

APPENDIX I – SEEP INVESTIGATION

APPENDIX I.1

SEEP INVESTIGATION SAMPLING AND ANALYSIS REPORT



**Watts Bar Fossil Plant
Seep Sampling and Analysis
Report**

TDEC Commissioner's Order:
Environmental Investigation Plan
Watts Bar Fossil Plant
Spring City, Tennessee

May 21, 2021

Prepared for:

Tennessee Valley Authority
Chattanooga, Tennessee



Prepared by:

Stantec Consulting Services Inc.
Lexington, Kentucky

WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Revision Record

Revision	Description	Date
0	Submittal to TDEC	May 21, 2021



Sign-off Sheet

This document entitled Watts Bar Fossil Plant Seep Sampling and Analysis Report was prepared by Stantec Consulting Services Inc. ("Stantec") for the account of Tennessee Valley Authority (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

Prepared by Hiedi Ann Waller

Hiedi Waller, Senior Engineer

Reviewed by Rebekah Brooks

Rebekah Brooks, Principal Hydrogeologist

Approved by Carole M. Farr

Carole M. Farr, Senior Principal Geologist



Table of Contents

ABBREVIATIONS	III
1.0 INTRODUCTION.....	1
2.0 OBJECTIVE AND SCOPE	3
3.0 FIELD ACTIVITIES	4
3.1 ACCESSIBLE AREA INSPECTION	5
3.2 INACCESSIBLE AREA INSPECTION AND WATER QUALITY PARAMETER MEASUREMENTS	5
3.2.1 Water Quality Parameter Measurements and Locations	5
3.3 DOCUMENTATION	6
3.3.1 Field Forms.....	6
3.4 EQUIPMENT CALIBRATION	8
3.5 WATER QUALITY PARAMETER DATA COLLECTION	8
3.6 AREA OF INTEREST SAMPLE COLLECTION	9
3.6.1 Soil Sampling.....	9
3.6.2 Sample Shipment	10
3.7 AOI OBSERVATIONS.....	10
3.8 INVESTIGATION DERIVED WASTE.....	10
3.9 VARIATIONS	11
3.9.1 Variations in Scope.....	11
3.9.2 Variations in Procedures	11
4.0 STATISTICAL ANALYSIS OF WATER QUALITY PARAMETER MEASUREMENTS.....	12
5.0 SUMMARY.....	13
6.0 REFERENCES.....	14

LIST OF APPENDICES

APPENDIX A EXHIBITS

Exhibit A.1	Water Quality Parameter Measurement Locations - Overview
Exhibit A.2	Water Quality Parameter Measurement Locations - Detail
Exhibit A.3	Additional Areas of Interest Identified from Statistical Analysis

APPENDIX B TABLES

Table B.1	Summary of Water Quality Parameter Results
Table B.2	Summary of AOI Soil Sample Analysis
Table B.3	Summary of AOI Soil Analytical Results for Metals, Anions, and General Chemistry
Table B.4	Summary of AOI Soil Analytical Results for Radiological Parameters
Table B.5	Summary of AOI Soil Field Parameter Results
Table B.6	Summary of AOI Observations



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

APPENDIX C PHOTOGRAPHS OF SITE CONDITIONS

APPENDIX D STATISTICAL ANALYSIS OF WATER QUALITY PARAMETERS



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Abbreviations

AOC	Area of Concern
AOI	Area of Interest
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
DI	Deionized Water
DO	Dissolved Oxygen
EAR	Environmental Assessment Report
EIP	Environmental Investigation Plan
EnvStd	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
VWPZ	Vibrating Wire Piezometers
WBF Plant	Watts Bar Fossil Plant



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Introduction
May 21, 2021

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 April 16, 2019 through August 5, 2019 at TVA's Watts Bar Fossil Plant (WBF Plant) located in Spring City, Tennessee.

The purpose of the seep investigation was to collect information regarding the potential presence of active seeps at the WBF 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 WBF 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 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 WBF 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 WBF 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; collecting soil samples associated with potentially active seeps, referred to herein as areas of interest (AOIs); and conducting 17 inspections at one of the identified AOIs.

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



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Introduction
May 21, 2021

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. Quality Assurance oversight of field data acquisition protocols, sampling practices, and data review was performed by Environmental Standards, Inc. (EnvStds) under direct contract to TVA.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Objective and Scope
May 21, 2021

2.0 OBJECTIVE AND SCOPE

The primary objective of the seep investigation conducted pursuant to the Seep SAP at the WBF 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 to assess whether active seeps exist in these areas
- 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 a soil sample at one of the identified AOIs for analysis of CCR-related constituents. Sufficient water was not present for water sample collection.
- Collecting field measurements of water quality parameters (pH, temperature, DO, and specific conductance) by boat in the Tennessee River adjacent to the identified AOIs and historical seep locations that were inaccessible due to riprap, etc.
- 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 or AOIs and to determine if additional investigation and/or sample collection are warranted in those areas
- Conducting observations at one of the identified AOIs.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

3.0 FIELD ACTIVITIES

Seep investigation field activities at the WBF Plant were conducted April 16, 2019 through August 5, 2019. 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 EnvStd's under direct contract with TVA. EnvStd's 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 and TDEC personnel to identify AOI locations
- Documented the locations of AOIs and water quality 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 the historical seep locations that were inaccessible due to structural mitigation (e.g., limestone riprap) and the identified AOI locations
- Measured surface water quality parameters using a boat in one control area considered to be upstream and outside the influence of CCR units, and at intermediate areas located downstream and upstream of historical seep locations
- Recorded field measurements of water quality parameters at 136 measurement locations
- Collected one soil sample for laboratory analysis at AOI01 identified during the accessible area inspection
- Collected field quality control (QC) samples, including: one duplicate soil sample, one field blank, and one equipment blank
- Conducted observations over approximately a two-month period at AOI01.

