Environmental Assessment Report

Watts Bar Fossil Plant

Spring City, Tennessee

Tennessee Valley Authority

Title and Approval Page

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Prepared By:	Tennessee Valley Authority
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Revision Log

Revision	Date	Description
0	November 7, 2023	EAR Submittal to TDEC
1	March 31, 2024	Addresses January 31, 2024 TDEC Review Comments and Issued for TDEC

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Executive Summary

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to Tennessee Valley Authority (TVA) to establish a process for investigating, assessing, and remediating unacceptable risks from management of coal combustion residuals (CCR) at TVA coal-fired plants in the state of Tennessee. TVA constructed the WBF Plant between 1940 and 1945 on approximately 34 acres and began generating power in 1942. TVA retired the four steam plant generating units in 1982. There are two CCR management units[1] at the Watts Bar Fossil Plant (WBF Plant) included in the TDEC Order: the Ash Pond and Slag Disposal Area. Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure.

In accordance with the TDEC Order, TVA and Stantec Consulting Services Inc. (Stantec), on behalf of TVA, prepared an Environmental Investigation Plan (EIP) for the WBF Plant to obtain and provide information requested by TDEC. As specified in the TDEC Order, the objective of the EIP was to "identify the extent of soil, surface water, and groundwater contamination by CCR" from onsite management of CCR material in impoundments and landfills. In addition, per TDEC's information requests, the EIP included assessment of CCR management unit structural stability and integrity.

Between 2018 and 2021, TVA and Stantec conducted the TDEC Order environmental investigations (EI) for the WBF Plant CCR management units. The EI included characterization of the site hydrogeology and investigations of CCR material, groundwater, background soils, seeps, surface streams, sediments, and ecology, as well as a Water Use Survey. EI activities were implemented in accordance with the approved Sampling and Analysis Plans and Quality Assurance Project Plans, including TVA- and TDEC-approved programmatic and project-specific changes made following approval of the EIP. Based on a comprehensive quality assurance review, the EI data are usable and meet the objectives of the TDEC Order.

The EI data were evaluated along with information collected as part of previous investigations and other ongoing regulatory monitoring programs conducted from the 1970s though 2022. The objectives of the TDEC Order are similar to these other programs, including the Ash Pond closure program. Collectively, these data provide a broad-based characterization of the CCR management units to meet the objectives of the EIP. Geotechnical data were used for CCR management unit stability and integrity evaluations. Environmental sample data were used to characterize the extent of potential impacts and were compared to constituent-specific TDEC-approved levels to identify CCR constituents that require further evaluation in the next phase of the TDEC Order, the Corrective Action / Risk Assessment (CARA) Plan.

This Environmental Assessment Report (EAR) describes the extent of surface stream water, sediment, and groundwater contamination from the WBF Plant CCR management units, and provides the information, data, and evaluations used to make those assessments. As described herein, more than 98% of the environmental sample results from approximately 300 samples were below the approved levels. The EI data indicate impacts to limited onsite groundwater areas, and that the CCR management units have had no impacts to sediment and surface stream water quality, and ecological communities in the Tennessee River. The EI data will be used to evaluate the basis and methods for CCR management

[1] The term "CCR management unit" is used in this document generally and is not intended to be a designation under federal or state regulations.

unit closure in the CARA Plan, including an evaluation of the performance of existing closure methods; modifications to closure methodology will be identified, as needed, in the CARA Plan.

The following are overall assessment findings based on data as presented in this EAR:

- Surface stream water quality is within ranges protective of human health and aquatic life in the Tennessee River.
- Sediment quality is within ranges protective of aquatic life in the Tennessee River adjacent to and downstream of the CCR management units.
- The EI data indicate that ecological communities are healthy in the Tennessee River adjacent to and downstream of the CCR management units and demonstrate more favorable ecological conditions than upstream locations.
- The CCR management units have adequate structural stability and slopes are stable under current static and seismic loading conditions, except for the post-earthquake, global stability at the Slag Disposal Area and the Ash Pond. TVA will be evaluating mitigation alternatives as part of the CARA Plan.
- During the EI, three Areas of Interest (AOIs) were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data and using the supplemental investigation results described in Chapter 6, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed. No AOIs were identified at the Ash Pond.
- Most TDEC Appendix I and United States Environmental Protection Agency CCR Rule (Title 40, Code of Federal Regulations Part 257, Subpart D) (CCR Rule) Appendix IV CCR constituent concentrations in onsite groundwater are below TDEC-approved groundwater screening levels (GSLs), and groundwater impacts are limited to onsite areas along the perimeter of the CCR management units. However, additional assessments will be included in the CARA Plan to evaluate the need for corrective action for targeted onsite groundwater remediation at locations where statistically significant concentrations of CCR constituents above GSLs exist.
- Drainage improvements or potential corrective actions are expected to reduce concentrations of CCR constituents to below GSLs in groundwater at downgradient monitoring locations.
- The horizontal groundwater flow direction within the uppermost aquifer is generally from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the CCR management units is bounded to the east by the Tennessee River.
- Based on the results of the Water Use Survey, no wells or springs potentially used for domestic or business purposes were identified in the Survey Area.

Exhibit ES-1 shows overall findings of the investigation and the locations where the environmental assessments concluded that no further evaluation is needed. It also shows where further evaluation is needed in the CARA Plan for onsite groundwater. Onsite groundwater impacts may require further evaluation regardless of the CCR management unit closure method, and groundwater remediation can be accomplished along with closure in place or closure by removal. TVA continues to evaluate additional ways to beneficially use CCR materials in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley.

Upon TDEC approval of the EAR, and in accordance with the TDEC Order, TVA will further evaluate these findings and prepare a CARA Plan for submittal to TDEC. The CARA Plan, which will be subject to a public review and comment process, will evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant. The CARA Plan will also specify the actions TVA plans to take at the CCR management units and the basis of those actions. It also will incorporate other modifications to stormwater drainage or cap systems planned or in progress by TVA, including details for CCR beneficial use operations, modification of the CCR management units as needed to meet regulatory standards, and long-term closure and monitoring.

Exhibit No.

ES-1

Title

Summary of Environmental Assessment Report Findings
Watts Bar Fossil Plant

Client/Project

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

Project Location | 175668050

Spring City, Tennessee | Prepared by KB on 2023-12-07

* All of the sediment and surface water samples in the Tennessee River were below approved levels.

CCR Management Unit

Drainage Improvements Area

Key Findings

The ecological communities are healthy in the Tennessee River adjacent to and downstream of the CCR management units based on the results of the environmental assessment and other monitoring efforts.

Nearly all of the environmental sample results were below the approved levels.

The health of the aquatic life is a key indicator of the health of the Tennessee River. This means that TVA is managing its CCR units in a way that's protective of the environment.

Investigation and Monitoring Findings

These symbols summarize the findings of the investigation and monitoring:

- No action is needed.
- Further evaluation is required in this area.
- Corrective action is being evaluated for seismic stability along the perimeter of the unit in this area.

Next Steps

With TDEC acceptance of the environmental assessment, TVA will further evaluate certain areas for potential corrective action.

TVA will use the findings from the environmental assessment to prepare and submit a corrective action plan to TDEC. This plan, which will be released for public review and comment, will specify measures TVA plans to take to address unacceptable risks.

TVA's efforts will continue until regulators are satisfied, and monitoring of groundwater will continue for many years.

Acronyms and Abbreviations

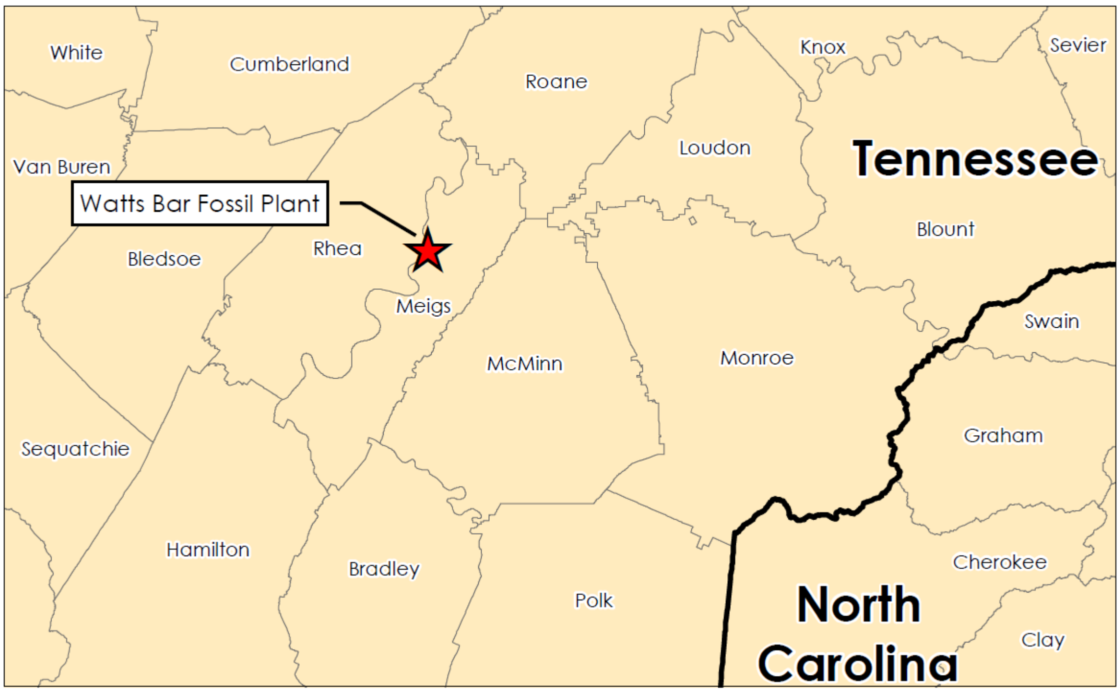
AOI	Area of Interest
ATL	Alternate Thermal Limits
BTV	Background Threshold Value
CARA	Corrective Action/Risk Assessment
CBR	Critical Body Residue
CCR	Coal Combustion Residuals
CCR Parameters	CCR Constituents listed in 40 CFR 257, Appendices III and IV, and the five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04
CCR Rule	USEPA Final Rule on Disposal of Coal Combustion Residuals from Electric Utilities
CFR	Code of Federal Regulations
CPT	Cone Penetration Test
CSM	Conceptual Site Model
°F	Degrees Fahrenheit
DMP	Data Management Plan
DSWM	TDEC Division of Solid Waste Management
EAR	Environmental Assessment Report
EDA	Exploratory Data Analysis
EI	Environmental Investigation
EIP	Environmental Investigation Plan
EnvStds	Environmental Standards, Inc.
ESV	Ecological Screening Value
EXD	Exploratory Drilling
ft amsl	Feet Above Mean Sea Level
ft bgs	Feet Below Ground Surface
GEL	GEL Laboratories, LLC
GSL	Groundwater Screening Level
HBI	Hilsenhoff Biotic Index
MQA	Material Quantity Assessment
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
PACE	Pace Analytical® Services, LLC
%	Percent
PLM	Polarized Light Microscopy
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBI	Reservoir Benthic Index
RFAI	Reservoir Fish Assemblage Index
RJ Lee	RJ Lee Group

SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
SPLP	Synthetic Precipitation Leaching Procedure
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order OGC15-0177
Terramodel	Trimble Terramodel 3D™ Software Package
TestAmerica	Eurofins Environment Testing America
the Survey	Desktop Survey Referenced in Section 5.4.1
TN	Tennessee
TriAD	TriAD Environmental Consultants, Inc.
TSMP	Tennessee Storm Water Multi-Sector General Permit
TTR	Total Taxa Richness
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTLs	Upper Tolerance Limits
WBF Plant	Watts Bar Fossil Plant
WBN Plant	Watts Bar Nuclear Plant
WET	Whole Effluent Toxicity

Chapter 1 Introduction

The Tennessee Valley Authority (TVA) and Stantec Consulting Services Inc. (Stantec), on behalf of TVA, prepared this Environmental Assessment Report (EAR) to provide an evaluation of the environmental conditions at the Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee, that may have been related to management of coal combustion residuals (CCR) in onsite impoundments and landfills. The WBF Plant is a former TVA coal-fired power plant in Rhea County, located in east Tennessee (see below and Exhibit 1-1).

WBF Plant Location



1.1 Background, Scope, and Objectives

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015, in Appendix A.1). The two closed CCR management units[2] at the WBF Plant included in the TDEC Order are: the Ash Pond and Slag Disposal Area (see below).

[2] The term "CCR management unit" is used in this document generally and is not intended to be a designation under federal or state regulations.

WBF CCR Management Units

In accordance with the TDEC Order, TVA prepared an Environmental Investigation Plan (EIP) for the WBF Plant (TVA 2018a) to obtain and provide information requested by TDEC. Following public review and comment on the draft, the EIP was approved by TDEC on November 27, 2018, and TVA implemented the activities between 2019 and 2021 in accordance with the approved EIP. As specified in the TDEC Order, the objective of the EIP was to "identify the extent of soil, surface water, and ground water contamination by CCR" from onsite management of CCR material in impoundments and landfills. In addition, per TDEC's information requests, the EIP included assessment of CCR management unit structural stability and integrity.

The EIP included characterization of the site hydrogeology and investigations of CCR material, groundwater, background soils, seeps, surface streams, sediments, and ecology at and near the WBF Plant CCR management units to supplement historical data. This EAR presents the results of those investigations and an evaluation of recent and historical data to provide conceptual site models (CSMs) for the CCR management units and overall findings for environmental media at the WBF Plant. CSMs describe sources of CCR constituents, pathways by which they can move, and environmental media potentially impacted if they are released. As required by the TDEC Order, this EAR will be revised to address TDEC comments until TDEC determines that the extent of CCR contamination has been defined.

1.2 Regulatory Framework

The onsite management of CCR material at the WBF Plant is subject to the following regulatory programs relevant to this investigation.

1.2.1 TDEC Order

The TDEC Order was issued to establish a process for investigating, assessing, and remediating unacceptable risks from management of CCR at TVA coal-fired plants in the state of Tennessee. The TDEC Order also established a process whereby TDEC would oversee TVA's implementation of the United States Environmental Protection Agency (USEPA) CCR Rule for coordination and compliance with Tennessee's solid waste management program. Information about the USEPA CCR Rule is provided in Section 1.2.2.

Upon TDEC approval of the EAR, TVA will prepare and submit a Corrective Action/Risk Assessment (CARA) Plan to TDEC. The CARA Plan, which will be subject to a public review and comment process, will specify the actions TVA plans to take to mitigate unacceptable risks at the WBF Plant CCR management units, including the basis of those actions. The information provided in this EAR will support TVA's preparation of the CARA Plan and TDEC's decision-making process regarding the actions to be taken at the WBF Plant CCR management units pursuant to the TDEC Order.

1.2.2 CCR Rule

The USEPA CCR Rule sets forth national criteria for the management of CCR, was published on April 17, 2015, and can be found in Title 40, Code of Federal Regulations (40 CFR) Part 257, Subpart D (CCR Rule). The two CCR management units at the WBF Plant that are included in the TDEC Order are not subject to the CCR Rule because both units ceased receiving CCR and were closed prior to October 19, 2015, which was the effective date of the CCR Rule requirements.

1.2.3 State Programs

In addition to the TDEC Order, TDEC has issued permits to TVA for ongoing CCR management and wastewater discharges from the WBF Plant CCR management units. Current permits include:

- TDEC Rule 0400-11-01-.04 Division of Solid Waste Management (DSWM) – Non-Registered Site Permit No. 72-0010 for the Ash Pond.
- Tennessee Storm Water Multi-Sector General Permit (TSMP) for Industrial Activities – TNR050000 National Pollutant Discharge Elimination System (NPDES) Permit Tracking No. TNR058427. Permitted wastewater discharges are to the Tennessee River via Outfalls F02 and F03 (which includes discharges from Equipment Support Services facility, the closed Slag Disposal Area, and Stormwater Pond).

The Slag Disposal Area was closed under Tennessee Solid Waste Disposal Act, TCA 68-211-101, et seq.- TNR190741, which is inactive. The Ash Pond was closed under NPDES Permit No. TN0005461, which was terminated on December 16, 2015 (TDEC 2015b).

The DSWM regulatory requirements govern CCR management and monitoring of groundwater for the TDEC non-registered sites (consisting of the Ash Pond). Records are maintained for groundwater monitoring well sample results and groundwater elevations throughout the life of the unit, including the post-closure care period. Groundwater monitoring results are reported to TDEC at the intervals specified in the Ash Pond closure program.

Under the NPDES permit, a Stormwater Pollution Prevention Plan is maintained in accordance with the permit requirements. Outfall monitoring results are recorded and submitted annually to TDEC's Division of Water Resources in the Discharge Monitoring Report. Weekly, quarterly, and annual inspections of the permitted facilities and outfalls are conducted, documented, and archived in accordance with the permit requirements.

1.3 Environmental Investigation Overview

The following provides an overview of the environmental investigation (EI) activities conducted in accordance with the EIP that are reported in this EAR. The evaluation of existing data from previous studies conducted at the WBF Plant served as the foundation to support the TDEC Order EI.

1.3.1 Investigation Activities

In November 2018, Revision 3 of the EIP was approved by TDEC (Appendix A.2), which details the proposed EI to be conducted by TVA to provide additional information requested by TDEC. The EIP is comprised of desktop studies, Sampling and Analysis Plans (SAPs), a Quality Assurance Project Plan (QAPP), a Data Management Plan (DMP), a proposed schedule of investigative activities, and responses to TDEC information requests and public comments.

Environmental media samples collected as part of the EI, or other ongoing environmental programs being conducted at the plant, were analyzed for CCR Parameters listed in the CCR Rule, Appendices III and IV. Five additional inorganic parameters listed in Appendix I of Tennessee (TN) Rule 0400-11-01-.04 that are not included in the CCR Rule Appendices III and IV were analyzed to maintain continuity with TDEC environmental programs.

CCR Parameters
CCR Rule Appendix III Parameters
Boron
Calcium
Chloride
Fluoride[1] (also Appendix IV)
pH
Sulfate
Total Dissolved Solids
CCR Rule Appendix IV Parameters
Antimony
Arsenic
Barium
Beryllium
Cadmium
Chromium
Cobalt
Lead
Lithium
Mercury
Molybdenum
Radium-226+228
Selenium
Thallium
Additional TDEC Appendix I Parameters
Copper
Nickel
Silver
Vanadium
Zinc

Notes: [1]Fluoride is both a CCR Rule Appendix III and CCR Rule Appendix IV CCR parameter. In this table, and in the results figures and tables for this report, fluoride has been grouped with the Appendix III CCR parameters only to avoid duplication. Only TDEC Appendix I and CCR Rule Appendix IV constituents are subject to potential corrective measures.

The combined CCR Rule Appendices III and IV parameters and TDEC Appendix I inorganic parameters are referenced collectively herein as “CCR Parameters”. As specified in the SAPs, additional parameter analyses were also performed based on the specific needs of the investigation. Where applicable, additional analyses are described in Chapters 3 through 7 below.

As documented in this EAR, the EI was implemented in accordance with the SAPs, which were updated with TVA- and TDEC-approved programmatic and project-specific changes made after approval of the EIP. EI results are summarized in this report, with details of each investigation provided in technical evaluation summaries and associated sampling and analysis reports (SARs) included as appendices. The purpose of the SARs was to document the work completed during the investigations and present the information and data collected to meet the objectives of the SAPs. The SARs were prepared and submitted to TDEC for review following completion of the SAP scopes of work. If TDEC provided comments after their initial reviews of the SARs, the comments were addressed, and the SARs were updated and re-submitted to TDEC for final acceptance. After each of the SARs was accepted by TDEC, those EI results, along with historical data collected under other State and/or CCR programs, were evaluated and are presented in this EAR.

The investigations and subsequent assessments completed pursuant to the EIP SAPs at the WBF Plant CCR management units are listed below:

- Background Soil Investigation
- Exploratory Drilling
- Stability Analysis
- CCR Material Characteristics Investigation
- Material Quantity Assessment
- Hydrogeological Investigation
- Groundwater Investigation
- Seep Investigation
- Surface Stream Investigation
- Sediment and Benthic Investigation
- Fish Tissue Investigation.

1.3.1.1 Screening Levels

Sampling results obtained during these investigations are evaluated in this EAR by comparing concentrations of CCR Parameters to TDEC-approved screening levels (Tables 1-1 through 1-5 and Appendix A.2). The purpose of this comparison is to identify CCR Parameters in environmental media that require further assessment in the CARA Plan. The screening levels are generic (not specific to an individual person or ecological receptor) and are protective of human and ecological health. Most screening levels are not regulatory standards and are conservatively based on published health studies. Concentrations above the screening level do not necessarily mean that an adverse health effect is occurring, but rather, that further evaluation is required in the CARA Plan to determine if an unacceptable risk exists, and if corrective action is required.

Groundwater screening levels (GSLs) and surface water screening levels are based on published human health risk-based values considering these media as potential potable water sources (Tables 1-1 and 1-2). Surface water, sediment, and mayfly and fish tissue screening levels are based on published ecological risk-based values drawn from regulatory guidance and published studies (Tables 1-2 through 1-5). In cases where there is more than one applicable screening level for an environmental medium (e.g., surface water), the lowest value, or both values, are compared to the analytical results.

The statistical evaluation conducted for groundwater analytical results in this EAR was for investigatory purposes to characterize the extent of CCR impacts as required by the TDEC Order. It was not conducted for compliance with the Ash Pond closure program. Groundwater monitoring reports for the Ash Pond closure program are submitted to TDEC within 60 days of sampling events.

1.3.1.2 Hydrogeological Terms

For purposes of this EAR, the following hydrogeological terms as they are defined below are used throughout this document.

- Pore water - subsurface water that occurs in pore spaces in CCR material
- Groundwater - subsurface water that occurs in pore spaces in unconsolidated or geologic materials (e.g., soil, bedrock)
- Aquifer - a geologic formation capable of yielding usable quantities of groundwater
- Confined aquifer - an aquifer present between two aquitards when the water level in a well is observed to be above the top of the aquifer due to the confining pressure (see graphic below).
- Aquitard – a geologic formation comprised of less permeable geologic materials that transmit groundwater more slowly than the aquifer
- Saturated – Unconsolidated or geologic materials (e.g., soil, bedrock) or CCR material where all of the pore space is filled with water. The use of the term "saturated" in references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material.
- Moisture content - the measure of the amount of water contained within unconsolidated or geologic materials (e.g., soil, bedrock) or CCR material. Moisture content of saturated material can be variable because the characteristics of the material determine the amount of pore space available for water to fill.
- Phreatic surface - the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water. Pore water levels are measured at locations where temporary wells or piezometers were installed within CCR material. The measured pore water levels are used to infer pore water levels between the wells and piezometers to develop the phreatic surface.
- Piezometric surface – the surface of groundwater defined by the level to which groundwater will rise in a well completed in a confined aquifer.
- Uppermost aquifer - the geologic formation nearest the natural ground surface that is an aquifer, as well as lower aquifers that are hydraulically interconnected with this aquifer within a facility's property boundary.

  In a confined aquifer, measured groundwater levels rise above the top of the aquifer. The difference between the measured groundwater levels within the aquifer and the top of the aquifer is called the pressure head. A figure showing pressure head for a confined aquifer and associated bounding aquitards is provided below. For confined aquifers, groundwater is not encountered in the interval shown as pressure head above the top of the aquifer because it is bounded by an upper aquitard, which also physically separates the groundwater from the geologic unit located above the upper aquitard.

Pore Water

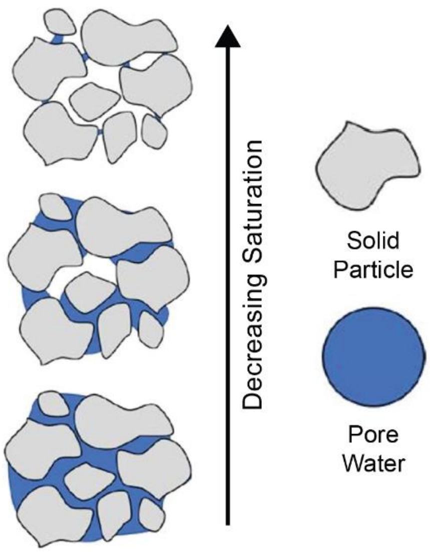
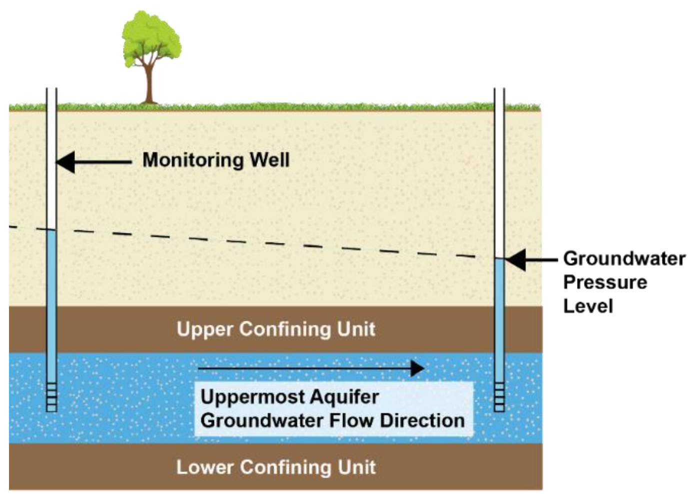


Figure Reference: Benson, C., *Water Flow in Coal Combustion Products and Drainage of Free Water*, Report No. 3002021963, Electric Power Research Institute, Palo Alto, CA.

This figure depicts how subsurface water occurs in the pore spaces in CCR material (referred to as "pore water" in this EAR), and how saturation varies within the CCR material. The phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water.

Confined Aquifer



Groundwater is subsurface water that occurs in pore spaces in soil or bedrock. Groundwater level measurements are used to estimate directions of groundwater movement. Groundwater generally flows much more slowly than water in a surface stream or river.

1.3.2 Data Management and Quality Assessment

For the EI, laboratory analytical testing was conducted by the following laboratories:

- GEL Laboratories, LLC (GEL) in Charleston, South Carolina
- Eurofins Environment Testing America Inc. (formerly known as TestAmerica and referenced herein as TestAmerica), in Nashville, Tennessee; Pittsburgh, Pennsylvania; and St. Louis, Missouri
- RJ Lee Group, Inc. (RJ Lee) in Monroeville, Pennsylvania
- Pace Analytical Services, LLC (Pace) in Green Bay, Wisconsin.

In addition, quantitative analysis of benthic invertebrate community samples was performed by Pennington and Associates, Inc. in Cookeville, Tennessee. Geotechnical laboratory testing and data review was performed by Stantec in Lexington and Louisville, Kentucky and also conducted by GeoTesting Express Inc. in Acton, Massachusetts.

Data management was performed by Environmental Standards, Inc. (EnvStds). Field data and laboratory analytical data collected under the EI were managed in a database in accordance with the DMP for the TDEC Order (EnvStds 2018b). The DMP was developed for data collected under the TDEC Order. Consolidated management of data related to the

TDEC Order allowed for environmental data associated with the investigation to be appropriately maintained and accessible to data end users. The DMP provided a basis for supporting technical data management with an emphasis on completeness, data usability, and defensibility of the data.

To support the EI, a Quality Assurance (QA) program was implemented to verify that environmental data used for decision-making were reliable. The overall QA objective for field activities, laboratory analyses, and data assessment was to produce data of sufficient and known quality to support program-specific objectives and produce high-quality, legally-defensible data. This objective was met by following the QAPP (EnvStds 2018a), included as Appendix C of the EIP.

The QAPP was followed for investigation data quality assessment, where data quality refers to the level of reliability associated with a dataset or data point. The QAPP describes QA procedures and Quality Control (QC) measures applied to EI activities, describes the generation and use of environmental data associated with the investigation, is applicable to sampling and monitoring programs associated with EI activities, and provides quantitative objectives for analytical data generated under the investigation activities.

Data collected during the EI were evaluated for usability by conducting a QA review, per the QAPP. As part of TVA's commitment to generate representative and reliable data, oversight of field activities, field documentation review, centralized data management, and data validation or verification of laboratory analytical results were performed by EnvStds. In addition, TDEC and TDEC's contractor Civil & Environmental Consultants, Inc., were periodically onsite to observe field activities and collect confirmation samples during the investigations. Based on the QA review performed by EnvStds, the EI data collected are considered usable for reporting and evaluation in this EAR and meet the objectives of the TDEC Order. Further documentation of the QA program implemented during the EI is provided in the *Data Quality Summary Report for the Tennessee Valley Authority Watts Bar Fossil Plant Environmental Investigation* prepared by EnvStds following completion of the EI (EnvStds 2022).

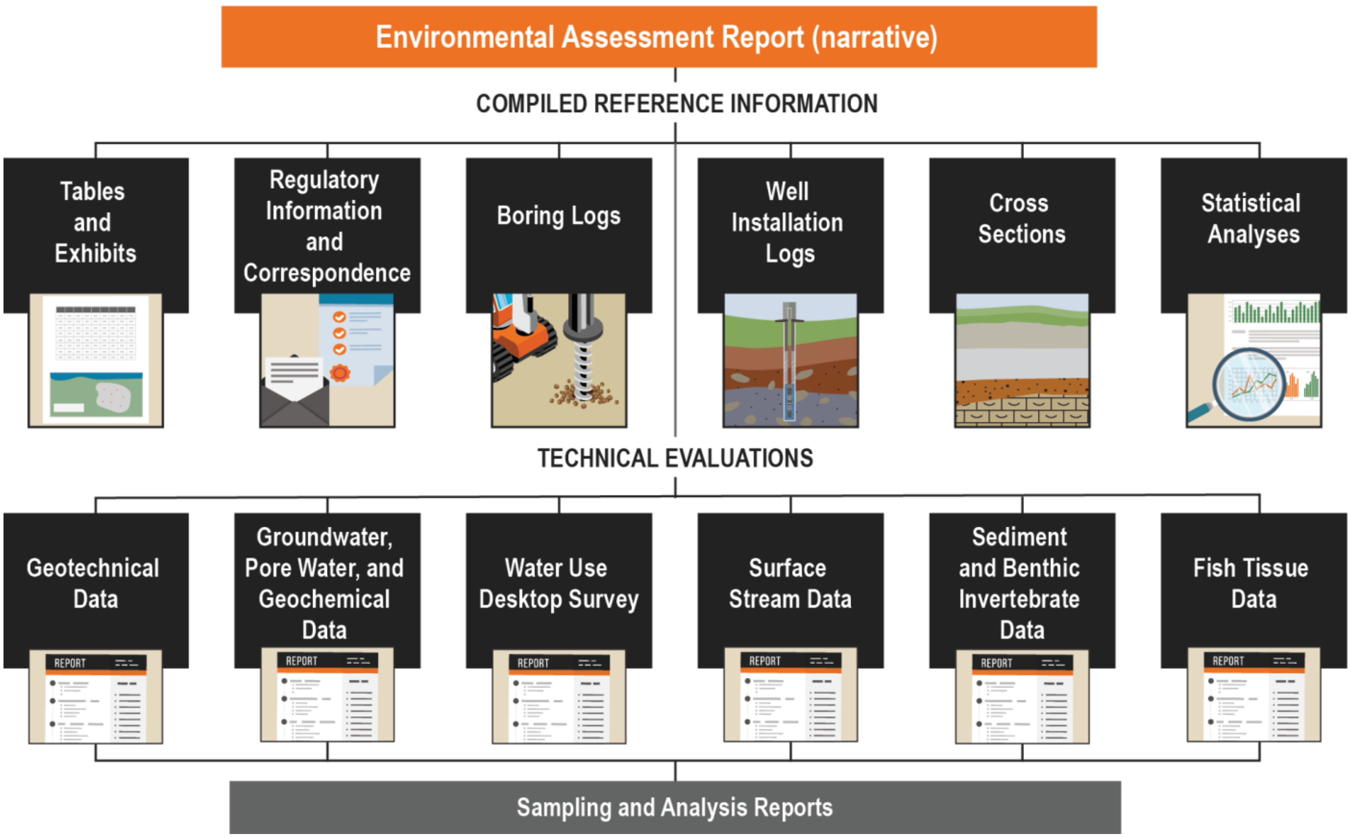
1.4 Key Milestones

A chronology of key milestones and events related to the TDEC Order and implementation of the EIP that occurred following approval of the EIP is provided below.

Date	Event
November 27, 2018	TDEC approval of WBF Plant EIP Revision 3
December 17, 2018	Kickoff meeting held with TVA and TDEC to discuss implementation of EIP
March 28, 2019	Phase 1 EI field activities commence
July 8, 2020	Phase 1 EI field activities substantially complete (excluding Phase 2 Sampling)
September 28, 2020	Initial SAR submitted to TDEC
June 7, 2021	Phase 2 field activities commenced
December 10, 2021	Phase 2 field activities completed
September 8, 2023	Last SAR accepted by TDEC
November 7, 2023	Submittal of WBF Plant EAR Revision 0 to TDEC
Janaury 31, 2024	TDEC comments on WBF Plant EAR Revision 0
March 31, 2024	Submittal of WBF Plant EAR Revision 1 to TDEC

1.5 Report Organization

This EAR is based on EI data and results from other ongoing environmental programs obtained for the WBF Plant CCR management units through 2022. To facilitate discussion of the interrelationships of the data collected during the EI, the EAR presents evaluation of findings organized in the following principal investigation components: background soils, CCR materials, hydrogeology, seeps, and ecology. Chapters 3 through 8 herein provide a summary of each investigation's scope and present the evaluation of those data, along with relevant historical or other environmental program data. The summary of findings presented in Chapters 3 through 8 are supported by detailed technical information and analyses presented in appendices as diagrammed below. Details of technical evaluations and information supporting those evaluations are included in appendices organized by subject matter. Field investigation activities sampling results are provided in SARs associated with each subject matter. The structure of the overall document is provided in the diagram below.



This EAR is organized as follows:

- **Executive Summary**: Describes the principal elements and findings of the environmental investigations presented in the EAR
- **Chapter 1 – Introduction:** Describes the background and purpose of the investigation, regulatory framework, an overview of the EI, public and agency involvement, and EAR organization
- **Chapter 2 – Site History and Physical Characteristics:** Presents the operational history, land use, and physical characteristics of the WBF Plant
- **Chapter 3 – Background Soil Investigation:** Summarizes the scope and provides the results of background soil investigations conducted for the WBF Plant
- **Chapter 4 – CCR Material Investigations:** Summarizes the CCR management unit geotechnical investigation results, including exploratory drilling, slope stability, structural integrity, and structural stability (bedrock) evaluations, findings from evaluations of pore water and CCR material characteristics investigation results, and provides information regarding CCR material characteristics and quantities
- **Chapter 5 – Hydrogeological Investigations:** Describes hydrogeologic conditions based on data from historical groundwater sampling and EI activities, and findings from geochemical evaluations of groundwater and pore water results. Additionally, the desktop findings of the water use survey are presented.
- **Chapter 6 – Seep Investigation:** Summarizes the results of the seep investigation
- **Chapter 7 – Surface Streams, Sediment, and Ecological Investigations:** Describes the historical activities and EI results and evaluation of the surface water, sediment, benthic macroinvertebrate community, and mayfly and fish tissue data
- **Chapter 8 – TDEC Order Investigation Summary and Conceptual Site Models:** Presents the WBF Plant CSMs describing the characterization of CCR material contained in the CCR management units, and a summary of the nature and extent of associated impacts (if any) to groundwater, soil, seeps, surface water, and ecology
- **Chapter 9 – Conclusions and Next Steps:** Presents a summary of, and conclusions based on, the EI conducted at the WBF Plant CCR management units and next steps for activities related to the TDEC Order
- **Chapter 10 – References:** List of documents referenced in the EAR
- **Tables and Exhibits:** Presented following the main text of this report, and are numbered according to the chapter that they are first presented in
- **Appendices:** Includes regulatory information, technical data (i.e., boring logs, well logs, cross sections), data and statistical analyses, technical evaluations, and SARs for each investigation. Technical evaluations and supporting information have been grouped into the investigation components described in the main report (e.g., background soils, CCR material, hydrogeology, seeps, surface water, sediment, and ecology).

Chapter 2 Site History and Physical Characteristics

2.1 Site Operations

After the construction of Watts Bar Dam and Chickamauga Dam, TVA constructed the WBF Plant between 1940 and 1945, with the first two of four generating units being placed into commercial operation in 1942 (TVA 1949). The third unit became operational in 1943, and the fourth (and final) unit became operational in 1945. TVA idled operation of the WBF Plant in 1957, then resumed operations from 1970 to 1982. TVA retired the four steam plant generating units in 1982. TVA terminated the air permit for the WBF Plant in 1997 and deconstructed the main powerhouse in 2012 (CDM Smith 2013).

The WBF Plant has two CCR management units, as shown below and on Exhibit 2-1: the Slag Disposal Area and Ash Pond. The total area of the CCR management units is approximately 34 acres. Stormwater discharges from the adjacent TVA Equipment Support Services facility, the southern area of the closed Slag Disposal Area, and the closed Ash Pond are conveyed to the Stormwater Pond prior to discharging through NPDES-permitted Outfall F03 to the Tennessee River. The northern area of the closed Slag Disposal Area is conveyed to the small detention basin on the north end of the Slag Disposal Area prior to discharging through NPDES-permitted Outfall F02 to the Tennessee River, (also referred to as Chickamauga Lake or Chickamauga Reservoir).

WBF Plant Features

2.2 CCR Management Unit History and Land Use

CCR material in the forms of fly ash, bottom ash, and slag were sluiced to the Slag Disposal Area from 1942 to 1957 (TVA 1940). The Slag Disposal Area was formed by a railroad embankment and a natural knoll to the west, stacked CCR material to the east, and a dike and spillway to the south constructed to discharge process water (refer to Exhibit 2-2; TVA 1969). TVA raised this dike using borrow soil material in 1969 to prepare for resuming power generation operations in 1970 (TVA 1973). The borrow material was excavated from the footprint of the future Ash Pond (TVA 1973). During operation of the Slag Disposal Area, process water and CCR material were also sent into the area now identified as the Drainage Improvements Area, which was an extension of the Slag Disposal Area (TVA 1977).

TVA constructed dikes with borrow material on the south and east sides of the borrow area to form the Ash Pond in 1974 (refer to Exhibit 2-2; TVA 1977). The borrow material was excavated from the interior of the proposed Ash Pond footprint. Process water flow was relocated to the west of the Slag Disposal Area and ultimately to the Ash Pond. A divider dike was constructed in 1977 to form a stilling pool within the Ash Pond (TVA 1977). TVA constructed a Metal Cleaning Pond west of the Slag Disposal Area in 1978 but it is unlikely that it was used for treatment of boiler cleaning water based on available operating information (TVA 1977). TVA ceased CCR material management operations in 1982 when all four steam plant generation units were retired (CDM Smith 2013).

Following the 1982 plant retirement, approximately 161,000 tons of slag were reclaimed for beneficial reuse in manufacturing products. This activity occurred from 1996 to 2005, until a majority of the material usable at the time was recovered. It is estimated that about 10 percent (%) of the CCR material was marketed for reuse. The Slag Disposal Area and Ash Pond were used for stormwater management and were closed as described in the following paragraphs (TVA 2007a).

In 2009, the Metal Cleaning Pond was filled with soil, and both the Slag Disposal Area and Metal Cleaning Pond were capped with soil and closed under TDEC Permit TNR190741 in accordance with applicable regulations in effect at the time of closure. The Slag Disposal Area cap consisted of a one-foot thick vegetative cover over a one-foot thick compacted clay layer. The Metal Cleaning Pond cap consisted of a one-foot thick vegetative cover above the soil fill (TVA 2009). During inspections following the closure, poor surface drainage was observed in the area west of the Slag Disposal Area. A separate drainage improvements project was completed in 2015 at the Drainage Improvements Area to place fill, improve drainage, and remove water around the Slag Disposal Area (AECOM 2016).

The Ash Pond was closed in 2015 under TDEC Permit TN0005461 in accordance with applicable regulations in effect at the time of closure. As part of the closure project, CCR material was excavated from the southern area of the Ash Pond and consolidated and capped in the northern area of the Ash Pond using a geosynthetic and soil cap (CDM Smith 2015). A clay divider dike was constructed from an onsite borrow area between the capped portion of the Ash Pond and the remaining area of the Ash Pond (CDM Smith 2015). The southern portion of the former Ash Pond was converted into a permitted stormwater pond (Permit No. TNR058427) for the site.

2.3 Ownership and Surrounding Land Use

The WBF Plant is owned and operated by TVA, a corporate agency of the United States, and is located on the Tennessee River approximately one river mile downstream of Watts Bar Dam, as shown on Exhibit 2-1. The WBF Plant is also situated approximately 0.5 miles northeast of the Watts Bar Nuclear Plant (WBN Plant).

Land use surrounding the WBF Plant is primarily undeveloped and includes forest, agriculture areas, and rural residential areas, with the nearest residence located approximately 1.4 miles northwest of the WBF Plant in Spring City. Public water surrounding the WBF Plant is supplied by three separate public water districts; the Town of Decatur Water System, the Watts Bar Utility District, and the Town of Spring City Water Utility. These public water districts source their water from locations either upstream of the WBF Plant or a spring located 3.5 miles south of the WBF Plant.

