2 **Photo Location:** Gypsum Storage Area **Direction:** Northwest **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: View from perimeter ditch access road, southwest side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 3	
Photo Location: Gypsum Storage Area	
Direction: North	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: View below perimeter ditch, southeast side of Gypsum Storage Area	
Photograph ID: 4	
Photo Location: Area of Interest (AOI) 1	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: AOI 1 identified at change in vegetation (Common Reed); below perimeter ditch, southeast side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 5	
Photo Location: AOI 1/Historical Seeps 4 and 5	
Direction: North	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: below perimeter ditch, southeast side of Gypsum Storage Area; reverse grade filter to the north	

Photograph ID: 6	
Photo Location: AOI 1	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: below perimeter ditch, southeast side of Gypsum Storage Area; unnamed tributary pond to the northeast	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 7 **Photo Location:** AOI 1 **Direction:** Southeast **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: below perimeter ditch, southeast side of Gypsum Storage Area; unnamed tributary ponds to the southeast	
Photograph ID: 8 **Photo Location:** Historical Seeps 4 and 5 **Direction:** Northeast **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: reverse grade filter; southeast side of Gypsum Storage Area; unnamed tributary ponds to the northeast	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 9	
Photo Location: Historical Seeps 4 and 5	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: reverse grade filter; southeast side of Gypsum Storage Area; unnamed tributary ponds to the northeast	

Photograph ID: 10	
Photo Location: Dry Ash Stack	
Direction: Northwest	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: view below perimeter ditch, south side of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 11 **Photo Location:** Dry Ash Stack **Direction:** Northwest **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: view below perimeter ditch, southwest side of Dry Ash Stack	
Photograph ID: 12 **Photo Location:** Dry Ash Stack **Direction:** Northwest **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: view of riprap and bridge over Wells Creek to south of Historical Seep 14; below perimeter ditch, west side of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 13	
Photo Location: Historical Area of Concern (AOC) 1	
Direction: Northwest	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: view of riprap and bridge over Wells Creek south of Historical Seep 14; below perimeter ditch, west side of Dry Ash Stack	

Photograph ID: 14	
Photo Location: Historical Seep 14	
Direction: North	
Photo Date: 10/1/2019	
Comments: Accessible area inspection: reverse grade filter; below perimeter ditch, west side of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 15 **Photo Location:** Stilling Pond **Direction:** Northeast **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: view of outer riprap area at northwest side of Stilling Pond	
Photograph ID: 16 **Photo Location:** Stilling Pond **Direction:** West **Photo Date:** 10/1/2019 **Comments:** Accessible area inspection: view of outer riprap area at northwest side of Stilling Pond	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 17 **Photo Location:** Historical Seep 6 **Direction:** Northwest **Photo Date:** 10/1/2019 **Comments:** Boat inspection: shoreline below perimeter ditch; south side of Gypsum Storage Area	
Photograph ID: 18 **Photo Location:** Historical Seep 6 **Direction:** Northwest **Photo Date:** 10/1/2019 **Comments:** Boat inspection: shoreline below perimeter ditch; south side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 19	
Photo Location: Historical Seep 6	
Direction: North	
Photo Date: 10/1/2019	
Comments: Boat inspection: shoreline below perimeter ditch; south side of Gypsum Storage Area	

Photograph ID: 20	
Photo Location: Historical Seep 6	
Direction: North	
Photo Date: 10/1/2019	
Comments: Boat inspection: shoreline below perimeter ditch; south side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 21 **Photo Location:** Historical Seep 6 **Direction:** North **Photo Date:** 10/1/2019 **Comments:** Boat inspection: shoreline below perimeter ditch; south side of Gypsum Storage Area	
Photograph ID: 22 **Photo Location:** AOI 2/Historical Seep 2 **Direction:** Southeast **Photo Date:** 10/1/2019 **Comments:** Boat inspection: reverse grade filter; southwest side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 23 **Photo Location:** AOI 2/Historical Seep 2 **Direction:** East **Photo Date:** 10/1/2019 **Comments:** Boat inspection: reverse grade filter; area vegetated with Common Reed; southwest side of Gypsum Storage Area	
Photograph ID: 24 **Photo Location:** AOI 2/Historical Seep 2 **Direction:** Northeast **Photo Date:** 10/1/2019 **Comments:** Boat inspection: water flow downslope of reverse grade filter and area vegetated with Common Reed; southeast side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 25	
Photo Location: AOI 2/Historical Seep 2	
Direction: Southeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: water flow downslope of reverse grade filter and area vegetated with Common Reed; southeast side of Gypsum Storage Area	

Photograph ID: 26	
Photo Location: AOI 2/Historical Seep 2	
Direction: East	
Photo Date: 10/1/2019	
Comments: Boat inspection: reverse grade filter; area vegetated with Common Reed; southwest side of Gypsum Storage Area.	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 27	
Photo Location: AOI 2/Historical Seep 2	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: water flow downslope of reverse grade filter and area vegetated with Common Reed; southeast side of Gypsum Storage Area	