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, AOI01 soil sample information and results, and 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.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

3.1 ACCESSIBLE AREA INSPECTION

An inspection of areas accessible by foot or vehicle was conducted on April 16, 2019 to identify AOIs and potential soil and water sample locations. TDEC and TVA staff accompanied Stantec personnel during the visual walkdown. The following AOIs and observations were recorded and included:

- AOI01 – downslope of Slag Disposal Area and historical seep A at a low spot at the base of the slope and along the access road adjacent to the Tennessee River. The AOI was described as approximately 90 feet by 6 feet in size, with standing water, generally clear, at the west central portion and wet at the east and west ends.
- AOI02 – downslope of the Slag Disposal Area in riprap between the access road and the Tennessee River, associated with historical Seep #1. The AOI was described as approximately 100-feet by 15-feet in size, with discoloration on the rocks and vegetation growing in the riprap.

The AOI01 location was identified during the accessible area inspection for collection of water and/or soil samples for laboratory analysis, if feasible, per TVA and TDEC onsite observations. Because AOI02 was riprap-covered, only water quality parameters were measured near the AOI02 location during the inaccessible area inspection.

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), a boat was used by TVA and Stantec field sampling personnel (FSP) on April 16-17, 2019 to access locations near the banks of the Tennessee River for measurement of water quality parameters. The water quality parameters were measured with a calibrated multi-parameter sonde in surface water upstream, adjacent to, and downstream of historical seep/AOI locations defined below, in intermediate (areas upstream and downstream of the historical seep/AOI locations), and an upstream control area. 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 six historical seep locations two AOI locations, one upstream control area and eight intermediate areas near the banks of the Tennessee River. The measurement locations are shown on Exhibits A.1 through A.3 in Appendix A and included on Table B.1 in Appendix B.

Water quality parameter measurements associated with the historical seep and AOI locations include the following:

- Historical Seep Locations Seep A, Seeps #1 – 5, and AOI01 and AOI02 Locations (HSA1-5): Because of their close proximity, the areas for these historical seep locations and the AOI locations were combined (referred to as a “cluster”) into a single dataset for evaluation.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

Parameter measurements #5 to #111 were taken at locations WBF-HSA1-5-D-5 to WBF-HSA1-5-U-111 downstream, adjacent and upstream of cluster HSA1-5.

- Intermediate Areas: parameter measurements #1 to #4 were taken at locations WBF-IA-1 to WBF-IA-4 downstream of cluster HSA1-5, and parameter measurements #112 to #115 were taken at locations WBF-IA-112 to WBF-IA-115 upstream of cluster HSA1-5.

Additional measurements were taken at an upstream control area along the Tennessee River with 21 parameter measurements #116 to #136 collected at locations WBF-UC-116 to WBF-UC-136, as shown on Exhibit A.1 in Appendix A.

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* 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 – Photographs.*

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*.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

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, or Upstream Control); measurement location (upstream, downstream, adjacent or control); 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 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 (e.g., soil); 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 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*.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

3.3.1.8 Area of Interest Observations – Photographs

Stantec FSP documented site conditions at AOI01 by photographs between June 7 and August 5, 2019, as requested by TVA and/or TDEC. The observations at AOI01 and dates of the site visits are provided in the photographic log in Appendix C. Documentation of the last recorded rainfall before each site visit and amount at the WBF Plant was obtained from TVA and compared to the presence/absence of standing water in the photographs to assess whether the presence of water was related to rainfall events.

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 Lovell Field (KCHA), 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 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 the Tennessee River 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 136 locations in the Tennessee River over a two-day period, April 16 and 17, 2019. The measurement locations were identified using GIS coordinates on maps in advance of field activities, with individual historical seep/AOI locations combined for evaluation purposes because of proximity (“cluster”). Water quality parameters were measured as close to the bank as possible immediately downstream, adjacent to, and upstream of each identified location and at an upstream control 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/AOI locations to minimize disturbance of water and sediment at the measurement location. Final measurement location coordinates were documented in the field using GPS.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

Measurements, associated locations, field activities and notable observations were documented on electronic field forms described in Section 3.1. A summary of the water quality parameter results at the 136 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. Soil samples were collected on April 18, 2019 at AOI01. Water samples were not collected at AOI01 as there was insufficient water. Soil and water sampling were not conducted at AOI02 because of the presence of riprap. Soil sampling at AOI01 was conducted in accordance with the Seep SAP, QAPP, and applicable TVA TIs. Soil sampling information is provided in Appendix B, including a list of the samples collected at AOI01 in Table B.2, soil sample data results in Tables B.3 and B.4, and soil field parameter results in Table B.5.

3.6.1 Soil Sampling

One soil sample (and associated field duplicate) was collected at AOI01 in accordance with ENV-TI-05.80.50, *Soil and Sediment Sampling* and ENV-TI-05.80.04, *Field Sampling Quality Control*. The soil sample consisted of a five-point composite from locations spatially distributed within the saturated soil area at AOI01. The soil sample was collected from a depth 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 water (DI) 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.5.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

3.6.2 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 sample was shipped to TestAmerica, Inc. in Pittsburgh, Pennsylvania. The laboratories submitted sample receipt confirmation forms to EnvStds for review and confirmation.

3.7 AOI OBSERVATIONS

Standing water was observed at AOI01 during the April 16, 2019, Accessible Area Inspection. Subsequently, site conditions were documented by photographs at this location from June 7, 2019 through August 5, 2019. Based on the site observations, the following items were evaluated:

- Time since last rainfall
- Presence/absence of shallow, standing water
- Presence/absence of soil staining
- Daily TVA rain gauge data from the WBF Plant.

Data from the AOI01 observations are summarized on Table B.6 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 WBF 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 WBF 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.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Field Activities
May 21, 2021

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, changes based on field conditions, or additional field sampling performed to complete the scope of work in the SAP 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 WBF Plant.

3.9.1 Variations in Scope

Variations in scope are provided below:

- An additional statistical analysis was conducted to identify and limit specific areas/AOIs within historical seep location WBF-HSA1-5 that may warrant additional investigation.