2.4 Physical Characteristics

2.4.1 Regional and Site Physiography

The WBF Plant is located within the Valley and Ridge physiographic province of the Appalachian Highlands physiographic division (Fenneman 1938). The Valley and Ridge Physiographic Province consists of a belt of northeast / southwest trending ridges and valleys formed by the differential erosion of a thick sequence of folded and faulted Paleozoic sedimentary rocks (USGS 1995). The elevations within the province range from about 380 feet above sea level to 4,604 feet above sea level (USEPA 1995). Exhibit 2-3 presents the 1935 regional United States Geological Survey (USGS) topographic map of a portion of the Valley and Ridge province in the vicinity of the WBF Plant prior to construction.

The figure below provides a current aerial photograph overlain on the topography of and near the WBF Plant. The plant is located in a topographically low area between higher elevation ridges to the north and west and the Tennessee River on the east. The WBF Plant pre-construction elevation ranged from approximately 680 to 740 feet above mean sea level (ft amsl).

WBF Physiographic Features

2.4.2 Regional Geology, Hydrogeology and Surface Water Hydrology

Regionally, the Valley and Ridge province is a series of northeast trending Paleozoic sedimentary rocks that form the alternating valleys and ridges (USGS 1995). Much of the valleys are made up of carbonates and shales, which are more susceptible to erosion, while the more resistant siltstone, sandstones and conglomerates form the ridges (USGS 1978). The folded strata are the result of the thrust faulting and the various deformation events that produced the Appalachian Mountains (USGS 1979). The folding is less intense in the Tennessee portion of the province, but major faults are common and vertical to overturned beds appear in many places, particularly on the northwestern sides of anticlines (USGS 1997).

2.4.2.1 Regional Geology

The WBF Plant sits on the east limb of a large anticline, or the west limb of a large syncline, where the average dip of the strata is 35 degrees southeast (Fox 1942). Onsite geologic mapping indicates that the plant is underlain by Cambrian age limestone and shale bedrock of the Conasauga Group Middle, and the Nolichucky Shale as shown on Exhibit 2-4. A large majority of the area and unconsolidated deposits around the WBF Plant have been disturbed due to construction related to plant operations (TVA 2015).

Exhibit 2-5 provides an overlay of faults and fractures in the vicinity of the WBF Plant. The faults and fractures were mapped as part of the work conducted for the USGS Tennessee Geologic Map (Hardeman et al, 1966).

2.4.2.2 Surface Water Hydrology

The WBF Plant is located on the south-flowing Tennessee River approximately one mile downstream of TVA Watts Bar Dam and 58 miles upstream of TVA Chickamauga Dam (Exhibit 2-1). Under normal conditions, the Tennessee River flow in the vicinity of the WBF Plant depends primarily upon releases from the Watts Bar Dam. The reservoir upstream of Chickamauga Dam was filled in 1940 (TVA 2022a). The reservoir upstream of Watts Bar Dam was filled in 1942 (TVA 2022b). After the construction of these dams, the WBF Plant was constructed in dry conditions between 1940 and 1945. Prior to the construction of the WBF Plant, a small tributary to the Tennessee River followed an alignment through the Slag Disposal Area (Exhibit 2-6).

2.4.2.3 Regional Hydrogeology

The principal aquifers in the Valley and Ridge Province in the region of the site consist of carbonate rocks that are Cambrian, Ordovician, and Mississippian in age (USGS 1995). Groundwater in the Valley and Ridge aquifers is primarily stored in and moves through fractures, bedding planes, and solution openings in the rocks. The sequence of Cambrian and Ordovician formations that includes some of the carbonate-rock aquifers in the Valley and Ridge Province is repeated several times by thrust faults in eastern Tennessee.

2.4.3 Local Climate

Locally near the WBF Plant, the average monthly high temperature at weather station USC00408540, Spring City, Tennessee (National Oceanic and Atmospheric Administration [NOAA] 2022) located approximately seven miles northwest of the WBF Plant, ranges between 47 degrees Fahrenheit (°F) in January to 87°F in July, and the average monthly low ranges between 26°F in January to 67°F in July. Average annual precipitation at this location is 57.03 inches, with July being the wettest month, averaging 5.61 inches, and August being the driest month, averaging 3.07 inches.

2.4.4 Cultural and Historical Resources

As part of the extensive history of environmental review of constructing and operating the WBN Plant, TVA has considered the potential impact on historic and archaeological resources associated with each project undertaking. Four archaeological sites are located within the WBN Plant property (40RH6, 40RH7, 40RH8, and 40RH64). The first three sites were recorded as part of the Watts Bar Basin survey in 1936. The latter was recorded later during a post-inundation shoreline survey. These sites are considered eligible or potentially eligible for the National Register of Historic Places based on the potential for intact buried archaeological deposits.

It was determined during the initial environmental review that two archaeological sites (40RH6 and 40RH7) would be adversely affected by construction of the plant (TVA 2017). Based on this finding, TVA proceeded with data recovery of these sites (Calabrese 1976; Schroedl 1978). One historic cemetery (Leuty Cemetery) was located on the property prior to plant construction. Two graves were removed in 1974 and placed in the Ewing Cemetery. Subsequent environmental reviews conducted resulted in a "no-effect finding" for archaeological resources.

TVA conducted environmental reviews during the planning phase of the EI to comply with the National Environmental Policy Act (NEPA). These reviews included an assessment through the NEPA categorical exclusion process of whether proposed activities, such as drilling soil borings and installing monitoring wells, would impact cultural and historical resources, natural resources, parks, recreation or refuge lands, wilderness areas, natural landmarks, wetlands and floodplains, and other ecologically significant or critical areas No issues were identified during this process. Therefore, additional measures to minimize or avoid adverse environmental impacts were not needed.

Chapter 3 Background Soil Investigation

Constituents in CCR material are also present in naturally occurring soil. To evaluate potential contributions of CCR Parameters in naturally occurring soil to other environmental media, such as surface water or groundwater, TVA reviewed information from historical studies and completed a background soil investigation as part of the EI. EI field activities were performed in general accordance with the following documents: *Background Soil SAP* (Stantec 2018a)*, Hydrogeological Investigation SAP* (Stantec 2018b)*,* and the *QAPP* (EnvStds 2018) including TVA- and TDEC-approved programmatic and project-specific changes made after approval of the EIP.

The following sections summarize historical studies and EI activities and present overall investigation and statistical evaluation findings for background soils based on data obtained during the EI. Additional information regarding the background soil statistical analyses and EI field activities are provided in the *Statistical Analysis of Background Soil Data* and *Background Soil Investigation SAR* included in Appendices E.1 and F.1, respectively.

3.1 Previous Studies and Assessments

As part of the development of the EIP, historical background soil data were reviewed to evaluate the need for additional data. In November 2016, Stantec conducted site activities to install one potential background monitoring well, WBF-100, and collected three soil samples from the screened interval for analytical testing of naturally occurring metals and other constituents. The analytical suite included most CCR Parameters; however, sulfate was not included because the soil sample analysis predated the defined objectives of the EI. These historical data were reviewed in conjunction with the background soils data collected for the EI described in Chapter 3.4 below. The well installation and soil sampling activities are further detailed in the *Geotechnical Field Services for Well Installations and Closures* report (Stantec 2017).

3.2 TDEC Order Investigation Activities

The objective of the TDEC Order background soil investigation was to characterize background soils on TVA property near the WBF Plant CCR management units by sampling locations where naturally occurring, undisturbed, native soils are present and unaffected by CCR material. A total of 69 samples were collected from 10 background soil borings and two from within the screened interval of two background well borings (WBF-102 and WBF-103). For the background soil borings, the sampling team typically collected approximately two-foot grab samples from the mid-point of each five-foot soil run based on recovery. These sampling locations are depicted on Exhibit 3-1.

Background soil borings were advanced and sampled using a direct push technology rig, and background well borings were advanced and sampled using a hollow stem auger drill rig. The average depth of the borings was approximately 16 feet below ground surface (bgs). Samples were analyzed for CCR Parameters. Surficial soil samples were collected from each background soil boring location and analyzed for the presence of ash (percent [%] ash) to evaluate the presence or absence of CCR material. Soil samples were also tested for pH in the field.

3.3 Lithology

Boring logs for the background soil borings and background monitoring well borings are provided in Appendix B. Review of the Geologic Map of the Decatur Quadrangle, Tennessee 2008, indicated that the borings and monitoring wells were installed in three different geologic units. These units and the associated borings are summarized in Table 3-1.

3.4 Background Soil Investigation Results Summary

Field and lithologic data were reviewed for each EI boring location to evaluate whether collected samples accurately represent unsaturated background conditions. Twelve samples were excluded from the statistical evaluation because they were collected from a saturated interval. Additionally, the three soil samples collected during the installation of well WBF-100 as part of the previous 2016 study were excluded from the evaluation because these samples were also collected from a saturated soil zone.

The EI background soils data collected from unsaturated intervals in native soils were statistically evaluated for potential outliers and anomalous data, dataset comparison parameters, and overall data variability. Multiple potential outliers were identified and flagged in the dataset. However, given the heterogeneity of naturally occurring inorganic compounds in soils, statistical outliers were not removed prior to statistical analysis.

Background threshold values (BTVs) are estimates of constituent concentrations in samples collected from unimpacted naturally occurring soils. Specifically, 95% one-sided Upper Tolerance Limits (UTLs) with 95% coverage (95% UTLs) were used to calculate BTVs, representing that there is a 95% confidence on average that 95% of the data are below the UTL and no more than 5% of the data are expected to exceed the UTL. UTLs were calculated at three depth intervals: 0 to 0.5 feet bgs, 0.5 to less than or equal to 10 feet bgs and greater than 10 feet bgs. In addition, a UTL was calculated for each CCR Parameter using results collected from the three depth intervals combined. The results of these calculations are summarized in the *Statistical Analysis of Background Soil Data* in Appendix E.1, with BTVs provided in Attachment E.1-A.

3.5 Rock Outcrop Survey

As a subtask of the background soil investigation, a rock outcrop survey was conducted to evaluate the rock types within the vicinity of the WBF Plant as potential sources of CCR constituents that may be present in the soil sampled during the background soil investigation. Seven different areas were chosen based on their locations in relation to the WBF Plant. Four were located on the WBF Plant property (Areas 02, 03, 04, and 05) and three were located north-northwest of the WBF Plant property (Areas 01, 06, and 07). Rock samples were collected January 21 through 23, 2020, from Areas 02, 03, 04, 06, and 07, whereas no samples were collected from Areas 01 and 05 (no outcrop was identified at Area 5) due to accessibility issues or lack of mineralization observed during field activities. The locations of the rock outcrop survey areas are depicted in Exhibit 3-2. Details of the rock outcrop survey are presented in the *Background Soil Sampling Investigation Sampling and Analysis Report* in Appendix F.1.

Dolomites of the Knox Group Undivided were observed in Area 01. The strike of the outcrops observed in this area was N29°E with a dip of 38°SE. The outcrop observed in Area 02 is comprised of sandstones, shales, and siltstones of the Rome Formation. The strike of the outcrop measured in this area was N35°E with a dip of 44°SE. Area 03 is comprised of siltstones, shales and fine-grained sandstones of the Pumpkin Valley Shale, three sets of strike and dip measurements were taken in this area, with strikes ranging from N25°E to N55°E and the dips ranging from 82°NW to 77°SE. Area 04 is made-up of a relatively large outcrop exposure where much of the overlying material was previously excavated as borrow material. It contains alternating layers of siltstones, shales, limestones, and thinly bedded sandstones which are consistent with the Conasauga Group Middle. The strike of the outcrop was measured as N35°E with a dip of 46°SE. Limestones and shales of the Sequatchie Formation were observed in Areas 06 and 07. The strike of the outcrops for these areas ranged from N39˚E to N40°E. The dip ranged from 13˚SE to 15°SE. Rocks in Areas 06 and 07 showed occasional crossbedding and on some surfaces ripple marks were visible.

Significant folding of beds was observed in the outcrops in Areas 02 and 03 with more minor folding observed in Area 04, but map scale structures, including fracture sets, were not observed. The observed rock types, formations, and orientation of beds were consistent with published information, including the Geologic Map of the Decatur Quadrangle, Tennessee (Lemiszki, Kohl, and Sutton 2008).

TVA conducted an additional Rock Outcrop Sampling Investigation as outlined in the *Background Soil Sampling and Analysis Plan, Watts Bar Fossil Plant – Addendum I Rock Outcrop survey Sampling* (Stantec 2021a). Additional rock samples were collected on June 24, 2021 and submitted for laboratory analysis to further assess the geochemical characteristics of the parent rock in select outcrops (Areas 02, 03, and 04) in the vicinity of the WBF Plant. The laboratory analyses targeted evaluation of metal hydroxides that could influence the availability of naturally occurring metals for leaching from exposed bedrock outcrops. Additionally, the bedrock outcrops also provided a proxy for the geochemistry of residuum that evolves from natural weathering of bedrock. The analyses conducted on the rock outcrop samples are provided in the *Background Soil SAP Addendum* (Stantec 2021a). The locations of the rock outcrop samples are provided on Exhibit 3-3, and results of the analyses are provided in Table 3-2.

A preliminary assessment of the analytical results indicated that certain naturally occurring metals, which are also CCR constituents, were present in sufficient amounts to potentially leach from bedrock, under certain pH and redox conditions, at concentrations similar to concentrations observed in groundwater samples collected downgradient of the CCR management units. The analytical results will be used to support a geochemical modeling evaluation to be conducted as part of the CARA Plan.

Chapter 4 CCR Material Investigations

To evaluate the extent, structural stability, characteristics, and quantities of CCR material in the management units, TVA reviewed information from historical studies, and performed investigations as part of the EI. EI field activities were performed in general accordance with the following documents: *Exploratory Drilling SAP and Addendum to Exploratory Drilling SAP* (Stantec 2018c, Stantec 2021b), *CCR Material Characteristics SAP* (Stantec 2018d), *Material Quantity SAP* (Stantec 2018e), and the *QAPP* (EnvStds 2018a), including TVA- and TDEC-approved programmatic and project-specific changes that were made after approval of the EIP. Field work included drilling 33 borings, installing 28 piezometers and four temporary wells, and collecting 23 CCR material samples and three pore water samples.

The following sections summarize the geotechnical stability evaluation findings, CCR material characteristic results, and CCR material quantity estimates based on the data obtained during previous investigations and the EI at the CCR management units at the WBF Plant. Additional details regarding these investigations are provided in Appendix G.

4.1 Geotechnical Investigation

The purpose of the geotechnical investigation component of the EI was to further characterize and evaluate subsurface conditions for the two CCR management units (Ash Pond and Slag Disposal Area) and two adjacent areas (Closed Metal Cleaning Pond and Drainage Improvements Area) at the WBF Plant. For this investigation, TVA reviewed information from previous representative studies and assessments, completed an exploratory drilling field program, and conducted evaluations for slope stability, structural integrity, and structural stability (bedrock).

The following sections summarize the previous studies and present overall geotechnical investigation and evaluation findings based on data obtained during previous studies and the EI for the WBF Plant CCR management units.

4.1.1 Exploratory Drilling

4.1.1.1 Previous Representative Studies and Assessments

Through the various information requests, as well as TDEC comments on the EIP, a need was identified for an evaluation of existing geotechnical data (borings, piezometric data, laboratory data, material parameters, analyses, etc.). The *Evaluation of Existing Geotechnical Data* (Appendix O of the EIP) was prepared to review the existing data and evaluate its adequacy with respect to responding to the various TDEC information requests. Evaluating the adequacy of existing data, in accordance with the QAPP, depends on both the type of data and its intended use. Where applicable, existing geotechnical data were used to support the subjects addressed throughout the EAR.

4.1.1.2 TDEC Order Investigation Activities

Exploratory Drilling (EXD) field work was conducted in two phases (Phase 1 and Phase 2) and consisted of four primary activities – drilling and sampling, installing temporary wells, installing piezometers, and conducting downhole geophysical testing. The primary objective of the Phase 1 EXD was to perform borings, install temporary wells, advance cone penetration test (CPT) soundings, and install piezometers to further characterize subsurface conditions at the Ash Pond, Slag Disposal Area, Closed Metal Cleaning Pond, and Drainage Improvements Area. The primary objective of the Phase

2 EXD was to perform borings, install vibrating wire piezometers, advance CPTs, and conduct downhole geophysical testing to further characterize subsurface conditions at the Ash Pond and Slag Disposal Area.

Boring and CPT layouts are shown on Exhibits 4-1 and 4-2. For additional details on the EXD activities, refer to Appendices G.1 and G.2 (*Technical Evaluation of Geotechnical Data* and the *WBF EXD SAR*, respectively).

4.1.1.3 Results and Discussion

At each boring location at the Ash Pond, the uppermost foundation soil was predominantly lean clay, with single occurrences of fat clay and poorly graded sand. At each boring location at the Slag Disposal Area, the uppermost foundation soil was predominantly lean to fat clay, with three occurrences of clayey sand, two occurrences of silty sand, two occurrences of poorly graded sand with clay, and single occurrences of well graded sand and silt. At each boring location at the Drainage Improvements Area, the uppermost foundation soil was predominantly clayey sand, with single occurrences of lean clay and clayey gravel. This is generally consistent with historical borings across the WBF Plant CCR management units.

At the Ash Pond, two temporary wells were planned to be screened in sluiced ash. The purpose was to allow for CCR pore water sampling within the sluiced ash. However, upon reaching the planned termination criteria, water levels in these borings were found to have insufficient depth of water to facilitate CCR pore water sampling. However, TVA elected to install a temporary well in one of the two borings (WBF-TW02) to facilitate an extended period of water level monitoring. Throughout the monitoring period, the temporary well continued to have insufficient depth of water to facilitate CCR pore water sampling.

During the Phase 1 EXD, two CPTs were performed in the interior of the Closed Metal Cleaning Pond and confirmed that the unit does not contain CCR material as backfill.

CPT soundings were advanced along the perimeter of the Slag Disposal Area (one segment) and along the perimeter of the Drainage Improvements Area (one segment). These CPTs were performed to better characterize the uppermost foundation soils in the immediate vicinity of the mapped, pre-construction stream channels. The CPT data were correlated to existing nearby boring logs to differentiate relatively sandy (i.e., more pervious) foundation soils, if present. In each of the two segments of closely spaced CPTs, the stream crossings targeted by TVA were successfully explored. Based on the CPT data and correlation to nearby borings, no significant preferential seepage pathways were identified beneath the unit perimeters.

4.1.2 Slope Stability

The load cases evaluated in the stability analyses are based on conventional practice and appropriate industry standards for landfills and surface water impoundments, as applicable, and are noted below:

- Static, long-term (i.e., normal operation conditions) global stability
- Static, long-term veneer (i.e., final cover) stability
- Seismic, pseudostatic global stability
- Seismic, pseudostatic veneer stability

- Seismic, post-earthquake global stability (includes a preceding liquefaction triggering assessment).

As described in the WBF Plant EIP, including the *Evaluation of Existing Geotechnical Data* (EIP Appendix O), the existing data are sufficient to establish appropriate shear strengths and stability results for certain static and seismic load cases. The summaries of existing geotechnical data demonstrate that existing data are representative and suitable to support the stability analyses. Supplemental geotechnical data were collected, per the EXD SAP, to support the new or updated stability analyses described in the EIP and the *Stability SAP*. For the WBF Plant, historical stability analyses were adequate to address:

- the Ash Pond static global slope stability analyses for the current, closed geometry.

For the WBF Plant, the *Stability SAP* was necessary to address:

- the Ash Pond static veneer, seismic global, and seismic veneer slope stability analyses for the current, closed geometry
- the Slag Disposal Area static and seismic slope stability analyses for the current, closed geometry.

4.1.2.1 Results and Discussion

The static and seismic stability results for the WBF Plant CCR management units are summarized and compared to criteria in Appendix G.1. For additional details on the analyses required under the *Stability SAP*, refer to the *Static Stability SAR* and *Seismic Stability SAR* provided as Appendix G.3 and Appendix G.4, respectively. The global stability and the veneer stability for each analyzed section meet the established factor of safety criteria for the static load cases. The pseudostatic, global stability and pseudostatic, veneer stability for each analyzed section meet the established factor of safety criteria for the seismic load cases.

The post-earthquake, global stability for the cross sections at the Slag Disposal Area and the Ash Pond do not meet the established factor of safety criteria for the seismic load cases. As part of the CARA Plan, TVA will be evaluating mitigation alternatives for the Slag Disposal Area and Ash Pond that would be designed to meet the seismic stability acceptance criteria, as defined in the *Stability SAP*.

4.1.3 Structural Integrity

"Structural integrity" considers structural potential failure modes that could lead to a release of CCR material, other than slope stability and structural stability of bedrock.

For the WBF Plant CCR management units, the EIP summarized historical reports that would be leveraged to address structural integrity, and those are referenced in Appendix G.1. There was no SAP specifically required under the TDEC Order program to address this subject.

4.1.3.1 Results and Discussion

Based on the historical report information, no significant deficiencies were identified with respect to structural integrity of the CCR management units. In addition, TVA further promotes structural integrity of the CCR management units by performing routine inspections and other compliance activities, in accordance with TVA policies and state regulations.

4.1.4 Structural Stability (Bedrock)

“Structural stability (bedrock)” considers stability of bedrock below fill areas—that is, evaluating the bedrock with respect to voids/cavities and faults/joints of significant lateral or vertical extent that could be large enough to lead to loss of structural support and potential release of the overlying CCR material.

For the WBF Plant CCR management units, the EIP, including the *Evaluation of Existing Geotechnical Data* (EIP Appendix O), summarized historical reports that would be leveraged to address structural stability of the bedrock. In addition, the *EXD SAR* includes new information specifically required under the TDEC Order program to address this subject.

4.1.4.1 Results and Discussion

The CCR management units at the WBF Plant are underlain by the Conasuaga Group. Locally, the Conasuaga Group shows little variation in composition and condition and consists primarily of limestone interbedded with shale or shale interbedded with limestone. No voids were noted in the rock cores. Based upon the site-specific geologic mapping, rock core borings, and CCR management unit performance, there is no evidence of voids/cavities that could lead to loss of structural support and potential release of the overlying CCR material.

4.2 CCR Material Characteristics

TVA reviewed information from historical studies and completed a CCR material characteristics investigation as part of the EI to characterize leachability of CCR constituents within two CCR management units at the WBF Plant: Slag Disposal Area and Ash Pond. EI field activities were performed in general accordance with the following documents: *CCR Material Characteristics SAP* (Stantec 2018d), *EXD SAP* (Stantec 2018c), and the *QAPP* (EnvStds 2018a), including TVA- and TDEC-approved programmatic and project-specific changes made after approval of the EIP.

The following sections summarize EI CCR material characterization activities, and present overall investigation and statistical evaluation findings. Additional information regarding the CCR material and pore water statistical analyses and the investigation are provided in Appendices E.2 and G.5, respectively. Further evaluation of the CCR material and pore water results is provided in Appendix G.1. Additional evaluation in context of the hydrogeologic conditions at the WBF Plant is provided in Chapter 5.1 and Appendix H.1.

4.2.1 Previous Studies and Assessments

No previous CCR characterization data are available.

4.2.2 TDEC Order Investigation Activities

The objective of the TDEC Order CCR material characteristics investigation was to characterize the leachability of CCR Parameters by collecting pore water and CCR material samples (saturated and unsaturated) from within the Consolidated and Capped CCR Unit and the Slag Disposal Area. A total of 21 CCR material samples were collected from five temporary well borings. These were analyzed for CCR Parameters (defined in Chapter 1.3) and additional parameters of interest for the CCR material characteristics investigation. The additional parameters of interest and analyses included total organic carbon, iron and manganese. TVA also performed Synthetic Precipitation Leaching Procedure (SPLP) analyses for metals and radiological parameters. During sampling, CCR material present at each boring was visually characterized using the Unified Soil Classification System, which classifies material by grain size distribution followed by the material's textural properties.

Following temporary well installation and development, pore water levels were measured prior to sampling, hydraulic conductivity testing was performed, and pore water samples were collected from three temporary well locations. The temporary well locations are depicted on Exhibit 4-1.

4.2.3 CCR Material Characteristics Evaluation

This section presents a summary of the evaluation of the CCR material and pore water analytical results to assess the presence of constituents in and their susceptibility to leach from CCR material. In addition, SPLP analysis of CCR material was conducted to assess whether SPLP can be used to predict pore water concentrations.

4.2.3.1 Total Metals and SPLP Evaluation Results

Statistical evaluations were conducted to evaluate whether the total concentrations of metals in CCR material could be used as a reliable predictor of leachable concentrations as represented by SPLP concentrations. The evaluations included comparison of total metals concentrations in CCR material to SPLP concentrations. The results indicated that the total concentrations of metals in CCR material are not a reliable predictor of the magnitude of the potentially leached concentrations using SPLP. Additional discussion of the evaluations is provided in Appendices E.2 and G.1.

TVA also compared pore water results to SPLP results for the CCR material to evaluate whether SPLP could be used as a predictor of pore water concentrations. The findings indicate that SPLP analysis of CCR material is not a good predictor of pore water concentrations. The results indicate that direct measurement of pore water concentrations is the most accurate method of characterizing potential leachability of CCR constituents from CCR material, but geochemical modeling is needed to predict the concentrations of constituents in groundwater. Additional discussion of the evaluations is provided in Appendices E.2 and G.1.

4.2.3.2 Pore Water Phreatic Surface

TVA measured pore water levels in the temporary wells on a monthly frequency for six months. In addition, the wells were gauged during bi-monthly EI groundwater sampling events. This information was combined with available information from other instruments to develop phreatic surface maps for each CCR management unit. The phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water. The use of the term "saturated" or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Saturated CCR material can have a range of moisture contents based on the characteristics of the material. Exhibit 4-3 provides a representative phreatic surface elevation contour map for EI Groundwater Sampling Event #6 conducted in July 2020. Table 4-1 provides a summary of the pore water gauging data from the six consecutive pore water gauging events, including EI Groundwater Sampling Event #6. Additional data for other gauging events can be found in Appendices H.3, H.4, H.5, H.6, and H.7.

Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein for the Slag Disposal Area may not represent steady-state conditions if modifications to cap systems or stormwater drainage were to be implemented. Within the Slag Disposal Area, the pore water phreatic surface was at an elevation higher than groundwater levels in the vicinity of the CCR management units. The observed relationship between pore water levels and surface water levels in an adjacent pond to the west suggests that the pond may be affecting pore water levels. Because of this finding, evaluation of drainage improvements to the area west of Slag Disposal Area will be part of the CARA Plan. The phreatic surface in the Slag Disposal Area would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.

Within the Ash Pond, information and data indicate that the CCR material was unsaturated. This indicates that the cap is performing as expected and has effectively eliminated infiltration of precipitation into the CCR material.

4.2.3.3 Pore Water Quality Evaluation

This section provides a summary of the analytical results for pore water samples collected from temporary wells installed as part of the EI. Pore water samples were collected during three sampling events. The first sampling event was conducted as part of the EI in September 2019. The second and third sampling events were conducted as part of other investigative activities in March and May 2021.

The pore water characterization evaluation is based on a comparison of porewater concentrations to groundwater concentrations and GSLs across the WBF Plant. GSLs are not directly applicable to pore water. Comparing pore water concentrations to GSLs is used to identify CCR constituents that have some potential to impact groundwater downgradient of CCR management units. Pore water concentrations were compared to GSLs for constituents listed in Appendix I of TDEC Rule 0400-11-01-.04 (TDEC Appendix I) and Appendix IV of the CCR Rule because these constituents are subject to corrective measures.

Seven TDEC Appendix I or CCR Rule Appendix IV constituents (antimony, arsenic, cobalt, lithium, molybdenum, thallium, and vanadium) had reported concentrations in one or more pore water samples above a GSL. Of these, only cadmium and cobalt had statistically significant concentrations in groundwater above a GSL.

The figure below summarizes reported pore water and groundwater analytical results and their comparisons to GSLs. The locations of temporary pore water wells are shown as symbols with an orange outer ring; groundwater well symbols have a blue outer ring. The colored slices in each symbol indicate CCR constituents detected above a GSL in each temporary pore water and groundwater well. The number of colored sections within each slice represents the magnitude of the reported concentrations relative to the GSL. The legend provides further explanation of the colors and rings.

Pore Water Quality (with Groundwater)

There is a distinct difference between pore water and groundwater quality. As this figure illustrates, many constituents detected above a GSL in pore water samples were below the applicable GSLs in groundwater samples from the same areas.

4.2.4 CCR Material Characteristics Summary

The CCR material and pore water data collected during the EI are evaluated, along with historical data and data collected from other programs.

The following are the key findings of the WBF Plant CCR material characteristics investigation:

- The total concentrations of metals in CCR material are not reliable predictors of the magnitude of the potentially leached concentrations represented by SPLP results, and SPLP analysis was not a good predictor of pore water concentrations. The results indicate that direct measurement of pore water concentrations is the most accurate way of characterizing potential leachability of CCR constituents from CCR material, but geochemical modeling is needed to predict future concentrations of constituents in groundwater.
- Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions.
- Generally, there is a distinct difference between pore water and groundwater quality.

4.3 CCR Material Quantity Assessment

TVA completed a Material Quantity Assessment (MQA) to estimate CCR material quantities and other properties in support of fulfilling the requirements for the TDEC Order. MQA activities were performed in general accordance with the *Material Quantity SAP* (Stantec 2018e). The following sections summarize historical studies and EI activities, and present overall evaluation findings for material quantity based on data obtained during previous studies and the EI for the WBF CCR management units.

4.3.1 Previous Studies and Assessments

Previous material quantity assessments were completed by TriAD Environmental Consultants, Inc. (TriAD) of Nashville, Tennessee, as part of their Historical Ash Volume Calculations (TriAD 2017). The calculations were performed for the Slag Disposal Area and Ash Pond. The TriAD historical ash volume results are provided in Appendix G.6.

4.3.2 TDEC Order Investigation Activities

The objectives of the MQA, conducted pursuant to the *Material Quantity SAP*, were to describe CCR management unit geometry, CCR material quantity, phreatic surface elevations, and subsurface conditions for the following CCR management units at the WBF Plant subject to the TDEC Order: Slag Disposal Area and Ash Pond (MQA Study Area). For the purpose of the MQA, the Drainage Improvements Area was included as part of the Slag Disposal Area.

Three-dimensional models of the MQA Study Area were developed using data from existing borings installed under different environmental or geotechnical programs, as well as pre-construction topographic information, historical drawings, and survey information for the MQA Study Area. The existing information was supplemented with data from borings drilled per the *EXD SAP*. For additional details regarding the development of the models, refer to the *MQA SAR* (Appendix G.7).

The three-dimensional models were analyzed using AutoDesk® AutoCAD® Civil 3D surface volumes to estimate CCR material volumes. Pore water level and pore water pressure measurements recorded in the temporary wells and piezometers per the *Material Quantity*, *CCR Material Characteristics* and *Groundwater Investigation SAPs* and summarized in Table 4-1, were compared to the three-dimensional models to estimate the quantity of CCR material below the phreatic surface in the CCR management units. Specifically, pore water level and pore water pressure measurements from Groundwater Investigation Event #6 shown on Exhibit 4-3 were used to estimate the quantity of CCR material below the phreatic surface in the Slag Disposal Area and Ash Pond.

4.3.3 Material Quantity Assessment Results

4.3.3.1 Cross Sections

Cross sections developed using the three-dimensional models are provided in Appendix D. As shown on Exhibit D-1, Section A-A' is a cross section of the Slag Disposal Area and Section B-B' is a cross section of the Ash Pond. The cross sections profile the CCR management units from the groundline based on a 2018 aerial survey to below the top of rock surface.

4.3.3.2 CCR Material Limits and Depth

Exhibit 4-4 shows estimated limits and depth ranges of CCR material within the MQA Study Area. The CCR limits shown on Exhibit 4-4 and the cross sections (Sections A-A' and B-B') correspond to an embankment to the west, dike to the south, and stacked CCR material to the east in the Slag Disposal Area, and an embankment to the west, dike to the south and east in the Ash Pond. Estimated CCR material thickness ranges from 0 to 30 feet. Table 4-2 provides the range of estimated CCR material depths and aerial extent for each CCR management unit.

4.3.3.3 CCR Material Volumes

CCR material volumes summarized in Table 4-2 were estimated using the three-dimensional models and AutoDesk® AutoCAD® Civil 3D volume surfaces. The volumes were also compared to the pore water elevation contours shown on Exhibit 4-3 to estimate the volume of CCR material below the phreatic surface. As explained in Chapter 1.3.1, the phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water. The use of the term "saturated" and/or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Saturated CCR material can have a range of moisture contents based on the characteristics of the material.

The total acreage of the CCR material limits for the CCR management units is approximately 34 acres. The estimated total volume of CCR material is approximately 757,000 cubic yards. Approximately 36% of the estimated total volume of CCR material is below the estimated phreatic surface.

Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions. The phreatic surface in the Slag Disposal Area would be expected to decrease in elevation if modifications to the existing soil cap system or drainage improvements were to be implemented.

4.3.3.4 Comparison to Previous MQA

TriAD previously computed material quantity volumes for the MQA Study Area, as discussed in Chapter 4.3.1. TriAD's estimated total aerial extent and volume of CCR material were approximately 38 acres and 615,000 cubic yards, respectively. The TriAD volumetric model did not include the Drainage Improvements Area. A comparison of the two volumetric models indicates that the EI CCR material volume estimates are approximately 18% to 25% higher for the Slag Disposal Area and the Ash Pond, respectively. These differences are likely because the EI volumetric models incorporated a more recent aerial survey of the CCR management units as well as consideration of additional data collected during EXD and CCR Material Characteristics activities conducted at the WBF Plant between 2019-2021. The data sources for the Slag Disposal Area bottom of CCR surface also differed between the Stantec and Triad volumetric models.

4.3.3.5 Secondary Volume Estimates and Verification Method

The CCR material quantity analyses completed in AutoDesk® AutoCAD® Civil 3D were verified with the Trimble Terramodel 3D™ software package (Terramodel). The top and bottom of the CCR material surfaces were imported into Terramodel to perform secondary CCR material volume estimates. The Terramodel analyses confirmed the Civil 3D volumes with a deviation of less than 0.5%. Terramodel CCR material volume estimate summaries are provided in Appendix G.6.

4.4 CCR Material Investigations Summary

CCR material investigations provided geotechnical and analytical data to evaluate the extent, structural stability, characteristics, and material quantities in the CCR management units. CCR material characteristics data were also further evaluated in the hydrogeological evaluations. Primary investigation findings are:

- For the Slag Disposal Area and the Ash Pond, the slope stability evaluation indicates that global and veneer slope stabilities meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. TVA will be evaluating mitigation alternatives as part of the CARA Plan.

- The two CCR management units have adequate structural integrity, and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material.

- CCR material and pore water have been characterized as specified in the EIP, and CCR material and phreatic surfaces have been estimated for each of the two CCR management units. CCR material and estimated depth ranges are depicted in plan view on Exhibit 4-4 and in cross-sections in Appendix D.

- Estimated CCR material volumes and areas for the two CCR management units are provided in Table 4-2. The total area of the CCR material within the CCR management units is approximately 34 acres, and the estimated total volume is approximately 757 thousand cubic yards. Approximately 36% of the estimated total volume of CCR material within the two units is below the estimated phreatic surface, which is explained in Section 4.3.3.3. Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions. The phreatic surface in the Slag Disposal Area would be expected to decrease in elevation if modifications to the existing soil cap system or drainage improvements were to be implemented. Multiple methods are regularly utilized to sufficiently stabilize saturated CCR material to facilitate safe construction and support of a final cover system.

- Direct measurement of pore water concentrations is the most accurate way of characterizing potential leachability of CCR constituents from CCR material.
- There is a distinct difference between pore water and groundwater quality.

Chapter 5 Hydrogeological Investigations

To evaluate hydrogeological conditions and to characterize groundwater quality, TVA reviewed information from previous studies, integrated data and findings from previous and other ongoing environmental programs and conducted hydrogeological and groundwater investigations as part of the EI (see Appendix H.1 for information included in the evaluation). EI field activities were conducted in general accordance with the following documents: *Hydrogeological Investigation SAP* (Stantec 2018b), *Groundwater Investigation SAP* (Stantec 2018f), and the *QAPP* (EnvStds 2018a), including TVA- and TDEC-approved programmatic and project-specific changes that were made after approval of the EIP. Field work included installing permanent wells and borings to collect samples of groundwater for analysis of CCR Parameters and geochemistry evaluation parameters. Additionally, as part of the EI, a water use desktop survey was performed in general accordance with the *Water Use Survey SAP* (Stantec 2018g).

The following sections summarize findings based on evaluation of the information collected from implementation of the EI and data collected under the Ash Pond closure program at and near the WBF Plant CCR management units. Additional details regarding these investigations and evaluations are provided in Appendices E.3 and H.1 through H.9.

5.1 Groundwater and Hydrogeological Investigations

The purpose of the groundwater and hydrogeological investigations was to further characterize and evaluate subsurface conditions in proximity to two CCR management units at the WBF Plant, including the Ash Pond and Slag Disposal Area. For this investigation, TVA reviewed information from previous representative studies and assessments, completed field sampling programs, and conducted evaluations related to geology, hydrogeology, and groundwater quality as part of the EI.

5.1.1 Previous Studies and Assessments

Exploratory drilling at the WBF Plant began in 1940 to evaluate the suitability for the foundation for a proposed power plant. Since that time, several exploratory drilling and hydrogeological investigations have been conducted. Groundwater monitoring has been underway at the WBF Plant since approximately 1989. A monitoring well network was previously installed to evaluate groundwater conditions as part of the Ash Pond closure program. Appendix H.1 provides summaries of informative studies related to the hydrogeology of the WBF Plant.

Groundwater data from the Ash Pond closure program follows quality assurance programs similar to that developed for the TDEC Order. Data from this historical and ongoing groundwater monitoring program is included in the evaluation summarized below.

5.1.2 TDEC Order Investigation Activities

The objectives of the TDEC Order groundwater and hydrogeological investigations were to characterize groundwater quality and evaluate groundwater flow conditions in the vicinity of the WBF Plant CCR management units. Well installation and sample location selection, sample collection methodology, sample analyses, and quality assurance/quality control (QA/QC) completed for the investigations are provided in the *Hydrogeological Investigation SAR* (Appendix H.2) and the *Groundwater Investigation SARs* for the six sampling events (Appendices H.3 through H.8). Exhibit 5-1 shows the locations of wells installed as part of the EI.

5.1.3 Hydrogeological Investigation Results

Several soil boring and well installation projects at and in the vicinity of the WBF Plant CCR management units yielded information about the geology, groundwater elevations, groundwater flow direction, and groundwater quality. This section provides an evaluation of the hydrogeological setting of WBF Plant CCR management units. Details of the evaluations are provided in Appendix H.1.

5.1.3.1 Lithology and Hydrostratigraphic Units

Chapter 2.4 provides a discussion of the regional geologic setting for the WBF Plant. This chapter provides a discussion of the site-specific lithology and hydrostratigraphic units of the WBF Plant. A discussion of CCR material is provided in Chapter 4.

The natural unconsolidated materials consist primarily of alluvium overlying bedrock. Alluvium refers to native materials that are deposited by moving water. Unconsolidated material thicknesses range from 0 to 32 feet based on the information collected during the EI. The unconsolidated materials are thickest near the Tennessee River and thinner at greater distances from the river. The alluvium can be differentiated into silts, clays, sands, and gravels, which exhibit a coarsening downward sequence. The upper fine-grained alluvium layer varies in thickness from approximately 0 to 27 feet and is primarily comprised of clay and silty clays. Clay soils of variable thickness are present under the CCR management units. The lower alluvial layer, ranging in thickness from 0 to 20 feet, is primarily silty sand, sand, and gravel. Geologic mapping indicates that the unconsolidated materials are underlain by bedrock comprised of the Conasauga Group, specifically the Conasauga Group Middle and the Nolichucky Shale. The upper bedrock consists of dark gray-green shale, weathered in the upper few feet, with varying amounts of gray limestone. The bedrock surface slopes east toward the Tennessee River, with elevations ranging from 696 feet above mean sea level (amsl) west of the Slag Disposal Area to 664 feet amsl along the Tennessee River. The Kingston Fault has been identified west of the plant.

The following figures show three-dimensional representations of the various geological deposits and CCR material. The first figure shows a lithologic model, including the locations of the CCR management units and a representation of the extent of CCR material at the WBF Plant. The second figure shows the extent of the unconsolidated materials consisting primarily of clay and silty clays colored brown. The third figure shows the extent of unconsolidated materials consisting primarily of silty sand, sand, and gravel colored light yellow. The fourth figure shows the bedrock surface colored gray. The dikes surrounding the CCR management units are shown in the brighter yellow color.