Photograph ID: 28	
Photo Location: AOI 2/Historical Seep 2	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: water flow downslope of reverse grade filter and area vegetated with Common Reed; southeast side of Gypsum Storage Area	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 29	
Photo Location: AOI 2/Historical Seep 2	
Direction: Northwest	
Photo Date: 10/1/2019	
Comments: Boat inspection: water flow downslope of reverse grade filter and area vegetated with Common Reed; southeast side of Gypsum Storage Area	

Photograph ID: 30	
Photo Location: Historical Seep 15	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: downslope of reverse grade filter; southern corner of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 31	
Photo Location: Historical Seep 15	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: downslope of reverse grade filter; southern corner of Dry Ash Stack	

Photograph ID: 32	
Photo Location: Historical Seep 15	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: downslope of reverse grade filter; southern corner of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 33	
Photo Location: Historical Seep 15	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: downslope of reverse grade filter; southern corner of Dry Ash Stack	

Photograph ID: 34	
Photo Location: Historical Seep 15	
Direction: Northeast	
Photo Date: 10/1/2019	
Comments: Boat inspection: downslope of reverse grade filter; southern corner of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 35	
Photo Location: Historical Seep 15	
Direction: East	
Photo Date: 10/1/2019	
Comments: Boat inspection: downslope of reverse grade filter; southern corner of Dry Ash Stack	

Photograph ID: 36	
Photo Location: Dry Ash Stack	
Direction: North	
Photo Date: 10/1/2019	
Comments: Boat inspection: shoreline northwest of Historical Seep 15; southern corner of Dry Ash Stack	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 37 **Photo Location:** AOI 2 **Direction:** North **Photo Date:** 10/3/2019 **Comments:** AOI 2 soil sample	
Photograph ID: 38 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 10/3/2019 **Comments:** AOI 2 water sample location	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 39 **Photo Location:** AOI 2 **Direction:** Southeast **Photo Date:** 10/15/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 40 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 10/15/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 41 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 10/15/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 42 **Photo Location:** AOI 2 **Direction:** Northeast **Photo Date:** 10/22/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 43 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 10/22/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 44 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 10/22/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 45 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 10/29/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 46 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 10/29/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 47 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 10/29/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 48 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 11/6/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 49 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 11/6/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 50 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 11/6/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 51 **Photo Location:** AOI 2 **Direction:** Northeast **Photo Date:** 11/13/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 52 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 11/13/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 53 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 11/13/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 54 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 11/13/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 55 **Photo Location:** AOI 2 **Direction:** Northeast **Photo Date:** 11/20/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 56 **Photo Location:** AOI 2 **Direction:** East **Photo Date:** 11/20/2019 **Comments:** AOI 2 observation; water flow present	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 57 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 11/20/2019 **Comments:** AOI 2 observation; water flow present	
Photograph ID: 58 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 12/2/2019 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 59 **Photo Location:** AOI 2 **Direction:** Northwest **Photo Date:** 12/19/2019 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	
Photograph ID: 60 **Photo Location:** AOI 2 **Direction:** Northwest **Photo Date:** 1/8/2020 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 61 **Photo Location:** AOI 2 **Direction:** Northwest **Photo Date:** 1/13/2020 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	
Photograph ID: 62 **Photo Location:** AOI 2 **Direction:** North **Photo Date:** 1/22/2020 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 63 **Photo Location:** AOI 2 **Direction:** Northeast **Photo Date:** 1/29/2020 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	
Photograph ID: 64 **Photo Location:** AOI 2 **Direction:** Northeast **Photo Date:** 1/26/2020 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 65 **Photo Location:** AOI 2 **Direction:** Northeast **Photo Date:** 1/29/2020 **Comments:** AOI 2 observation; Wells Creek stage above previously observed flow	
Photograph ID: 66 **Photo Location:** AOI 2 **Direction:** Southwest **Photo Date:** 2/5/2020 **Comments:** AOI2 monitoring, River stage above previously observed flow.	

Client:	**Tennessee Valley Authority**	**Project:**	**TDEC Order**
Site Name:	**Cumberland Fossil (CUF) Plant**	**Site Location:**	**Cumberland City, Tennessee**

Photograph ID: 67

Photo Location:
AOI 2

Direction:
Northeast

Photo Date:
2/5/2020

Comments:
AOI 2 observation; Wells Creek stage above previously observed flow

APPENDIX D - STATISTICAL ANALYSIS OF WATER QUALITY PARAMETERS

REFER TO APPENDIX E.4 - SEEPS

APPENDIX I.2
DATA SCREENING RESULTS FOR AOI2 WATER SAMPLES

TABLE I.2 - Data Screening Results for AOI2 Water Samples
Cumberland Fossil Plant