3.9.2 Variations in Procedures

There were no variations in procedures documented during field activities.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Statistical Analysis of Water Quality Parameter Measurements
May 21, 2021

4.0 STATISTICAL ANALYSIS OF WATER QUALITY PARAMETER MEASUREMENTS

A statistical analysis of water quality parameter data collected in surface water adjacent to the WBF 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/AOI locations and between intermediate and upstream control areas. The statistical methods used in this analysis and the analysis results are provided in Appendix D.

Based on the statistical evaluation, three distinct areas were identified as AOIs within the WBF-HSA1-5 cluster area that warrant future investigation. The statistical results indicated that all four water quality parameters (pH, temperature, DO, and specific conductance) were either above or below their respective tolerance limits at each of the individual measurement locations within these three areas:

- AOI02: bracketed by measurement location #35 to measurement location #43
- AOI03: bracketed by measurement location #68 to measurement location #74
- AOI04: bracketed by measurement location #90 to measurement location #92.

AOI02 was initially identified during the accessible area inspection (see Section 3.1) and then confirmed using the statistical analysis. AOI03 and AOI04 were identified based on the statistical evaluation results. These locations are shown on Exhibit A.3 in Appendix A.

Due to high river levels and flow velocities downstream of Watts Bar Dam, TVA determined that excavating the riprap revetment to evaluate AOI02, AOI03, and AOI04 would pose erosion and stability concerns along the riverbank. Further, during the review of river levels and phreatic levels within the Slag Disposal Area, TVA observed the phreatic levels within the unit trended with the river levels. In addition to the river potentially impacting the east/river side of the unit, the phreatic levels were observed to gradually increase up to a ponded area located west of the Slag Disposal Area.

Based on these observations, TVA drilled supplemental geotechnical borings (WBF-B12, WBF-B13, and WBF-B14) and installed additional multi-level vibrating wire piezometers (VWPZs) adjacent to AOI02, AOI03, and AOI04 to monitor the phreatic levels at the riverbank. Two additional geotechnical borings (WBF-B15 and WBF-B16) were drilled to install VWPZs on the western edge of the Slag Disposal Area, and to monitor the ponded area and its impact on phreatic levels in the unit.

Refer to the Exploratory Drilling SAP for details on drilling and sampling locations and methodology, VWPZ installation methodology, geotechnical testing methodology, and logging.

Water level measurements are currently obtained from existing monitoring wells and piezometers as part of the Groundwater Investigation SAP and CCR Materials Characteristics SAP for the WBF Plant EIP.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

Summary
May 21, 2021

5.0 SUMMARY

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

- Visually inspected accessible areas to identify potential active seeps and locations for additional investigation, if warranted
- Collected water quality parameters in the Tennessee River adjacent to identified historical seep locations/AOIs that were inaccessible due to riprap, etc.
- Conducted 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 136 measurement locations along the banks of the Tennessee River associated with six historical seeps, two AOI locations and at intermediate and upstream control locations. 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 and AOI locations, there were three locations where all four parameters indicated statistically significant differences when compared with upstream locations. One location, AOI02, was identified during both the accessible area inspection as well as the statistical analysis. Therefore, three AOIs associated with historical seeps (AOI02, AOI03, and AOI04) were identified at the WBF Plant in the inaccessible areas for further investigation or data collection. The locations of these AOIs are provided on Exhibit A.3 in Appendix A.

One soil sample was collected at AOI01 for analysis of CCR Parameters during the WBF Plant seep investigation, except as identified above. Soil 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 B4, and field pH results in Table B5.

Stantec has completed the seep investigation at the WBF Plant in Spring 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.



WATTS BAR FOSSIL PLANT SEEP SAMPLING AND ANALYSIS REPORT

References
May 21, 2021

6.0 REFERENCES

Environmental Standards, Inc. 2018. *Quality Assurance Project Plan for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation*. Prepared for Tennessee Valley Authority. Revision 3. December 2018.

Stantec Consulting Services Inc. (Stantec). 2018a. *Seep Sampling and Analysis Plan (SAP), Watts Bar Fossil Plant*. Revision 4. Prepared for Tennessee Valley Authority. December 17, 2018.

Stantec. 2018b. *Environmental Investigation Plan, Watts Bar Fossil Plant*. Revision 4. Prepared for Tennessee Valley Authority. December 17, 2018.

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



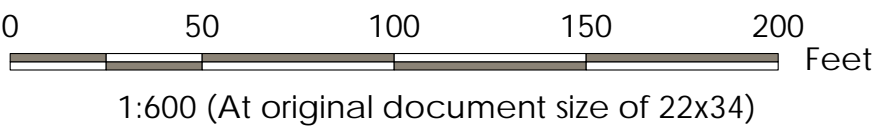
Exhibit No.
A.2

Title
Water Quality Parameter Measurement Locations - Detail

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2021-03-09
Technical Review by HW on 2021-03-09



Legend

- Measurement Locations**
- Adjacent (A)
 - Downstream (D)
 - Upstream (U)
 - Historic Seep (HS)
 - ✱ Area of Interest (AOI) Location
 - 2018 Imagery Boundary
 - CCR Unit Area (Approximate)
 - Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

- Notes**
- Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 - Imagery Provided by Bing Imagery; 2018 Imagery Provided by TVA and is dated September 12, 2018





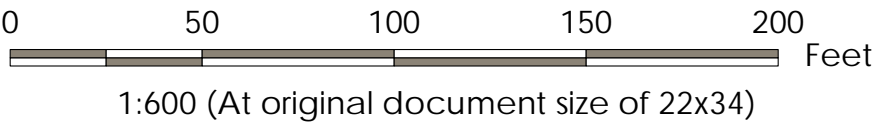
Exhibit No.
A.3

Title
Additional Areas of Interest Identified from Statistical Analysis

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2021-03-29
Technical Review by HW on 2021-03-29



Legend

Historic Seep (HS)

Area of Interest (AOI) Location identified during Accessible Area Inspection

Area of Interest (Riprap Covered) identified from statistical analysis

Sonde Measurement Location

2018 Imagery Boundary

CCR Unit Area (Approximate)