WBF Plant CCR and Unconsolidated Materials

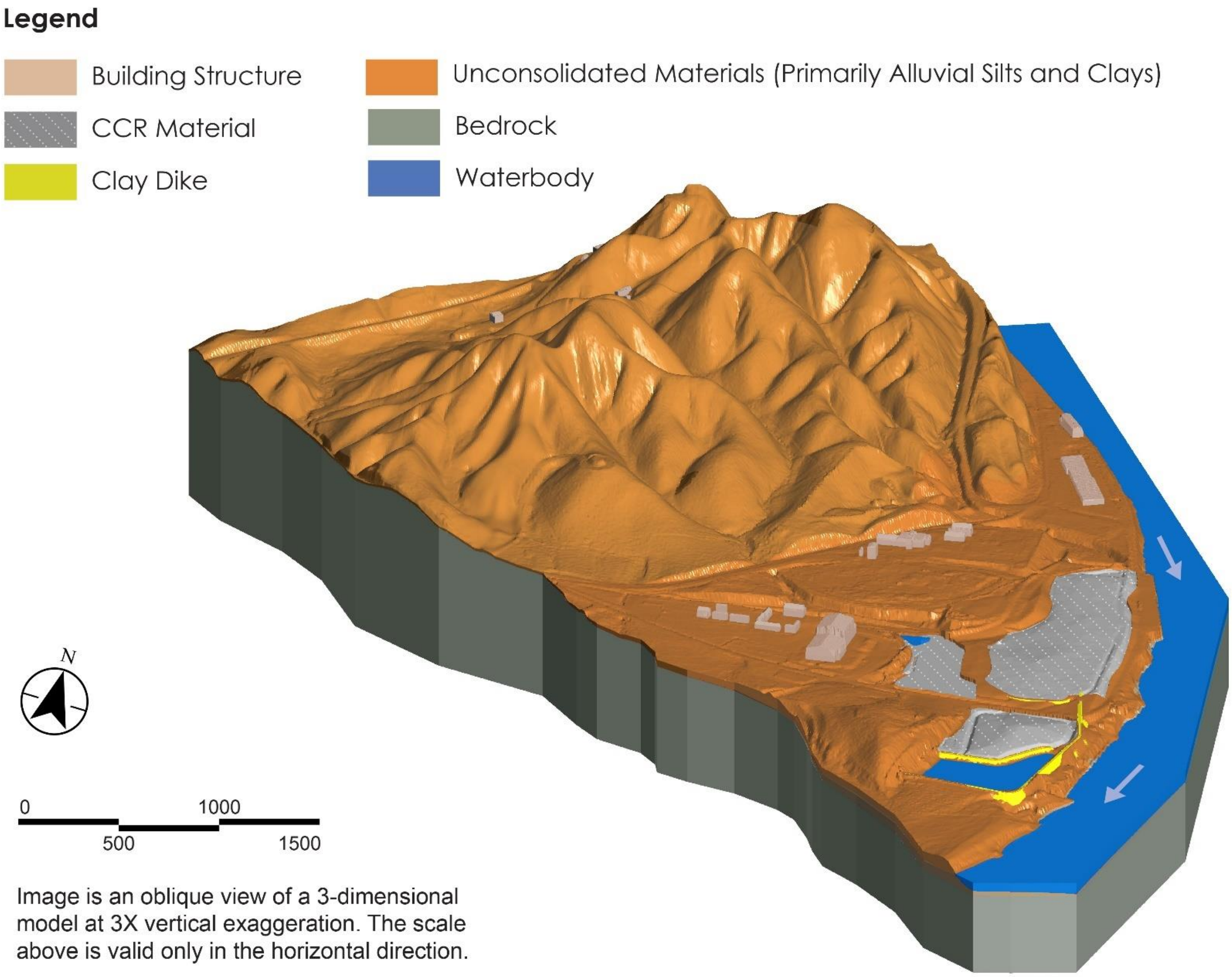
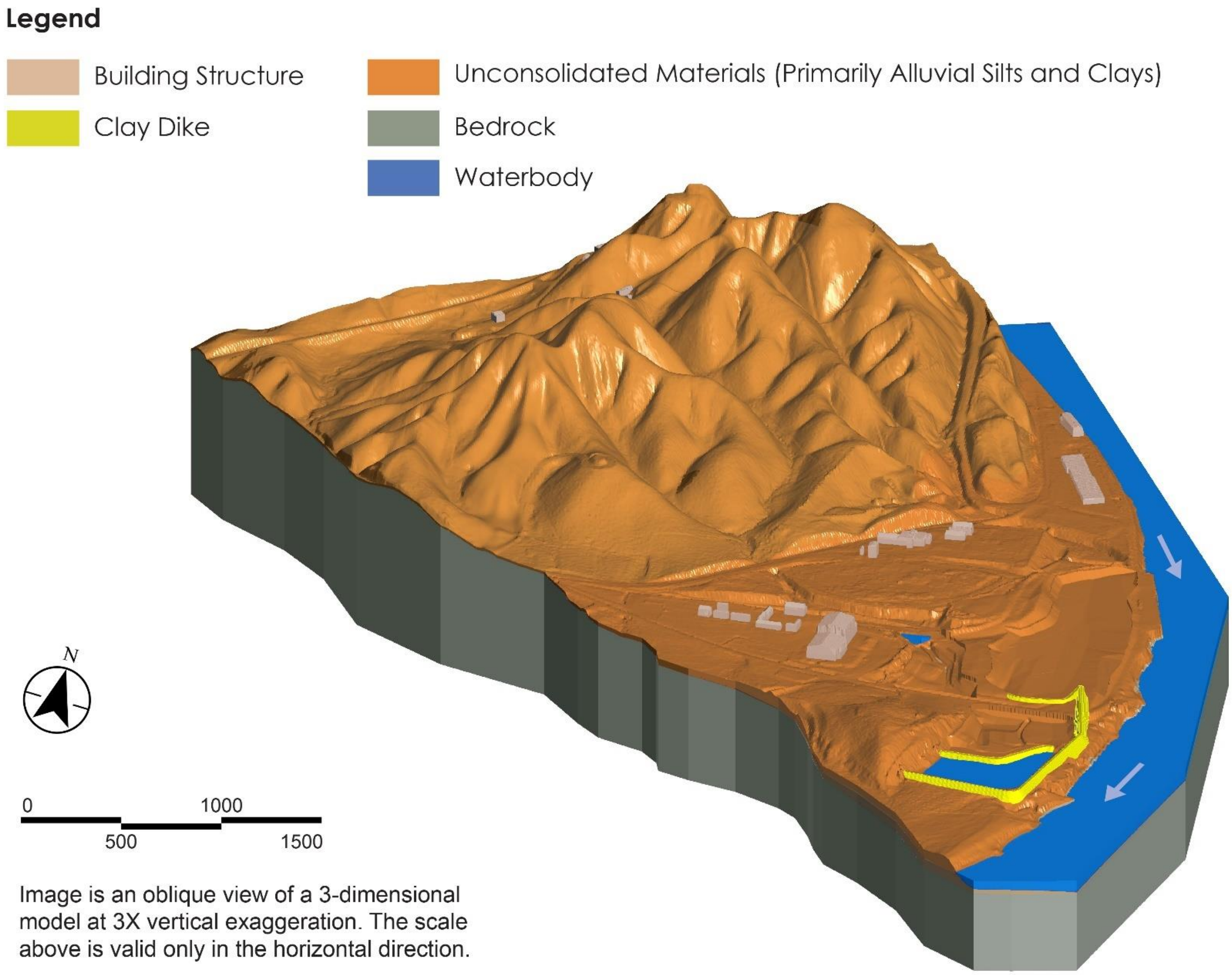


Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

WBF Plant Unconsolidated Materials (Primarily Clay and Silty Clays)



WBF Plant Unconsolidated Materials (Primarily Silty Sand, Sand, and Gravel)

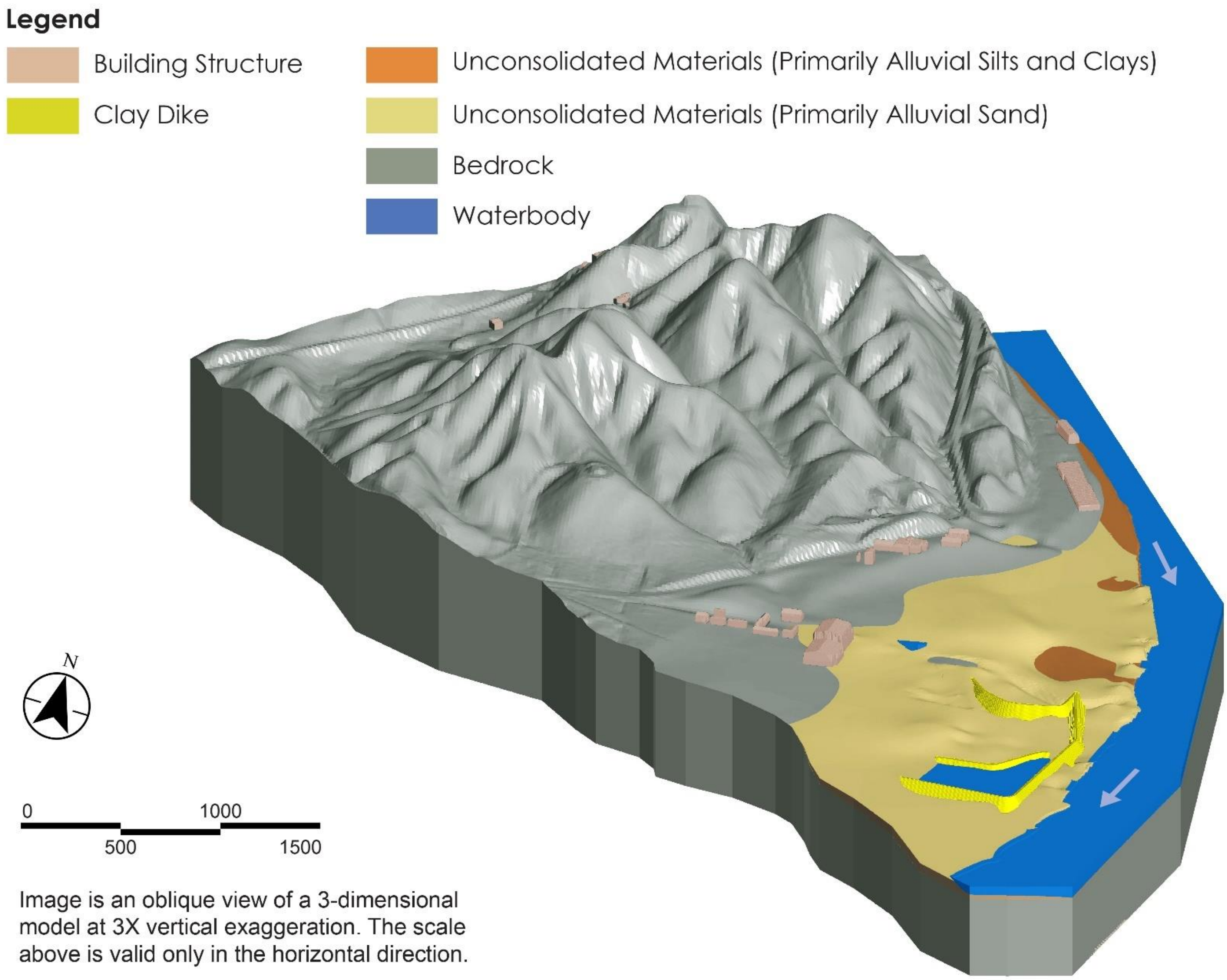
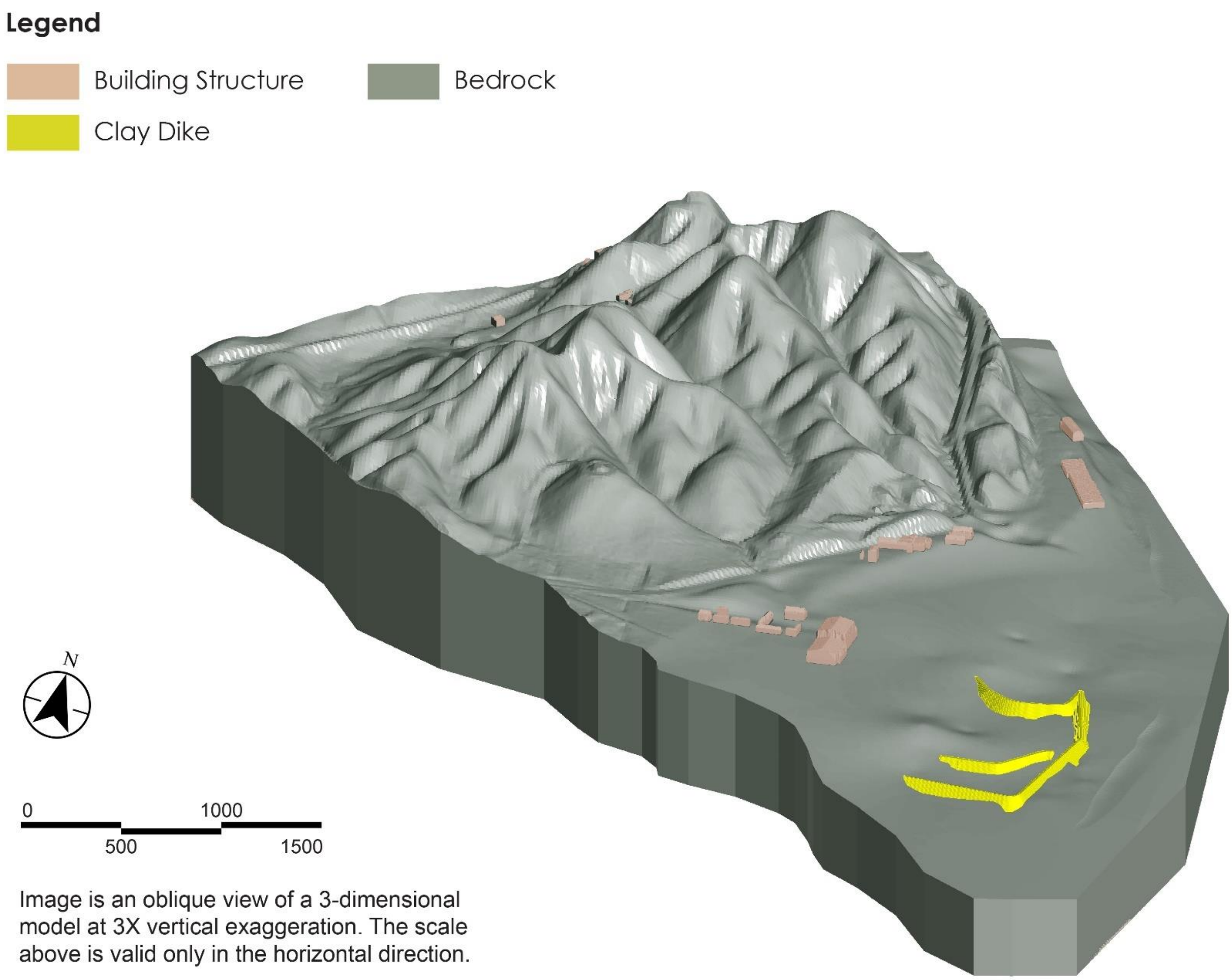


Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

WBF Plant Bedrock Surface



Representative cross sections, showing the underlying lithologic units and CCR material are provided in Appendix D. Exhibit D-1 is a transect location map for the cross sections. Exhibit D-2 depicts profiles across the Ash Pond and Slag Disposal Area.

Hydrostratigraphic units are geological formations that have been defined to characterize the hydrogeology of the WBF Plant to understand where and how groundwater is flowing. In saturated geological formations that have higher permeability than adjacent formations, groundwater flows in a mostly horizontal direction. In saturated geological formations that have lower permeability than adjacent formations, groundwater flows in a more vertical direction. The more permeable geological formations capable of yielding useable quantities of groundwater are called aquifers. Aquifers are targeted for development as water sources by property owners. The less permeable geological formations are called aquitards.

The hydraulic characteristics of aquifers are used to classify them. If an aquifer is located between two aquitards, then the aquifer is called a confined aquifer. Groundwater can flow through aquitards into underlying aquifers, but the rate of flow is commonly much slower than the rate of flow within the aquifer. Aquifers can be considered confined even if they are not completely covered by an aquitard. For example, the Memphis aquifer in western Tennessee is a confined aquifer, yet it is known that the aquitard above the Memphis aquifer is thin or absent in some areas (Parks and Carmichael 1990).

In a confined aquifer, measured groundwater levels rise above the top of the aquifer. The difference between the measured groundwater levels within the aquifer and the top of the aquifer is called the pressure head. For confined aquifers, groundwater is not encountered in the interval shown as pressure head above the top of the aquifer because it is bounded by an upper aquitard, which also physically separates the groundwater from the geologic unit located above the upper aquitard.

In state and federal regulations, the term uppermost aquifer is used. This is the aquifer closest to ground surface. Regulations are designed to protect the groundwater in the uppermost aquifer because it could be used by property owners as a source of water. The term uppermost aquifer is used in this report.

5.1.3.2 Uppermost Aquifer and Groundwater Flow

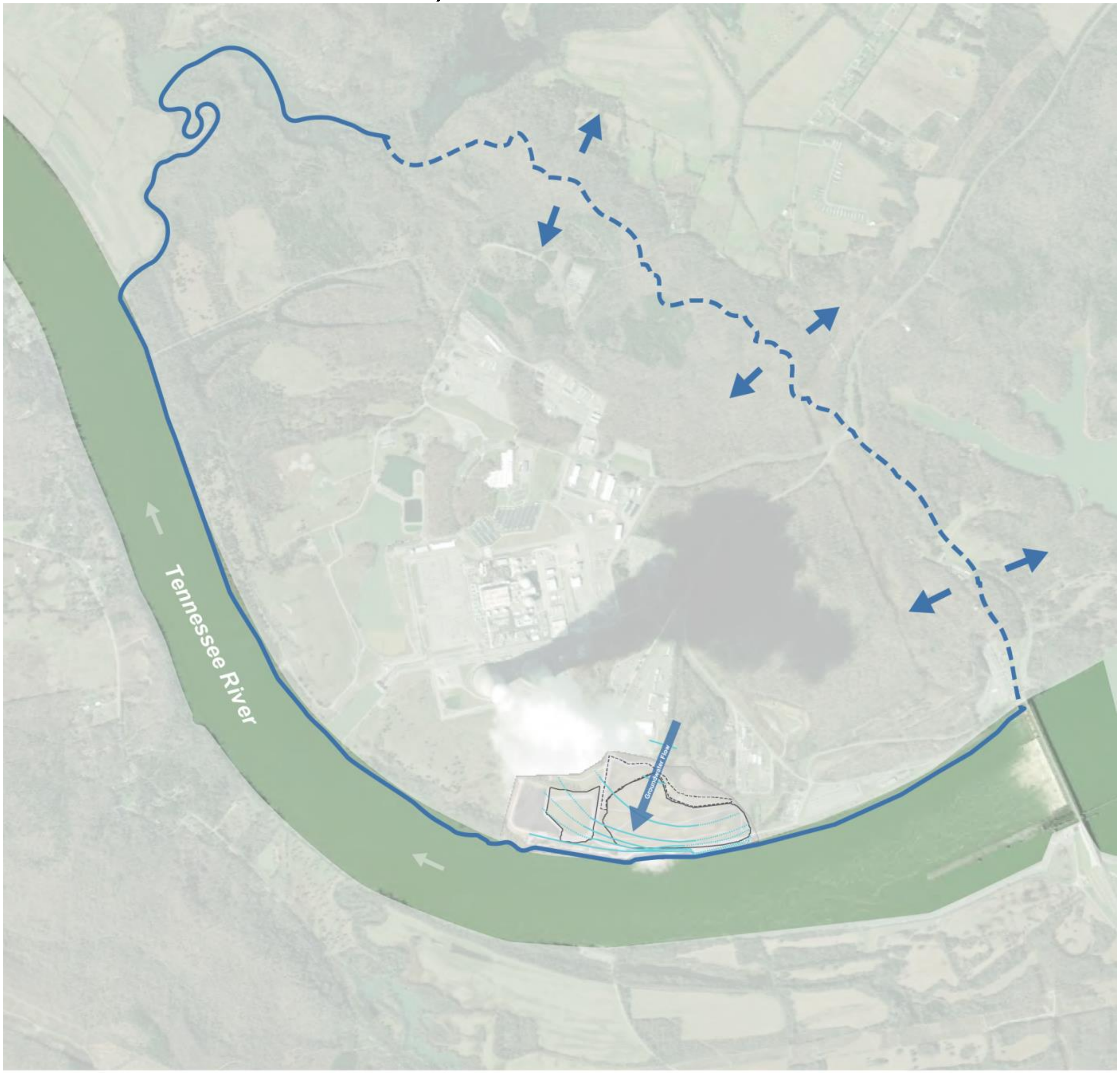
This section provides a discussion of how groundwater flows at the WBF Plant. Groundwater flow occurs because gravity moves groundwater from areas of higher groundwater elevations to areas of lower elevations along flow paths that are generally perpendicular to groundwater elevation contours. Physiographic and hydrogeological features affect how groundwater flows. Hydrogeological barriers (i.e., rivers and surface streams) and divides (i.e., ridges that form watershed boundaries) bound the extent of groundwater flow. Groundwater flows toward, but not across, hydrogeological barriers and away from hydrogeological divides.

Based on the geology and hydraulic conductivities measured in the vicinity of the CCR management units, the alluvial sands and gravels above bedrock (also referred to as unconsolidated materials) are defined as the uppermost aquifer. The uppermost aquifer is overlain by less permeable clays that are defined as an aquitard; therefore, the uppermost aquifer is a confined aquifer. Groundwater in the confined aquifer is not in contact with the CCR material inside the CCR management units where the aquitard is present because the aquitard physically separates them. Appendix H.1 provides additional details regarding the characterization of the uppermost aquifer and the distribution and thickness of the aquitard.

During the EI, groundwater levels were measured within the uppermost aquifer and the underlying bedrock prior to the six groundwater sampling events to evaluate the direction and rate of groundwater flow in the uppermost aquifer. Surface water elevations were measured at the Tennessee River because the elevations of surface streams can affect groundwater flow.

The available data indicated that groundwater generally flows from the west-northwest to the east-southeast toward the Tennessee River. Calculated groundwater flow rates ranged from approximately 35 to 50 feet/year, which is generally much slower than water flow in surface streams or rivers. Flow rates in surface streams or rivers generally are measured in feet per second (USGS 1999). Exhibit 5-1 is a representative groundwater contour map. Physiographic features that affect groundwater flow in the vicinity of the WBF Plant include the steep topography of the ridges to the northwest, relatively flat floodplain of the Tennessee River, and the Tennessee River (see figure below). In the vicinity of the CCR management units, groundwater flow is bounded to the east by the Tennessee River. Groundwater flow directions, boundaries, and the topographic divide are shown in the following figure. Additional discussion of the hydrogeology and groundwater flow is provided in Appendix H.1.

Groundwater Flow Directions, Boundaries and Divides



Legend

- Interpolated Groundwater Contour
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Surface stream that bounds groundwater flow
- Hydrogeological Divide
- Generalized groundwater flow direction
- CCR Unit Area (Approximate)

Note: Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 5-1, Groundwater Elevation Contour Map Event #6 (July 6, 2020), for actual groundwater elevations and groundwater contours.

Imagery Provided by TVA (9/12/2018) and BING Imagery

5.1.3.3 Groundwater/Surface Stream/Pore Water Relationships

TVA measured pore water levels within the temporary wells monthly for six months. In addition, the wells were gauged during bi-monthly groundwater sampling events. This information was combined with available information from other instruments to develop maps of the phreatic surfaces for the Slag Disposal Area and Ash Pond at the time of gauging. The phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water. The use of the term “saturated” or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Saturated CCR material can have a range of moisture contents based on the characteristics of the material. In addition, some of the other instruments that measure pore water, groundwater, and surface stream levels have been automated to provide time-series data, which have been plotted to evaluate the relationships of the elevations of pore water, groundwater, and surface streams. Detailed discussion of these relationships is provided below and in Appendix H.1.

Within the Slag Disposal Area, the pore water phreatic surface was at an elevation higher than groundwater levels in the uppermost aquifer. An observed relationship between water levels in piezometers WBF-B15A/B and WBF-B16B and precipitation events suggests that an adjacent pond may be losing water into the subsurface, which may be affecting pore water levels. Because of this finding, evaluation of drainage improvements to the area west of Slag Disposal Area will be part of the CARA Plan.

Within the Ash Pond, information and data indicate that the CCR material was unsaturated. This suggests that the cap is performing as expected and has effectively eliminated infiltration of precipitation into the CCR material.

The fluctuations in groundwater levels in the uppermost aquifer were correlated with fluctuations in the Tennessee River stage. The fluctuations in groundwater levels in some piezometers were correlated with precipitation events. The fluctuations in pore water levels generally show a closer correlation with precipitation than to the Tennessee River stage.

Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions. The phreatic surface in the Slag Disposal Area would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.

5.1.3.4 Groundwater Quality Evaluation

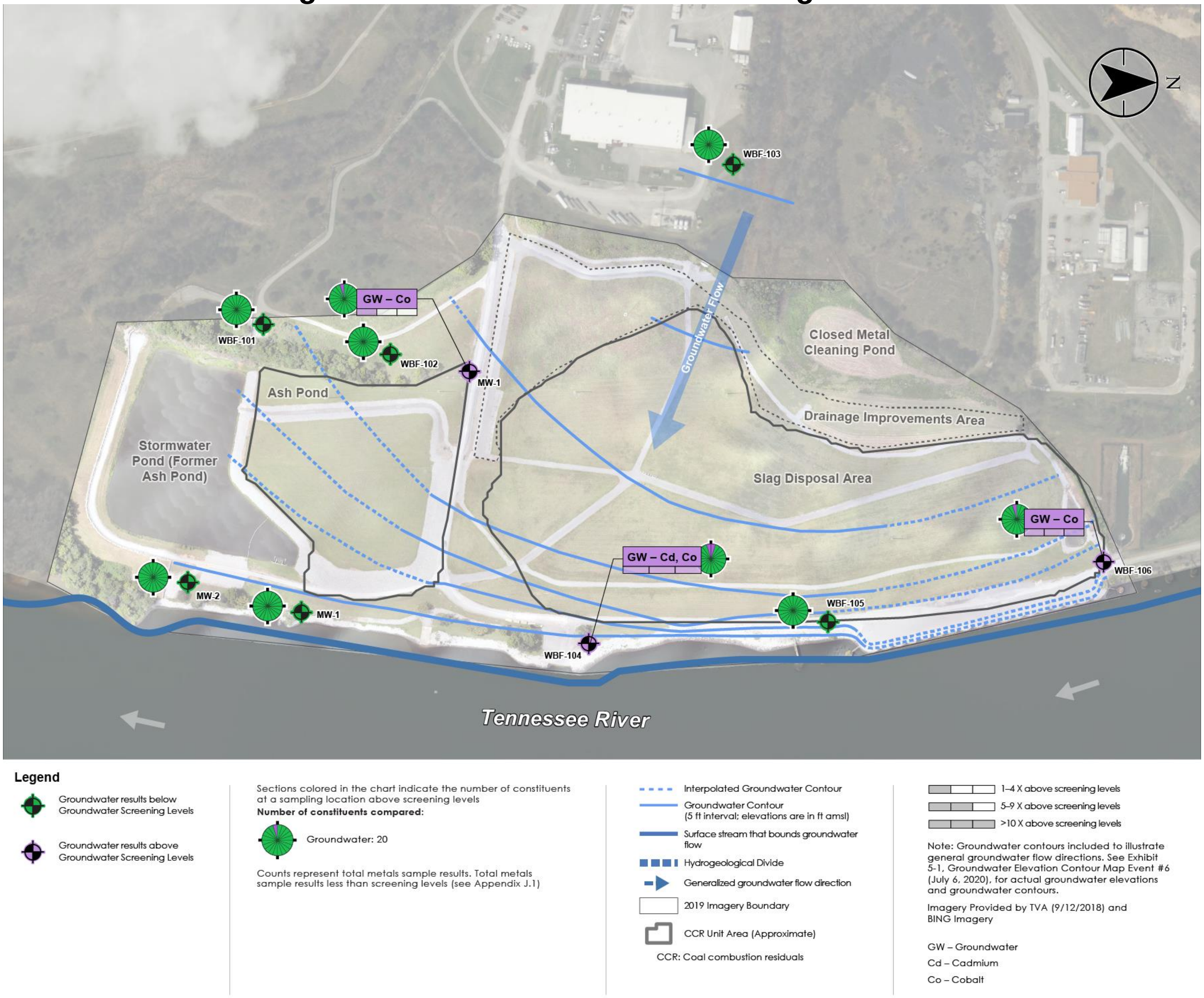
This section provides a discussion of the analytical results for groundwater samples collected from monitoring wells installed as part of the EI and previously installed wells monitored as part of the Ash Pond closure monitoring program. The groundwater quality evaluation is based on a statistical evaluation of constituents listed in Appendix I of TDEC Rule 0400-11-01-.04 (TDEC Appendix I) and Appendices III and IV of the CCR Rule. The analytical results were compared to GSLs approved by TDEC (see Table 1-1 and Appendix A.2). The statistical evaluation of groundwater analytical data is provided in Appendix E.3. Additional discussion of the results of the statistical evaluation is provided in Appendix H.1.

The dataset compiled for statistical analysis includes available analytical data for groundwater samples collected between October 2014 and October 2022, although the specific start date and frequency of sampling may vary between wells based on date of well installation and the applicable monitoring program. This time period was selected because it includes data that met the requirements of the data quality objectives for the TDEC Order program.

Two CCR Rule Appendix IV CCR constituents (which are also TDEC Appendix I constituents) had statistically significant concentrations in onsite groundwater above a GSL in three wells that require further evaluation in the CARA Plan to determine the need for corrective action that will be based on statistically significant concentrations above an established GWPS. These constituents include cadmium (WBF-104), and cobalt (MW-1, WBF-104, and WBF-106). Two wells had only one statistically significant constituent concentration greater than a GSL, and one well had two statistically significant constituent concentrations greater than the GSLs. The groundwater impacts described above are limited to onsite areas along the perimeter of the CCR management units.

The following figure shows the results of the statistical evaluation of CCR Rule Appendix IV and TDEC Appendix I constituents. Each monitoring well is represented by a symbol that is divided into 20 slices within a circle. The slices are colored green for each of the 20 CCR constituents that was detected at concentrations below the GSLs. Slices colored purple represent constituents that were detected above GSLs. The small boxes provide the constituents that were detected above the GSL. The bars below the boxes provide a gauge for how much the concentrations were above the GSL. See the legend in the figure for further explanation of the symbols. Additional discussion of the results of the statistical evaluation are provided in Appendix H.1.

Groundwater Findings Near the WBF Plant CCR Management Units



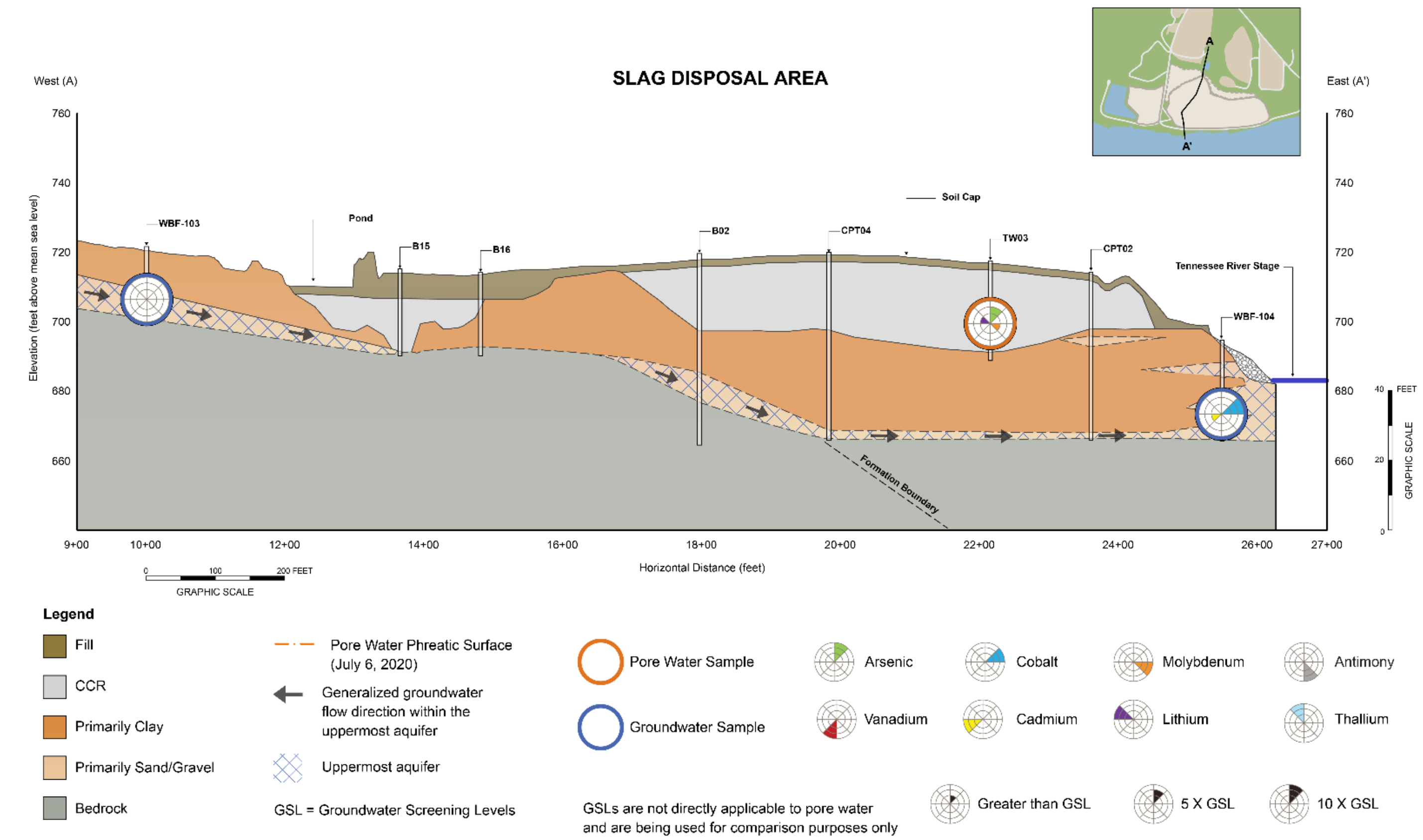
The figure shows that most constituents were detected below the GSLs. Three wells had constituents with statistically significant concentrations above a GSL.

In addition, the quality of pore water was compared to groundwater quality. The following two figures illustrate the difference between pore water quality (symbol with orange outer ring) measured within the CCR management units and groundwater quality (symbol with blue outer ring) measured at the edge of the CCR management units. The first figure is a plan view showing the differences in water quality by comparison of the colors within the symbols. The CCR constituents detected are represented by different colors, as shown in the legend. The relative concentration of the constituent detected compared to the GSLs is represented by the number of colored sections within each slice.

The second figure is a cross section through the Slag Disposal Area that also shows the same differences in water quality. These two figures show that generally the constituents detected in downgradient groundwater along the edge of the CCR management units are different than those detected in pore water within the CCR management units. This can be explained by geochemical reactions that can occur as water flows through natural geological materials.

Pore Water and Groundwater Concentration Comparison

Cross Section View of Pore Water and Groundwater Comparison



5.2 Geochemical Evaluation of Groundwater Data

Groundwater quality is affected by numerous geochemical processes during groundwater flow through geological materials. The distinct difference between the chemical characteristics of pore water within the CCR material, presented in Chapter 4, and the characteristics of groundwater quality downgradient of the CCR management units at the WBF Plant is difficult to explain without the aid of geochemistry. It is well documented in the literature that certain CCR constituents that are detected in pore water (typically at higher concentrations than in groundwater) can be affected by geochemical processes that occur between constituents dissolved in groundwater and geological materials through which it flows. The effects of these geochemical processes, which often result in the attenuation of CCR constituents (i.e., reduced concentrations) can explain observed differences between the characteristics of pore water and groundwater. The extent of the interactions between dissolved constituents in groundwater and geological materials ranges from limited interaction for constituents such as boron, chloride, and sulfate, to strong interactions for constituents such as arsenic and cobalt.

Observations of groundwater and pore water chemistry can indicate the extent to which geochemical processes chemically change groundwater and influence groundwater quality at the WBF Plant. Boron, chloride, and sulfate commonly occur in high concentrations in pore water and are minimally attenuated by geochemical processes. Thus, they can be used to infer locations in the groundwater monitoring program where there is an influence from pore water. In contrast, those CCR constituents most likely to be influenced by interactions between geological materials and groundwater (e.g., arsenic, lithium, and molybdenum) typically show concentrations in groundwater monitoring wells that are much different than those observed in pore water, indicating that groundwater is being chemically changed relative to pore water by some physical or geochemical process (or a combination of both) occurring as it flows through geological materials.

Understanding the geochemistry of geological materials is important in interpreting the processes influencing current conditions of groundwater chemistry at the WBF Plant and evaluating effects of activities, such as cap or drainage modifications or groundwater remediation, on the evolution of groundwater quality. Further evaluation of the geochemical processes acting in the upgradient system at the WBF Plant to influence groundwater quality will be included in the CARA Plan during assessments of remedies, where needed.

5.3 Water Use Survey

The objectives of the EI water use survey are to update a previous survey of domestic water supplies near the WBF Plant completed by TVA in 2008. The survey update was completed by reviewing state databases to identify existing private water wells or surface water supplies within ½-mile of the boundary of the WBF Plant, including water well inventory records on file with TDEC for Rhea and Meigs Counties. This area is referred to herein as the Survey Area as outlined in the EIP and shown in the figure below. This EAR provides the results of the initial desktop survey phase of the water use survey intended to identify usable water wells and springs within the Survey Area. A description of the survey and a summary of results is provided in Appendix H.9.

5.3.1 Desktop Survey

The water use survey was a desktop survey to identify usable private wells and springs. This included a review of registered well information obtained from TDEC, historical hydrogeologic reports, aerial photographs, and contacting public water supply providers in the vicinity of the WBF Plant. The goal was to identify potential and known wells or springs within the Survey Area.

Based on the results of the desktop survey, no wells or springs potentially used for domestic or business purposes were identified in the Survey Area, as shown on the figure below.

Water Use Survey Area

Legend

- Interpolated Groundwater Contour
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Surface stream that bounds groundwater flow
- Hydrogeological Divide
- Generalized groundwater flow direction
- CCR Unit Area (Approximate)
- WUS Survey Area

Note: Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 5-1, Groundwater Elevation Contour Map Event #6 (July 6, 2020), for actual groundwater elevations and groundwater contours.

Imagery Provided by TVA (9/12/2018) and BING Imagery

5.4 Hydrogeological Investigation Summary

The objectives of the TDEC Order hydrogeological and groundwater investigations were to characterize the hydrogeology and groundwater quality and evaluate groundwater flow conditions in the vicinity of the WBF Plant CCR management units. The key findings of the WBF Plant hydrogeological and groundwater investigations are summarized below.

- TVA evaluated analytical results for groundwater in support of the EAR based on data collected under two groundwater monitoring programs, including the EI and the Ash Pond closure monitoring programs. Monitoring well locations and CCR constituents that will require further evaluation in the CARA Plan are provided below.

Summary of Findings Requiring Further Evaluation in the CARA Plan	
CCR Management Unit	**Groundwater**
Ash Pond	Cobalt (Well MW-1)
Slag Disposal Area	Cadmium (Well WBF-104) Cobalt (Wells WBF-104 and WBF-106)

- Drainage modifications or potential corrective actions are expected to reduce concentrations of CCR constituents to below GSLs in groundwater at downgradient monitoring locations.

- Pore water within the CCR material has specific chemical characteristics that are different from the characteristics of groundwater downgradient of the CCR management units. Certain CCR constituents that have been detected in pore water are affected by geochemical processes during transport by groundwater through geological materials. The effect of these geochemical processes, which can result in the attenuation of CCR constituents and reduced dissolved groundwater concentrations, can explain the observed differences between the characteristics of pore water and groundwater quality.

- The pore water levels reported herein for the Slag Disposal Area may not represent steady-state conditions. The pore water levels would be expected to decrease in elevation if modifications to stormwater drainage or the existing soil cap system were to be implemented. Available information indicates that the Ash Pond is unsaturated. The use of the term flow, or other terms such as “saturated” in reference to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material.

- The coarse-grained unconsolidated alluvial deposits above bedrock are considered to be the uppermost aquifer and are under confined conditions. The uppermost aquifer is typically overlain by clays that act as an aquitard. Available water level data, including the effect of the Tennessee River stage, indicate that the aquitard provides a hydraulic separation between the uppermost aquifer and the CCR material.

- The groundwater flow direction within the uppermost aquifer beneath the CCR management units is generally from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the CCR management units is bounded to the east by the Tennessee River.

TVA will continue to monitor the trends of cadmium and cobalt and conduct further evaluation in the CARA Plan to determine if corrective actions are needed. The influence of geochemical processes on groundwater quality will be further evaluated in the CARA Plan as part of the assessment of remedies, where needed.

Chapter 6 Seep Investigation

To evaluate potentially active seeps and collect data to assess potential seepage to surface water streams adjacent to the WBF Plant CCR management units, TVA reviewed historical seep management information and conducted a seep investigation as part of the TDEC Order EI. A summary of the historical seep information for the WBF Plant CCR management units is presented in Chapter 6.1. Because historical seep management at the CCR management units did not include collecting soil or surface water for analysis, samples of these media were obtained and analyzed for the EI as described in Chapter 6.2. The overall evaluation of the EI seep investigation results, including relevant historical data, are presented in Chapter 6.3. Additional information regarding the investigation field activities and sampling results is provided in the *Seep SAR* (Appendix I.1).

6.1 Historical Information

This section provides a brief summary of the historical information available that formed the basis of scope of the EI seep investigation. A detailed compilation of historical seep locations, remedial actions, and monitoring actions is presented in Appendix R of the EIP.