Sample Location		Ecological Surface Water Screening Levels		AOI2	
Sample Date				3-Oct-19	3-Oct-19
Sample ID				CUF-SeW-02-20191003	CUF-SeW-DUP01-20191003
Sample Type				Normal Environmental Sample	Field Duplicate Sample
Level of Review[1]	Units	Wells Creek (Hardness = 140 mg/L)		Final-Verified / Final QC Review[2]	Final-Verified
		Chronic	Acute		
Total Metals					
Antimony	ug/L	190[A]	900[B]	<0.378	<0.378
Arsenic	ug/L	150[A]	340[B]	0.561 J	0.570 J
Barium	ug/L	220[A]	2,000[B]	30.3	30.6
Beryllium	ug/L	11[A]	93[B]	0.424 U*	0.436 U*
Boron	ug/L	7,200[A]	34,000[B]	**9,680[A]**	**10,000[A]**
Cadmium	ug/L	1.03[A]	2.65[B]	<0.125	<0.125
Calcium	ug/L	116,000[A]	n/v	**592,000[A]**	**625,000[A]**
Chromium	ug/L	114[A]	2,375[B]	<1.53	<1.53
Cobalt	ug/L	19[A]	120[B]	0.310 J	0.289 J
Copper	ug/L	12.4[A]	19.2[B]	3.24 U*	4.21 U*
Lead	ug/L	4.88[A]	125[B]	0.270 J	0.282 J
Lithium	ug/L	440[A]	910[B]	23.6	23.6
Mercury	ug/L	0.77[A]	1.4[B]	<0.101	<0.101
Molybdenum	ug/L	800[A]	7,200[B]	121	127
Nickel	ug/L	69.3[A]	624[B]	0.512 U*	1.13 U*
Selenium	ug/L	3.1[A]	20[B]	<1.51	<1.51
Silver	ug/L	n/v	6.75[B]	<0.177	<0.177
Sodium	ug/L	n/v	n/v	9,730	10,300
Thallium	ug/L	6[A]	54[B]	<0.148	<0.148
Vanadium	ug/L	27[A]	79[B]	2.53 U*	3.21 U*
Zinc	ug/L	159[A]	159[B]	4.90 J	5.28
Dissolved Metals					
Antimony	ug/L	n/v	n/v	0.677 J	<0.378
Arsenic	ug/L	150[C]	340[D]	0.629 U*	0.537 U*
Barium	ug/L	n/v	n/v	27.8	28.2
Beryllium	ug/L	n/v	n/v	0.661 U*	0.360 U*
Boron	ug/L	n/v	n/v	9,770	9,930
Cadmium	ug/L	0.925[C]	2.47[D]	<0.125	<0.125
Calcium	ug/L	n/v	n/v	614,000	599,000
Chromium	ug/L	97.6[C]	751[D]	<1.53	<1.53
Cobalt	ug/L	n/v	n/v	0.168 J	0.241 J
Copper	ug/L	11.9[C]	18.5[D]	3.94 U*	3.56 U*
Lead	ug/L	3.62[C]	93.0[D]	<0.128	<0.128
Lithium	ug/L	n/v	n/v	23.3	23.7
Mercury	ug/L	0.77[C]	1.4[D]	<0.101	<0.101
Molybdenum	ug/L	n/v	n/v	123	124
Nickel	ug/L	69.1[C]	622[D]	3.69 J	4.85 J
Selenium	ug/L	n/v	n/v	<1.51	<1.51
Silver	ug/L	n/v	5.74[D]	<0.177	<0.177
Sodium	ug/L	n/v	n/v	10,000	9,820
Thallium	ug/L	n/v	n/v	<0.148	<0.148
Vanadium	ug/L	n/v	n/v	2.40 U*	2.48 U*
Zinc	ug/L	157[C]	156[D]	3.35 J	6.08
Anions					
Chloride	mg/L	230[A]	860[B]	168	186
Fluoride	mg/L	2.7[A]	9.8[B]	2.02	2.48
Sulfate	mg/L	n/v	n/v	1,610	1,710
Field Parameters/General Chemistry					
pH (field)	SU	n/v	n/v	6.65	-
Total Dissolved Solids	mg/L	n/v	n/v	2,890	2,530
Total Suspended Solids	mg/L	n/v	n/v	10.3 J	8.10 J

Notes:

[A]	Ecological Surface Water Screening Levels - Wells Creek (Hardness = 140 mg/l) Total Chronic
[B]	Ecological Surface Water Screening Levels - Wells Creek (Hardness = 140 mg/l) Total Acute
[C]	Ecological Surface Water Screening Levels - Wells Creek (Hardness = 140 mg/l) Dissolved Chronic
[D]	Ecological Surface Water Screening Levels - Wells Creek (Hardness = 140 mg/l) Dissolved Acute
n/v	No standard/guideline value
6.5[A]	Concentration is greater than the indicated standard.
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/L	milligrams per Liter
n/v	No standard/guideline value
SU	Standard Units
U*	result should be considered “not detected” because it was detected in an associated field or laboratory blank at a similar level
ug/L	micrograms per Liter
uS/cm	microSiemens per centimeter

1. Level of review is defined in the Quality Assurance Project Plan.
2. All data validated except for field parameters which had final QC review.