Drainage Improvements Area: Stormwater Pond (Former Ash Pond)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet

2. Imagery Provided by Bing Imagery; 2018 Imagery Provided by TVA and is dated September 12, 2018

APPENDIX B - TABLES

TABLE B.1 - Summary of Water Quality Parameter Results
Watts Bar Fossil Plant
April 2019

Measurement ID	Measurement Date	Dissolved Oxygen	pH (field)	Specific Cond. (Field)	Temperature, Water (C)
		mg/L	SU	uS/cm	DEG C
WBF-IA-1	4/16/2019 2:58:00 PM	11.04	8.00	157.3	17.7
WBF-IA-2	4/16/2019 3:05:00 PM	11.27	8.04	159.3	17.8
WBF-IA-3	4/16/2019 3:12:00 PM	11.04	8.27	157.9	17.9
WBF-IA-4	4/16/2019 3:20:00 PM	11.65	8.32	162.3	18.5
WBF-HSA1-5-D-5	4/16/2019 3:25:00 PM	11.18	8.26	159.6	17.7
WBF-HSA1-5-D-6	4/16/2019 3:32:00 PM	10.74	8.26	161.4	18.0
WBF-HSA1-5-D-7	4/16/2019 3:36:00 PM	10.62	8.15	166.5	18.1
WBF-HSA1-5-D-8	4/16/2019 3:41:00 PM	10.39	8.11	165.4	17.7
WBF-HSA1-5-D-9	4/16/2019 3:46:00 PM	10.70	8.16	159.0	17.8
WBF-HSA1-5-D-10	4/16/2019 3:51:00 PM	10.60	8.11	162.1	17.7
WBF-HSA1-5-D-11	4/16/2019 3:56:00 PM	11.16	8.17	158.4	17.2
WBF-HSA1-5-D-12	4/16/2019 4:03:00 PM	11.13	8.15	158.2	17.2
WBF-HSA1-5-D-13	4/16/2019 4:08:00 PM	11.17	8.16	157.8	17.1
WBF-HSA1-5-D-14	4/16/2019 4:13:00 PM	11.01	8.18	157.9	17.1
WBF-HSA1-5-A-15	4/16/2019 4:19:00 PM	10.87	8.17	160.2	17.3
WBF-HSA1-5-A-16	4/16/2019 4:23:00 PM	11.12	8.11	163.0	17.2
WBF-HSA1-5-A-17	4/16/2019 4:27:00 PM	10.60	8.17	163.8	17.6
WBF-HSA1-5-A-18	4/16/2019 4:32:00 PM	10.79	8.23	157.9	17.2
WBF-HSA1-5-A-19	4/16/2019 4:37:00 PM	11.08	8.19	158.3	17.2
WBF-HSA1-5-A-20	4/16/2019 4:41:00 PM	10.97	8.16	159.6	17.3
WBF-HSA1-5-A-21	4/16/2019 4:44:00 PM	11.11	8.20	159.0	17.3
WBF-HSA1-5-A-22	4/16/2019 4:48:00 PM	11.06	8.25	159.6	17.2
WBF-HSA1-5-A-23	4/16/2019 4:52:00 PM	10.75	8.26	160.6	17.3
WBF-HSA1-5-A-24	4/16/2019 4:55:00 PM	10.49	8.27	160.4	17.4
WBF-HSA1-5-A-25	4/16/2019 4:58:00 PM	11.08	8.23	164.9	17.4
WBF-HSA1-5-A-26	4/16/2019 5:01:00 PM	11.06	8.17	180.4	17.3
WBF-HSA1-5-A-27	4/16/2019 5:05:00 PM	10.93	8.10	182.5	17.4
WBF-HSA1-5-A-28	4/16/2019 5:11:00 PM	10.85	7.66	301.5	18.2
WBF-HSA1-5-A-29	4/16/2019 5:15:00 PM	10.84	8.06	183.8	17.6
WBF-HSA1-5-A-30	4/16/2019 5:20:00 PM	11.13	8.23	160.4	17.1
WBF-HSA1-5-A-31	4/17/2019 10:04:00 AM	10.36	7.80	168.0	16.6
WBF-HSA1-5-A-32	4/17/2019 10:11:00 AM	10.67	7.90	170.1	16.7
WBF-HSA1-5-A-33	4/17/2019 10:14:00 AM	10.47	7.98	166.0	16.8
WBF-HSA1-5-A-34	4/17/2019 10:18:00 AM	11.07	7.97	172.8	16.8
WBF-HSA1-5-A-35	4/17/2019 10:24:00 AM	10.52	7.99	177.2	18.9
WBF-HSA1-5-A-36	4/17/2019 10:27:00 AM	10.63	7.91	181.4	16.9
WBF-HSA1-5-A-37	4/17/2019 10:35:00 AM	10.64	7.15	265.9	17.1
WBF-HSA1-5-A-38	4/17/2019 10:38:00 AM	10.65	7.86	177.1	16.9
WBF-HSA1-5-A-39	4/17/2019 10:42:00 AM	9.61	7.78	196.9	16.9
WBF-HSA1-5-A-40	4/17/2019 10:45:00 AM	10.14	7.55	217.9	17.1
WBF-HSA1-5-A-41	4/17/2019 10:48:00 AM	10.93	7.99	165.6	16.8
WBF-HSA1-5-A-42	4/17/2019 10:50:00 AM	10.42	8.04	171.9	16.9
WBF-HSA1-5-A-43	4/17/2019 10:53:00 AM	9.77	7.96	186.9	17.0
WBF-HSA1-5-A-44	4/17/2019 10:55:00 AM	11.36	7.75	215.5	17.0
WBF-HSA1-5-A-45	4/17/2019 11:01:00 AM	10.76	7.43	329.1	17.3
WBF-HSA1-5-A-46	4/17/2019 11:05:00 AM	10.29	8.08	187.3	16.9
WBF-HSA1-5-A-47	4/17/2019 11:07:00 AM	10.15	8.15	175.6	16.8
WBF-HSA1-5-A-48	4/17/2019 11:10:00 AM	10.95	7.94	242.5	16.8
WBF-HSA1-5-A-49	4/17/2019 11:12:00 AM	10.74	8.12	190.7	16.8
WBF-HSA1-5-A-50	4/17/2019 11:14:00 AM	10.45	8.12	198.1	16.8
WBF-HSA1-5-A-51	4/17/2019 11:16:00 AM	10.70	8.23	172.7	16.9
WBF-HSA1-5-A-52	4/17/2019 11:18:00 AM	9.71	8.34	171.8	16.9
WBF-HSA1-5-A-53	4/17/2019 11:21:00 AM	9.35	8.23	179.7	16.9
WBF-HSA1-5-A-54	4/17/2019 11:24:00 AM	8.99	8.17	182.1	16.8
WBF-HSA1-5-A-55	4/17/2019 11:28:00 AM	9.35	8.27	168.0	17.0