TVA conducted annual CCR management unit dike inspections from 1967 to 2014. Historical reports and inspections identified Seep A and Seeps #1 through 5 as historical seeps as summarized in the EIP. Historically, TVA addressed wet areas and potential seepage areas in a conservative manner to anticipate possible structural concerns at the CCR management units. Identified wet areas were classified as seeps unless observational evidence suggested an alternative water source such as poor drainage or precipitation. The six historical seeps are identified on Exhibit 6-1.

A surface water drainage improvement project was completed in 2015. The project consisted of drainage improvements to reduce infiltration through the cap and to reduce ponded water around the perimeter of the Slag Disposal Area. A seep cut-off trench was also installed to prevent seepage. As a result of this project, three non-flowing seepage areas between the Slag Disposal Area and the Tennessee River were mitigated. No flow was reported at the seepage areas during or after the 2015 mitigation was completed. During EIP preparation, there were no active seeps at the site.

6.2 TDEC Order Investigation Activities

The primary objectives of the TDEC Order EI seep investigation at the WBF Plant CCR management units were to identify and collect information regarding the potential presence of active seepage, and if identified, evaluate the data obtained to assess potential movement of groundwater or pore water with dissolved CCR constituents into adjacent surface water streams. Seep investigation field activities and statistical evaluation of the data collected were performed in general accordance with the *Seep SAP* (Stantec 2018h) and the *QAPP* (EnvStds 2018a), including TVA- and TDEC-approved programmatic and project-specific changes made following approval of the EIP. Sample location selection, collection methodology, analyses, and QA/QC completed for the investigation are provided in the *Seep SAR* included in Appendix I.1.

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; measuring field parameters in surface water in areas monitored by boat;

collecting soil and water samples associated with potentially active seeps (as feasible), referred to herein as areas of interest (AOIs); and conducting observations at applicable AOIs.

6.3 Seep Investigation Results Summary

Accessible Area Inspections

During the visual walkdown inspection conducted by TVA and TDEC on April 16, 2019, two AOIs were identified (Exhibit 6-1):

- AOI01 – downslope of the 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 six-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.

Soil samples were collected at AOI01 for the analysis of CCR Parameters, but water samples were not collected due to insufficient water. Soil and water sampling at AOI02 was not conducted due to the presence of riprap. Sample collection information and analysis results at AOI01 are provided in Appendices I.1 and I.2, respectively.

AOI observations were conducted at AOI01 between June 6, 2019 through August 8, 2019; and the observations are documented in the *Seep SAR* (Appendix I.1). Based upon the monitoring evidence, it was demonstrated that AOI01 was the result of poor drainage along the roadway. Agreement was reached between TVA and TDEC in meetings during August 2019 to cease monitoring at the AOI01 location, with the conclusion that no active seep was present at AOI01.

Inaccessible Area Inspections

Six historical seeps and the two AOI locations identified during the accessible area inspections were investigated further by boat during April 2019. These locations are adjacent to the Slag Disposal Area along the Tennessee River bank. Water quality parameters were measured at 136 locations in the Tennessee River downstream, adjacent and upstream of these locations (Exhibit 6-1). As detailed in Appendix E.4, a statistical analysis of the results was performed to evaluate whether there were statistically significant differences between areas adjacent to and upstream of potential seep locations. The statistical results identified three adjacent locations where the 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 (AOI02, AOI03, and AOI04) were identified at the WBF Plant in the inaccessible areas for further investigation or data collection. The three AOIs are identified on the figure below.

Seep Investigation

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WBF Area of Interest Locations

During the review of the Tennessee River levels and initial EI data within the Slag Disposal Area, TVA observed the phreatic levels within the unit trending with the river levels. Additionally, the phreatic levels were observed to gradually increase in elevation toward a ponded area located west of the Slag Disposal Area. In June 2020, additional multi-level vibrating wire piezometers were installed adjacent to each AOI (AOI02, AOI03, and AOI04) to monitor groundwater levels at the Tennessee River bank. Also, two additional multi-level vibrating wire piezometers were installed to monitor potential influence of the ponded area on the phreatic surface within the Slag Disposal Area. The supplemental investigation procedures and piezometer locations are provided in Appendix G.2. Based on the EI data, and using the supplemental investigation results described above, the three AOIs (AOI02, AOI03, and AOI04) adjacent to the Slag Disposal Area along the Tennessee River bank will be further evaluated in the CARA Plan to determine if corrective actions are needed.

Chapter 7 Surface Streams, Sediment, and Ecological Investigations

To characterize environmental conditions and evaluate potential impacts to surface streams, sediments, and associated ecological receptors in the vicinity of the WBF Plant, TVA reviewed information from historical studies, and performed surface water, sediment, benthic macroinvertebrate community, Asiatic clam tissue, and fish tissue investigations as part of the EI. EI field activities were performed in general accordance with the following documents: *Surface Stream SAP* (Stantec 2018i), *Benthic SAP* (Stantec 2018j), *Fish Tissue SAP* (Stantec 2018k), and the *QAPP* (EnvStds 2018a), including TVA- and TDEC-approved programmatic and project-specific changes made after approval of the EIP. As described below, the scopes of these investigations varied, but environmental media generally were sampled upstream, adjacent, and downstream of the WBF Plant CCR management units.

The following sections summarize historical and EI activities, and present overall investigation and evaluation findings for surface stream water, sediment, benthic invertebrate community, Asiatic clam tissue (sampled instead of mayfly tissue as discussed in Chapter 7.2), and fish tissue based on data obtained during previous studies and the EI. Statistical analyses of the surface stream water, sediment, Asiatic clam tissue, and fish tissue data are provided in Appendices E.5 through E.8, respectively. A detailed technical evaluation of these results and associated SARs are provided in Appendices J.1 through J.6.

7.1 Previous Studies and Assessments

7.1.1 Surface Stream Studies and Ongoing Monitoring Activities

WBN Plant pre-operational aquatic monitoring was conducted between 1973 and 1985 (two sample periods, 1973 to 1977 and 1982 to 1985) and operational aquatic monitoring conducted in 1996 and 1997 included trace metals, solids (suspended and dissolved), turbidity, phosphorous and other parameters in addition to general water quality measurements (e.g., temperature, dissolved oxygen) (TVA 1996 and 1998a). Surface stream monitoring for general water quality parameters has been conducted near the WBF site under TVA's Reservoir Release Improvement (RRI) program established in 1991, after the WBF Plant became inactive. No specific sampling to evaluate potential CCR contamination was performed under the RRI program.

TVA is currently conducting ongoing monitoring of surface stream water quality in the Tennessee River at the WBN Plant along with Whole Effluent Toxicity (WET) testing twice per year at each outfall in accordance with its NPDES Permit.

The key findings from several years' results of water quality monitoring in the Tennessee River and whole effluent toxicity testing of WBN Plant outfalls are as follows:

- Water quality in the Tennessee River near the WBN and WBF Plants is similar to that observed in the Tennessee River both upstream and downstream. The water is moderately hard, slightly alkaline, contains sufficient nutrients to support a diverse assemblage of aquatic plants and animals, and water quality varies slightly in response to rainfall, runoff, and regulation of flows by upstream dams.

- General water quality characteristics in the Tennessee River near the WBN and WBF Plants exhibit typical seasonal patterns of higher turbidity and nutrient levels during high flow periods associated with wet weather, and lower levels of turbidity and nutrients during drier periods.
- Water in the Tennessee River near the WBN and WBF Plants typically meets Tennessee water quality criteria for all uses, and there are no state-issued advisories cautioning the public about using the river near the plants as a source of water for municipal or agricultural water supplies, or for fishing and other water-based recreation.
- Results of Whole Effluent Toxicity testing of the WBN Plant NPDES-permitted outfalls consistently meet permit limits.

7.1.2 Sediment and Benthic Invertebrate Studies

TVA has conducted biological assessments by periodically monitoring aquatic communities (fish and benthic invertebrates) to evaluate their status upstream and downstream of the WBF Plant as detailed in Appendix J.3. These assessments began in the 1970s and have varied in scope and periodicity. From 2001 through the date of this EAR, benthic invertebrate assessments have been conducted annually during 2001-2005, 2007-2013, 2015, 2017, and 2020 in accordance with the WBN Plant NPDES permit. Historical sediment sampling for CCR constituents has not been conducted in the Tennessee River adjacent to the WBF Plant.

The 1970s to 1990s data related to benthic invertebrate communities showed the following key findings:

- The assemblages of benthic invertebrates in the vicinity of WBF (upstream, adjacent, and downstream), were diverse and abundant, and consistent with biota of mainstem Tennessee River reservoirs
- The benthic communities at sample locations were similar
- TVA concluded that the first two years (1996 and 1997) of the WBN Plant operation did not negatively impact the benthic invertebrate communities (TVA 1998a).

Additionally, since initiation of benthic sampling in 2001, the WBF Plant benthic sample results have shown consistently higher biological integrity adjacent to and downstream of the WBF Plant compared to upstream conditions, located above the Watts Bar Dam. Reservoir Benthic Index (RBI) outcomes for upstream communities reflect a level of habitat-related stress associated with the impoundment, and therefore, the upstream transects are not ideal control locations. However, historical monitoring data, demonstrate consistently ‘Excellent’ biological integrity in downstream reaches since 2011 (and from 2003 through 2005).

7.1.3 Fish Community and Fish Tissue Studies

The WBF Plant was decommissioned in 1982 and is currently inactive, and the WBN Plant became operational in 1996. Located adjacent to the WBF Plant, the WBN Plant has similar ecological ranges for fishery study evaluation, and fishery studies completed between 1977 and 1985 were often completed as pre-operational studies for the WBN Plant. As noted above, TVA has conducted biological assessments by periodically monitoring aquatic communities (fish and benthic invertebrates) to evaluate their status upstream and downstream of the WBF Plant. Historical fish population assessments were from the 1970s through 2015, as detailed in Appendix J.5. Additionally, sport fish surveys, fish impingement monitoring, entrainment studies, and fish tissue studies were conducted. Conclusions based on previous fish population assessments and tissue studies near the WBF Plant are as follows:

Fish Population Monitoring. Key findings from historical fish population monitoring studies include:

- Biological assessment data has demonstrated, with acceptance by TDEC and USEPA Region 4, that the presence, protection, and maintenance of a balanced indigenous population in the Chickamauga Reservoir supports the continuance of the alternate thermal limits (ATL) in the WBN Plant NPDES permit (TVA 2018a).
- The WBN Plant has maintained a good compliance record with its ATL throughout each NPDES permit term since first authorized in the late-1990s; ongoing biological monitoring has consistently demonstrated the ATL is protective of aquatic communities in the river near the facility (TVA 2018a).
- TVA's Reservoir Fish Assemblage Index (RFAI) assessment data has consistently indicated that Chickamauga Reservoir fish assemblages downstream from the WBN Plant, and thus the WBF Plant, remain similar over time demonstrating balanced indigenous populations (TVA 2018a).
- TVA concluded that the first two years of the WBN Plant operation did not negatively impact the tailwater fish population downstream from the plant (TVA 1998b).

Therefore, in the context of USEPA's interpretation of the regulatory definition of a balanced indigenous population, TVA maintains that a balanced indigenous population is currently being demonstrated in Chickamauga Reservoir (i.e., in the Tennessee River in the vicinity of the WBF Plant).

Fish Impingement Monitoring. The initial 1974-1975 WBF Plant impingement monitoring study and later 2005-2007 and 2010-2011 WBN Plant impingement monitoring studies concluded that no fish species were impinged at those facilities in sufficient numbers to impact Watts Bar and Chickamauga Reservoir fish communities (TVA 1975, 2007b, 2011, and 2017). The numbers of each species of fish impinged were low in comparison to estimates of their populations in Watts Bar and Chickamauga reservoirs.

Fish Entrainment Studies. The 1975 WBF Plant entrainment study found no significant impact on the Watts Bar Reservoir fishery resource, and that the WBF Plant's low demand for cooling water as a peaking plant minimized the impact on larval fish (TVA 1976). Entrainment studies conducted from 2010 through 2012 demonstrated that the WBN Plant did not adversely impact the ichthyoplankton (fish eggs and larvae) population below the Watts Bar Dam in the upper Chickamauga Reservoir. Low numbers of ichthyoplankton were entrained relative to the numbers transported past the WBN Plant, and fish community monitoring indicated no measurable adverse environmental impacts at the population level from the operations of the plant.

Fish Tissue Collection. With the exception of mercury concentrations in largemouth bass collected from the Hiwassee River arm of the Chickamauga Reservoir, historical fish tissue contaminant concentrations were either below detectable levels or below TDEC fish consumption advisory levels. TDEC has issued a precautionary advisory specific to Hiwassee River miles 7.4 to 18.9 for largemouth bass consumption due to mercury levels (TDEC 2023). TDEC identifies industrial discharge and atmospheric deposition as the most significant potential sources of mercury. No fish consumption advisories have been issued for the Tennessee River arm of Chickamauga Reservoir.

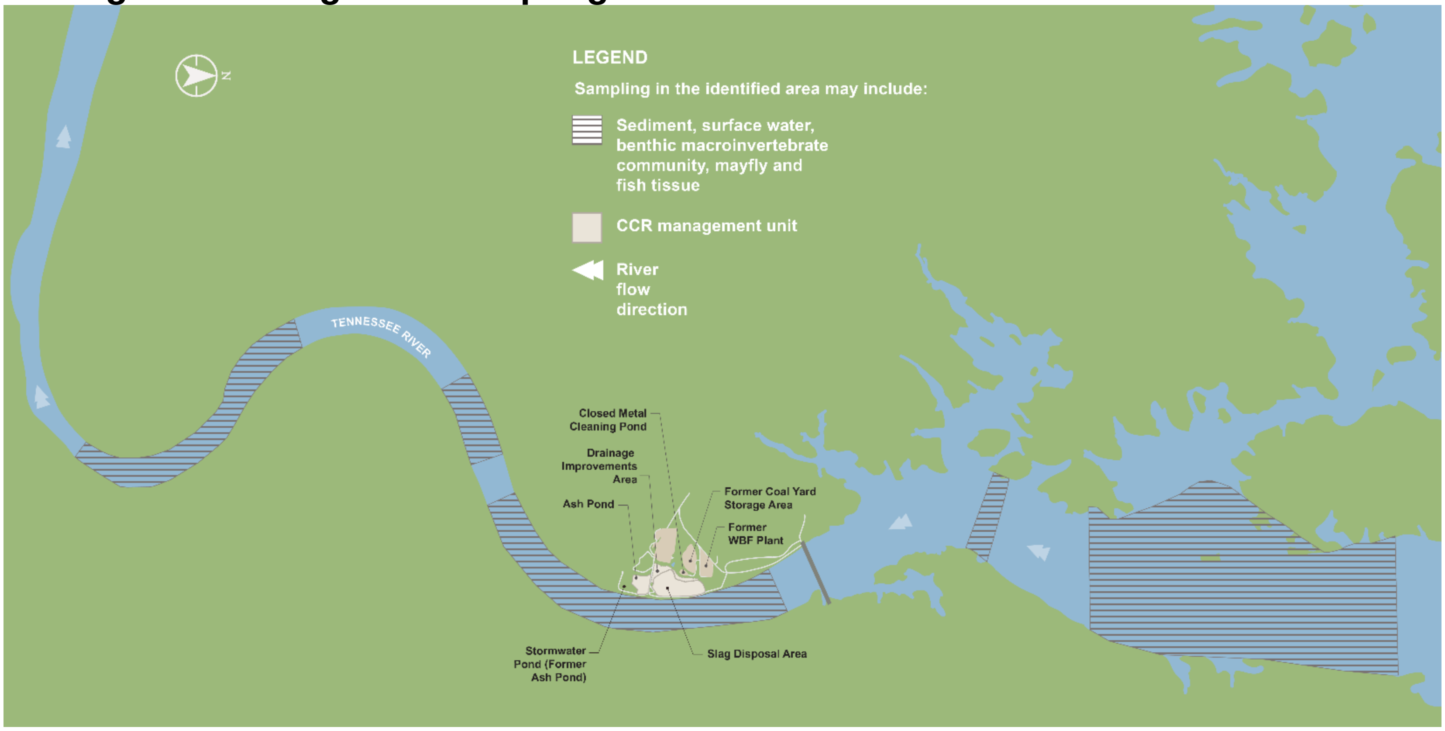
7.2 TDEC Order Investigation Activities

The objectives of the ecological investigations were to characterize water quality, sediment chemistry, benthic macroinvertebrate community composition, Asiatic clam tissue, and fish tissue in the vicinity of the WBF Plant and to provide information to evaluate if CCR material and/or dissolved CCR constituents have moved from the CCR management units, potentially impacting these environmental media. In addition, sediment, Asiatic clam, and fish tissue data were collected to evaluate potential bioaccumulation impacts.

The EI field activities were performed in 2019 and 2020 in general accordance with the *Surface Stream SAP, Benthic SAP, Fish Tissue SAP,* and the *QAPP*, including TVA- and TDEC-approved programmatic and project-specific changes made following approval of the EIP. Surface stream samples were collected from transects located upstream, adjacent, and downstream of the CCR management units in the Tennessee River. Sediment sampling was proposed along seven transects in the Tennessee River located downstream of the Watts Bar Dam, however due to high flow velocities in this river reach, depositional areas were lacking. Due to the absence of depositional substrates, it was only possible to collect sediment samples from locations immediately adjacent to the CCR management units and farther downstream in the Tennessee River.

The Benthic SAP specified the collection of composite samples of mayfly (*Hexgenia* spp.) adults and nymphs but allowed for the evaluation of other benthic macroinvertebrate species if an insufficient number of mayflies were encountered in the designated areas. Mayflies, which inhabit fine silt-clay substrates versus the sand-gravel substrates encountered in the study area, were not encountered in sufficient numbers to generate the composite samples during the proposed sampling. Composite Asiatic clam (*Corbicula* spp.) tissue samples were therefore collected in lieu of mayflies. Asiatic clam and fish tissue samples were collected in sampling areas and reaches located in similar areas as the surface stream and sediment transects within the Tennessee River (see below).

Ecological Investigation Sampling Transects and Reaches



In summary:

- A total of 113 primary surface stream samples were collected during EI activities from transects located in the Tennessee River. Technical evaluation of these sampling results is presented in the *Technical Evaluation of Surface Stream Data* (Appendix J.1), and investigation sampling information is provided in the *Surface Stream SAR* (Appendix J.2).

- Due to the absence of depositional substrates, it was only possible to collect sediment samples from a total of seven locations during sediment sampling; five of the 21 stations originally proposed in the Benthic SAP and two additional stations substantially offset from the proposed locations. Only surficial sediments (zero to six inches deep) were encountered in the WBF Plant study area, and each sediment sample was composited from several substrate grabs within an approximately 300-foot distance upstream and/or downstream of each sampling transect to obtain sufficient sample volumes to meet study objectives. A total of seven shallow sediment samples were therefore collected during EI activities from the Tennessee River. Technical evaluation of these sampling results is presented in the *Technical Evaluation of Sediment and Benthic Invertebrate Data* (Appendix J.3), and investigation sampling information is provided in the *Benthic SAR* (Appendix J.4).

- A total of six composite Asiatic clam tissue samples were collected during EI activities from individual areas in the Tennessee River. Technical evaluation of these sampling results is presented in Appendix J.3, and investigation sampling information is provided in Appendix J.4.

- Five fish species consisting of bluegill, redear sunfish, largemouth bass, channel catfish, and shad were targeted for EI sampling in sampling reaches located in the Tennessee River (Exhibit 7-1). The fish were resected and composited to provide a total of 39 fish tissue samples comprised of muscle, liver, and ovary tissue samples for the gamefish, and whole fish for the shad. Technical evaluation of these sampling results is presented in the *Technical Evaluation of Fish Community and Fish Tissue Data* (Appendix J.5), and investigation sampling information is provided in the *Fish Tissue SAR* (Appendix J.6).

- A total of 35 benthic macroinvertebrate community samples were collected from seven transects located in the Tennessee River. The five samples collected along each transect were processed individually by the laboratory, and individual sample taxa lists (and counts) were later composited to generate a comprehensive taxa list for each sampled river segment. Technical evaluation of these sampling results is presented in Appendix J.3, and investigation sampling methods are provided in Appendix J.4.

7.3 Results and Discussion

The following summarizes the results of the surface stream water, sediment, benthic macroinvertebrate community, Asiatic clam tissue, and fish tissue investigations for the WBF Plant CCR management units. Sampling results for the fish tissue are presented in Exhibit 7-1.

Sampling data obtained during these investigations were evaluated by comparing measured concentrations to TDEC-approved screening levels for the EAR (Tables 1-2 through 1-5 and Appendix A.2). As described in Chapter 1.3.1, most screening levels are not regulatory standards, and are used to identify CCR Parameters in environmental media that require further evaluation in the CARA Plan to determine if an unacceptable risk exists and corrective action is required. In this section and the supporting technical evaluation appendices, screening values are used to evaluate potential impacts related to measured CCR Parameter concentrations. Screening values are conservative and protective of human and ecological health. Because they are conservative, sampling results above these levels do not necessarily indicate there are impacts to aquatic organisms or the environment, but rather, that the results require further evaluation in the CARA Plan.

Surface water screening levels for human health, which are based on use of surface water as a drinking water supply source, are applied to surface stream results for the Tennessee River, as it is a potable surface water source potentially affected by the WBF Plant CCR management units. Ecological screening levels, based on published studies of CCR Parameters health effects on ecological receptors, are applied to surface stream, sediment, and fish tissue results.

The ecological data evaluation approach utilized a two-step process. First, an exploratory data analysis (EDA) identified CCR Parameters present at concentrations higher than the EAR Ecological Screening Values (ESVs) (Tables 1-2 through 1-5 and Appendix A.2) in surface stream water and sediment samples. Second, when CCR Parameters were detected above surface water and sediment ESVs, fish tissue concentrations for those constituents were compared to TDEC-approved Critical Body Residue (CBR) values. Due to their potential for bioaccumulation effects, mercury and selenium were evaluated in fish and Asiatic clam tissue samples even if these constituents were not detected above ESVs in surface stream water and sediment samples.

7.3.1 Surface Stream, Sediment, Asiatic Clam and Fish Tissues Analyses

CCR Parameter concentrations in surface stream samples from the Tennessee River were below human health screening levels and below acute and chronic ESVs.

None of the Polarized Light Microscopy (PLM) results for sediment samples from the Tennessee River were above 5% ash, well below the 20% ash threshold that would trigger Phase 2 supplemental sampling. Additionally, none of the CCR Parameter concentrations in sediment samples collected from the Tennessee River were above their respective ESVs.

For Asiatic clam composite tissue samples collected in the Tennessee River, only mercury and selenium were reviewed due to their potential for bioaccumulation in the tissues of aquatic organisms. Non-depurated and depurated composite Asiatic clam tissue sample concentrations of mercury and selenium were very low in all three reaches and, only minimal variability was identified in the concentrations of each relative to sampling locations (i.e., upstream versus adjacent and downstream of the WBF Plant). Although there are clear differences between the ecosystems in the Tennessee River upstream of Watts Bar Dam and downstream of the dam in Chickamauga Reservoir and only a small number of composite samples were collected, the overall similarity and low Asiatic clam tissue sample results suggest that the detected concentrations are not related to WBF Plant CCR management unit activities.

Both mercury and selenium concentrations in gamefish liver tissues were detected above CBR values in each sampling reach, but selenium concentrations for gamefish muscle and ovary tissues and whole fish samples were lower than the CBR values for each sampling reach. Mercury concentrations were above CBR values for whole fish samples and largemouth bass muscle tissues for each sampling reach. By necessity, the upstream control sampling reach was established upstream of Watts Bar Dam, resulting in the downstream and adjacent sampling reaches being located in the Chickamauga Reservoir inflow zone and the upstream sampling reach being established in the Watts Bar Reservoir forebay zone. Although the flow regimes and ecologies of the two reservoir zone types differ, the overall mercury and selenium fish tissue results were similar among the three sampling reaches and the tissue concentrations displayed no consistent spatial patterns relative to the CCR management units.

These data result from a sampling design formulated to minimize overlapping fish home ranges and to include different feeding guilds. The similar results for all reaches, in combination with results from historical fish community assessments and both historical and EI benthic community data indicate that fish tissue concentrations greater than CBR values, regardless of the source, are not impacting the fish or benthic communities in this area. Additionally, the detected fish tissue concentrations displayed no spatial patterns relative to the CCR management units.

Tennessee River Sediment and Surface Stream Sampling Locations

7.3.2 Benthic Macroinvertebrate Community Analysis

For the EI, benthic macroinvertebrate community collection was performed in 2019 using a Ponar dredge sampler within the Tennessee River. Sampling transects were established at locations adjacent to and downstream of the WBF Plant CCR management units, as well as upstream of the Watts Bar Dam within the Reservoir. As previously discussed, upstream communities are likely affected by habitat-related stress associated with the impoundment and are not ideal as study controls. The benthic community taxa lists and counts were composited by transect to capture a comprehensive cross section of the existing benthic community in each representative river segment. Community metrics were then used as indicators of biological integrity and water quality, including an RBI Total Score and supplemental metrics as described below.

In 2019, the RBI categorized all adjacent and downstream EI sampling locations as having 'Excellent' biological integrity, while upstream communities scored comparably much lower. This is consistent with historical results, and an 'Excellent' rating has been continuously maintained since 2011. As such, EI results show that conditions have been largely unchanged in the long term and that benthic communities remain productive and healthy. Therefore, they do not reflect impacts associated with the WBF Plant CCR management units.

In addition to the inclusive multi-metric RBI results, supplemental metrics were calculated and are included in Appendix J.3, where the results are discussed in greater detail. Of these, select metrics that offer corroborative information for discussion in this EAR include Total Taxa Richness (TTR) and the Hilsenhoff Biotic Index (HBI). TTR is a count of the number of different types of organisms (typically as genera or next lowest practicable identification level) observed within the benthic community samples collected from each transect. Based on the 2019 survey, TTR generally increased moving from upstream to downstream, with the greatest richness observed at the farthest downstream transect (TR07), and communities adjacent to and downstream of the WBF Plant were consistently richer than those in the reservoir upstream of the Plant. For the reasons explained previously (see Chapter 7.1.2), these upstream locations are not suitable as a comparable control; however, there is no indication that the WBF Plant CCR management units are constraining local communities, resulting in reduced richness. The HBI is a metric that reflects environmental stress tolerance for the community as a whole. Similar to the RBI and TTR metrics, HBI scores were consistently higher adjacent to and downstream of the WBF Plant than upstream within the reservoir. Scores in potential impact areas (adjacent and downstream) all fell within the same rating category, as well, demonstrating similarly sensitive benthic communities in these areas. The evaluation of TTR and the HBI metrics corroborate the findings of the RBI evaluation.

Additionally, in support of these benthic macroinvertebrate community results, RFAI scores were reviewed from historical NPDES biological monitoring studies. RFAI scores from 2000 through 2017 indicated consistent and balanced indigenous fish populations, with minor seasonal variations over a 17-year period. As a demonstration of overall ecological health, these findings are consistent with EI benthic community results described above.

In summary, benthic communities within adjacent and downstream areas appear to be healthy, rich, and sensitive and demonstrate more favorable ecological conditions compared to locations upstream of the WBF Plant in the reservoir above Watts Bar Dam. Impacts from the CCR management units in surface stream water quality are not reflected in the benthic community data.

7.4 Surface Streams, Sediment, and Ecological Investigation Summary

The evaluation of EI surface stream, sediment, benthic macroinvertebrate community, Asiatic clam tissue, and fish tissue sampling results indicates that impacts to water quality and aquatic life were not identified as summarized below.

- Surface stream water quality in the Tennessee River is within ranges protective of human health and aquatic life. Sampling results were below chronic ESVs and indicate no water quality impacts from the CCR management units.
- Sediment quality is within ranges protective of aquatic life in the Tennessee River. Sampling results for % ash and CCR Parameter concentrations in sediment samples from the Tennessee River were below the % ash screening

level and chronic ESVs, respectively. These results indicate that sediment quality in the Tennessee River is within ranges that are protective of aquatic life.

- The adjacent and downstream Asiatic clam and fish tissue sampling results for the Tennessee River were similar to upstream control locations (Exhibit 7-1). These results do not indicate impacts or bioaccumulation effects within these populations related to the WBF Plant CCR management units.

- The adjacent and downstream benthic communities in the Tennessee River appear to be healthy, rich, and sensitive, and they demonstrate more favorable ecological conditions than upstream locations in the reservoir above Watts Bar Dam. Collectively, the benthic community data reflect no impacts from the CCR management units.

Overall, the EI sample results in conjunction with historical benthic community and fish population data demonstrate healthy and consistent ecological communities within the investigation area and indicate that the WBF Plant CCR management units have had no impacts to sediment and surface stream water quality or ecological communities of the Tennessee River.

Based on the EI findings, environmental sampling results in the Tennessee River were below ESVs and do not require further evaluation in the CARA Plan.

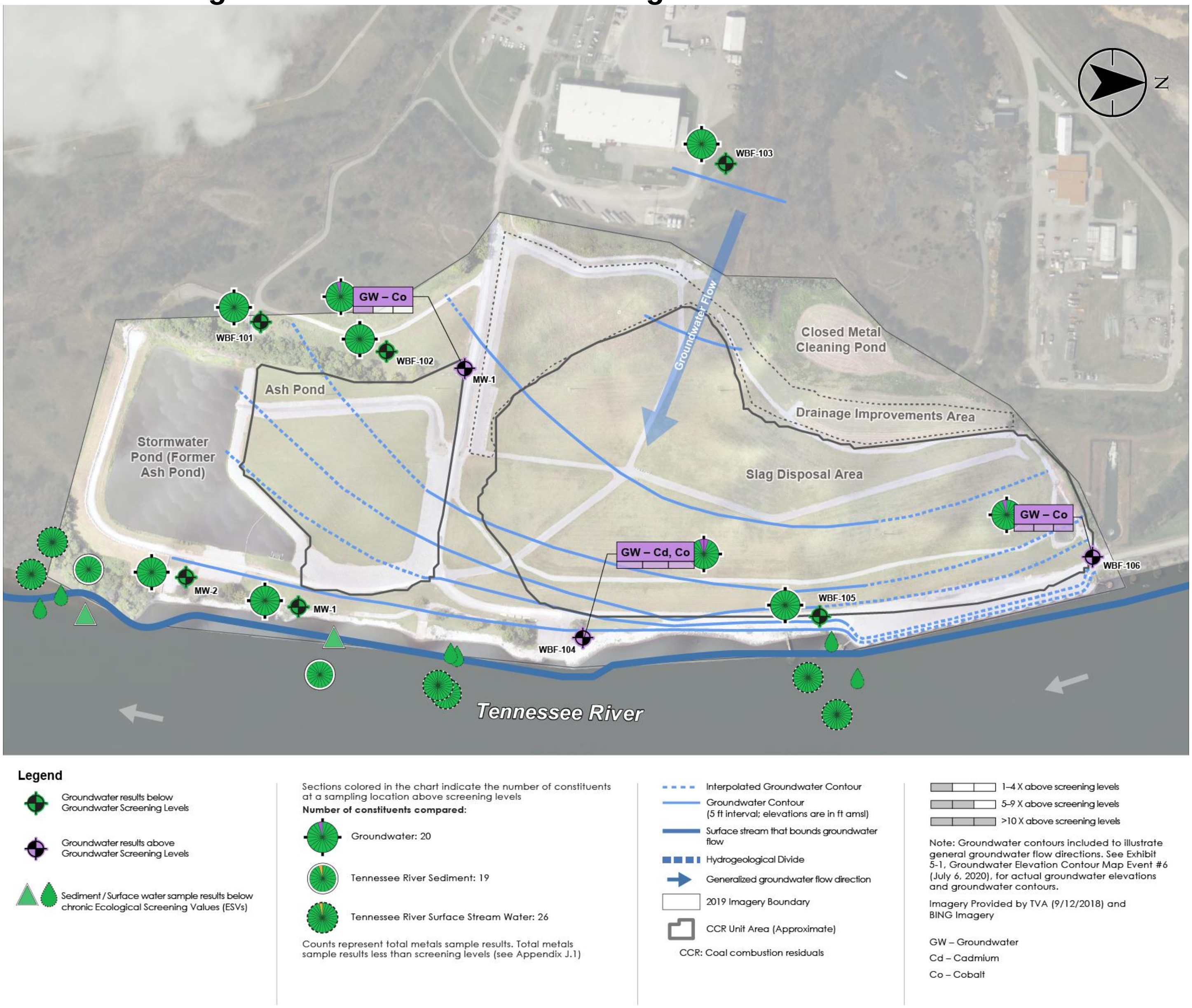
Chapter 8 TDEC Order Investigation Summary and Conceptual Site Models

This section summarizes the assessment of CCR material, structural stability and integrity of the CCR management units, and extent of CCR Parameters within environmental media investigated during the EI at the WBF Plant. CSMs for the CCR management units and overall findings are also presented based on the EI and associated historical and ongoing program results. CSMs describe sources of CCR constituents, pathways by which they can move, and environment media potentially impacted if they are released.

Analytical results were compared to TDEC-approved EAR screening levels to identify areas that require further evaluation. Most screening levels are not regulatory standards and are conservatively based on published health studies. Concentrations above the screening level do not necessarily mean that an adverse health effect is occurring, but rather, that further evaluation is required in the CARA Plan to determine if an unacceptable risk exists, and if corrective action is required. CCR management units were evaluated for potential slope stability impacts, which were defined as those areas having analysis results (i.e., factors of safety) that do not meet TDEC-approved criteria for one or more load cases. This section provides a summary of potential impacts identified during the EI that will be further evaluated in the CARA Plan.

Several EI findings are common among the CCR management units and are discussed in Chapter 8.1. Specific EI findings and CSMs for each CCR management unit are described in Chapters 8.2 and 8.3 and presented in Exhibits 8-1 and 8-2. These exhibits depict findings discussed in this EAR on a representative cross-section of subsurface conditions for each unit. Results of the EI are presented for the overall investigation area on Exhibit 8-3 and near the CCR management units as shown on the figure below and on Exhibit 8-4.

Overall Findings Near WBF Plant CCR Management Units



8.1 Common Findings

The common TDEC Order EI findings for the WBF Plant CCR management units are as follows:

Structural Stability and Integrity: The global slope stability and the veneer slope stability for each of the two CCR management units meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. TVA will be evaluating mitigation alternatives as part of the CARA Plan. The two CCR management units have adequate structural integrity, and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material.

Hydrogeology: The coarse-grained unconsolidated alluvial deposits above bedrock have been defined as the uppermost aquifer, which is under confined conditions and is monitored downgradient of the CCR management units.

The horizontal groundwater flow direction within the uppermost aquifer is generally from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the CCR management units is bounded to the east by the Tennessee River.

Pore water within the CCR material has specific chemical characteristics that are different from the characteristics of groundwater downgradient of the CCR management units. Certain CCR constituents that have been detected in pore water are affected by geochemical processes during transport by groundwater through geological materials. The effect of these geochemical processes, which can result in the attenuation of CCR constituents and reduced dissolved groundwater concentrations, can explain the observed differences between the characteristics of pore water and groundwater quality.

Surface Streams: Surface stream water quality in the Tennessee River was within ranges protective of human health and aquatic life. Sampling results were below chronic ESVs and indicate no potential water quality impacts from the CCR management units.

Sediment: Sediment quality was within ranges protective of aquatic life in the Tennessee River adjacent to and downstream of the CCR management units. Sampling results for % ash and CCR Parameter concentrations in sediment samples from the Tennessee River were below the % ash screening level and chronic ESVs, respectively.

Bioaccumulation: Asiatic clam and fish tissue results were similar upstream, adjacent to, and downstream of the CCR management units in the Tennessee River. These results do not indicate impacts or bioaccumulation effects within these populations related to the WBF Plant CCR management units.

Benthic Communities: The adjacent and downstream benthic communities in the Tennessee River appear to be healthy, rich, and sensitive, and they demonstrate more favorable ecological conditions than upstream locations in the reservoir above Watts Bar Dam. Collectively, the benthic community data reflect no impacts from the CCR management units.

8.2 Ash Pond

A summary of EI evaluation findings and a CSM for the Ash Pond are provided on Exhibit 8-1 in cross-sectional view and on Exhibit 8-4 in plan view. These exhibits also illustrate the surrounding units and surface stream for the Ash Pond.

CCR material in this unit, which is capped, is comingled CCR (stacked fly ash placed as part of closure and sluiced fly ash), with an estimated total volume of about 190,000 cubic yards.

Available information indicates that the Ash Pond is unsaturated. The use of the term flow, or other terms such as “saturated” in reference to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Also, during the EI, no AOIs were identified near the Ash Pond.

Most TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater were below GSLs. The primary constituent of interest in groundwater for the Ash Pond is cobalt at well MW-1. Concentrations of cobalt were below the ESVs in sediment and surface stream water samples collected from the Tennessee River, which serves as a hydraulic boundary for groundwater flow.

The results of the EI and other ongoing ecological monitoring programs indicate operations at this CCR management unit have not impacted sediment and surface stream water quality, benthic macroinvertebrate communities, or Asiatic clam and fish tissues and populations in the Tennessee River.

In summary, potential impacts associated with the Ash Pond CCR management unit based on EI sampling results are limited to cobalt in onsite groundwater at one monitoring well. This constituent will be further evaluated in the CARA Plan to determine if unacceptable risks exist and corrective actions are needed.

8.3 Slag Disposal Area

A summary of EI evaluation findings and a CSM for the Slag Disposal Area is provided on Exhibit 8-2 in cross-sectional view, and on Exhibit 8-4 in plan view. These exhibits also illustrate the surrounding unit and surface stream for the Slag Disposal Area.

CCR material in this unit, which is capped, is comingled CCR (sluiced and stacked fly ash, bottom ash, and slag), with an estimated total volume of about 570,000 cubic yards, which also includes the volume estimate for the Drainage Improvements Area.

The pore water levels reported herein for the Slag Disposal Area may not represent steady-state conditions. The pore water levels would be expected to decrease in elevation if modifications to stormwater drainage or the existing soil cap system were to be implemented.

Most TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater were below GSLs. The primary constituents of interest in groundwater for the Slag Disposal Area are cadmium and cobalt at two monitoring wells. Concentrations of cadmium and cobalt were below the ESVs in sediment and surface stream water samples collected from the Tennessee River, which serves as a hydraulic boundary for groundwater flow.

Three AOIs (AOI02, AOI03, and AOI04) were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data and using the supplemental investigation results described in Chapter 6, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed.

The results of the EI and other ongoing ecological monitoring programs indicate operations at this CCR management unit have not impacted sediment and surface stream water quality, benthic macroinvertebrate communities, or Asiatic clam and fish tissues and populations in the Tennessee River.

In summary, potential impacts associated with the Slag Disposal Area CCR management unit based on EI sampling results are limited to three AOIs, cadmium in onsite groundwater at one monitoring well and cobalt at two monitoring wells. These AOIs and groundwater constituents will be further evaluated in the CARA Plan to determine if unacceptable risks exist and corrective actions are needed.

Chapter 9 Conclusions and Next Steps

9.1 Conclusions

In accordance with the TDEC Order, TVA prepared an EIP for the WBF Plant CCR management units to obtain and provide information requested by TDEC. As specified in the TDEC Order, the objective of the EIP was to "identify the extent of soil, surface water, and ground water contamination by CCR" from onsite management of CCR material in impoundments and landfills. In addition, per TDEC's information requests, the EIP included assessment of CCR management unit structural stability and integrity. Between 2019 and 2021, TVA and Stantec implemented EI activities in accordance with the approved EIP. The EI included characterization of the site hydrogeology and investigations of CCR material, groundwater, background soils, seeps, surface streams, sediments, and ecology, as well as the Water Use Survey.

This EAR presents the results of those investigations, describes the extent of surface stream water, sediment, and groundwater contamination from the WBF Plant CCR management units, and provides the information, data, and evaluations used to make those assessments. Geotechnical analysis findings and environmental sampling results above TDEC approved screening levels in specific media will be further evaluated in the CARA Plan to determine whether unacceptable risks exist that require corrective action. As required by the TDEC Order, this EAR will be revised to address TDEC comments until the objective of the EIP is met.

In summary, more than 98% of the environmental sample results from approximately 300 samples were below screening levels. Most screening levels are not regulatory standards and are conservatively based on published health studies. The EI data indicate impacts to limited onsite groundwater areas and that the CCR management units have not impacted sediment and surface stream water quality, and ecological communities in the Tennessee River. The following are overall assessment findings for the investigation based on data as presented in this EAR:

- Surface stream water quality is within ranges protective of human health and aquatic life in the Tennessee River.
- Sediment quality is within ranges protective of aquatic life in the Tennessee River adjacent to and downstream of the CCR management units.
- The EI data indicate that ecological communities are healthy in the Tennessee River adjacent to and downstream of the CCR management units and demonstrate more favorable ecological conditions than upstream locations.
- The CCR management units have adequate structural stability, and slopes are stable under current static and seismic loading conditions, except for the post-earthquake, global stability at the Slag Disposal Area and the Ash Pond. TVA will be evaluating mitigation alternatives as part of the CARA Plan.
- During the EI, three AOIs were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data and using the supplemental investigation results described in Chapter 6, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed. No AOIs were identified at the Ash Pond.
- Most TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater are below TDEC-approved GSLs, and groundwater impacts are limited to onsite areas along the perimeter of the

CCR management units. However, additional assessments will be included in the CARA Plan to evaluate the need for corrective action for targeted onsite groundwater remediation at locations where statistically significant concentrations of CCR constituents above GSLs exist.

- Drainage modifications or potential corrective actions are expected to reduce concentrations of CCR constituents to below GSLs in groundwater at downgradient monitoring locations.

- The Tennessee River is a boundary to groundwater flow. Based on the results of the Water Use Survey, no wells or springs potentially used for domestic or business purposes were identified in the Survey Area.

The following summary provides the specific findings requiring further evaluation in the CARA Plan.

Summary of Findings Requiring Further Evaluation in the CARA Plan					
CCR Management Unit	**Stability**	**Groundwater**	**Seeps**	**Surface Stream, Sediment, Ecology**	**Drainage Modifications**
Ash Pond	Seismic mitigation alternatives for post-earthquake, global stability	Cobalt (Well MW-1)	None	None	None
Slag Disposal Area		Cadmium (Well WBF-104) Cobalt (Wells WBF-104 and WBF-106)	Three AOIs (AOI02, AOI03, and AOI04)		Area adjacent to the Slag Disposal Area

9.2 Next Steps

Upon approval of the EAR, TVA will prepare and submit a CARA Plan to TDEC in accordance with the TDEC Order. The CARA Plan, which will be subject to a public review and comment process, will evaluate whether unacceptable risks related to management of CCR material exist at the WBF Plant. The EI data will be used to evaluate the basis and methods for CCR management unit closure in the CARA Plan, including an evaluation of the performance of existing closure methods; modifications to closure methodology will be identified, as needed, in the CARA Plan. The CARA Plan will also specify the actions TVA plans to take at the CCR management units and the basis of those actions. It also will incorporate other modifications to stormwater drainage or cap systems planned or in progress by TVA, including details for CCR material beneficial use operations, modification of the CCR management units as needed to meet regulatory standards, and long-term closure and monitoring. TVA continues to evaluate additional ways to beneficially use CCR material in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley.

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

TVA. ENV-TI-05.80.21, Monitoring Well Inspection and Maintenance.

TVA. ENV-TI-05.80.42, Groundwater Sampling.

TVA. ENV-TI-05.80.44, Groundwater Level and Well Depth Measurement.

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TABLES

Table 1-1. Human Health Screening Levels for Groundwater
Environmental Assessment Report

CCR Parameters	Groundwater Screening Levels (µg/L)	Source
CCR Rule Appendix III Constituents :		
Boron	4,000	RSL
Calcium	--	--
Chloride	250,000	SMCL
Fluoride	4,000	MCL
pH	6.5-8.5 S.U.	SMCL
Sulfate	250,000	SMCL
Total Dissolved Solids	500,000	SMCL
CCR Rule Appendix IV Constituents :		
Antimony	6	MCL
Arsenic	10	MCL
Barium	2,000	MCL
Beryllium	4	MCL
Cadmium	5	MCL
Chromium (total)	100	MCL
Cobalt	6	CCR Rule GWPS
Fluoride	4,000	MCL
Lead	15	CCR Rule GWPS
Lithium	40	CCR Rule GWPS
Mercury	2	MCL
Molybdenum	100	CCR Rule GWPS
Radium-226 & 228	5 pCi/L	MCL
Selenium	50	MCL
Thallium	2	MCL
TDEC Appendix I Constituents :		
Copper	1,300	MCLG
Nickel	100	TN MCL
Silver	100	TN SMCL
Vanadium	86	RSL
Zinc	5,000	SMCL

Notes:
MCL: USEPA maximum contaminant level
MCLG: Maximum contaminant level goal
pCi/L: picocuries per liter
RSL: USEPA regional screening level (November 2018)
SMCL: USEPA secondary maximum contaminant level
S.U. : Standard units
TN MCL: maximum contaminant level promulgated by State of Tennessee
TN SMCL: secondary maximum contaminant level promulgated by State of Tennessee
ug/L: micrograms per liter

Table 1-2. Human Health and Ecological Site Specific Screening Levels for Surface Water
Environmental Assessment Report[1]

CCR Parameters	Watts Bar Fossil Plant						
	Human Health Surface Water Screening Levels		Ecological Surface Water Screening Levels				
			Tennessee River (Hardness = 75 mg/L)				
	(µg/L)	Source	Total Chronic (µg/L)	Total Acute (µg/L)	Dissolved Chronic (µg/L)	Dissolved Acute (µg/L)	
CCR Rule Appendix III Constituents :							
Boron	4,000	RSL	7,200	34,000	NA	NA	a
Calcium	--	--	116,000	NA	NA	NA	a
Chloride	250,000	SMCL	230,000	860,000	NA	NA	a
Fluoride	4,000	MCL	2,700	9,800	NA	NA	a
pH	6 - 9 S.U.	TN DWS	6.5 - 9	NA	NA	NA	b
Sulfate	250,000	SMCL	NA	NA	NA	NA	
Total Dissolved Solids	500,000	TN DWS/SMCL	NA	NA	NA	NA	
CCR Rule Appendix IV Constituents :							
Antimony	6	TN DWS/MCL	190	900	NA	NA	a
Arsenic	10	TN DWS/MCL	150	340	150	340	a
Barium	2,000	TN DWS/MCL	220	2,000	NA	NA	a
Beryllium	4	TN DWS/MCL	11	93	NA	NA	a
Cadmium*	5	TN DWS/MCL	0.628	1.44	0.579	1.38	b
Chromium*	100	TN DWS/MCL	68.1	1425	58.6	450	b
Cobalt	6	RSL	19	120	NA	NA	a
Fluoride	4,000	MCL	2,700	9,800	NA	NA	a
Lead*	5	TN DWS	2.21	56.6	1.84	47.2	b
Lithium	40	RSL	440	910	NA	NA	a
Mercury	2	TN DWS/MCL	0.77	1.4	0.77	1.4	a
Molybdenum	100	RSL	800	7,200	NA	NA	a
Radium-226 & 228	5 pCi/L	MCL	3 pCi/L	3 pCi/L	NA	NA	c
Selenium	50	TN DWS/MCL	3.1	20	NA	NA	b
Thallium	2	TN DWS/MCL	6	54	NA	NA	a
TDEC Appendix I Constituents :							
Copper*	1,300	MCL	7.30	10.7	7.00	10.2	b
Nickel*	100	TN DWS	40.9	368	40.8	367	b
Silver*	94	RSL	NA	2.31	NA	1.96	b
Vanadium	86	RSL	27	79	NA	NA	a
Zinc*	2,000	HAL	93.9	93.9	92.6	91.8	b

Notes:

[1] The proposed screening level for evaluation of surface water in the EAR is the lowest (most conservative) of the available values for each parameter.

* The freshwater screening values are hardness dependent.

ug/L: micrograms per liter

mg/L: milligrams per liter

pCi/L: picocuries per liter

NA: not applicable

SMCL: USEPA secondary maximum contaminant level

MCL: USEPA maximum contaminant level

MCLG: Maximum contaminant level goal

TN MCL: maximum contaminant level promulgated by State of Tennessee

TN DWS: Tennessee Drinking Water Standards

RSL: USEPA regional screening level (November 2018)

a USEPA Region 4 Surface Water Screening Values for Hazardous Waste Sites (March 2018 Revision).

b Tennessee Department of Environment and Consevation (TDEC), 2019. Chapter 0400-40-03, General Water Quality Criteria.

c U.S. Department of Energy (DOE), 2019. DOE Standard (DOE-STD-1153-2019), A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota. Biota Concentration Guides for water of 4 pCi/L for Radium-226 and 3 pCi/L for Radium-228.

Red highlight denotes bioaccumulative constituent (USEPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update).

Table 1-3. Proposed Ecological Screening Levels for Freshwater Sediment
Environmental Assessment Report

CCR Parameters	Freshwater Sediment Screening Values				Sediment Quality Assessment Guidelines[a]	
	Chronic (mg/kg-dw)		Acute (mg/kg-dw)		TEC (mg/kg)	PEC (mg/kg)
CCR Rule Appendix III Constituents :						
Percent Ash	20%	b	40%	c	NA	NA
Boron	NA		NA		NA	NA
Calcium	NA		NA		NA	NA
Chloride	NA		NA		NA	NA
Fluoride	NA		NA		NA	NA
pH	NA		NA		NA	NA
Sulfate	NA		NA		NA	NA
Total Dissolved Solids	NA		NA		NA	NA
CCR Rule Appendix IV Constituents :						
Antimony	2		25	e	NA	NA
Arsenic	9.8		33	e	9.8	33
Barium	240		22,925	f	NA	NA
Beryllium	1.2		42	f	NA	NA
Cadmium	1		5	e	1	5
Chromium	43.4		111	e	43	110
Cobalt	50		NA	e	50	NA
Fluoride	NA		NA		NA	NA
Lead	35.8		128	e	36	130
Lithium	NA		NA		NA	NA
Mercury	0.18		1.1	e	0.18	1.1
Molybdenum	38		69,760	f	NA	NA
Radium-226 & 228	90 pCi/g		90 pCi/g	d	NA	NA
Selenium	2	g	2.9	e	NA	NA
Thallium	1.2		10	f	NA	NA
TDEC Appendix I Constituents :						
Copper	31.6		149	e	32	150
Nickel	22.7		48.6	e	23	49
Silver	1		2.2	e	NA	NA
Vanadium	66		564	f	NA	NA
Zinc	121		459	e	120	460

NA - Not Available

a MacDonald, et al., 2003. Development and Evaluation of Numerical Sediment Quality Assessment Guidelines for Florida Inland Waters.
TEC - Threshold Effect Concentration, PEC - Probable Effect Concentration.

b Environmental Investigation Plans (EIP) for TVA fossil plants under the TDEC Consent Order.

c Arcadis, 2012. Kingston Ash Recovery Project Non-Time Critical Removal Action River System Baseline Ecological Risk Assessment (BERA).

d U.S. Department of Energy (DOE), 2019. DOE Standard (DOE-STD-1153-2019), A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota. Biota Concentration Guides for sediment of 100 pCi/g for Radium-226 and 90 pCi/g for Radium-228.

e USEPA Region 4 Sediment Screening Values for Hazardous Waste Sites (March 2018 Revision).

f National Institute for Public Health and the Environment (RIVM), 2005. Environmental Risk Limits for Nine Trace Elements.
The Maximum Permissible Concentration (MPC) is used for the chronic value and the Serious Risk Addition (SRA_{eco}) is used for the acute value.

g Lemly, A.D., 2002. Selenium Assessment in Aquatic Ecosystems

Red highlight denotes bioaccumulative constituent (USEPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update).

Table 1-4. Screening Levels for Mayfly Tissue Critical Body Residues
Environmental Assessment Report

CCR Parameters	Mayfly Tissue Critical Body Residue NOAEL (mg/kg-ww)	Mayfly Tissue Critical Body Residue LOAEL (mg/kg-ww)	
CCR Rule Appendix III Constituents :			
Boron	NA	NA	
Calcium	NA	NA	
Chloride	NA	NA	
Fluoride	NA	NA	
pH	NA	NA	
Sulfate	NA	NA	
Total Dissolved Solids	NA	NA	
CCR Rule Appendix IV Constituents :			
Antimony	NA	NA	
Arsenic	0.0249	0.249	a
Barium	NA	NA	
Beryllium	NA	NA	
Cadmium	15.6	156	a
Chromium (total)	0.144	1.44	a
Cobalt	0.1061	1.061	
Fluoride	NA	NA	
Lead	269	2690	a
Lithium	NA	NA	
Mercury	2.7	27	a
Molybdenum	NA	NA	
Radium-226 & 228	NA	NA	
Selenium	0.051	0.51	a
Thallium	1.206	12.06	a
TDEC Appendix I Constituents :			
Copper	26	260	a
Nickel	0.115	1.15	a
Silver	0.23	2.3	a
Vanadium	0.604	6.04	a
Zinc	382	3820	a

Notes:

a Arcadis, 2012. Kingston Ash Recovery Project Non-Time Critical Removal Action River System Baseline Ecological Risk Assessment (BERA).

Toxicity values were selected from the U.S. Army Corps of Engineers/ USEPA Environmental Residue-Effects Database (ERED).

mg/kg-dw - milligrams per kilogram, dry weight

mg/kg-ww - milligrams per kilogram, wet weight

LOAEL – Lowest Observed Adverse Effect Level

NOAEL - No Observed Adverse Effect Level

Red highlight denotes bioaccumulative constituent (USEPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update).

Table 1-5. Screening Levels for Fish Tissue Critical Body Residues
Environmental Assessment Report

CCR Parameters	Whole Body Fish Tissue Critical Body Residue			Liver Tissue Critical Body Residue			Muscle Tissue Critical Body Residue			Ovary Tissue Critical Body Residue		
	NOAEL (mg/kg-ww)	LOAEL (mg/kg-ww)		NOAEL (mg/kg-ww)	LOAEL (mg/kg-ww)		NOAEL (mg/kg-ww)	LOAEL (mg/kg-ww)		NOAEL (mg/kg-ww)	LOAEL (mg/kg-ww)	
CCR Rule Appendix III Constituents :												
Boron	NA	NA		NA	NA		NA	NA		NA	NA	
Calcium	NA	NA		NA	NA		NA	NA		NA	NA	
Chloride	NA	NA		NA	NA		NA	NA		NA	NA	
Fluoride	NA	NA		NA	NA		NA	NA		NA	NA	
pH	NA	NA		NA	NA		NA	NA		NA	NA	
Sulfate	NA	NA		NA	NA		NA	NA		NA	NA	
Total Dissolved Solids	NA	NA		NA	NA		NA	NA		NA	NA	
CCR Rule Appendix IV Constituents :												
Antimony	NA	NA		NA	NA		NA	NA		NA	NA	
Arsenic	0.04	0.4	a	0.569	5.69	a	0.076	0.76	a	8.4	84	a
Barium	NA	NA		NA	NA		NA	NA		NA	NA	
Beryllium	5.13	51.3	a	NA	NA		NA	NA		NA	NA	
Cadmium	0.0019	0.019	a	0.0000137	0.000137	a	0.03	0.12	a	NA	NA	
Chromium (total)	0.128	1.28	a	0.042	0.42	a	NA	NA		NA	NA	
Cobalt	NA	NA		NA	NA		NA	NA		NA	NA	
Fluoride	NA	NA		NA	NA		NA	NA		NA	NA	
Lead	0.0278	0.278	a	0.0393	0.393	a	2.3	23	a	NA	NA	
Lithium	NA	NA		NA	NA		NA	NA		NA	NA	
Mercury	0.006	0.06	a	0.0009	0.009	a	0.08	0.8	a	NA	NA	
Molybdenum	NA	NA		NA	NA		NA	NA		NA	NA	
Radium-226 & 228	NA	NA		NA	NA		NA	NA		NA	NA	
Selenium	8.5	8.5	b	0.524	5.24	a	11.3	11.3	b	15.1	15.1	b
Thallium	0.027	0.27	a	NA	NA		NA	NA		NA	NA	
TDEC Appendix I Constituents :												
Copper	0.196	1.96	a	6.52	65.2	a	3.4	34	a	NA	NA	
Nickel	11.81	118.1	a	8.22	82.2	a	11.81	118.1	a	NA	NA	
Silver	0.0114	0.114	a	19	190	a	NA	NA		NA	NA	
Vanadium	0.68	2.7	a	0.03	0.3	a	NA	NA		NA	NA	
Zinc	0.45	4.5	a	3.4	34	a	NA	NA		NA	NA	

Notes:

a Arcadis, 2012. Kingston Ash Recovery Project Non-Time Critical Removal Action River System Baseline Ecological Risk Assessment (BERA).
Toxicity values were selected from the U.S. Army Corps of Engineers/USEPA Environmental Residue-Effects Database (ERED).

b USEPA, 2016. Chronic Ambient Water Quality Criterion for Selenium. Fish tissue concentrations expressed as mg/kg-dry weight.

mg/kg-dw - milligrams per kilogram, dry weight

mg/kg-ww - milligrams per kilogram, wet weight

LOAEL – Lowest Observed Adverse Effect Level

NOAEL - No Observed Adverse Effect Level

Red highlight denotes bioaccumulative constituent (USEPA Region 4 Ecological Risk Assessment Supplemental Guidance (March 2018 Update).

Table 3-1 - Background Soils Lithologic Summary
Watts Barr Fossil Plant
June - September 2019

Geologic Unit	Boring IDs	Depth Range	Group Name and Particle-size Range	Color Range	Additional Observations
Alluvial deposits	WBF-BG01, WBF-BG03, WBF-BG04, WBF-BG05, WBF-BG06, WBF-BG07	Ground surface to between 30.7 and 41.2; 20.0 and 34.9; 23.8 and 36.3; 6.0 and 18.2; 20.0 and 35.2; 22.5 and 32.0 feet bgs east of the Tennesseee River.	Sandy lean clays that grade to poorly graded sands, silty sands, well graded sand with gravel, poorly graded sand with clay to clayey sands at varying depths in borings WBF-BG01 and WBF-BG03 through WBF-BG07.	Dark grayish brown to very dark gray; dark yellowish brown; yellowish brown to dark gray; strong brown to yellowish brown to dark grayish brown in various soil types throughout.	Generally fine to coarse gravels to medium plasticity clays, wet, with some multicolored gravels, loose with some manganese and iron oxide staining. Wood pieces from 36.7 to 40.0 feet bgs in WBF-BG01.
Conasauga Group Middle	WBF-103, WBF-BG08, WBF-BG10, WBF-BG11, WBF-BG12	Ground surface to between 12.5 and 31.7 feet bgs west of the Tennessee River.	Silty and sandy lean clays generally with sandstone and siltstone fragments throughout. Poorly graded sand with clay between 15.0 and 22.0 ft bgs in BRF-BG12.	Reddish brown or yellowish red to brownish yellow or yellowish brown.	Generally medium plasticity lean clays to fine to medium sands to multicolred gravel and iron oxide staining. Wood fragments from 29.6 to 30.0 feet bgs in WBF-BG08
Nolichucky Shale	WBF-102	Ground surface to 20.8 feet bgs west of the Ash Pond.	Silty lean clay to poorly graded sand to well graded sand.	Dark yellowish brown to reddish yellow to grayish brown.	Generally to low to medium plasticity, medium dense with organics, chert, quartz, and iron oxide staining.

Notes:

bgs - below ground surface
ID - identification

Table 3-2 - Rock Outcrop Phase 2 Geochemistry Analytical Results
Watts Bar Fossil Plant

Sample Location		Area 02-02								
Sample Date		25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21
Sample ID		WBF-WR-A02-02A-A-20210625	WBF-WR-A02-02A-B-20210625	WBF-WR-A02-02A-C-20210625	WBF-WR-A02-02B-A-20210625	WBF-WR-A02-02B-B-20210625	WBF-WR-A02-02B-C-20210625	WBF-WR-A02-02C-A-20210625	WBF-WR-A02-02C-B-20210625	WBF-WR-A02-02C-C-20210625
Parent Sample ID										
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
General Chemistry										
Cation Exchange Capacity	meq/100gm	7.21	7.31	6.31	7.27	6.12	4.04	2.91	5.21	3.11
SEP Metals										
Aluminum	mg/kg	157	212	169	85.6	80.9	74.1	121	122	109
Antimony	mg/kg	<0.284	<0.284	<0.285	<0.283	<0.286	<0.283	<0.281	<0.280	<0.281
Arsenic	mg/kg	0.275 J	0.318 J	0.284 J	<0.131	<0.133	<0.131	<0.130	<0.130	<0.130
Barium	mg/kg	12.3	12.3	11.8	26.4	30.8	21.3	15.7	15.4	15.4
Beryllium	mg/kg	0.0807 J	0.0893 J	0.0855 J	0.0737 J	0.0694 J	0.0672 J	0.109 J	0.107 J	0.0933 J
Cadmium	mg/kg	<0.0112	<0.0112	<0.0112	<0.0111	<0.0112	<0.0111	<0.0110	<0.0110	<0.0110
Calcium	mg/kg	4.36 J	4.54 J	4.52 J	3.68 J	4.22 J	3.67 J	4.58 J	4.67 J	4.57 J
Chromium	mg/kg	0.318 J	0.558	0.457 J	0.0873 J	0.100 J	0.0818 J	0.282 J	0.311 J	0.238 J
Cobalt	mg/kg	3.43	3.82	3.89	<0.0454	<0.0459	<0.0455	0.186 J	0.199 J	0.217 J
Copper	mg/kg	4.68	7.84	7.02	<0.262	<0.265	<0.263	<0.261	<0.260	<0.261
Iron	mg/kg	629	1000	816	141	137	113	252	246	232
Lead	mg/kg	0.551	0.545	0.584	<0.111	<0.112	<0.111	0.161 J	0.186 J	0.283 J
Lithium	mg/kg	0.407 J	0.472 J	0.411 J	<0.151	<0.153	<0.152	0.261 J	0.280 J	0.234 J
Manganese	mg/kg	167	311	285	3.8	4.91	3.08	18.8	19	23.4
Molybdenum	mg/kg	<0.0832	<0.0832	<0.0834	<0.0828	<0.0837	<0.0828	<0.0822	<0.0821	<0.0822
Nickel	mg/kg	1.83 J	2.18	2.82	0.136 J	0.128 J	0.0884 J	0.527 J	0.678 J	0.645 J
Potassium	mg/kg	111 J	122 J	124 J	135 J	137 J	125 J	157 J	151 J	139 J
Selenium	mg/kg	<0.173	<0.173	<0.173	<0.172	<0.173	<0.172	<0.171	<0.170	<0.170
Silver	mg/kg	<0.112	<0.112	<0.112	<0.111	<0.112	<0.111	<0.110	<0.110	<0.110
Thallium	mg/kg	<0.213	<0.213	0.214 UJ	<0.212	<0.214	<0.212	<0.211	<0.210	<0.211
Vanadium	mg/kg	0.391 J	0.545 J	0.470 J	0.227 J	0.268 J	0.216 J	0.388 J	0.337 J	0.278 J
Zinc	mg/kg	1.74 U*	2.26 U*	2.06 U*	0.732 U*	0.729 U*	0.677 U*	0.985 U*	1.13 U*	1.12 U*
Total Metals										
Aluminum	mg/kg	10300	10100	10000	4730	2560	4110	3590	4470	3130
Antimony	mg/kg	0.0397 UJ	0.0408 UJ	0.0377 UJ	0.0322 UJ	0.0323 UJ	0.0381 UJ	0.0431 UJ	0.0368 UJ	0.0351 UJ
Arsenic	mg/kg	1.62	1.55	1.64	0.304	0.192	0.283	0.601	0.821	2.15
Barium	mg/kg	60.5	78.7	65.8	115	44.8	69.7	56.3	58.8	119
Beryllium	mg/kg	0.592	0.578	0.608	0.453	0.283	0.401	0.344	0.502	0.417
Cadmium	mg/kg	<0.0157	<0.0161	<0.0149	<0.0127	<0.0128	<0.0151	<0.0171	<0.0146	<0.0139
Calcium	mg/kg	2990	1740	2670	627	429	577	1160	1230	1130
Chromium	mg/kg	23.4	23.8	23.5	25.7	11.7	20.4	7.84	10.6	6.56
Cobalt	mg/kg	14	13.4	13.7	6.01	3.32	5.22	4.37	5.64	5.09
Copper	mg/kg	30.2	15.5	32.3	1.01	0.478	0.823	0.647	0.967	1.19
Iron	mg/kg	21000	20200	20200	16800	8560	14600	6050	7430	5480
Lead	mg/kg	3.69	3.47	3.6	1.78	0.909	1.5	0.905	1.47	2.86
Lithium	mg/kg	27.7	26.8	27.1	8.54	5.2	7.51	6.87	8.97	7.14
Manganese	mg/kg	979	732	877	66.9	42	58.5	99.6	113	109
Molybdenum	mg/kg	<0.150	<0.155	<0.143	<0.122	<0.122	<0.144	<0.163	<0.140	0.168 J
Nickel	mg/kg	28.7	29.7	29.3	16.2	9.43	14.3	12.5	16	13.1
Potassium	mg/kg	2180	2140	2090	2030	958	1750	1510	1760	988
Selenium	mg/kg	0.113 UJ	0.116 UJ	0.107 UJ	0.0912 UJ	0.0915 UJ	0.108 UJ	0.122 UJ	0.104 UJ	0.0995 UJ
Silver	mg/kg	0.0468 J	0.0453 J	0.0419 J	<0.0202	<0.0203	<0.0239	<0.0271	<0.0231	<0.0220
Sodium	mg/kg	56.4	54.3	55.5	46.2	25.4 J	38.5 J	33.7 J	41.9 J	28.6 J
Thallium	mg/kg	0.145	0.144	0.137	0.113	0.0662 J	0.0968	<0.0692	0.0868	<0.0563
Vanadium	mg/kg	17.5 J	17.3 J	17.4 J	20.5 J	8.41 J	16.6 J	5.56 J	6.67 J	2.51 J
Zinc	mg/kg	53.7	52.7	53.2	23.5	12.9	19.6	16.7	21.5	16.7
SEM Bulk Mineral										
Al-Rich	%mass	<0.0000622	<0.0000284	<0.0000337	<0.000039	0.000345	0.0443	<0.000173	<0.000543	<0.000139
Ba-S Rich	%mass	<0.0000622	<0.0000284	<0.0000337	0.00457	<0.00000679	<0.0000285	0.0497	0.00223	0.0210
Ca-Rich	%mass	11.8	0.00172	0.0332	0.0182	0.00330	0.957	0.0159	0.157	0.650
Ca-S Rich	%mass	<0.0000622	<0.0000284	<0.0000337	<0.000039	<0.00000679	<0.0000285	<0.000173	<0.000543	<0.000139
Fe-Rich	%mass	0.123	0.146	0.272	3.56	0.761	0.244	3.76	0.483	0.230
Fe-S Rich	%mass	0.0639	0.0127	0.356	<0.000039	0.00227	<0.0000285	0.00256	0.00794	<0.000139
Mn-Rich	%mass	0.00310	<0.0000284	0.185	<0.000039	<0.00000679	<0.0000285	0.00252	<0.000543	0.00863
XRD Bulk Mineral										
Albite	%mass	10	10	9	11	11	12	10	9	9
Amorphous	%mass	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anorthoclase	%mass	<1	<1	<1	3	2	2	<1	<1	<1
Calcite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorite	%mass	11	10	11	3	3	3	4	4	4
Clay	%mass	4	4	4	<1	<1	<1	3	3	3
Crystalline Silica, Quartz	%mass	39	39	41	37	41	38	46	49	52
Dolomite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Goethite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Hematite	%mass	<1	<1	<1	2	2	2	<1	<1	<1
Kaolinite	%mass	4	4	4	<1	<1	<1	3	3	2
Lepidocrocite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mica/Illite	%mass	21	22	21	33	31	32	22	21	18
Microcline	%mass	11	11	11	10	10	10	13	12	12
Pyrite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1

See notes on last page.

Table 3-2 - Rock Outcrop Phase 2 Geochemistry Analytical Results
Watts Bar Fossil Plant

Sample Location		Area 03-01			Area 03-02			Area 03-03		
Sample Date		25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21
Sample ID		WBF-WR-A03-01-A-20210625	WBF-WR-A03-01-B-20210625	WBF-WR-A03-01-C-20210625	WBF-WR-A03-02-A-20210625	WBF-WR-A03-02-B-20210625	WBF-WR-A03-02-C-20210625	WBF-WR-A03-03-A-20210625	WBF-WR-A03-03-B-20210625	WBF-WR-A03-03-C-20210625
Parent Sample ID										
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
General Chemistry										
Cation Exchange Capacity	meq/100gm	5.22	4.03	5.42	2.72	2.53	5.17	7.57	7.09	9.28
SEP Metals										
Aluminum	mg/kg	412	290	321	401	438	431	428	520	574
Antimony	mg/kg	<0.286	<0.282	<0.281	<0.282	<0.284	<0.284	<0.287	<0.288	<0.286
Arsenic	mg/kg	0.343 J	0.306 J	0.215 J	0.56	0.548	0.654	1.84	2.11	2.7
Barium	mg/kg	49.6	44.3	55.7	6.65	5.1	6.32	33.3	24.7	27.9
Beryllium	mg/kg	0.0430 J	0.0383 J	0.0371 J	0.0760 J	0.0709 J	0.0689 J	0.150 J	0.183 J	0.198 J
Cadmium	mg/kg	<0.0113	<0.0111	<0.0110	<0.0111	<0.0111	<0.0111	0.0711 J	0.0426 J	0.0224 J
Calcium	mg/kg	5.54 J	4.95 J	5.22 J	4.03 J	3.71 J	3.79 J	5.40 J	4.59 J	4.43 J
Chromium	mg/kg	1.19	0.783	1.03	0.963	1.01	0.862	0.955	1.05	1.11
Cobalt	mg/kg	5.45	4.01	4.84	0.767 J	0.475 J	0.276 J	0.742 J	1.11 J	0.737 J
Copper	mg/kg	0.803 J	0.990 J	0.710 J	1.49	1.39	1.49	0.548 J	0.666 J	0.536 J
Iron	mg/kg	1370	1010	1010	1570	1770	1640	2710	3100	3420
Lead	mg/kg	0.817	0.564	0.77	0.282 J	0.290 J	0.292 J	0.376 J	0.172 J	0.197 J
Lithium	mg/kg	2.7	1.69 J	2.21 J	0.751 J	0.786 J	0.500 J	<0.154	0.219 J	0.154 J
Manganese	mg/kg	1620	931	1400	372	176	94.5	526	371	249
Molybdenum	mg/kg	<0.0839	<0.0826	<0.0822	<0.0826	<0.0831	<0.0831	<0.0839	<0.0842	<0.0836
Nickel	mg/kg	6.05	3.44	4.2	1.69 J	1.42 J	1.14 J	0.934 J	0.846 J	0.777 J
Potassium	mg/kg	130 J	118 J	139 J	49.1 J	63.7 J	61.9 J	190 J	205 J	218 J
Selenium	mg/kg	0.513 J	<0.171	0.441 J	<0.171	<0.172	<0.172	<0.174	<0.175	<0.173
Silver	mg/kg	0.212 J	0.111 J	0.181 J	<0.111	<0.111	<0.111	<0.113	<0.113	<0.112
Thallium	mg/kg	<0.430	0.212 UJ	<0.421	0.212 UJ	<0.213	<0.213	<0.215	<0.216	<0.214
Vanadium	mg/kg	0.643 J	0.435 J	0.535 J	0.618 J	0.631 J	0.618 J	1.04 J	1.14 J	1.30 J
Zinc	mg/kg	3.69	3.23	3	2.65 U*	2.37 U*	1.93 U*	42.5	35.2	22
Total Metals										
Aluminum	mg/kg	14500	15300	13300	10500	10000	10300	13400	9180	4450
Antimony	mg/kg	0.0389 UJ	0.0413 UJ	0.0319 UJ	0.0383 UJ	0.0423 UJ	0.0436 UJ	0.0440 UJ	0.0391 UJ	0.0226 UJ
Arsenic	mg/kg	5.37	9.08	7.12	3.42	3.67	3.16	7.61	6.9	1.97
Barium	mg/kg	637	778	397	84.1	54.9	64.1	446	595	44
Beryllium	mg/kg	0.372	0.491	0.356	0.423	0.361	0.363	0.743	0.821	0.422
Cadmium	mg/kg	<0.0154	<0.0163	<0.0126	<0.0152	<0.0167	<0.0172	0.217	1.15	0.704
Calcium	mg/kg	6890	8080	6470	3030	2720	5200	3800	5350	801
Chromium	mg/kg	13.1	23.5	16	19.1	19.2	16.6	19.3	14.4	7.46
Cobalt	mg/kg	8.14	18.7	10.7	4.51	3.48	3.57	12.1	11.6	3.46
Copper	mg/kg	5.8	15.5	12.1	8.53	6.26	10.3	7.94	7.18	36.2
Iron	mg/kg	35200	37600	32500	22000	21300	20900	31600	28100	15900
Lead	mg/kg	7.01	13	9.68	5.2	6.46	6.16	4.96	7.68	5.08
Lithium	mg/kg	35.2	41.2	35.6	23.9	22.4	24.3	27.7	18.7	9.22
Manganese	mg/kg	2380	3470	2360	243	92.5	231	1020	8840	207
Molybdenum	mg/kg	<0.148	0.210 J	0.157 J	<0.145	<0.160	<0.165	<0.167	<0.148	<0.0857
Nickel	mg/kg	32.1	35	29.9	22.4	19.4	19.5	41.4	34.6	12.2
Potassium	mg/kg	932	1640	1030	1430	1170	1170	1840	1580	276
Selenium	mg/kg	0.110 UJ	0.117 UJ	0.0906 UJ	0.109 UJ	0.120 UJ	0.124 UJ	0.125 UJ	0.111 UJ	0.0641 UJ
Silver	mg/kg	<0.0244	<0.0259	<0.0201	<0.0241	<0.0266	<0.0274	<0.0276	<0.0245	<0.0142
Sodium	mg/kg	57.5	67.2	51.5	52.3	42.0 J	66.8	38.6 J	48.3	<10.5
Thallium	mg/kg	<0.0625	0.0890 J	0.0577 J	0.0881 J	0.0696 J	<0.0699	0.0801 J	0.106	0.0421 J
Vanadium	mg/kg	13.8 J	17.0 J	13.4 J	12.2 J	12.3 J	11.7 J	14.3 J	10.1 J	4.78 J
Zinc	mg/kg	62.9	69.3	60.8	44	38.6	39.5	208	478	1160
SEM Bulk Mineral										
Al-Rich	%mass	0.0305	<0.0000722	<0.00024	0.0279	<0.000111	<0.000321	<0.0000839	<0.0004	0.0194
Ba-S Rich	%mass	0.0457	0.0452	0.0105	<0.0000813	0.374	<0.000321	0.0290	0.513	0.123
Ca-Rich	%mass	<0.000119	<0.0000722	<0.00024	<0.0000813	<0.000111	<0.000321	<0.0000839	<0.0004	<0.0000552
Ca-S Rich	%mass	<0.000119	<0.0000722	<0.00024	<0.0000813	<0.000111	<0.000321	<0.0000839	<0.0004	<0.0000552
Fe-Rich	%mass	1.72	1.48	0.827	3.68	0.613	8.09	1.11	11.1	3.55
Fe-S Rich	%mass	<0.000119	<0.0000722	<0.00024	<0.0000813	0.0413	0.0181	<0.0000839	<0.0004	<0.0000552
Mn-Rich	%mass	0.114	0.787	0.0448	<0.0000813	0.00341	<0.000321	0.957	0.338	<0.0000552
XRD Bulk Mineral										
Albite	%mass	5	3	5	4	7	7	4	4	3
Amorphous	%mass	<10	<10	<10	<10	<10	<10	<10	<10	11
Anorthoclase	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorite	%mass	16	15	13	8	10	13	11	8	7
Clay	%mass	2	3	2	3	3	4	4	3	4
Crystalline Silica, Quartz	%mass	62	60	59	55	52	46	58	60	52
Dolomite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Goethite	%mass	1	<1	<1	1	<1	<1	<1	1	<1
Hematite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Kaolinite	%mass	7	9	10	10	14	15	6	7	6
Lepidocrocite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Mica/Illite	%mass	8	11	12	18	13	16	16	17	18
Microcline	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pyrite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1

See notes on last page.

Table 3-2 - Rock Outcrop Phase 2 Geochemistry Analytical Results
Watts Bar Fossil Plant

Sample Location		Area 04-02										
Sample Date		25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21	25-Jun-21
Sample ID		WBF-WR-A04-02A-A-20210625	WBF-WR-A04-02A-B-20210625	WBF-WR-A04-02A-C-20210625	WBF-WR-FD01-20210625	WBF-WR-A04-02B-A-20210625	WBF-WR-A04-02B-B-20210625	WBF-WR-A04-02B-C-20210625	WBF-WR-FD02-20210625	WBF-WR-A04-02C-A-20210625	WBF-WR-A04-02C-B-20210625	WBF-WR-A04-02C-C-20210625
Parent Sample ID					WBF-WR-A04-02A-A/B/C**				WBF-WR-A04-02B-A/B/C**			
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
General Chemistry												
Cation Exchange Capacity	meq/100gm	15.8	12.8	16.1	21.1	12.8	15.7	11.3	11.8	33.0	31.2	27.4
SEP Metals												
Aluminum	mg/kg	1060	902	990	1050	913	896	851	889	1300	1360	1300
Antimony	mg/kg	<0.291	<0.289	<0.291	<0.296	<0.294	<0.297	<0.293	<0.294	<0.661	<0.649	<0.659
Arsenic	mg/kg	0.381 J	0.408 J	0.392 J	0.377 J	<0.136	0.171 J	<0.136	<0.137	0.395 J	0.372 J	0.433 J
Barium	mg/kg	12.5	13.9	11.7	7.33	27.7	30.5	25.6	20.5	0.648 J	0.546 J	0.573 J
Beryllium	mg/kg	0.149 J	0.164 J	0.167 J	0.169 J	0.160 J	0.161 J	0.157 J	0.157 J	0.111 J	0.127 J	0.119 J
Cadmium	mg/kg	0.0140 J	<0.0113	0.0182 J	0.0122 J	0.0136 J	<0.0117	<0.0115	0.0116 J	<0.0260	<0.0255	<0.0259
Calcium	mg/kg	5.66 J	4.58 J	5.48 J	6.13 J	7.62 J	7.47 J	7.60 J	6.12 J	5.03 J	6.16 J	4.89 J
Chromium	mg/kg	1.11	1.02	1.47	1.23	0.856	1.09	0.961	1.32	0.245 J	0.273 J	0.256 J
Cobalt	mg/kg	20.8	10.4	19.2	12.1	40.7	36	39.1	38.1	0.673 J	1.10 J	0.669 J
Copper	mg/kg	1.74	1.32	1.69	1.15 J	2.22	2.22	2.37	2.17	2.43 J	2.50 J	2.38 J
Iron	mg/kg	2740	2550	3140	2710	1970	2000	1680	1920	173	273	239
Lead	mg/kg	<0.114	0.337 J	<0.114	<0.116	0.862	0.747	0.983	0.804	<0.260	<0.255	<0.259
Lithium	mg/kg	1.05 J	0.447 J	1.11 J	0.648 J	0.344 J	0.418 J	0.530 J	0.485 J	<0.354	<0.347	<0.353
Manganese	mg/kg	889	525	745	508	934	866	870	829	12.2	19.2	7.96
Molybdenum	mg/kg	<0.0851	<0.0846	<0.0852	<0.0867	<0.0861	<0.0869	<0.0858	<0.0862	<0.194	<0.190	<0.193
Nickel	mg/kg	3	1.45 J	3.35	1.64 J	1.32 J	1.52 J	1.58 J	1.52 J	0.334 J	0.352 J	0.310 J
Potassium	mg/kg	43.4 J	40.1 J	40.2 J	42.0 J	49.8 J	49.1 J	51.5 J	49.9 J	<61.4	70.4 J	<61.1
Selenium	mg/kg	<0.176	<0.175	<0.177	<0.180	<0.178	<0.180	<0.178	0.179 J	<0.402	<0.394	<0.400
Silver	mg/kg	0.133 J	<0.113	0.119 J	<0.116	0.157 J	0.137 J	0.144 J	0.157 J	<0.260	<0.255	<0.259
Thallium	mg/kg	<0.218	<0.217	<0.218	<0.222	<0.220	<0.222	<0.220	<0.221	<0.496	<0.486	<0.494
Vanadium	mg/kg	1.60 J	1.53 J	1.66 J	1.69 J	1.02 J	1.02 J	0.874 J	1.13 J	0.800 J	0.888 J	0.804 J
Zinc	mg/kg	2.77 U*	2.28 U*	2.86 U*	2.14 U*	2.57 U*	2.79 U*	2.65 U*	2.51 U*	1.93 U*	2.05 U*	1.93 U*
Total Metals												
Aluminum	mg/kg	9630	11600	11900	13200	9900	8040	9070	7770	17900	13600	13600
Antimony	mg/kg	0.0310 UJ	0.0422 UJ	0.0386 J	0.0426 J	0.0415 J	0.0430 UJ	0.0431 J	0.0390 UJ	0.0488 UJ	0.0429 UJ	0.0501 UJ
Arsenic	mg/kg	10.3	11.5	8.93	11.8	8.92	8.48	10.9	7.62	5.87	5.04	4.55
Barium	mg/kg	664	652	848 J	966 J	809 J	407 J	934 J	332 J	164 J	197 J	206 J
Beryllium	mg/kg	2.07	2.84	1.95	2.75	2.06	2.54	2.9	2.15	1.21	1.01	0.939
Cadmium	mg/kg	<0.0123	0.0216 J	0.0180 J	0.0297 J	<0.0151	<0.0170	0.0176 J	<0.0154	<0.0193	<0.0170	<0.0198
Calcium	mg/kg	495	418	661	604	358	222	453	187	315	375	282
Chromium	mg/kg	37.6	47.6	21.5	38.6	27.9	46.9	37.7	36.8	33.5	27.8	25.4
Cobalt	mg/kg	35.1	65.5	35.4	54.1	71.5	42.5	64.4	26.2	3.41	3.28	3.31
Copper	mg/kg	24.4	36.8	25.6	34.1	40.7	48.2	44.7	42.3	24.1	22.7	24.9
Iron	mg/kg	58900	92400	46500	79000	74100	95300	92700	97600	14700	14700	14200
Lead	mg/kg	8.85	11.2	9.25	10.6	13.1	8.81	14.6	7.44	7.75	7.01	5.74
Lithium	mg/kg	14.9	18	17	19.2	5.98	4.17	6.54	3.01	4.81	4.11	8.72
Manganese	mg/kg	1900	2690	1790 J	4020 J	2570 J	800 J	1780 J	701 J	32.3 J	42.7 J	49.0 J
Molybdenum	mg/kg	<0.117	0.176 J	<0.130	<0.160	0.233 J	0.228 J	0.298 J	0.188 J	<0.185	<0.163	<0.190
Nickel	mg/kg	29.6	34.1	26.4 J	34.5 J	13.9 J	16.6 J	22.8 J	11.0 J	7.20 J	5.95 J	10.1 J
Potassium	mg/kg	1030	1400	1960 J	1910 J	1590 J	1220 J	1500 J	1250 J	3190 J	2490 J	2310 J
Selenium	mg/kg	0.0879 UJ	0.120 UJ	0.0975 UJ	0.119 UJ	0.109 UJ	0.122 UJ	0.117 UJ	0.111 UJ	0.139 UJ	0.122 UJ	0.142 UJ
Silver	mg/kg	<0.0195	<0.0265	<0.0216	0.0343 J	<0.0240	<0.0270	<0.0259	<0.0245	<0.0307	<0.0270	<0.0314
Sodium	mg/kg	15.5 J	22.3 J	23.3 J	29.3 J	28.2 J	20.1 J	24.6 J	19.8 J	45.1 J	36.9 J	35.3 J
Thallium	mg/kg	0.243	0.379	0.294	0.605	0.539	0.26	0.514	0.242	0.249	0.209	0.194
Vanadium	mg/kg	16.6 J	23.6 J	17	21.1	21.2	20.9	19.9	21.4	26.8	23.4	21.2
Zinc	mg/kg	51.9	61.6	54.7 J	72.8 J	48.4 J	56.9 J	58.1 J	58.2 J	19.5 J	18.0 J	25.2 J
SEM Bulk Mineral												
Al-Rich	%mass	0.0206	0.000842	0.00670	0.00206	0.0125	0.0118	<0.0000727	0.0105	<0.0000543	<0.000136	0.0919
Ba-S Rich	%mass	<0.0000467	<0.000027	<0.000101	<0.0000647	<0.0000785	<0.0000344	<0.0000727	<0.0000597	<0.0000543	<0.000136	0.0381
Ca-Rich	%mass	0.00132	<0.000027	<0.000101	0.0128	0.162	0.00630	<0.0000727	<0.0000597	<0.0000543	3.57	0.00329
Ca-S Rich	%mass	0.132	<0.000027	<0.000101	<0.0000647	0.00320	<0.0000344	<0.0000727	0.0237	<0.0000543	<0.000136	<0.0000428
Fe-Rich	%mass	3.08	1.80	15.3	3.98	5.77	16.1	16.0	8.61	0.576	0.157	0.248
Fe-S Rich	%mass	<0.0000467	<0.000027	<0.000101	<0.0000647	<0.0000785	<0.0000344	<0.0000727	<0.0000597	<0.0000543	<0.000136	<0.0000428
Mn-Rich	%mass	1.93	0.0273	0.104	0.0951	0.0210	0.0111	0.00594	0.00975	<0.0000543	<0.000136	<0.0000428
XRD Bulk Mineral												
Albite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Amorphous	%mass	25	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anorthoclase	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorite	%mass	2	4	3	4	<1	<1	<1	<1	<1	<1	<1
Clay	%mass	5	7	6	6	6	6	10	10	17	15	15
Crystalline Silica, Quartz	%mass	36	47	50	43	31	33	31	31	13	15	18
Dolomite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Goethite	%mass	5	7	6	12	18	17	18	19	<1	<1	<1
Hematite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	1	1	<1
Kaolinite	%mass	8	11	11	14	17	17	19	19	25	25	26
Lepidocrocite	%mass	<1	<1	<1	1	1	1	<1	1	<1	<1	<1
Mica/Illite	%mass	19	23	24	21	27	26	21	21	45	45	43
Microcline	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pyrite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

See notes on last page.