See notes on last page.

TABLE B.1 - Summary of Water Quality Parameter Results
Watts Bar Fossil Plant
April 2019

Measurement ID	Measurement Date	Dissolved Oxygen	pH (field)	Specific Cond. (Field)	Temperature, Water (C)
		mg/L	SU	uS/cm	DEG C
WBF-HSA1-5-A-56	4/17/2019 11:30:00 AM	10.15	8.28	167.4	16.9
WBF-HSA1-5-A-57	4/17/2019 11:33:00 AM	10.23	8.40	171.3	17.3
WBF-HSA1-5-A-58	4/17/2019 11:38:00 AM	11.19	8.33	169.3	17.2
WBF-HSA1-5-A-59	4/17/2019 11:42:00 AM	9.95	8.24	161.0	16.9
WBF-HSA1-5-A-60	4/17/2019 11:44:00 AM	10.05	8.23	161.2	16.9
WBF-HSA1-5-A-61	4/17/2019 11:47:00 AM	9.74	8.20	176.8	17.0
WBF-HSA1-5-A-62	4/17/2019 11:51:00 AM	9.71	8.21	158.6	16.9
WBF-HSA1-5-A-63	4/17/2019 11:56:00 AM	11.11	8.20	159.9	17.0
WBF-HSA1-5-A-64	4/17/2019 11:59:00 AM	11.20	8.20	158.2	16.9
WBF-HSA1-5-A-65	4/17/2019 12:03:00 PM	9.50	8.21	165.6	17.2
WBF-HSA1-5-A-66	4/17/2019 12:06:00 PM	10.37	8.22	174.5	17.4
WBF-HSA1-5-A-67	4/17/2019 12:09:00 PM	10.98	8.23	159.6	17.0
WBF-HSA1-5-A-68	4/17/2019 12:14:00 PM	10.06	7.97	162.6	17.0
WBF-HSA1-5-A-69	4/17/2019 12:16:00 PM	11.16	8.06	167.9	17.0
WBF-HSA1-5-A-70	4/17/2019 12:19:00 PM	11.09	8.11	189.9	17.2
WBF-HSA1-5-A-71	4/17/2019 12:23:00 PM	10.44	8.17	179.1	17.0
WBF-HSA1-5-A-72	4/17/2019 12:26:00 PM	11.00	8.22	168.9	17.1
WBF-HSA1-5-A-73	4/17/2019 12:29:00 PM	9.61	7.97	257.9	17.0
WBF-HSA1-5-A-74	4/17/2019 1:19:00 PM	10.61	7.97	215.2	17.5
WBF-HSA1-5-A-75	4/17/2019 1:22:00 PM	11.09	8.04	184.6	17.6
WBF-HSA1-5-A-76	4/17/2019 1:26:00 PM	11.63	8.21	161.8	17.5
WBF-HSA1-5-A-77	4/17/2019 1:29:00 PM	11.43	8.26	163.5	17.9
WBF-HSA1-5-A-78	4/17/2019 1:32:00 PM	11.41	8.24	162.4	17.7
WBF-HSA1-5-A-79	4/17/2019 1:35:00 PM	11.46	8.23	140.5	17.8
WBF-HSA1-5-A-80	4/17/2019 1:38:00 PM	11.55	8.22	161.8	17.6
WBF-HSA1-5-A-81	4/17/2019 1:41:00 PM	11.52	8.21	162.4	17.6
WBF-HSA1-5-A-82	4/17/2019 1:44:00 PM	11.47	8.20	163.1	17.4
WBF-HSA1-5-A-83	4/17/2019 1:54:00 PM	10.98	8.05	167.7	17.3
WBF-HSA1-5-A-84	4/17/2019 1:58:00 PM	11.44	7.97	176.5	17.4
WBF-HSA1-5-A-85	4/17/2019 2:00:00 PM	11.34	7.94	176.9	17.2
WBF-HSA1-5-A-86	4/17/2019 2:03:00 PM	11.30	7.75	187.9	17.3
WBF-HSA1-5-A-87	4/17/2019 2:07:00 PM	11.08	7.47	222.7	17.3
WBF-HSA1-5-A-88	4/17/2019 2:13:00 PM	10.85	7.63	192.7	17.3
WBF-HSA1-5-A-89	4/17/2019 2:19:00 PM	10.89	7.95	170.8	17.1
WBF-HSA1-5-A-90	4/17/2019 2:24:00 PM	10.14	7.40	231.0	17.1
WBF-HSA1-5-A-91	4/17/2019 2:28:00 PM	10.88	7.80	178.0	17.0
WBF-HSA1-5-A-92	4/17/2019 2:31:00 PM	10.55	7.94	172.9	17.1
WBF-HSA1-5-A-93	4/17/2019 2:34:00 PM	11.35	8.13	159.4	17.0
WBF-HSA1-5-A-94	4/17/2019 2:36:00 PM	11.15	8.12	164.7	17.1
WBF-HSA1-5-A-95	4/17/2019 2:39:00 PM	11.13	8.20	158.5	17.0
WBF-HSA1-5-A-96	4/17/2019 2:42:00 PM	11.28	8.16	161.3	17.0
WBF-HSA1-5-A-97	4/17/2019 2:44:00 PM	11.14	8.15	157.4	16.9
WBF-HSA1-5-A-98	4/17/2019 2:46:00 PM	11.22	8.19	159.3	16.9
WBF-HSA1-5-A-99	4/17/2019 2:49:00 PM	10.39	8.13	170.5	16.9
WBF-HSA1-5-U-100	4/17/2019 2:52:00 PM	11.02	8.18	158.2	16.9
WBF-HSA1-5-U-101	4/17/2019 2:55:00 PM	10.99	8.19	157.6	16.9
WBF-HSA1-5-U-102	4/17/2019 2:58:00 PM	10.65	8.18	156.7	16.9
WBF-HSA1-5-U-103	4/17/2019 3:05:00 PM	10.71	8.21	156.8	16.9
WBF-HSA1-5-U-104	4/17/2019 3:10:00 PM	11.43	8.23	156.9	16.8
WBF-HSA1-5-U-105	4/17/2019 3:14:00 PM	11.58	8.22	156.7	16.8
WBF-HSA1-5-U-106	4/17/2019 3:17:00 PM	11.40	8.23	156.8	16.8
WBF-HSA1-5-U-107	4/17/2019 3:21:00 PM	11.44	8.24	157.2	16.8
WBF-HSA1-5-U-108	4/17/2019 3:25:00 PM	11.33	8.25	156.9	16.8
WBF-HSA1-5-U-109	4/17/2019 3:28:00 PM	11.55	8.25	156.5	16.8
WBF-HSA1-5-U-110	4/17/2019 3:33:00 PM	11.51	8.26	156.3	16.9