Table 3-2 - Rock Outcrop Phase 2 Geochemistry Analytical Results
Watts Bar Fossil Plant

Sample Location			Area 04-02						Area 04-03				
Sample Date		25-Jun-21	25-Jun-21	25-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21
Sample ID		WBF-WR-A04-02D-A-20210625	WBF-WR-A04-02D-B-20210625	WBF-WR-A04-02D-C-20210625	WBF-WR-A04-03A-A-20210626	WBF-WR-A04-03A-B-20210626	WBF-WR-A04-03A-C-20210626	WBF-WR-A04-03B-A-20210626	WBF-WR-A04-03B-B-20210626	WBF-WR-A04-03B-C-20210626	WBF-WR-A04-03C-A-20210626	WBF-WR-A04-03C-B-20210626	WBF-WR-A04-03C-C-20210626
Parent Sample ID													
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample
General Chemistry													
Cation Exchange Capacity	meq/100gm	24.3	20.9	12.6	19.7	14.8	18.3	9.64	12.9	9.72	18.1	22.9	16.2
SEP Metals													
Aluminum	mg/kg	1290	1480	1280	1140	1120	1060	1110	837	998	1030	931	1100
Antimony	mg/kg	<0.306	<1.49	<0.308	<0.582	<0.584	<0.584	<0.293	<0.293	<0.293	<0.301	<0.305	<0.299
Arsenic	mg/kg	1.99	1.62 J	2.11	2.01	1.76	1.77	<0.136	0.172 J	0.312 J	0.413 J	0.401 J	0.349 J
Barium	mg/kg	0.583 J	<0.638	0.634 J	0.472 J	0.686 J	0.754 J	116	126	137	1.82 J	0.819 J	3.14
Beryllium	mg/kg	0.529	0.561 J	0.563	0.130 J	0.124 J	0.119 J	0.0408 J	0.0707 J	0.0894 J	0.191 J	0.192 J	0.182 J
Cadmium	mg/kg	0.0180 J	<0.0585	0.0187 J	<0.0229	<0.0229	<0.0229	0.0236 J	0.0330 J	0.0272 J	0.0129 J	<0.0120	0.0134 J
Calcium	mg/kg	4.16 J	<7.98	6.85 J	6.43 J	8.42 J	6.15 J	7.12 J	7.01 J	7.90 J	6.04 J	6.46 J	6.58 J
Chromium	mg/kg	4.79	2.50 J	5.14	1.13	0.924 J	0.966 J	2.48	2.15	2.4	1.48	1.2	1.66
Cobalt	mg/kg	1.18 J	1.31 J	1.63 J	1.45 J	1.61 J	0.669 J	84.5	50.4	49.9	4.97	2.82	11.3
Copper	mg/kg	3.5	4.04 J	3.68	0.619 J	0.692 J	0.571 J	5.79	5.11	4.81	1.06 J	0.930 J	1.27 J
Iron	mg/kg	4370	3320	4370	5040	4640	4060	2680	3030	3260	2980	2510	2620
Lead	mg/kg	<0.120	<0.585	<0.121	<0.229	<0.229	<0.229	0.477 J	0.462 J	0.497 J	<0.118	<0.120	<0.118
Lithium	mg/kg	<0.164	<0.798	<0.165	<0.312	<0.313	<0.313	3.41	2.23 J	2.68	<0.161	<0.163	0.475 J
Manganese	mg/kg	20.3	24.5	25.3	34.1	22.3	13.9	4040	3400	3390	261	97.1	372
Molybdenum	mg/kg	<0.0896	<0.436	<0.0902	<0.170	<0.171	<0.171	<0.0859	<0.0859	<0.0857	<0.0882	<0.0894	<0.0876
Nickel	mg/kg	<0.0918	<0.447	<0.0924	0.425 J	0.385 J	0.299 J	8.06	6.19	6.02	0.463 J	0.117 J	1.01 J
Potassium	mg/kg	55.3 J	<138	54.5 J	<54.0	<54.2	<54.2	66.5 J	54.8 J	55.0 J	34.5 J	32.4 J	38.5 J
Selenium	mg/kg	<0.186	<0.904	<0.187	<0.353	0.432 J	<0.354	1.17 J	1.10 J	1.03 J	<0.183	<0.185	<0.182
Silver	mg/kg	<0.120	<0.585	<0.121	<0.229	<0.229	<0.229	0.561 J	0.480 J	0.487 J	<0.118	<0.120	<0.118
Thallium	mg/kg	<0.229	<1.12	<0.231	<0.436	<0.438	<0.438	<1.10	<1.10	<1.10	<0.226	<0.229	<0.224
Vanadium	mg/kg	1.86 J	1.40 J	1.66 J	2.13 J	1.86 J	1.77 J	1.99 J	1.58 J	1.95 J	1.93 J	1.69 J	1.75 J
Zinc	mg/kg	3.57 U*	2.31 U*	2.05 U*	1.48 U*	1.76 U*	1.50 U*	5.79	5.19 U*	5.62	1.36 U*	1.27 U*	1.78 U*
Total Metals													
Aluminum	mg/kg	12600	8260	11600	13700	14700	15400	8980	10200	12000	10800	11200	7400
Antimony	mg/kg	0.0416 UJ	0.0453 UJ	0.0372 UJ	0.0329 UJ	0.0342 UJ	0.0427 UJ	0.0525 J	0.0660 J	0.0709 J	0.0449 J	0.0484 J	0.0488 J
Arsenic	mg/kg	7.1	5.23	6.73	6.24	8.58	7.02	17.7	15.9	14.4	6.92	7.1	6.26
Barium	mg/kg	357 J	282 J	316 J	713 J	541 J	600 J	737 J	1190 J	2670	420	377	244
Beryllium	mg/kg	2.17	1.38	2.09	0.816	0.941	0.8	3.36	2.01	3.75	2.67	2.71	2.41
Cadmium	mg/kg	0.0414 J	<0.0179	0.0300 J	<0.0130	<0.0135	<0.0169	0.0213 J	0.0149 J	0.0583 J	<0.0169	<0.0173	<0.0165
Calcium	mg/kg	7830	4590	8610	706	469	766	149	662	282	358	352	160
Chromium	mg/kg	21.1	12.4	18.1	19.9	24	22.2	42	105	46.2 J	32.6 J	33.2 J	47.4 J
Cobalt	mg/kg	5.42	2.98	4.82	10.2	11.2	9.54	62.7	33.4	157	10.1	19.7	17.5
Copper	mg/kg	24.3	18.5	23.2	7.65	9.52	8.43	53.1	38.7	66.5	18.8	18.9	22.7
Iron	mg/kg	16200	9030	11600	29500	33900	33000	173000	114000	115000	43600	43900	52100
Lead	mg/kg	30.3	27.4	31.1	7.23	6.21	17.8	7.17	24.1	6.89 J	8.62 J	7.93 J	6.60 J
Lithium	mg/kg	5.98	5.15	6.94	18.7	24.9	21.1	10.7	11.6	18.6	8.8	9.12	6.75
Manganese	mg/kg	60.7 J	27.3 J	52.4 J	109 J	106 J	92.2 J	5240 J	2380 J	17600 J	391 J	571 J	697 J
Molybdenum	mg/kg	<0.158	<0.172	<0.141	<0.125	<0.130	<0.162	0.184 J	0.163 J	0.272 J	<0.162	<0.166	<0.158
Nickel	mg/kg	9.58 J	8.52 J	10.5 J	33.9 J	41.4 J	40.0 J	22.5 J	20.7 J	32.4	10.9	12.2	10.2
Potassium	mg/kg	3100 J	2120 J	3010 J	1720 J	1380 J	1720 J	938 J	1090 J	1540 J	3120 J	3400 J	1570 J
Selenium	mg/kg	0.118 UJ	0.128 UJ	0.106 UJ	0.0932 UJ	0.0971 UJ	0.121 UJ	0.109 UJ	0.370 UJ	0.152 J	0.122 UJ	0.124 UJ	0.118 UJ
Silver	mg/kg	<0.0261	<0.0284	<0.0234	<0.0206	<0.0215	<0.0268	<0.0242	0.0202 J	0.0696 J	<0.0269	<0.0275	<0.0262
Sodium	mg/kg	61.6	34.9 J	60.2	19.1 J	17.9 J	20.2 J	19.5 J	17.4 J	43.0 J	28.7 J	28.5 J	19.3 UJ
Thallium	mg/kg	0.213	0.15	0.177	0.101	0.0948	0.101	0.215	0.248	0.752	0.212	0.236	0.192
Vanadium	mg/kg	14.4	9.65	12.4	16.3	17.7	17.8	27.3	61.3	35.4 J	22.9 J	22.3 J	20.8 J
Zinc	mg/kg	28.2 J	21.1 J	27.3 J	57.0 J	70.0 J	66.4 J	56.2 J	52.9 J	170	48.8	48.6	38.9
SEM Bulk Mineral													
Al-Rich	%mass	<0.0000359	0.239	0.00254	0.0311	<0.0000302	0.00512	0.0236	0.0172	0.0187	0.00263	0.00851	0.00319
Ba-S Rich	%mass	<0.0000359	<0.0055	0.00314	0.000608	<0.0000302	0.000711	<0.0000149	<0.00000629	<0.0000485	<0.0000755	<0.0000197	<0.000236
Ca-Rich	%mass	0.00336	<0.0055	<0.0000175	0.0395	0.00755	0.00695	<0.0000149	<0.00000629	<0.0000485	<0.0000755	<0.0000197	<0.000236
Ca-S Rich	%mass	<0.0000359	<0.0055	<0.0000175	0.0119	<0.0000302	<0.0000366	<0.0000149	<0.00000629	<0.0000485	<0.0000755	<0.0000197	0.00755
Fe-Rich	%mass	0.0586	4.08	0.145	3.59	0.849	0.184	5.03	10.6	40.8	2.77	2.76	3.65
Fe-S Rich	%mass	<0.0000359	<0.0055	<0.0000175	<0.0000154	<0.0000302	<0.0000366	<0.0000149	<0.00000629	<0.0000485	<0.0000755	<0.0000197	<0.000236
Mn-Rich	%mass	<0.0000359	<0.0055	<0.0000175	<0.0000154	<0.0000302	<0.0000366	0.0664	0.0201	0.480	<0.0000755	0.0274	<0.000236
XRD Bulk Mineral													
Albite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Amorphous	%mass	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Anorthoclase	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Calcite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorite	%mass	<1	<1	6	12	9	9	9	5	<1	<1	<1	<1
Clay	%mass	11	15	11	9	8	8	11	6	5	9	13	9
Crystalline Silica, Quartz	%mass	44	35	34	52	58	55	34	46	35	45	46	45
Dolomite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Goethite	%mass	<1	1	<1	1	1	1	19	7	23	5	6	4
Hematite	%mass	<1	<1	<1	1	1	1	<1	<1	<1	1	<1	<1
Kaolinite	%mass	13	17	15	6	6	7	15	16	16	10	11	9
Lepidocrocite	%mass	<1	<1	<1	<1	<1	<1	3	1	2	<1	<1	1
Mica/Illite	%mass	31	32	34	18	18	20	10	19	19	30	25	32
Microcline	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Pyrite	%mass	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

See notes on last page.

Table 3-2 - Rock Outcrop Phase 2 Geochemistry Analytical Results
Watts Bar Fossil Plant

Sample Location		Area 04-03			
Sample Date		26-Jun-21	26-Jun-21	26-Jun-21	26-Jun-21
Sample ID		WBF-WR-A04-03D-A-20210626	WBF-WR-A04-03D-B-20210626	WBF-WR-A04-03D-C-20210626	WBF-WR-FD03-20210626
Parent Sample ID					WBF-WR-A04-03D-A/B/C***
Sample Type	Units	Normal Environmental Sample	Normal Environmental Sample	Normal Environmental Sample	Field Duplicate
General Chemistry					
Cation Exchange Capacity	meq/100gm	11.7	16.1	13.2	18.4
SEP Metals					
Aluminum	mg/kg	974	1210	1160	974
Antimony	mg/kg	<0.292	<0.367	<0.323	<0.327
Arsenic	mg/kg	1.22	1.73	1.78	1.28
Barium	mg/kg	0.993 J	1.35 J	1.80 J	1.02 J
Beryllium	mg/kg	0.178 J	0.210 J	0.172 J	0.188 J
Cadmium	mg/kg	0.0313 J	0.0439 J	0.0357 J	0.0363 J
Calcium	mg/kg	4.52 J	4.52 J	7.23 J	5.24 J
Chromium	mg/kg	1.11	1.35	1.09	0.841
Cobalt	mg/kg	6.04	6.08	5.96	3.68
Copper	mg/kg	1.31	1.71	1.51	1.22 J
Iron	mg/kg	4700	6220	5870	4260
Lead	mg/kg	<0.115	<0.144	<0.127	<0.129
Lithium	mg/kg	<0.157	<0.197	<0.346	<0.175
Manganese	mg/kg	115	130	126	83
Molybdenum	mg/kg	<0.0856	<0.107	<0.0945	<0.0959
Nickel	mg/kg	0.482 J	0.320 J	0.395 J	0.109 J
Potassium	mg/kg	31.4 J	41.3 J	<59.9	32.3 J
Selenium	mg/kg	<0.177	<0.223	<0.196	<0.199
Silver	mg/kg	<0.115	<0.144	<0.127	<0.129
Thallium	mg/kg	<0.219	<0.275	<0.242	<0.246
Vanadium	mg/kg	2.40 J	2.78 J	2.08 J	2.38 J
Zinc	mg/kg	1.22 U*	1.56 U*	1.36 U*	1.30 U*
Total Metals					
Aluminum	mg/kg	8580	12900	11400	10900
Antimony	mg/kg	0.0325 J	0.0389 UJ	0.0329 J	0.0550 J
Arsenic	mg/kg	10.9	13.3	11.9	17.1
Barium	mg/kg	920	1250	1180	1380
Beryllium	mg/kg	2.06	2.64	2.45	2.85
Cadmium	mg/kg	<0.0119	0.0281 J	<0.0130	0.0185 J
Calcium	mg/kg	708	1650	881	966
Chromium	mg/kg	16.7 J	26.7 J	25.9 J	23.1 J
Cobalt	mg/kg	10.3	10.7	7.41	16.3
Copper	mg/kg	20.1	24.2	22.7	23.2
Iron	mg/kg	25300	34800	31800	30400
Lead	mg/kg	28.0 J	51.8 J	23.4 J	49.1 J
Lithium	mg/kg	9.6	10.6	11.7	8.26
Manganese	mg/kg	206 J	192 J	135 J	240 J
Molybdenum	mg/kg	0.134 J	0.162 J	0.130 J	0.187 J
Nickel	mg/kg	14.2	19	17.5	15.2
Potassium	mg/kg	1240 J	2570 J	2000 J	1470 J
Selenium	mg/kg	0.0855 UJ	0.110 UJ	0.0931 UJ	0.111 J
Silver	mg/kg	<0.0189	<0.0244	<0.0206	<0.0234
Sodium	mg/kg	16.7 J	31.2 J	22.9 J	19.1 J
Thallium	mg/kg	0.145	0.21	0.169	0.201
Vanadium	mg/kg	14.2 J	19.4 J	18.2 J	17.2 J
Zinc	mg/kg	66.2	89.2	86.2	86.8
SEM Bulk Mineral					
Al-Rich	%mass	0.00101	<0.000015	0.0320	<0.0000572
Ba-S Rich	%mass	<0.0000492	<0.000015	<0.000131	<0.0000572
Ca-Rich	%mass	<0.0000492	0.00996	0.00544	0.00164
Ca-S Rich	%mass	<0.0000492	<0.000015	<0.000131	<0.0000572
Fe-Rich	%mass	2.74	0.305	2.57	0.714
Fe-S Rich	%mass	<0.0000492	<0.000015	<0.000131	<0.0000572
Mn-Rich	%mass	0.00739	0.00114	<0.000131	<0.0000572
XRD Bulk Mineral					
Albite	%mass	<1	<1	<1	<1
Amorphous	%mass	<10	<10	<10	<10
Anorthoclase	%mass	<1	<1	<1	<1
Calcite	%mass	<1	<1	<1	<1
Chlorite	%mass	1	1	2	1
Clay	%mass	5	7	5	4
Crystalline Silica, Quartz	%mass	51	49	55	56
Dolomite	%mass	<1	<1	<1	<1
Goethite	%mass	<1	<1	<1	<1
Hematite	%mass	<1	<1	<1	<1
Kaolinite	%mass	20	17	20	20
Lepidocrocite	%mass	<1	<1	<1	<1
Mica/Illite	%mass	24	25	19	20
Microcline	%mass	<1	<1	<1	<1
Pyrite	%mass	<1	<1	<1	<1

Notes:
Please note that units have been converted automatically in this table, and significant figures may not have been maintained.

15.2	measured concentration did not exceed the indicated standard
<0.03	analyte was not detected at a concentration greater than the Method Detection Limit
**	Field duplicate sample collected from a subset of a larger group of samples (A/B/C).
ID	Identification
J	quantitation is approximate due to limitations identified during data validation
U*	result should be considered "not detected" because it was detected in an associated field or laboratory blank at a similar level
UJ	This compound was not detected, but the reporting or detection limit should be considered estimated due to a bias identified during data validation.
meq/100gm	milliequivalents per 100 grams
mg/kg	milligrams per kilogram
%mass	percent mass
SEM	Scanning Electron Microscopy
XRD	X-ray Diffraction

TABLE 4-1 – Pore Water Level Measurements
Watts Bar Fossil Plant
August 2019-February 2020

Temporary Well / Piezometer ID	Top of Casing Elevation	Piezometer Sensor Elevation	Pore Water Elevation (ft msl)					
	ft msl	ft msl	8/26/2019	9/30/2019	10/28/2019	11/25/2019	1/7/2020	2/5/2020
Temporary Wells								
WBF-TW02	718.34	n/a	dry	694.79*	dry	695.13*	695.25*	695.26*
WBF-TW03	721.19	n/a	703.10	702.04	701.28	701.62	703.88	705.17
WBF-TW04	719.27	n/a	706.42	705.19	704.85	705.75	707.62	708.54
WBF-TW05	717.97	n/a	703.60	702.55	701.82	702.00	703.38	705.09
Piezometers								
WBF-B02A	n/a	699.5	711.1	NM	708.0	NM	710.8	NM
WBF-B04A	n/a	696.4	704.0	NM	702.2	NM	704.1	NM
WBF-B05A	n/a	696.2	704.0	NM	702.3	NM	704.2	NM
WBF-B15A	n/a	704.7	NM	NM	NM	NM	NM	NM

Notes:

dry	water was not detected
ft	feet
ID	identification
msl	mean sea level
n/a	not applicable
NM	not measured

*Water level readings within WBF-TW02 are considered to be in the sump, therefore this well is considered dry.

1. Top of casing elevations were obtained from well survey data.

2. For piezometers, pore water elevations and piezometer data were obtained from historical TVA documents and TVA iSite database. Data from piezometers were averaged for the measurement date.

3. Pore water elevations in piezometers are calculated values. Depth to pore water in the vibrating wire piezometers is not manually measured. Accuracy of piezometer data is to 0.1 ft.

4. In select piezometers noted as 'NM' above, pore water elevation data were not available for this event.

Table 4-2 - Estimated CCR Material Areas, Depths, and Volumes
Watts Bar Fossil Plant

CCR Unit	CCR Material Above Phreatic Surface (CY)	CCR Material Below Phreatic Surface (CY)	Total (CY)	Minimum CCR Depth (FT)	Maximum CCR Depth (FT)	CCR Unit Area (Acres)
Ash Pond	188,416	0	188,416	0	22	7
Slag Disposal Area	294,309	274,153	568,462	0	30	27
Study Area Units Total	**482,725**	**274,153**	**756,878**	**Not Applicable**	**Not Applicable**	**34**

Notes:

1. CCR – coal combustion residuals
2. CY – cubic yards
3. The volumes reported herein may not represent steady-state conditions. The phreatic surface in the Slag Disposal Area would be expected to decrease in elevation if modifications to the existing soil cap system or drainage improvements were to be implemented.
4. For details regarding the development of the three-dimensional models of the CCR management units, refer to the MQA SAR (Appendix G.7).
5. Volumes for the Slag Disposal Area include those found in the Drainage Improvements Area, refer to Chapter 4.3.2.
6. For details regarding water level measurements used to estimate the phreatic surface elevation, refer to Chapter 4.3.3.3.

EXHIBITS

Exhibit No.
1-1

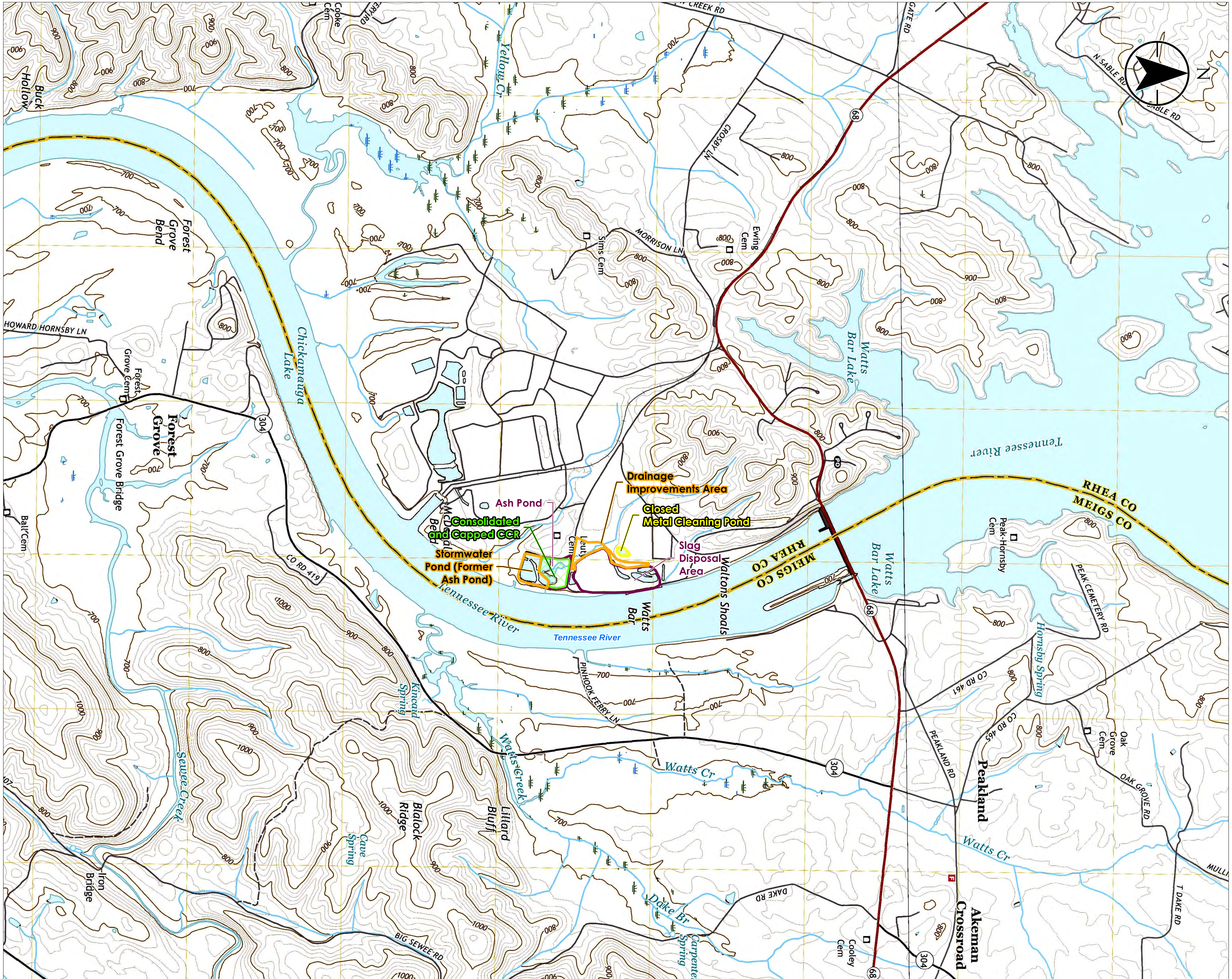
Title
Location Plan and Topographic Map

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

Project Location: Spring City, Tennessee

175566336
Prepared by DMB on 2022-06-07
Technical Review by EM on 2022-06-07

0 | 1,000 | 2,000 | 3,000 | 4,000 Feet
1:12,000 (At original document size of 22x34)

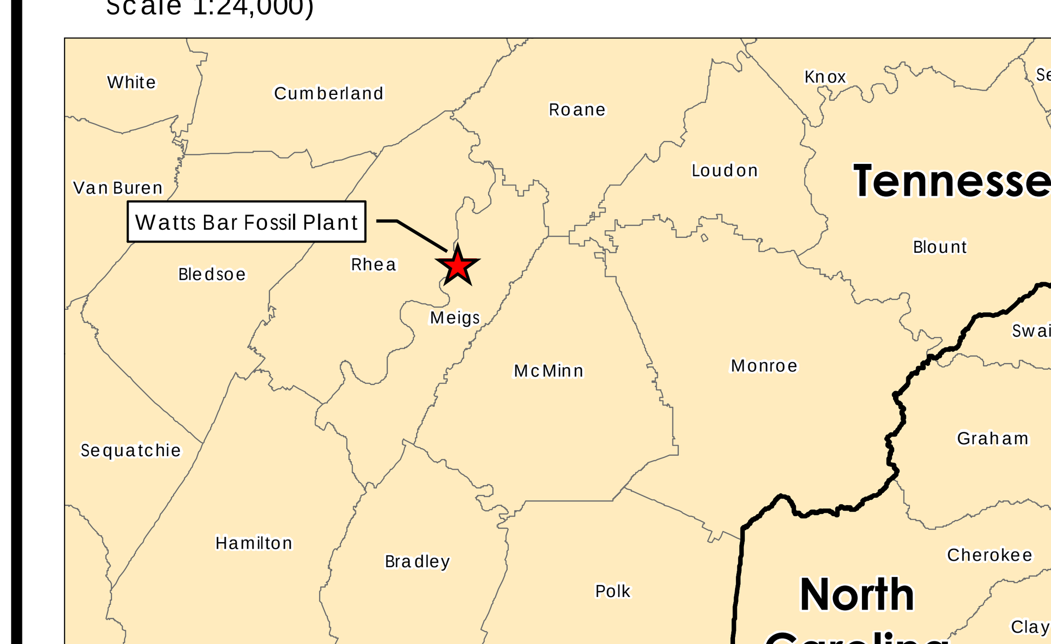


Legend

- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic mapping corresponds to the Decatur Quadrangle (Edition of 2019, Scale 1:24,000) and the Spring City Quadrangle (Edition of 2019, Scale 1:24,000)



Stantec TVA

Exhibit No.

2-1

Title

WBF Plant Overview

Client/Project

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

Project Location 175668050

Spring City, Tennessee

Prepared by MB on 2023-10-02
Technical Review by EM on 2023-10-02

0 400 800 1,200 1,600 Feet

1:4,800 (At original document size of 22x34)

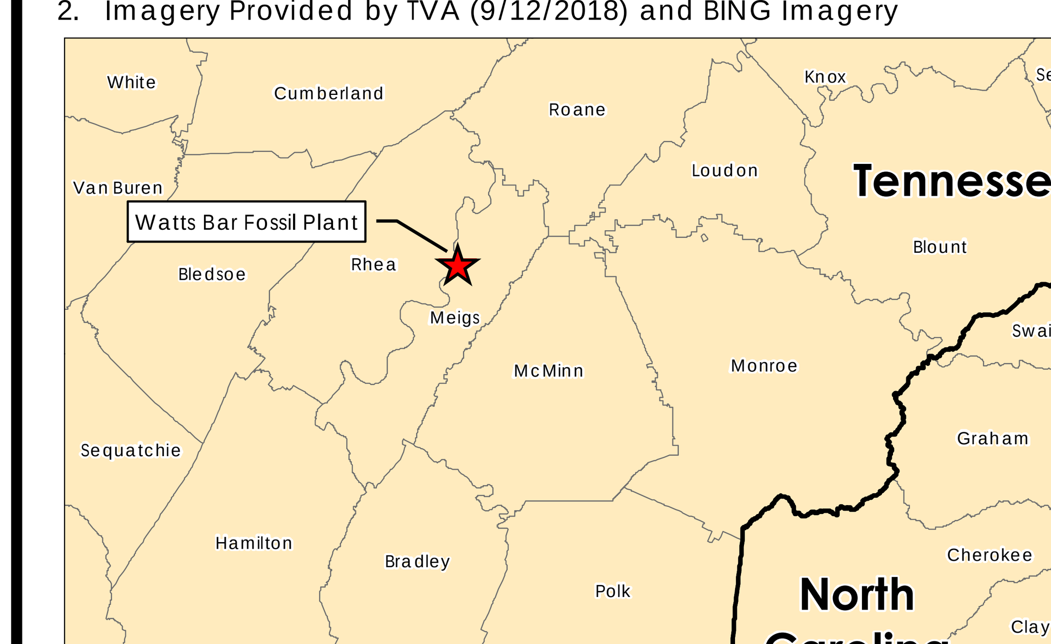
Legend

- NPDES Outfalls (Historical)
- Surface Stream Flow
- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

Exhibit No.
2-2

Title
Dike Construction History

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2022-06-08
Technical Review by EM on 2022-06-08

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

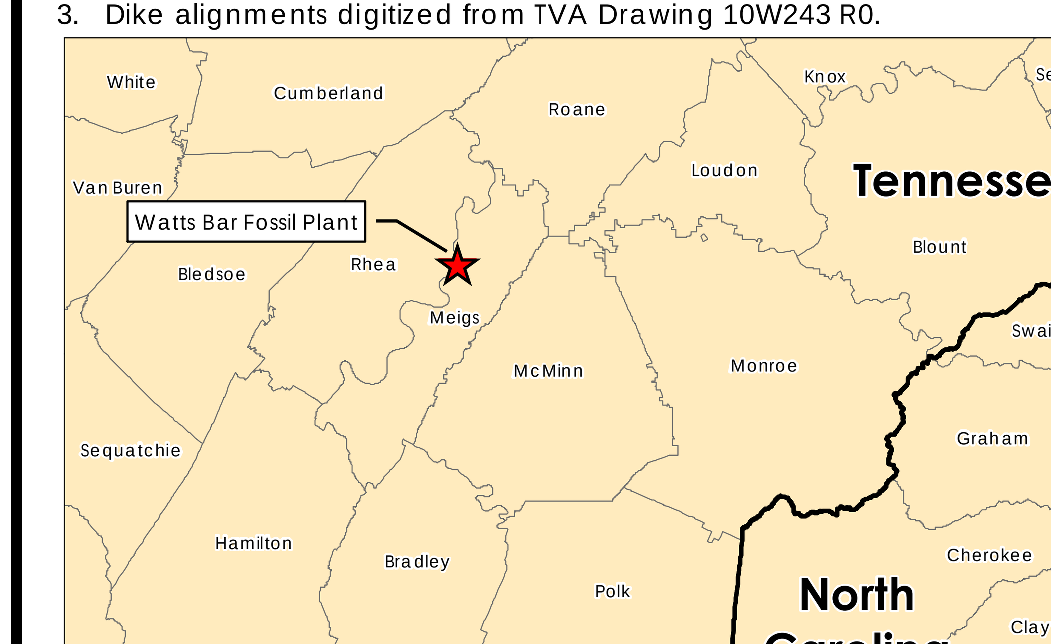
Legend

- 1969: Slag Disposal Area Raised Dike
- 1974: Ash Pond Dikes
- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Dike alignments digitized from TVA Drawing 10W243 R0.