See notes on last page.

TABLE B.1 - Summary of Water Quality Parameter Results
Watts Bar Fossil Plant
April 2019

Measurement ID	Measurement Date	Dissolved Oxygen	pH (field)	Specific Cond. (Field)	Temperature, Water (C)
		mg/L	SU	uS/cm	DEG C
WBF-HSA1-5-U-111	4/17/2019 3:35:00 PM	11.46	8.27	157.3	16.8
WBF-IA-112	4/17/2019 3:39:00 PM	11.59	8.25	156.7	16.7
WBF-IA-113	4/17/2019 3:44:00 PM	11.57	8.25	156.4	16.7
WBF-IA-114	4/17/2019 3:51:00 PM	11.41	8.27	156.6	16.7
WBF-IA-115	4/17/2019 3:56:00 PM	11.23	8.17	172.3	16.8
WBF-UC-116	4/17/2019 4:02:00 PM	11.43	8.36	156.1	17.3
WBF-UC-117	4/17/2019 4:04:00 PM	11.44	8.37	155.9	17.4
WBF-UC-118	4/17/2019 4:05:00 PM	11.37	8.35	156.0	17.3
WBF-UC-119	4/17/2019 4:07:00 PM	11.42	8.33	156.1	17.2
WBF-UC-120	4/17/2019 4:09:00 PM	11.39	8.33	156.2	17.2
WBF-UC-121	4/17/2019 4:11:00 PM	11.26	8.30	156.0	17.0
WBF-UC-122	4/17/2019 4:19:00 PM	11.16	8.30	155.9	17.2
WBF-UC-123	4/17/2019 4:22:00 PM	11.16	8.26	155.7	17.0
WBF-UC-124	4/17/2019 4:23:00 PM	11.42	8.28	156.1	17.1
WBF-UC-125	4/17/2019 4:25:00 PM	11.49	8.25	155.9	17.0
WBF-UC-126	4/17/2019 4:27:00 PM	11.37	8.24	155.6	17.0
WBF-UC-127	4/17/2019 4:29:00 PM	11.38	8.22	155.9	17.0
WBF-UC-128	4/17/2019 4:30:00 PM	11.13	8.24	156.1	17.0
WBF-UC-129	4/17/2019 4:32:00 PM	11.35	8.28	155.5	17.1
WBF-UC-130	4/17/2019 4:34:00 PM	11.48	8.34	156.0	17.2
WBF-UC-131	4/17/2019 4:36:00 PM	11.50	8.32	151.9	17.1
WBF-UC-132	4/17/2019 4:38:00 PM	11.26	8.33	155.6	17.1
WBF-UC-133	4/17/2019 4:40:00 PM	11.24	8.35	155.8	17.1
WBF-UC-134	4/17/2019 4:42:00 PM	11.27	8.31	155.8	17.1
WBF-UC-135	4/17/2019 4:44:00 PM	11.42	8.32	155.9	17.0
WBF-UC-136	4/17/2019 4:46:00 PM	11.34	8.31	155.8	17.0

Notes:

- Cond.

DEG C

ID

mg/L

SU

uS/cm
- conductance

degrees Celsius

identification

milligrams per Liter

Standard Units

microSiemens per centimeter

TABLE B.2 Summary of AOI Soil Sample Analysis
Watts Bar Fossil Plant
April 2019

Analysis Type									
Location ID	Sample ID	Sample Type	Medium	Total Metals	Total Mercury	Anions	pH (laboratory)	pH (field)	Radium-226, Radium-228, Radium-226+228
AOI01	WBF-SeS-01-20190418	Normal Environmental Sample	AOI Soils	x	x	x	x	x	x
	WBF-SeS-DUP01-20190418	Field Duplicate Sample	AOI Soils	x	x	x	x		x

Notes:

- Total Metals
- SW-846 6020A
- Total Mercury
- SW-846 7471B
- Anions
- SW-846 9056A
- pH (laboratory)
- SW-846 9045D
- Radium-226, Radium-228, Radium-226+228
- EPA 901.1
- ID
- identification

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 Watts Bar Fossil Plant April 2019