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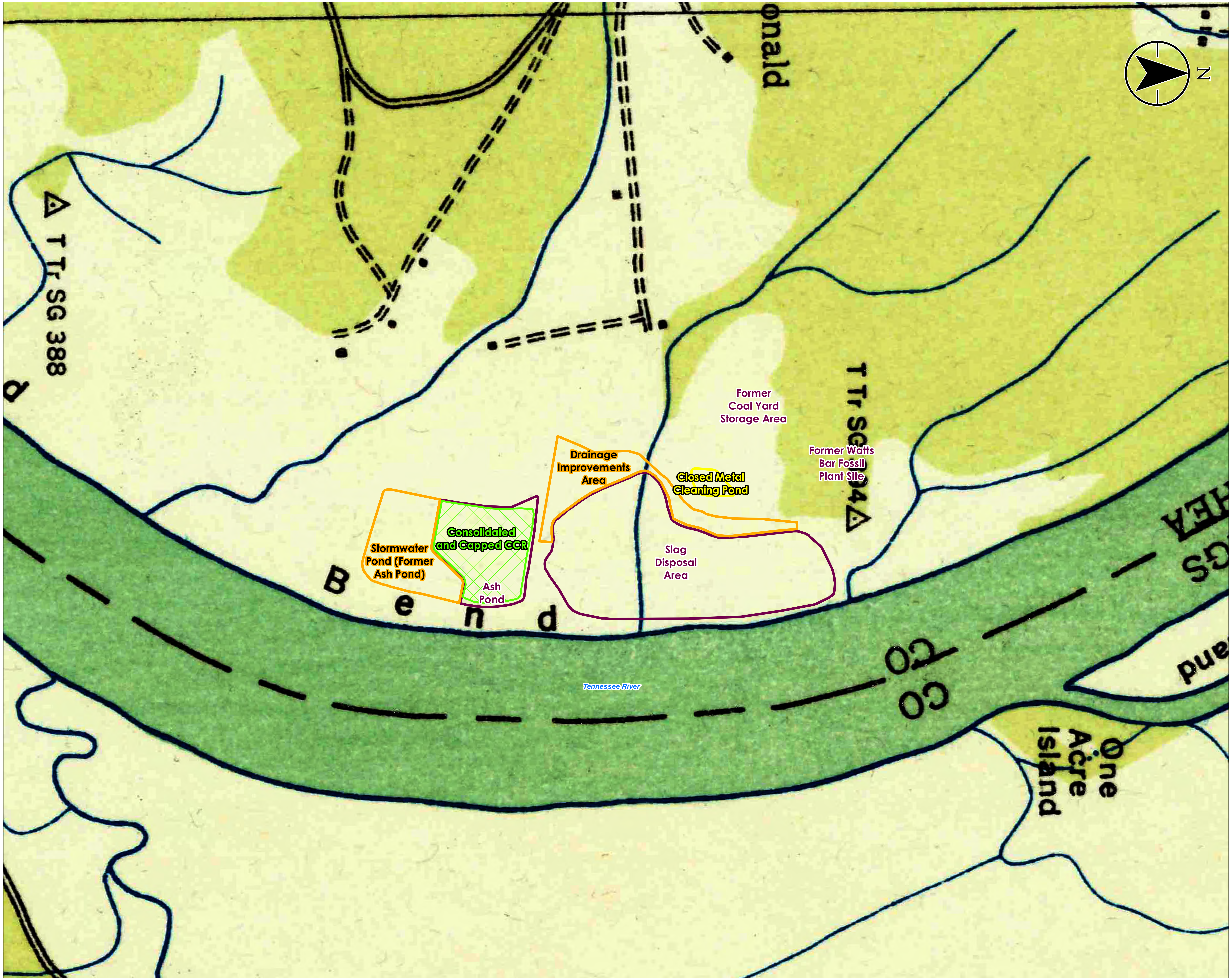


Exhibit No.
2-3

Title
Topographic Map - USGS (1935)

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2022-06-07
Technical Review by EM on 2022-06-07

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

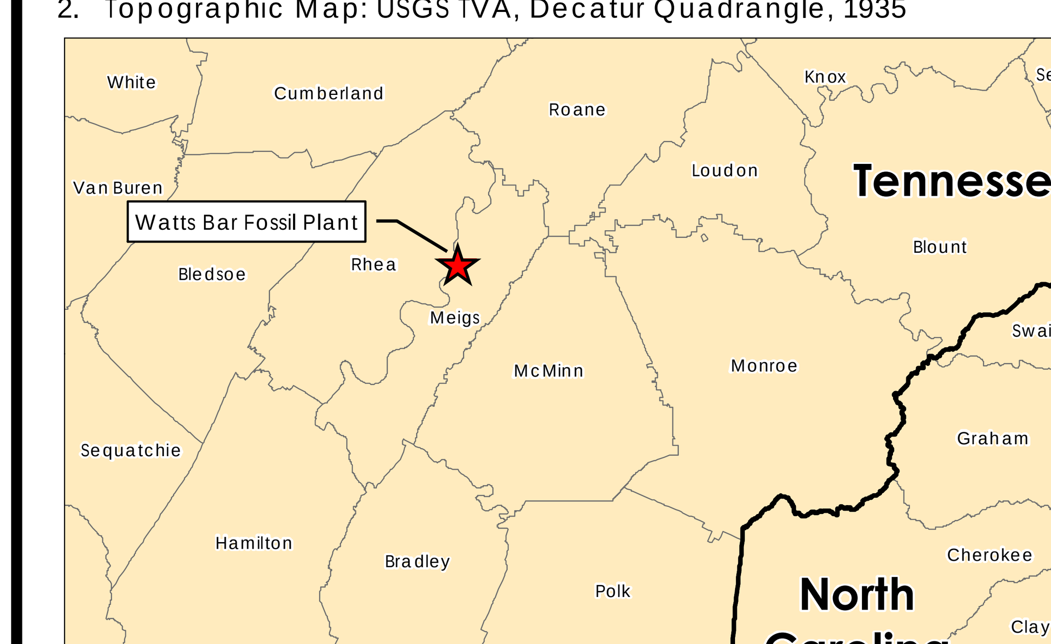
Legend

- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Topographic Map: USGS TVA, Decatur Quadrangle, 1935



Stantec TVA

V:\TVA-EP\175668050_WBF_WorkPlans\gis\mxd\EAR\2-3_TopographicMapUSGS1935.mxd Revised: 2022-06-07 By: mbough

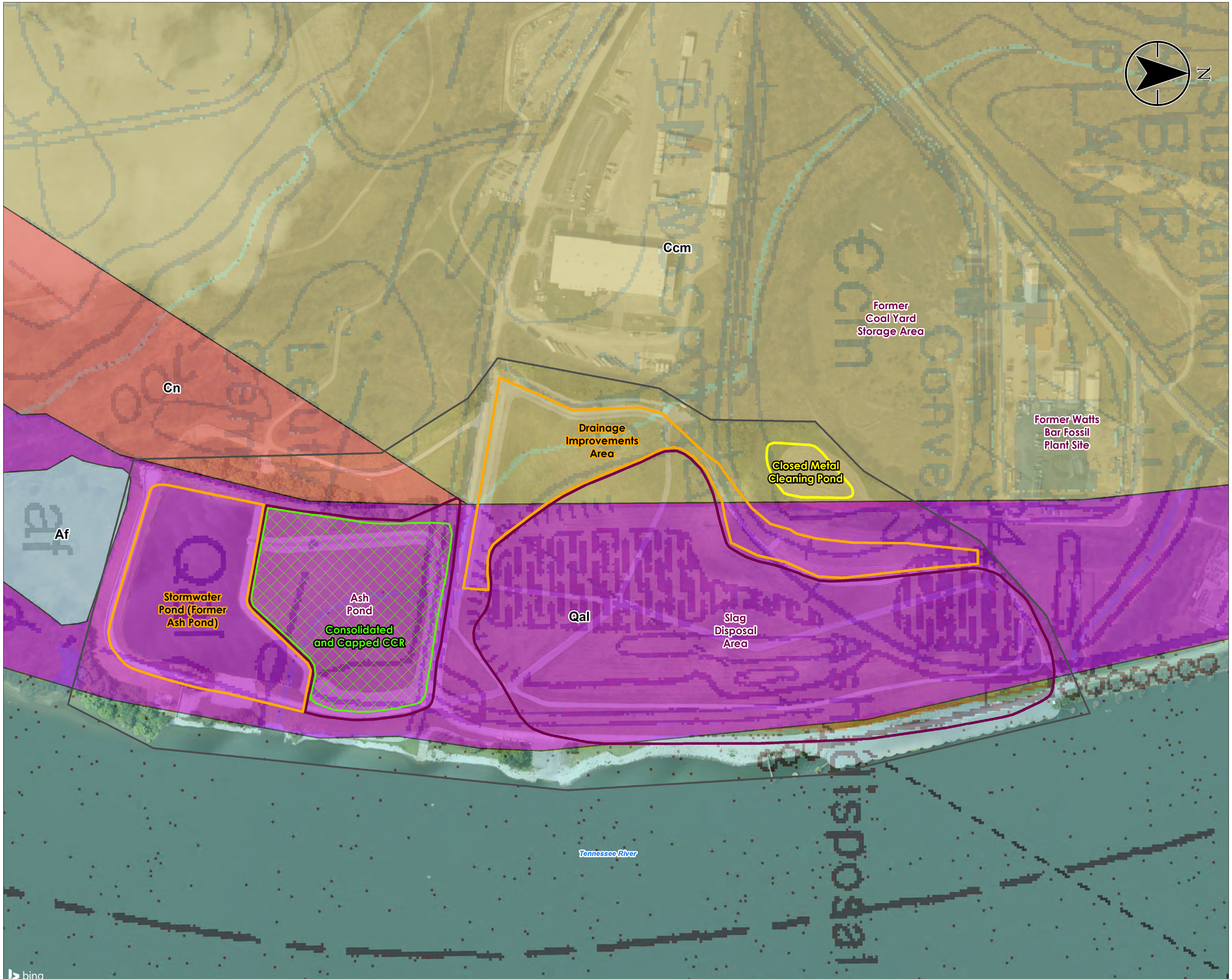


Exhibit No.
2-4

Title
Geologic Map

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

Project Location 175668050
Spring City, Tennessee
Prepared by MB on 2022-08-04
Technical Review by EM on 2022-08-04

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

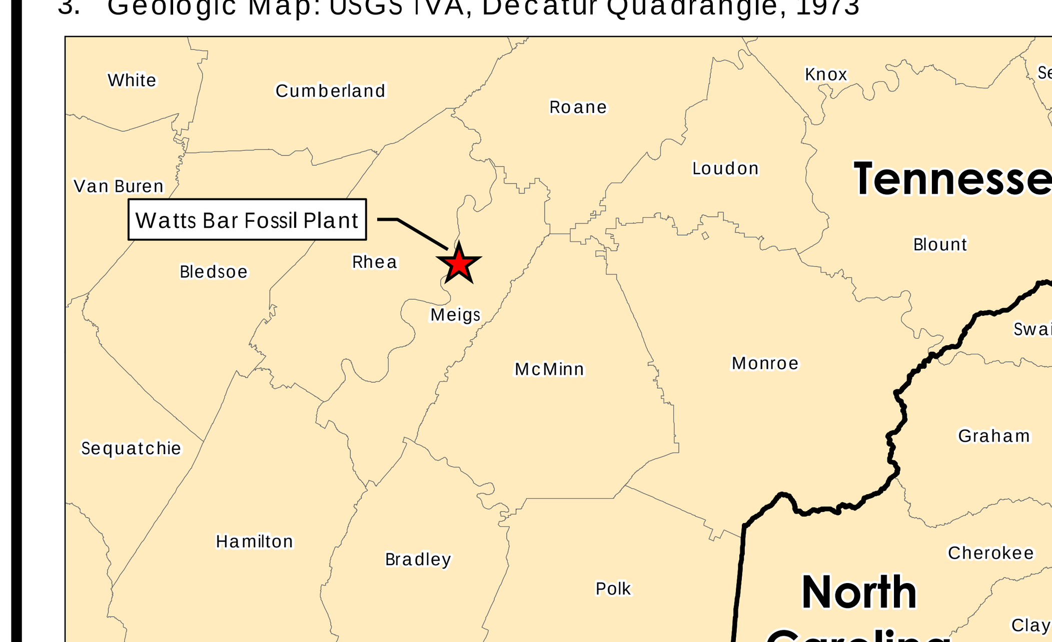
Legend

- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- Af - Artificial Fill
- Qal - Surficial Deposits
- Ccm - Conasauga Group Middle
- Cn - Nolichucky Shale

CCR: Coal combustion residuals

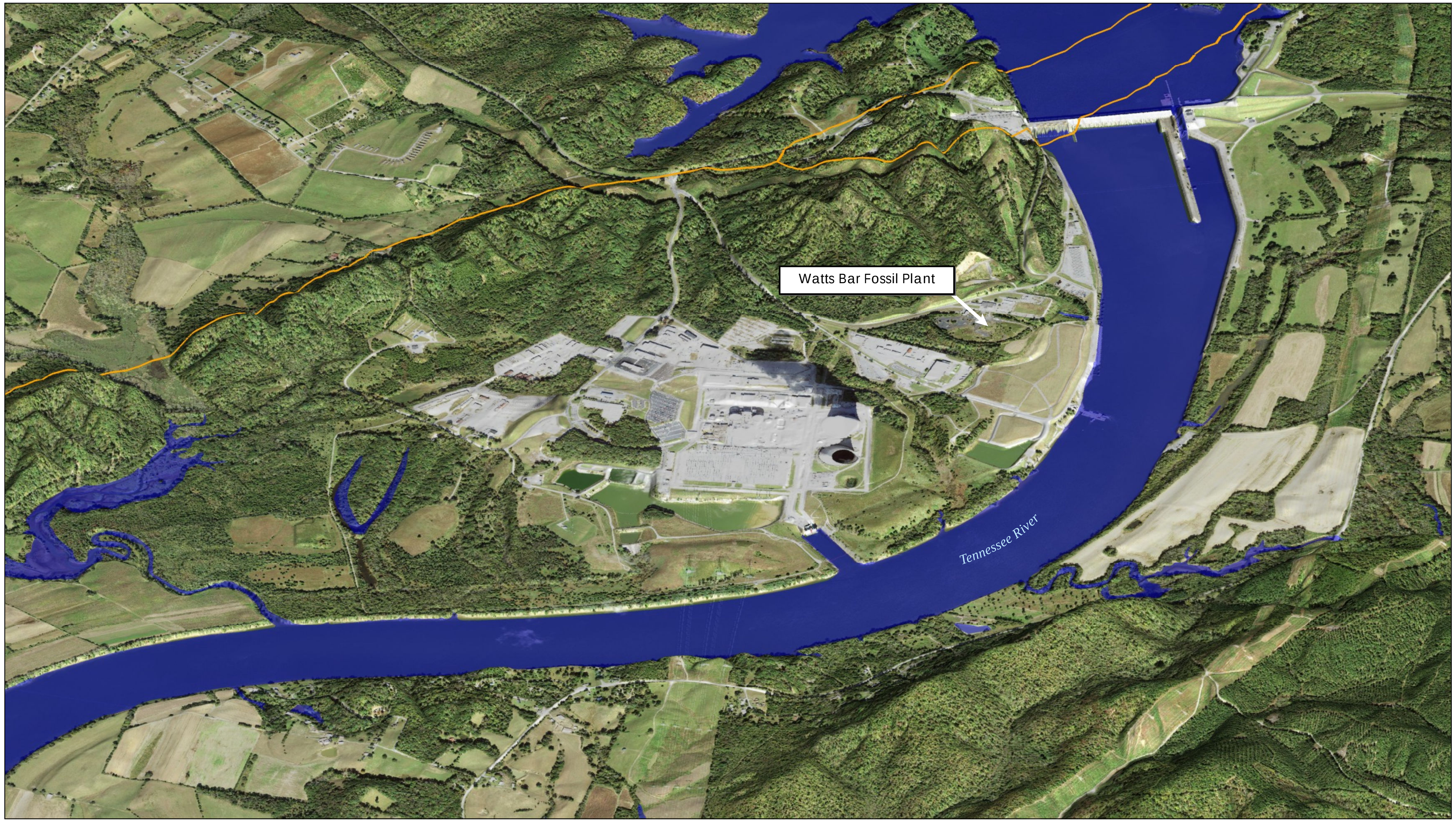
Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Geologic Map: USGS TVA, Decatur Quadrangle, 1973



Stantec TVA

V:\TVA-EIP\175668050_WBF_WorkPlans\gis\mxd\EAR\2-4_WBF_GeologicMap.mxd Revised: 2022-08-04 By: mbough



Oblique View

Exhibit No.

2-5

Title

Faults and Topographic Relief

Client/Project 1755668050

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

Project Location

Decatur, Tennessee

Prepared by TH on 2021-11-11
TR by CH on 2021-01-27
IR Review by SG on 2021-01-27

Legend

Water Bodies

Faults Mapped as Part of the USGS Tennessee Geologic Map, Hardeman et al, 1966

Notes:
Imagery is an oblique view of a 3-dimensional representation of a digital elevation model with 2X vertical exaggeration. The scale below is valid only in the horizontal direction.

N

0 1,000 2,000 Feet

Horizontal Scale

Stantec

TVA

Q:\active\TVA\WBF\MXD\20220609_topographic_exhibit\WBF_exhibit_2-5_topography.mxd Revised: 2022-08-04 By: theller

Exhibit No.
2-6

Title
Historic Stream Alignment

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

Project Location: Spring City, Tennessee

175668050
Prepared by MB on 2022-08-04
Technical Review by EM on 2022-08-04

0 300 600 900 1,200 Feet
1:3,600 (At original document size of 22x34)

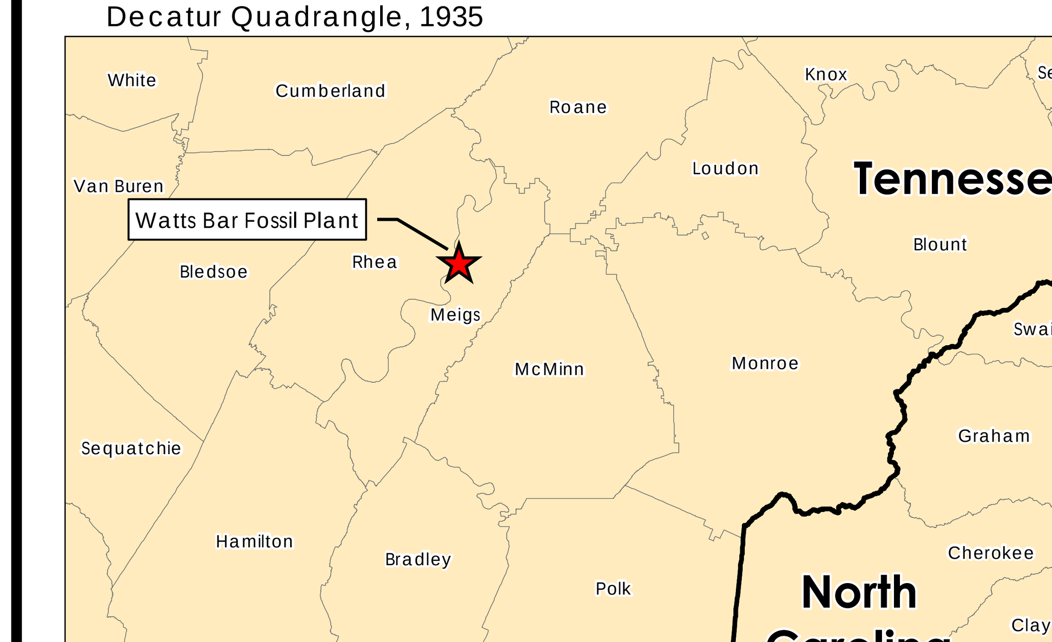
Legend

- Historic Stream Alignment
- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Historic stream alignments digitized from Topographic Map USGS TVA, Decatur Quadrangle, 1935



Stantec TVA

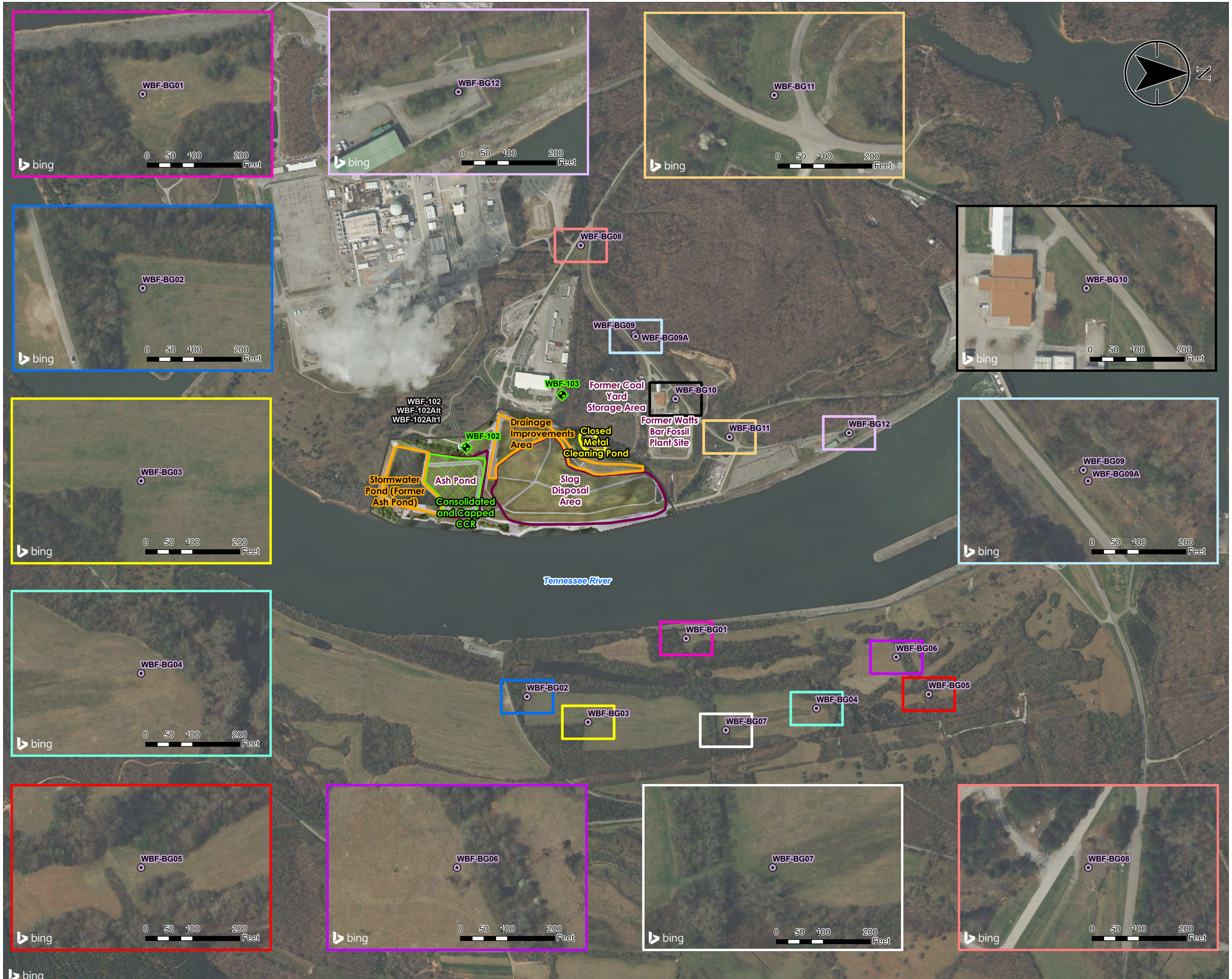


Exhibit No.

3-1

Title

Background Soil Boring Location Map

Client/Project

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

Project Location

Spring City, Tennessee

175566336

Prepared by DMB on 2022-08-04
Technical Review by RN on 2022-08-04

0 500 1,000 1,500 2,000 Feet

1:6,000 (At original document size of 22x34)

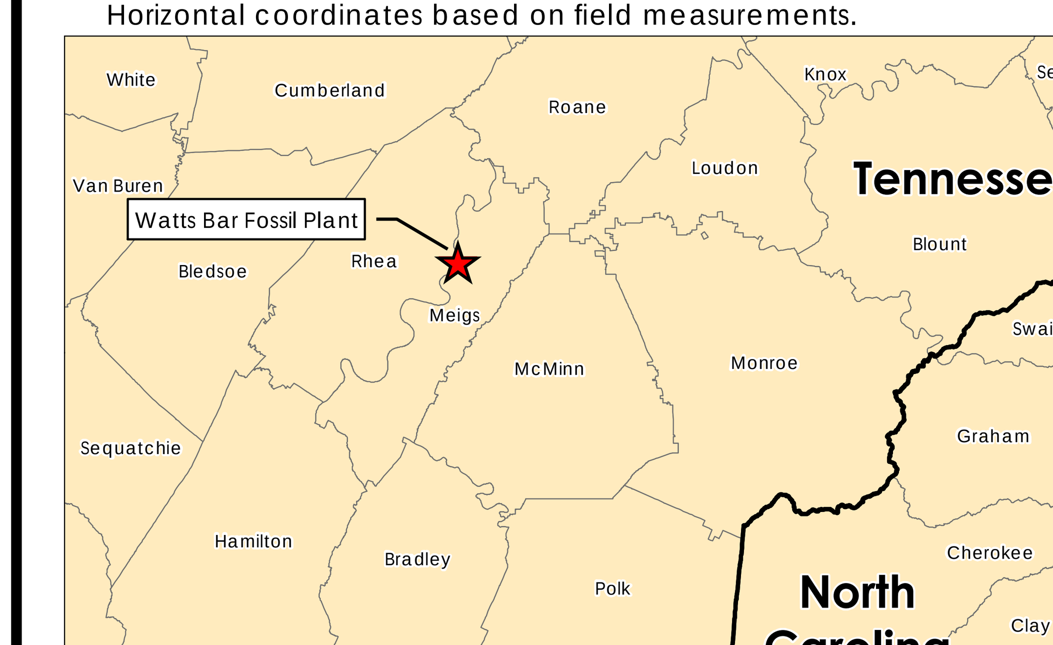
Legend

- Background Soil Boring
- Background Monitoring Well
- Drilled and Abandoned Borehole
- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2018-09-12) and Bing Imagery
3. WBF-BG02 was not drilled due to the presence of an archaeologic site.
4. WBF-BG09 and WBF-BG09A were drilled, but no samples were collected due to presence of CCR.
5. Boring shown as WBF-BG10 was drilled as WBF-BG10A and logged as WBF-BG10.
6. Background monitoring well WBF-102 was logged and sampled at WBF-102Alt2(Sonic).
7. Background well borings WBF-102, WBF-102Alt, and WBF-102Alt1 were attempted, but were not the final location of the background well. As-drilled boring locations were not surveyed for these borings. Horizontal coordinates based on field measurements.



Stantec TVA

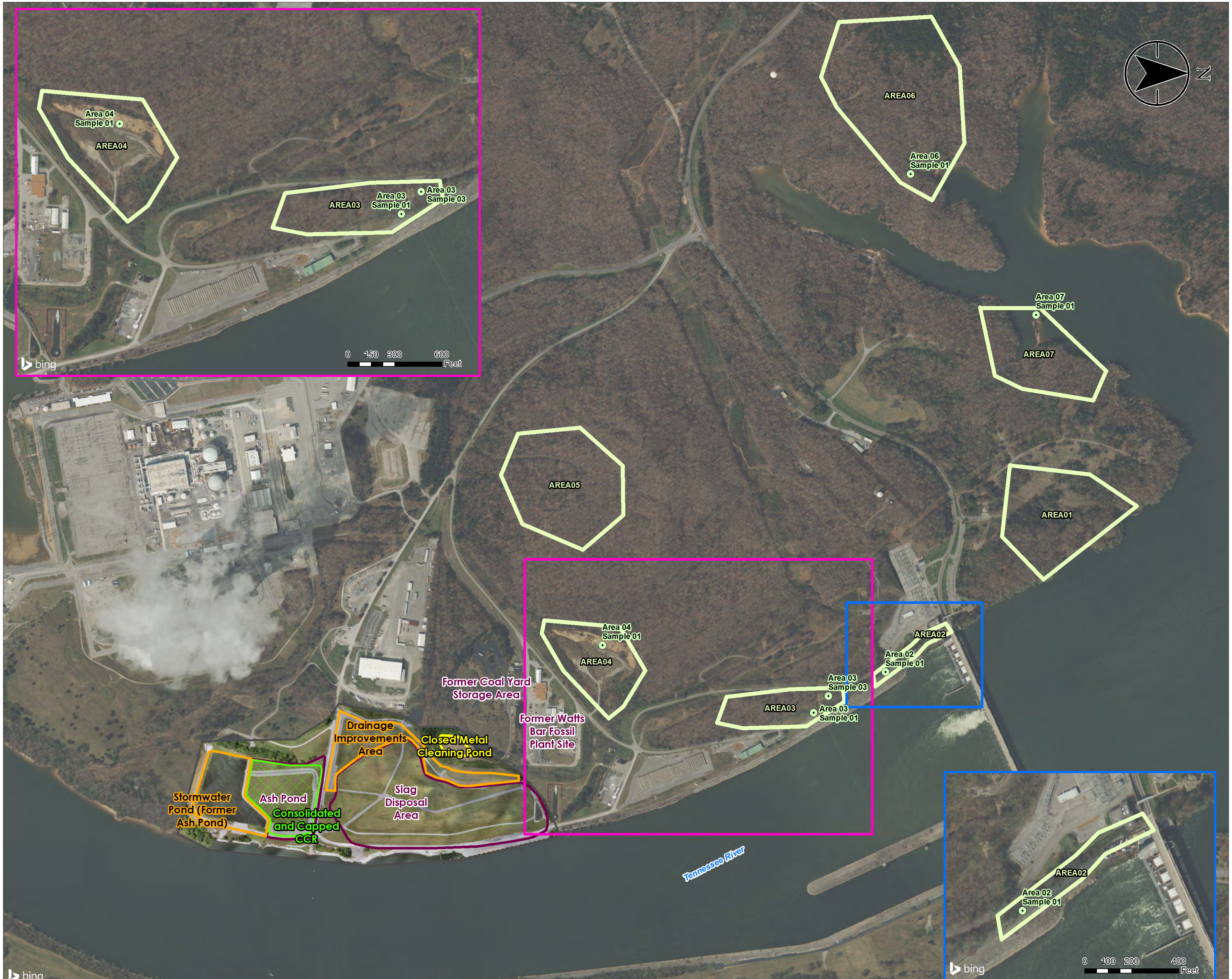


Exhibit No.

3-2

Title

Rock Outcrop Survey Area

Client/Project

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

Project Location

Spring City, Tennessee

175566336
Prepared by DMB on 2023-03-20
Technical Review by RN on 2023-03-20

0 400 800 1,200 1,600 Feet

1:4,800 (At original document size of 22x34)

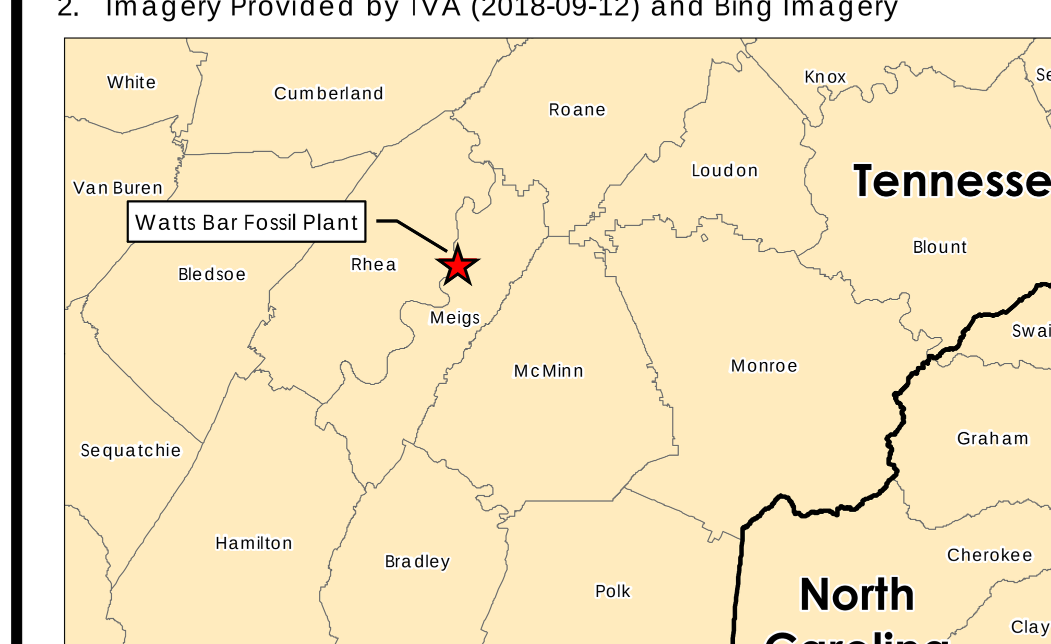
Legend

- Rock Sample
- Rock Outcrop Survey Area
- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2018-09-12) and Bing Imagery



Stantec TVA

Exhibit No.
3-3

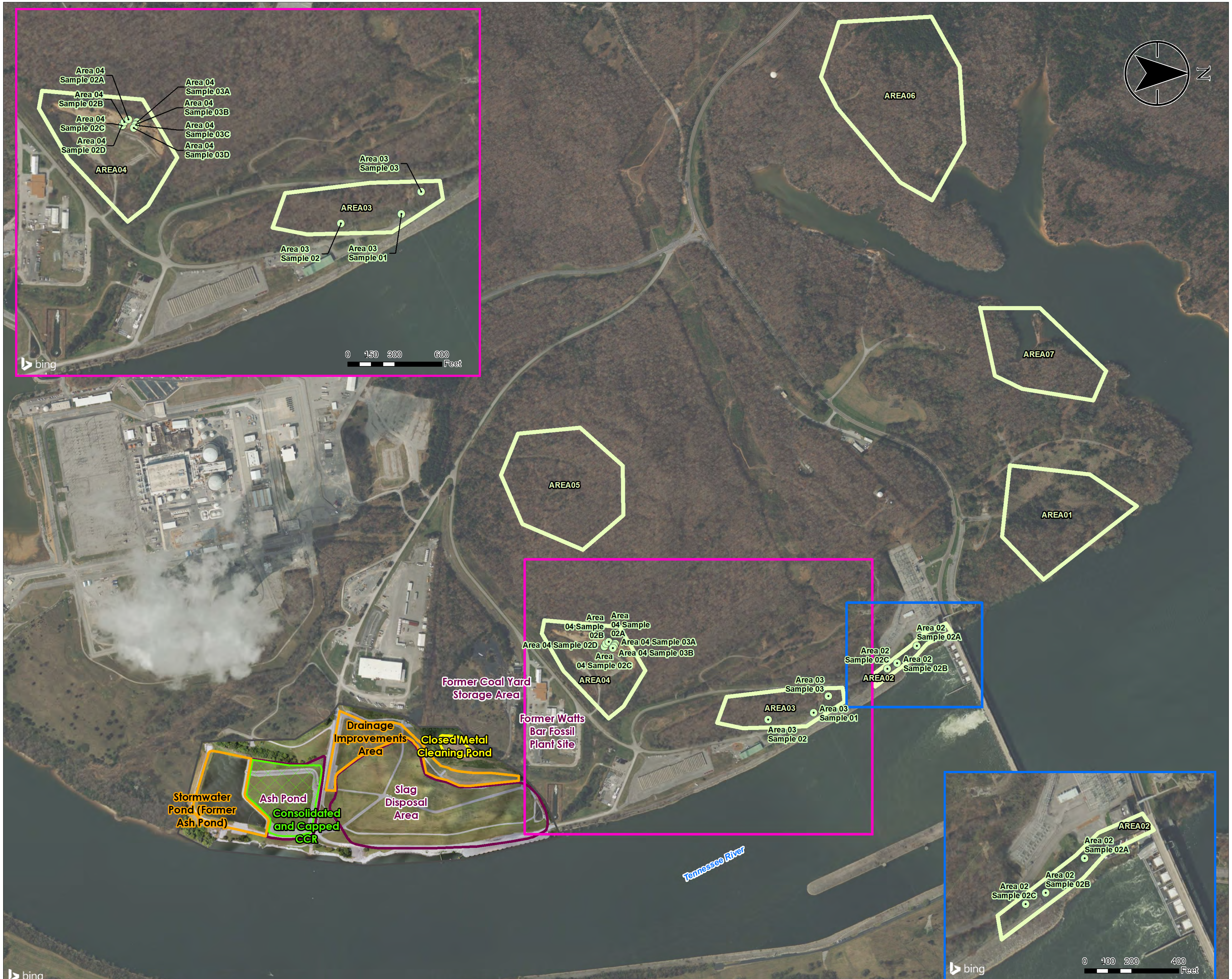
Title
Phase 2 Rock Outcrop Survey

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

Project Location
Spring City, Tennessee

175566336
Prepared by DMB on 2023-04-25
Technical Review by RN on 2023-04-25

0 400 800 1,200 1,600 Feet
1:4,800 (At original document size of 22x34)

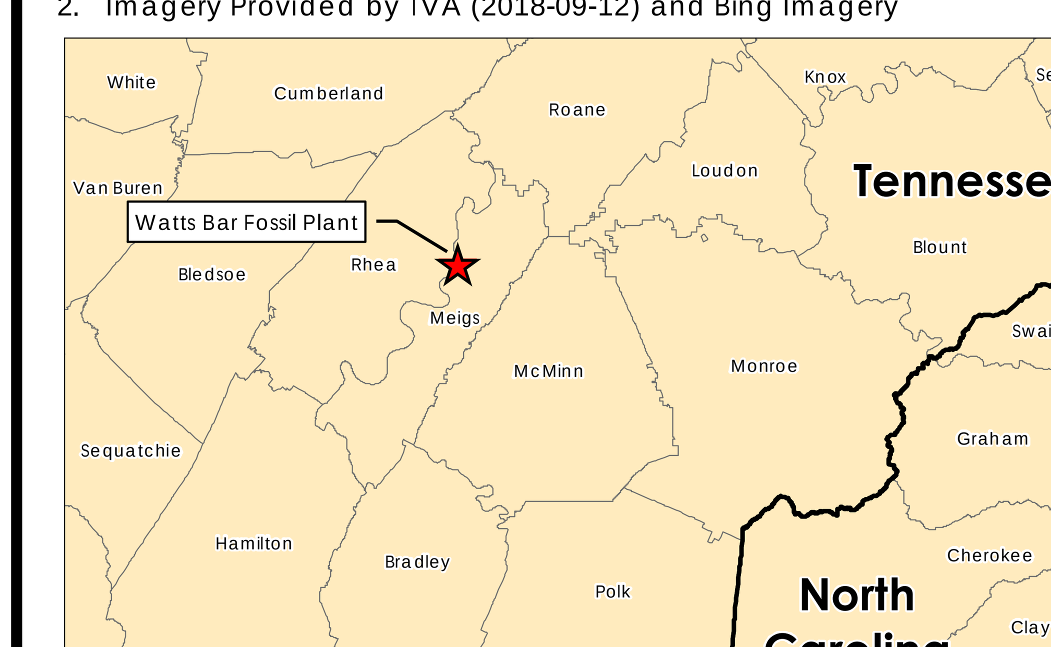


Legend

- Rock Sample
- Rock Outcrop Survey Area
- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

CCR: Coal combustion residuals

Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2018-09-12) and Bing Imagery



Stantec TVA

Exhibit No.
4-1

Title
Phase 1 Boring Location Map

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

Project Location
Spring City, Tennessee

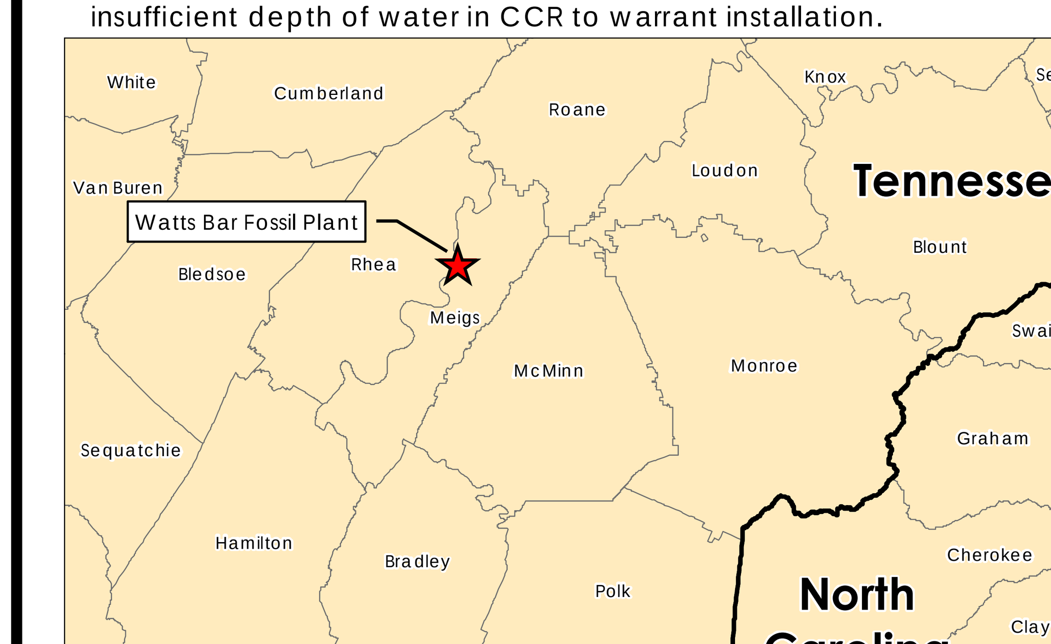
175668050
Prepared by MB on 2022-06-30
Technical Review by ND on 2022-06-30

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Geotechnical Boring
- Geotechnical Boring with Vibrating Wire Piezometer
- Cone Penetration Test
- Temporary Well (Screened Interval)
- Historical Stream Alignment (Approximate)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond Area (Approximate)
- Consolidated and Capped CCR 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
3. Boring locations surveyed by Stantec on August 26, 2019 and July 10, 2020.
4. Temporary Well TW01 was not installed because the boring had insufficient depth of water in CCR to warrant installation.



Stantec TVA

Revised: 2022-06-30 By: mbough

Exhibit No.

4-2

Title

Phase 2 Boring Location Map

Client/Project

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

Project Location

Spring City, Tennessee

175668050
Prepared by MB on 2022-06-30
Technical Review by ND on 2022-06-30

0 150 300 450 600 Feet

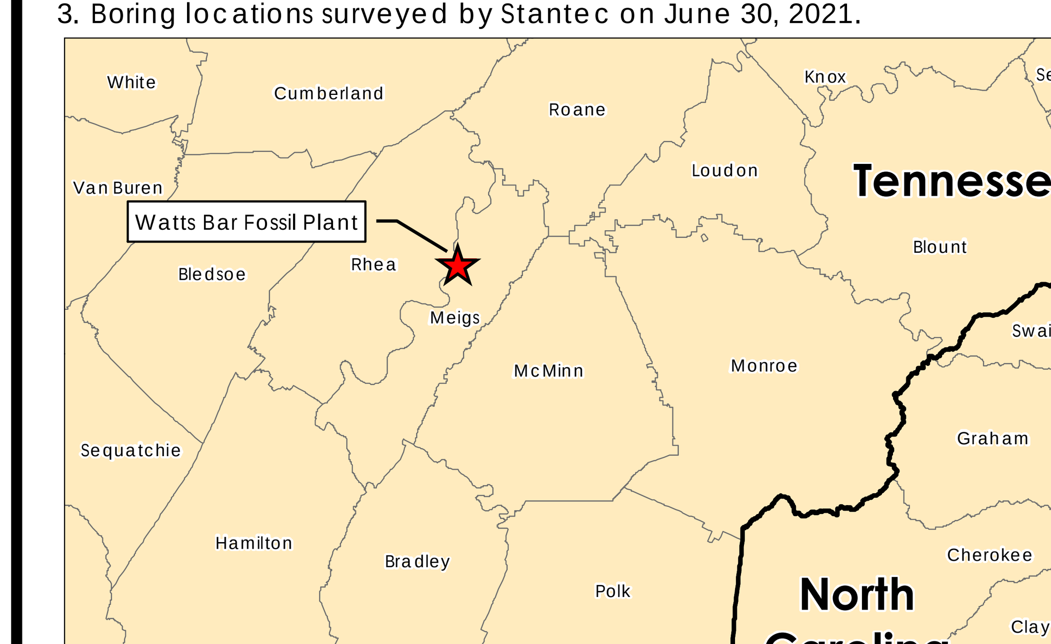
1:1,800 (At original document size of 22x34)

Legend

- Geotechnical Boring
- Geotechnical Boring with Vibrating Wire Piezometer
- Cone Penetration Test
- Historical Stream Alignment (Approximate)
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond Area (Approximate)
- Consolidated and Capped CCR 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
3. Boring locations surveyed by Stantec on June 30, 2021.