Sample Location		AOI01	
Sample Date		18-Apr-19	18-Apr-19
Sample ID		WBF-SeS-01-20190418	WBF-SeS-DUP01-20190418
Sample Depth		0 - 0.3 ft	
Sample Type		Normal Environmental Sample	Field Duplicate Sample
Level of Review		Validated	Validated
Units			
Total Metals			
Antimony	mg/kg	0.490 J	0.392 J
Arsenic	mg/kg	12.5	10.0
Barium	mg/kg	76.7	60.9
Beryllium	mg/kg	0.681	0.638
Boron	mg/kg	2.14 J	1.89 J
Cadmium	mg/kg	0.0828 J	0.0590 J
Calcium	mg/kg	1,470	1,240
Chromium	mg/kg	55.8 J	64.5 J
Cobalt	mg/kg	32.6 J	20.8 J
Copper	mg/kg	7.13	7.39
Lead	mg/kg	50.2	35.2
Lithium	mg/kg	6.12 J	6.35 J
Mercury	mg/kg	0.0936	0.0648
Molybdenum	mg/kg	1.62	1.10
Nickel	mg/kg	11.8 J	12.3 J
Selenium	mg/kg	0.889	0.953
Silver	mg/kg	<0.0317	<0.0327
Sodium	mg/kg	<22.1	<22.7
Thallium	mg/kg	0.317	0.240
Vanadium	mg/kg	47.2	40.3
Zinc	mg/kg	29.2	30.8
Anions			
Chloride	mg/kg	12.2 J	5.43 J
Fluoride	mg/kg	1.82 J	2.05
Sulfate	mg/kg	474 J	397
General Chemistry			
pH (lab)	SU	7.1	7.0

Notes:		
<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/kg		milligrams per kilogram
SU		Standard Units

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

TABLE B.4 Summary of AOI Soil Analytical Results for Radiological Parameters
Watts Bar Fossil Plant
April 2019

Sample Location		AOI01	
Sample Date		18-Apr-19	18-Apr-19
Sample ID		WBF-SeS-01-20190418	WBF-SeS-DUP01-20190418
Sample Depth		0 - 0.3 ft	
Sample Type		Normal Environmental Sample	Field Duplicate Sample
Level of Review		Validated	Validated
		Units	
Radiological Parameters			
Radium-226	pCi/g	1.48 +/- (0.325)	1.32 +/- (0.266)
Radium-228	pCi/g	1.43 +/- (0.459)	1.53 +/- (0.328)
Radium-226+228	pCi/g	2.91 +/- (0.562)	2.85 +/- (0.422)

Notes:

ft	feet
ID	identification
pCi/g	picoCurie per gram

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

TABLE B.5 - Summary of AOI Soil Field Parameter Results
Watts Bar Fossil Plant
April 2019

Measurement ID	Measurement Date	Depth	pH (field)
			SU
WBF-SeS-01-20190418	4/18/2019 10:41:00 AM	0 - 0.3 ft	7.07

Notes:

ID	identification
SU	Standard Units

TABLE B.6 - Summary of Weekly AOI01 Observations
Watts Bar Fossil Plant
June 2019 to August 2019

Date	Rainfall Total for Prior 7 Days (inches)	Standing Water Evident?	Staining Evident?
6/7/2019	0.45	No	N/A
6/10/2019	1.53	Yes	No
6/13/2019	1.99	Yes	No
6/14/2019	1.61	Yes	No
6/17/2019	0.67	No	N/A
6/20/2019	1.51	Yes	No
6/24/2019	3.46	Yes	No
7/9/2019	0.18	No	N/A
7/12/2019	0.28	Yes	No
7/15/2019	0.88	Yes	No
7/16/2019	0.86	No	N/A
7/17/2019	1.79	Yes	No
7/19/2019	1.91	Yes	No
7/29/2019	0.32	No	N/A
8/1/2019	0.46	Yes	No
8/2/2019	0.46	No	N/A
8/5/2019	0.48	No	N/A

Notes:

N/A : Not Applicable

Rainfall measured at WBN - Watts Bar Fossil Plant, TN

APPENDIX C - PHOTOGRAPHS OF SITE CONDITIONS



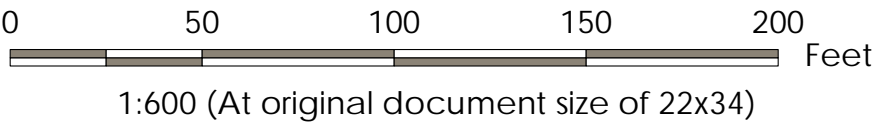
Exhibit No.
C.1

Title
Photographs of Site Conditions

Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order

Project Location
Spring City, Tennessee

175668050
Prepared by DMB on 2021-03-24
Technical Review by RB on 2021-03-24







Legend



- Historic Seep (HS)
- ✱ Area of Interest (AOI) Location
- Area of Interest (Riprap Covered)
- Sonde Measurement Location
- ▲ # Photo Location
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)



- Notes**
- Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 - Imagery Provided by Bing Imagery; 2018 Imagery Provided by TVA and is dated September 12, 2018
 - The river stage depicted on the aerial is higher than at the time of sonde measurements. As such, sonde measurement locations appear off shore. However, sond measurement locations were at the surface water/ rip rap interface.
 - Photo No. 17 is off the map and was taken in the parking lot to the west.
 - 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.







Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 1			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, Area of Interest (AOI)01, access road on southeast side of Slag Disposal Area.			
Photograph ID: 2			
Photo Location: Slag Disposal Area			
Direction: South			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, boat ramp access road east of AOI01, southeast side of Slag Disposal Area.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 3			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, gravel area east of AOI01, southeast side of Slag Disposal Area.			
Photograph ID: 4			
Photo Location: Slag Disposal Area			
Direction: Northeast			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, gravel area east of AOI01, southeast side of Slag Disposal Area.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 5			
Photo Location: Slag Disposal Area			
Direction: South			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, gravel area east of AOI01, southeast side of Slag Disposal Area.			
Photograph ID: 6			
Photo Location: Slag Disposal Area			
Direction: West			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI01, access road on southeast side of Slag Disposal Area.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 7			
Photo Location: Slag Disposal Area			
Direction: Southwest			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI01, access road on southeast side of Slag Disposal Area.			
Photograph ID: 8			
Photo Location: Slag Disposal Area			
Direction: West			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI01, access road on southeast side of Slag Disposal Area.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 9			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI01 to left, access road on southeast side of Slag Disposal Area.			
Photograph ID: 10			
Photo Location: Slag Disposal Area			
Direction: Northeast			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI02, rip rap area on east side of Slag Disposal Area.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 11			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI02, rip rap area on east side of Slag Disposal Area.			
Photograph ID: 12			
Photo Location: Slag Disposal Area			
Direction: Southeast			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI02, rip rap area on east side of Slag Disposal Area.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 13			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, access road, east side of Slag Disposal Area.			
Photograph ID: 14			
Photo Location: Slag Disposal Area			
Direction: East			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI02, east side of Slag Disposal Area.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 15			
Photo Location: Slag Disposal Area			
Direction: West			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI02, base of rip rap from boat east side of Slag Disposal Area.			
Photograph ID: 16			
Photo Location: Slag Disposal Area			
Direction: Southwest			
Photo Date: 4/16/2019			
Comments: Walkdown inspection, AOI02, base of rip rap from boat east side of Slag Disposal Area.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 17			
Photo Location: Slag Disposal Area			
Direction: Northeast			
Photo Date: 4/16/2019			
Comments: Sonde calibration.			
Photograph ID: 18			
Photo Location: Slag Disposal Area			
Direction: East			
Photo Date: 4/16/2019			
Comments: Sonde measurements from boat.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 19			
Photo Location: Slag Disposal Area			
Direction: East			
Photo Date: 4/16/2019			
Comments: Sonde measurements from boat.			
Photograph ID: 20			
Photo Location: Slag Disposal Area			
Direction: East			
Photo Date: 4/18/2019			
Comments: Preparation for soil sampling, AOI01 location.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 21			
Photo Location: Slag Disposal Area			
Direction: West			
Photo Date: 4/18/2019			
Comments: Preparation for soil sampling, AOI01 location, composite locations.			
Photograph ID: 22			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 4/18/2019			
Comments: Soil sampling, AOI01 location, composite locations.			


Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 23			
Photo Location: Slag Disposal Area			
Direction: East			
Photo Date: 4/18/2019			
Comments: Soil sampling, AOI01 location, composite samples.			
Photograph ID: 24			
Photo Location: Slag Disposal Area			
Direction: West			
Photo Date: 6/7/2019			
Comments: AOI01 location monitoring.			


Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 25			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 6/10/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 26			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 6/13/2019			
Comments: AOI01 location monitoring.			



Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 27			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 6/14/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 28			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 6/17/2019			
Comments: AOI01 location monitoring.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 29			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 6/20/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 30			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 6/24/2019			
Comments: AOI01 location monitoring.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 31			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/9/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 32			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/12/2019			
Comments: AOI01 location monitoring.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 33			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/15/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 34			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/16/2019			
Comments: AOI01 location monitoring.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 35			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/17/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 36			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/19/2019			
Comments: AOI01 location monitoring.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 37			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 7/29/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 38			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 8/1/2019			
Comments: AOI01 location monitoring.			

Client:	Tennessee Valley Authority	Project:	Seep Investigation
Site Name:	Watts Bar Fossil Plant	Site Location:	Spring City, Tennessee
Photograph ID: 39			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 8/2/2019			
Comments: AOI01 location monitoring.			
Photograph ID: 40			
Photo Location: Slag Disposal Area			
Direction: North			
Photo Date: 8/5/2019			
Comments: AOI01 location monitoring.			

APPENDIX D - STATISTICAL ANALYSIS OF WATER QUALITY PARAMETERS

REFER TO APPENDIX E.4

APPENDIX I.2

DATA SCREENING RESULTS FOR AOI2 WATER SAMPLES

Appendix I.2 - Seep Investigation AOI Soil Sample Results Watts Bar Fossil Plant

Sample Location		AOI01
Sample Date		18-Apr-19
Sample ID		WBF-SeS-01-20190418
Sample Depth		0 - 0.3 ft
Sample Type		Normal Environmental Sample
Level of Review	Units	Validated / Final QC Review ²
Metals		
Antimony	mg/kg	0.490 J
Arsenic	mg/kg	12.5
Barium	mg/kg	76.7
Beryllium	mg/kg	0.681
Boron	mg/kg	2.14 J
Cadmium	mg/kg	0.0828 J
Calcium	mg/kg	1,470
Chromium	mg/kg	55.8 J
Cobalt	mg/kg	32.6 J
Copper	mg/kg	7.13
Lead	mg/kg	50.2
Lithium	mg/kg	6.12 J
Mercury	mg/kg	0.0936
Molybdenum	mg/kg	1.62
Nickel	mg/kg	11.8 J
Selenium	mg/kg	0.889
Silver	mg/kg	<0.0317
Sodium	mg/kg	<22.1
Thallium	mg/kg	0.317
Vanadium	mg/kg	47.2
Zinc	mg/kg	29.2
Anions		
Chloride	mg/kg	12.2 J
Fluoride	mg/kg	1.82 J
Sulfate	mg/kg	474 J
Radiological Parameters		
Radium-226	pCi/g	1.48 +/- (0.325)
Radium-228	pCi/g	1.43 +/- (0.459)
Radium-226+228	pCi/g	2.91 +/- (0.562)
Field Parameters/General C		
pH (field)	SU	7.07
pH (lab)	SU	7.1

Notes:

<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
ft	feet below ground surface
ID	identification
J	quantitation is approximate due to limitations identified during data validation
mg/kg	milligrams per kilogram
pCi/g	picoCurie per gram
SU	Standard Unit

1. Level of review is defined in the Quality Assurance Project Plan.
2. All data validated except for pH (field) which had final QC review.
3. AOI01 observations suggest this feature is not a seep and, therefore, is not compared to background threshold values.