Stantec TVA

Exhibit No.
4-3

Title
Pore Water Elevation Contour Map, Event #6 (July 6, 2020)

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

Project Location 175668050
Spring City, Tennessee
Prepared by DMB on 2023-03-20
Technical Review by MD on 2023-03-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl); value not used for contouring
- Other Monitoring Well groundwater elevation in ft amsl; value not used for contouring
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl
- Interpolated Pore water Contour (2 ft interval; elevations are in ft amsl)
- Pore water Contour (2 ft interval; elevations are in ft amsl)
- Inferred Pore water Flow
- Surface Stream Flow
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

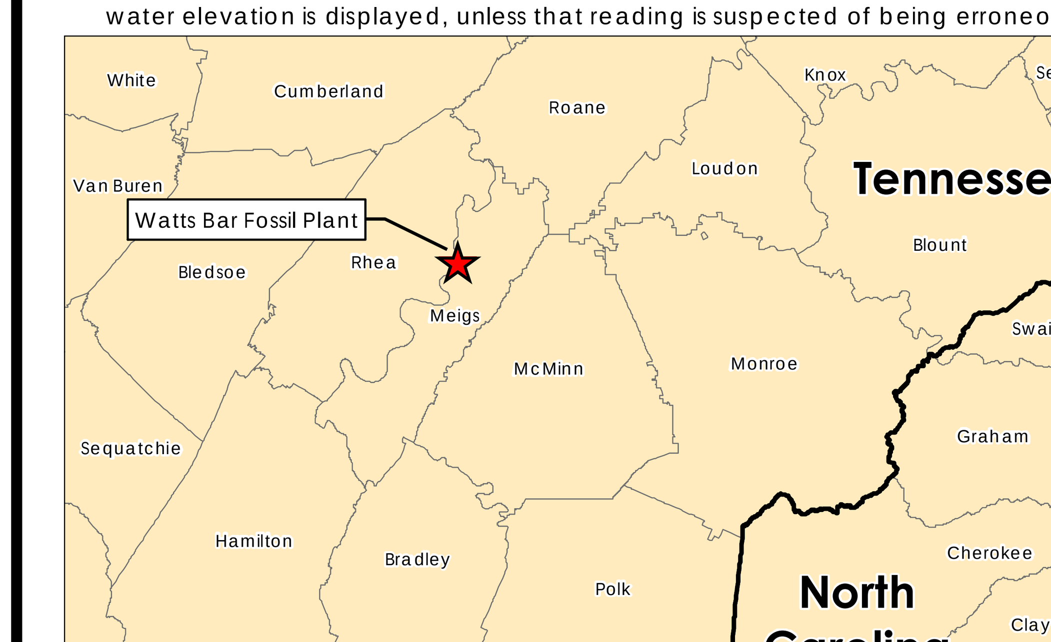
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Pore water contours were created with manual adjustment using Surfer Version 16 (December 13, 2018)
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

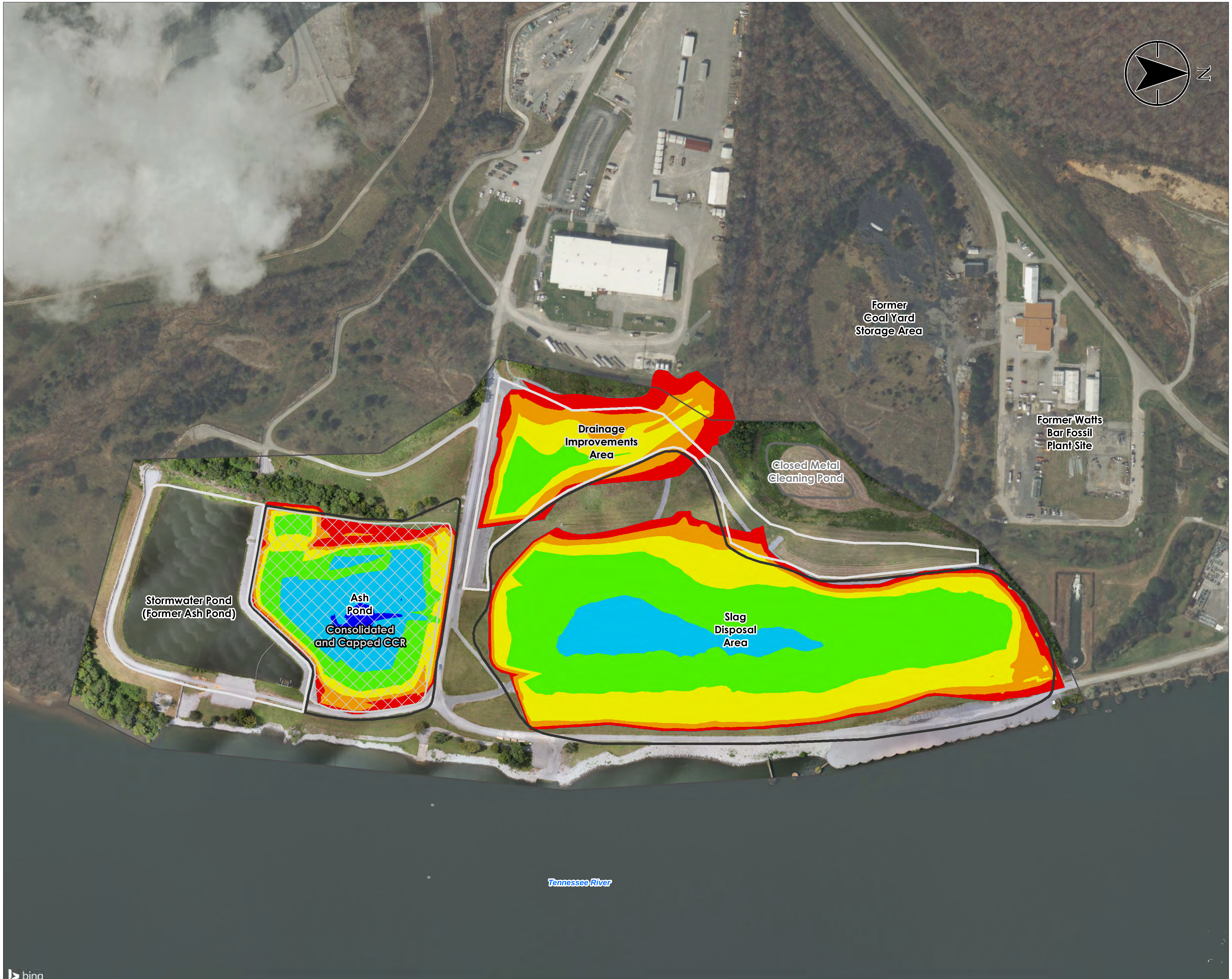


Exhibit No.

4-4

Title

Material Quantity Assessment Study Area Estimated Limits and Depths of CCR Material

Client/Project

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

Project Location 175668050

Spring City, Tennessee

Prepared by MB on 2023-09-14
Technical Review by EM on 2023-09-14

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

Legend

- 2018 Imagery Boundary
- CCR Management Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

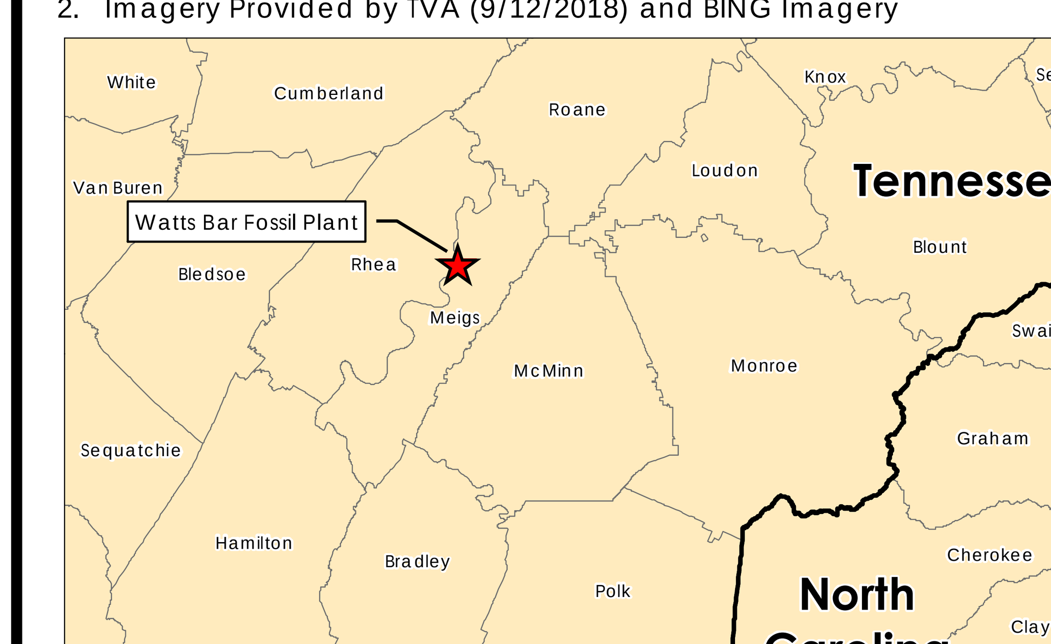
CCR: Coal combustion residuals

SUMMARY TABLE

NUMBER	MIN. DEPTH (FT)	MAX. DEPTH (FT)	AREA (AC)	COLOR
1	0.00	5.00	4.2	Red
2	5.00	10.00	4.4	Orange
3	10.00	15.00	8.0	Yellow
4	15.00	20.00	12.6	Green
5	20.00	25.00	4.5	Light blue
6	25.00	30.00	0.2	Blue

Notes

1. Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
2. Imagery Provided by TVA (9/12/2018) and BING Imagery



Stantec TVA

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Exhibit No.
5-1

Title
Groundwater Elevation Contour Map, Event #6 (July 6, 2020)

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

Project Location: Spring City, Tennessee
175668050
Prepared by DMB on 2023-03-20
Technical Review by MD on 2023-03-20

0 150 300 450 600 Feet
1:1,800 (At original document size of 22x34)

Legend

- Groundwater Investigation Monitoring Well groundwater elevation in feet above mean sea level (ft amsl)
- Other Monitoring Well groundwater elevation in ft amsl
- Piezometer, groundwater label in blue text, pore water label in yellow highlighted black text (e.g., WBF-B02C) (e.g., WBF-B02A)
- Temporary well in CCR pore water elevation in ft amsl; value not used for contouring
- Interpolated Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Groundwater Contour (5 ft interval; elevations are in ft amsl)
- Inferred Groundwater Flow
- Surface Stream Flow
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond)

CCR: Coal combustion residuals

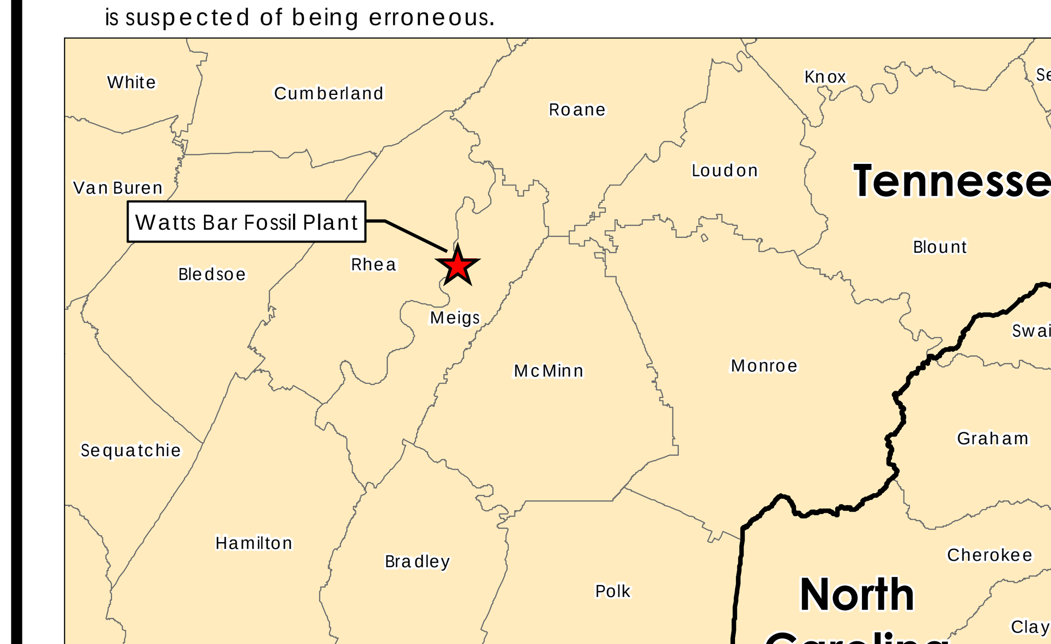
River Gauge (Not Shown - See Note 4) surface water elevation in ft amsl

*Groundwater elevation displayed but not used as input for contouring due to factors such as well construction or being screened in a different hydrogeologic unit.

*** Nested VWPZ sensors monitoring pore water and groundwater elevations in the same borehole, and the location is shown by a single symbol.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (9/12/2018) and BING Imagery
3. Groundwater contours were created using Surfer Version 16.1.350 (December 13, 2018) and manual adjustment
4. Surface water elevation is measured from the tailwater reading from Watts Bar Dam located ~4,000 ft North of well WBF-106
5. For PZ's with multiple instruments in CCR material, the reading with the highest pore water elevation is displayed, unless that reading is suspected of being erroneous.



Stantec TVA

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Exhibit No.

6-1

Title

Seep Investigation Areas of Interest and Water Quality Parameter Measurement Locations

Client/Project

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

Project Location

Spring City, Tennessee

175668050

Prepared by DMB on 2022-08-04
Technical Review by HW on 2022-08-04

0 150 300 450 600 Feet

1:1,800 (At original document size of 22x34)

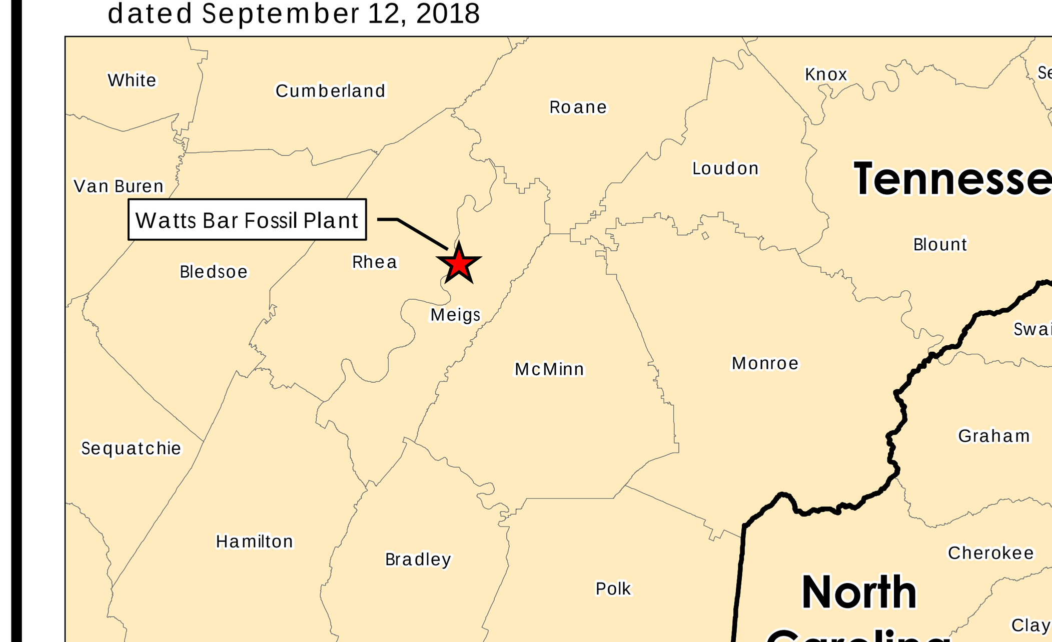
Legend

Measurement Locations

- Adjacent (A)
- Downstream (D)
- Upstream (U)
- Upstream Control (UC)
- Intermediate Area (IA)
- Historical Seep (HS)
- Area of Interest (AOI) Location
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Consolidated and Capped CCR Area (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

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



Stantec TVA

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Exhibit No.

7-1

Title

Fish Tissue Sampling Results Equal to or Above Critical Body Residue Values

Client/Project

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

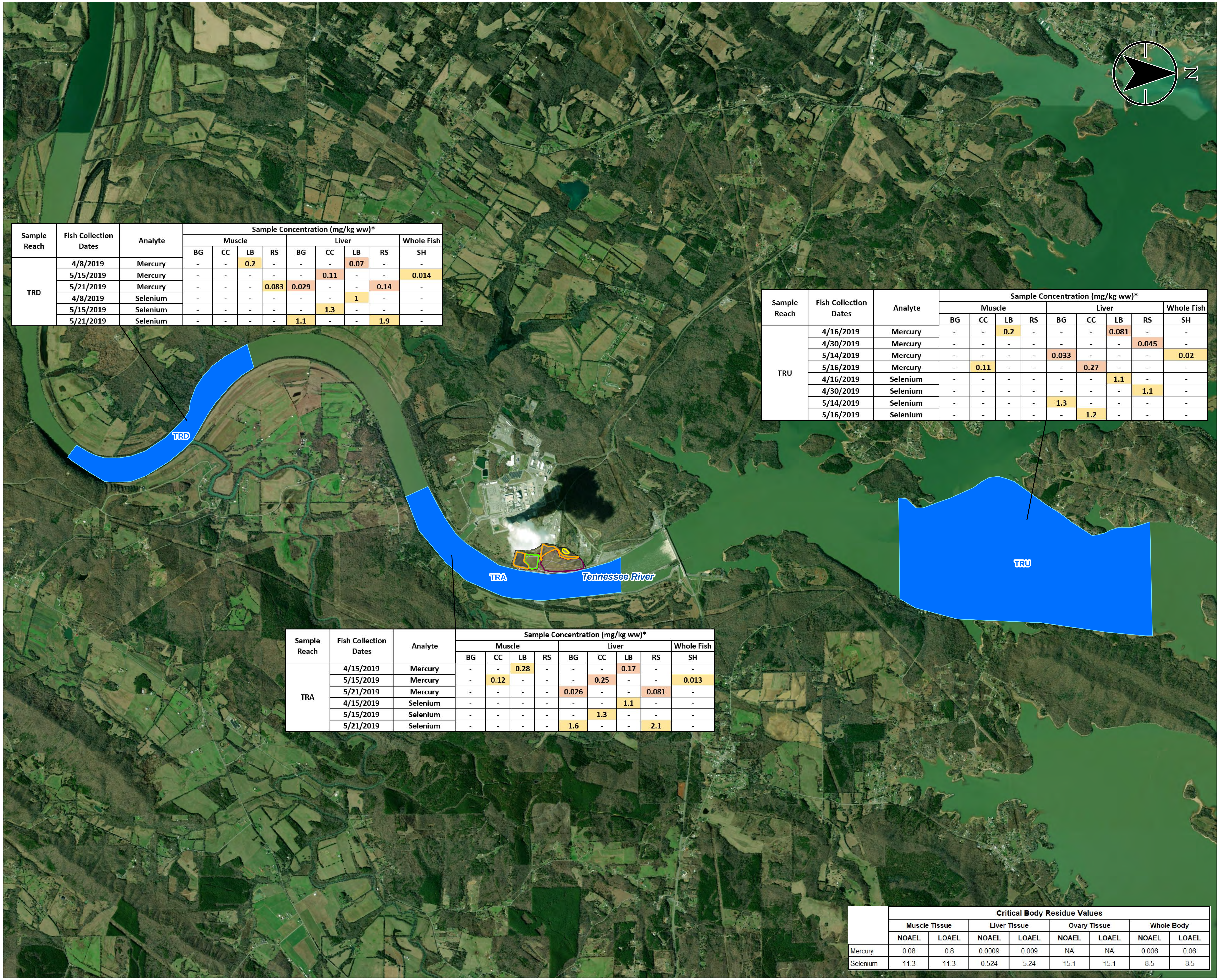
Project Location

Spring City, Tennessee

175668050
Prepared by MB on 2023-10-12
Technical Review by CA on 2023-10-12

0 2,000 4,000 6,000 8,000 Feet

1:24,000 (At original document size of 22x34)



Sample Reach	Fish Collection Dates	Analyte	Sample Concentration (mg/kg ww)*								
			Muscle				Liver				Whole Fish
			BG	CC	LB	RS	BG	CC	LB	RS	SH
TRD	4/8/2019	Mercury	-	-	0.2	-	-	-	0.07	-	-
	5/15/2019	Mercury	-	-	-	-	-	0.11	-	-	0.014
	5/21/2019	Mercury	-	-	-	0.083	0.029	-	-	0.14	-
	4/8/2019	Selenium	-	-	-	-	-	-	1	-	-
	5/15/2019	Selenium	-	-	-	-	-	1.3	-	-	-
	5/21/2019	Selenium	-	-	-	-	1.1	-	-	1.9	-

Sample Reach	Fish Collection Dates	Analyte	Sample Concentration (mg/kg ww)*								
			Muscle				Liver				Whole Fish
			BG	CC	LB	RS	BG	CC	LB	RS	SH
TRU	4/16/2019	Mercury	-	-	0.2	-	-	-	0.081	-	-
	4/30/2019	Mercury	-	-	-	-	-	-	-	0.045	-
	5/14/2019	Mercury	-	-	-	-	0.033	-	-	-	0.02
	5/16/2019	Mercury	-	0.11	-	-	-	0.27	-	-	-
	4/16/2019	Selenium	-	-	-	-	-	-	1.1	-	-
	4/30/2019	Selenium	-	-	-	-	-	-	-	1.1	-
	5/14/2019	Selenium	-	-	-	-	1.3	-	-	-	-
	5/16/2019	Selenium	-	-	-	-	-	1.2	-	-	-

Sample Reach	Fish Collection Dates	Analyte	Sample Concentration (mg/kg ww)*								
			Muscle				Liver				Whole Fish
			BG	CC	LB	RS	BG	CC	LB	RS	SH
TRA	4/15/2019	Mercury	-	-	0.28	-	-	-	0.17	-	-
	5/15/2019	Mercury	-	0.12	-	-	-	0.25	-	-	0.013
	5/21/2019	Mercury	-	-	-	-	0.026	-	-	0.081	-
	4/15/2019	Selenium	-	-	-	-	-	-	1.1	-	-
	5/15/2019	Selenium	-	-	-	-	-	1.3	-	-	-
	5/21/2019	Selenium	-	-	-	-	1.6	-	-	2.1	-

	Critical Body Residue Values							
	Muscle Tissue		Liver Tissue		Ovary Tissue		Whole Body	
	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL	NOAEL	LOAEL
Mercury	0.08	0.8	0.0009	0.009	NA	NA	0.006	0.06
Selenium	11.3	11.3	0.524	5.24	15.1	15.1	8.5	8.5

Legend

Fish Sampling Reaches: *TRU - Tennessee River Upstream*, *TRA - Tennessee River Adjacent*, *TRD - Tennessee River Downstream*

CCR Unit Area (Approximate)

Closed Metal Cleaning Pond (Approximate)

Consolidated and Capped CCR Area (Approximate)

Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)

Concentration > CBR NOAEL

Concentration > CBR LOAEL

Abbreviations:

BG	Bluegill
CC	Channel Catfish
LB	Largemouth Bass
RS	Redear Sunfish
SH	Shad

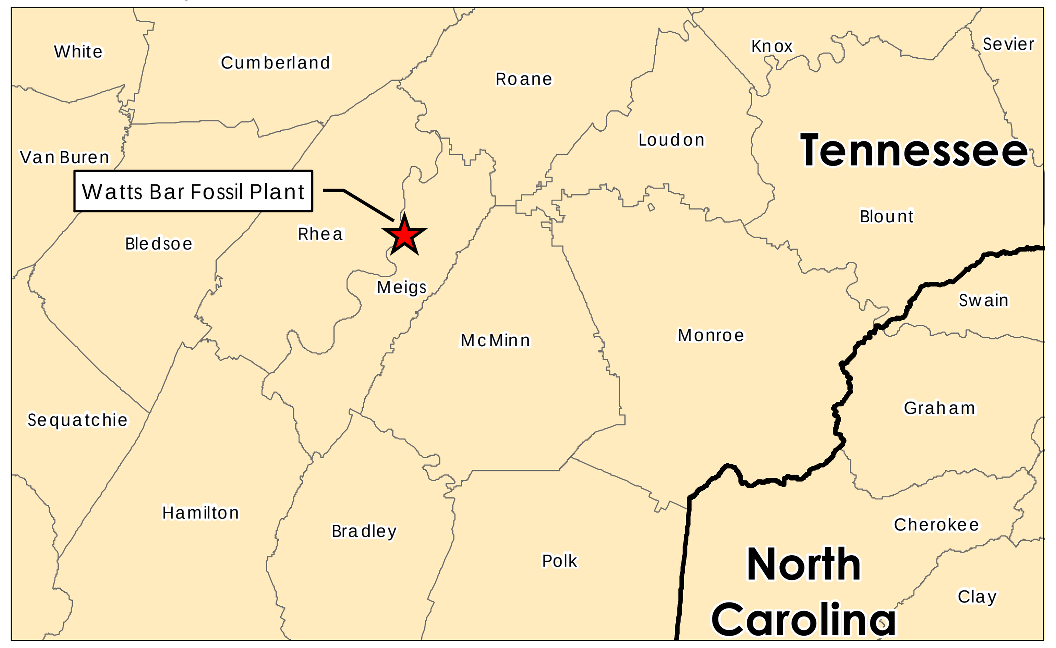
TR = Tennessee River
U = Upstream
A = Adjacent
D = Downstream

CBR - Critical Body Residue
NOAEL - No Observed Adverse Effects Value
LOAEL - Lowest Observed Adverse Effects Value

* Selenium concentrations reported as mg/kg wet weight (ww) for liver tissue and mg/kg dry weight for whole body, muscle, and ovary samples to permit direct comparison to the selenium CBRs for these tissues.

Notes

1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by ESRI Imagery; 2018 Imagery Provided by TVA and is dated September 12, 2018



Stantec TVA

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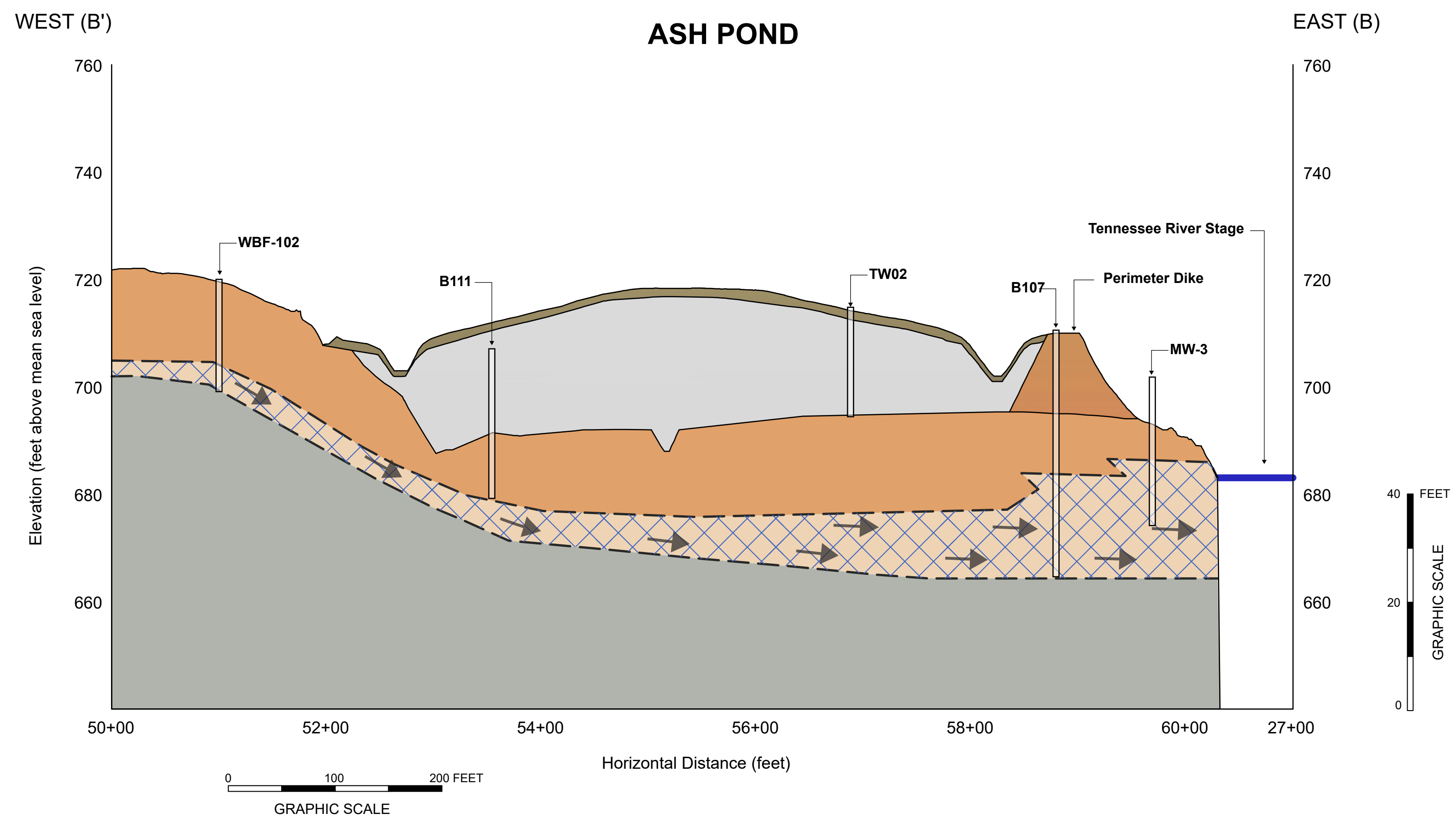


1 CCR Material

- CCR material is comingled CCR (stacked fly ash placed as part of closure, sluiced fly ash), and the estimated total volume of CCR based on the EI is about 190,000 cubic yards.
- The global slope stability and the veneer slope stability for the Ash Pond meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. As part of the CARA phase of the TDEC Order program, TVA will be evaluating mitigation alternatives.
- The structural integrity of the CCR management unit is adequate and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material.

2 Groundwater Quality

- Information and data from the EI indicate that the CCR material was unsaturated. This suggests that the cap is performing as expected and has effectively eliminated infiltration of precipitation into the CCR material.
- Most TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater are below GSLs. Cobalt in well MW-1 was detected above the GSL. This constituent will be further evaluated and addressed in the CARA Plan to determine if corrective actions are needed.

3 Potential Seep

- During the EI, no AOIs were identified.

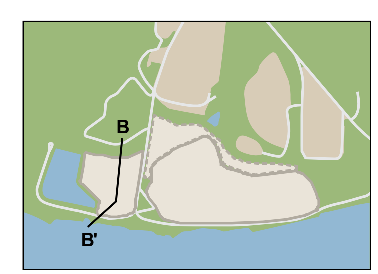
4 Surface Stream, Sediment and Ecology

- CCR Parameter concentrations in surface stream and sediment samples from the Tennessee River collected adjacent to and downstream of the CCR management unit were below ESVs.
- Based on the results of the EI and other ongoing ecological monitoring programs, operations at this CCR management unit have not impacted sediment and surface stream water quality, benthic macroinvertebrate communities, or Asiatic clam and fish tissues and populations in the Tennessee River.

Legend

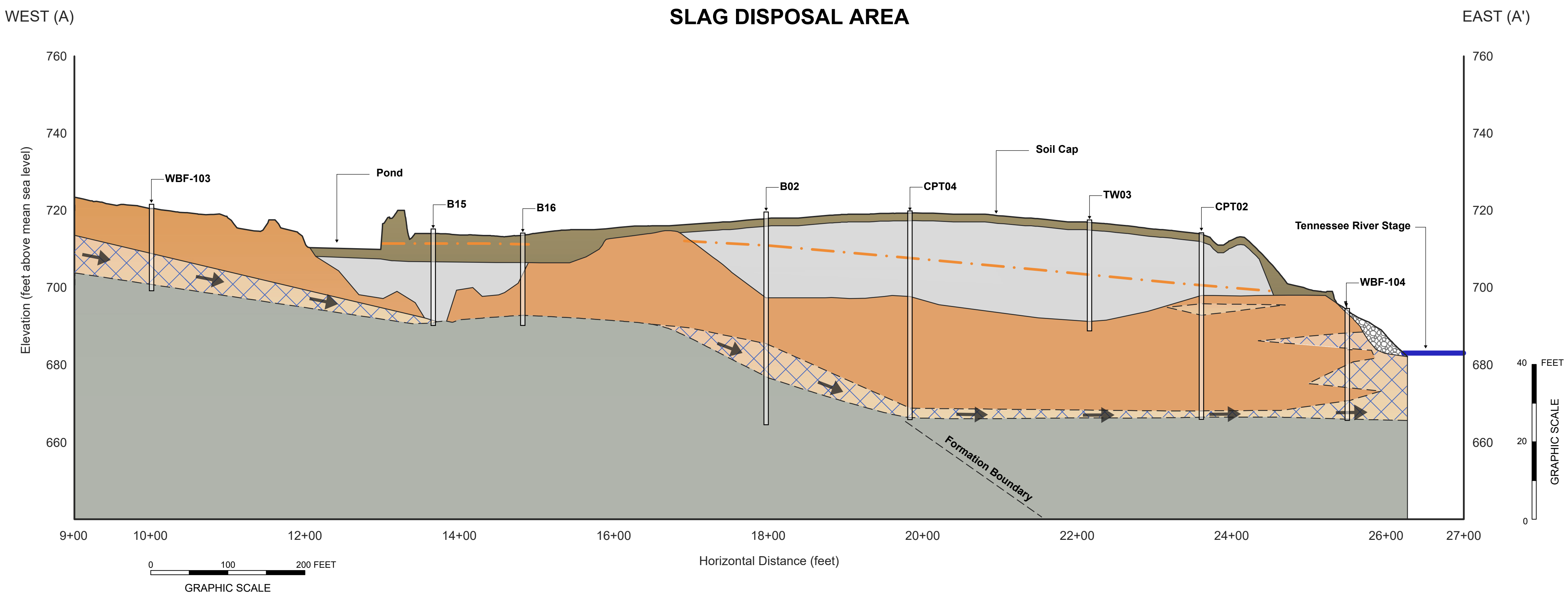
- Geosynthetic and Soil Cap
- CCR
- Perimeter Dike
- Primarily Clay
- Primarily Sand/Gravel
- Bedrock
- Generalized groundwater flow direction within the uppermost aquifer
- Uppermost aquifer

Notes:
Cross-section transect line is shown on Exhibit D-1.
AOI — Area of Interest
CCR — coal combustion residuals
EI — Environmental Investigation
ESV — Ecological Screening Value
GSL — Groundwater Screening Level



Stantec TVA

Exhibit No.
8-1
Title
ASH POND CROSS-SECTION B–B'
CONCEPTUAL SITE MODEL
Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order
Project Location
Spring City, Tennessee
175668050
Prepared by KB on 2023-09-28



1 CCR Material

- CCR material is comingled CCR (sluiced and stacked fly ash, bottom ash, and slag), and the estimated total volume of CCR based on the EI is about 570,000 cubic yards, which also includes the volume estimate for the Drainage Improvements Area.
- The global slope stability and the veneer slope stability for the Slag Disposal Area meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. As part of the CARA phase of the TDEC Order program, TVA will be evaluating mitigation alternatives.
- The structural integrity of the CCR management unit is adequate and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material.

2 Groundwater Quality

- The pore water phreatic surface was at an elevation higher than groundwater levels in the uppermost aquifer. An observed relationship between water levels in piezometers and precipitation events suggests that an adjacent pond may be losing water into the subsurface, which may be affecting pore water levels. Because of this finding, evaluation of drainage improvements to the area west of Slag Disposal Area will be part of the CARA Plan.
- The pore water levels reported herein may not represent steady-state conditions. The phreatic surface in the Slag Disposal Area would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.
- Most TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater are below GSLs. Cadmium in well WBF-104 and cobalt in wells WBF-104 and WBF-106 were detected above the GSLs. These constituents will be further evaluated and addressed in the CARA Plan to determine if corrective actions are needed.

3 Potential Seep

- Three AOIs (AOI02, AOI03, and AOI04) were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data, and using the supplemental investigation results, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed.

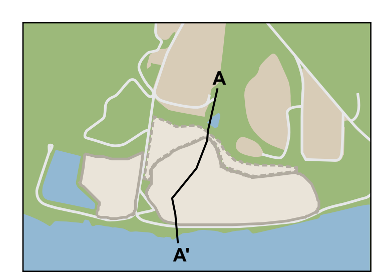
4 Surface Stream, Sediment and Ecology

- CCR Parameter concentrations in surface stream water and sediment samples from the Tennessee River collected adjacent to and downstream of the CCR management unit were below ESVs.
- Based on the results of the EI and other ongoing ecological monitoring programs, operations at this CCR management unit have not impacted sediment and surface stream water quality, benthic macroinvertebrate communities, or Asiatic clam and fish tissues and populations in the Tennessee River.

Legend

- Fill
- CCR
- Primarily Clay
- Primarily Sand/Gravel
- Bedrock
- Phreatic Surface Groundwater / Pore Water Gauging (July 6, 2020)
- Generalized groundwater flow direction within the uppermost aquifer
- Uppermost aquifer

Notes:
Cross-section transect line is shown on Exhibit D-1.
AOI — Area of Interest
CCR — coal combustion residuals
EI — Environmental Investigation
ESV — Ecological Screening Value
GSL — Groundwater Screening Level



Stantec TVA

Exhibit No.
8-2
Title
SLAG DISPOSAL AREA CROSS-SECTION A–A' CONCEPTUAL SITE MODEL
Client/Project
Tennessee Valley Authority
Watts Bar Fossil (WBF) Plant TDEC Order
Project Location
Spring City, Tennessee
175668050
Prepared by KB on 2023-09-28

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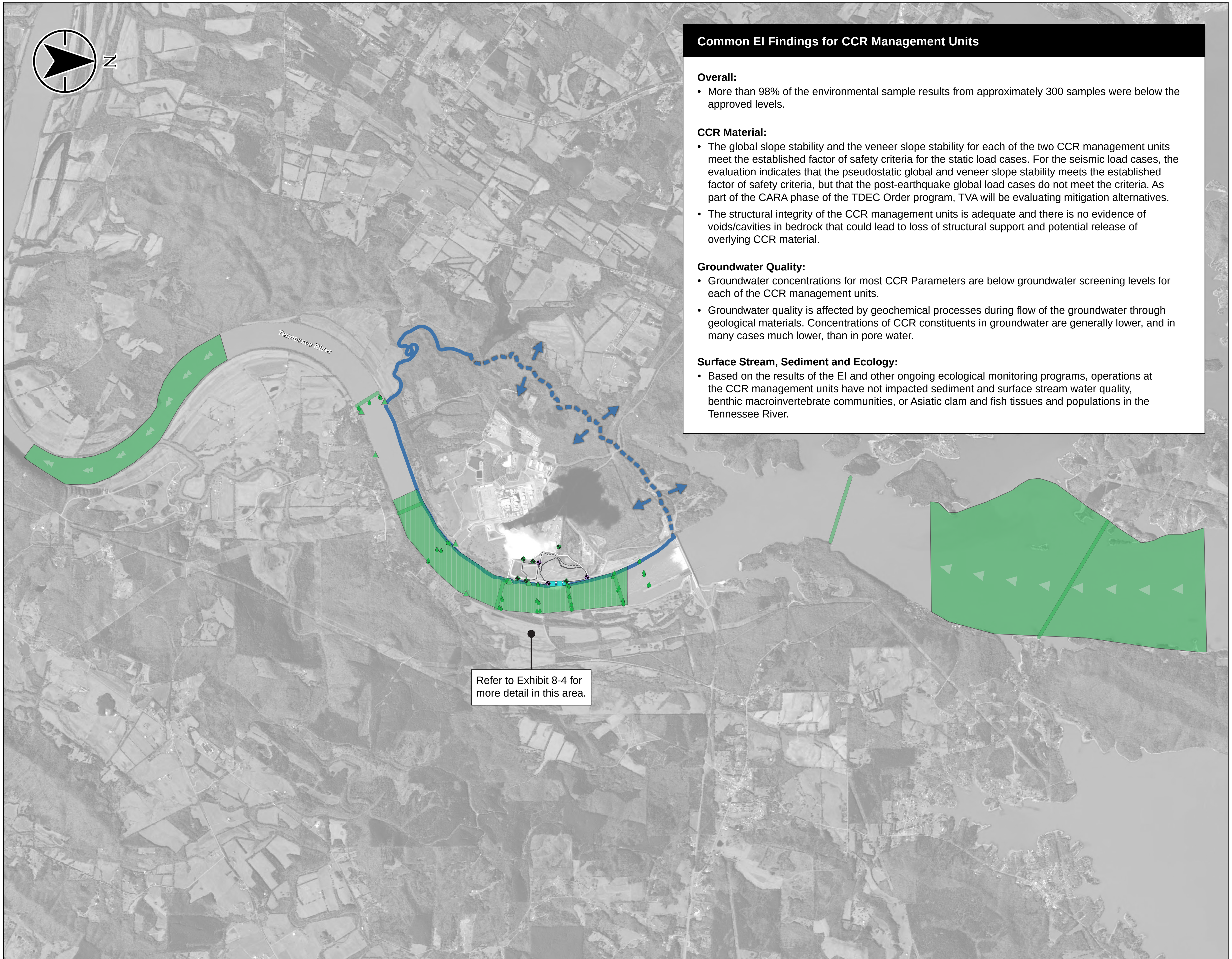

Common EI Findings for CCR Management Units

Overall:

- More than 98% of the environmental sample results from approximately 300 samples were below the approved levels.

CCR Material:

- The global slope stability and the veneer slope stability for each of the two CCR management units meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. As part of the CARA phase of the TDEC Order program, TVA will be evaluating mitigation alternatives.
- The structural integrity of the CCR management units is adequate and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material.

Groundwater Quality:

- Groundwater concentrations for most CCR Parameters are below groundwater screening levels for each of the CCR management units.
- Groundwater quality is affected by geochemical processes during flow of the groundwater through geological materials. Concentrations of CCR constituents in groundwater are generally lower, and in many cases much lower, than in pore water.

Surface Stream, Sediment and Ecology:

- Based on the results of the EI and other ongoing ecological monitoring programs, operations at the CCR management units have not impacted sediment and surface stream water quality, benthic macroinvertebrate communities, or Asiatic clam and fish tissues and populations in the Tennessee River.

Exhibit No.

8-3

Title

Overall Investigation Area Findings

Client/Project

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

Project Location: Spring City, Tennessee

175668050

Prepared by KB on 2023-06-06

0 2,000 4,000 6,000 8,000 Feet

Legend

- Area of Interest (AOI)
- Groundwater results below Groundwater Screening Levels
- Groundwater results above Groundwater Screening Levels
- Sediment sample results below Ecological Screening Values
- Surface water sample results below Ecological Screening Values
- Benthic macroinvertebrate community sampling transect (See Surface Stream, Sediment and Ecology note on exhibit)
- Upstream Asiatic clam and fish tissue sampling (See Surface Stream, Sediment and Ecology note on exhibit)
- Adjacent Asiatic clam and fish tissue sampling (See Surface Stream, Sediment and Ecology note on exhibit)
- Downstream Asiatic clam and fish tissue sampling (See Surface Stream, Sediment and Ecology note on exhibit)
- Surface stream that bounds groundwater flow
- Hydrogeological Divide
- Generalized groundwater flow direction
- 2018 Imagery Boundary
- CCR Unit Area (Approximate)

Abbreviations:

CCR: Coal combustion residuals
EI: Environmental Investigation

Imagery Provided by ESRI Imagery; 2018 Imagery Provided by TVA and is dated September 12, 2018

Stantec TVA

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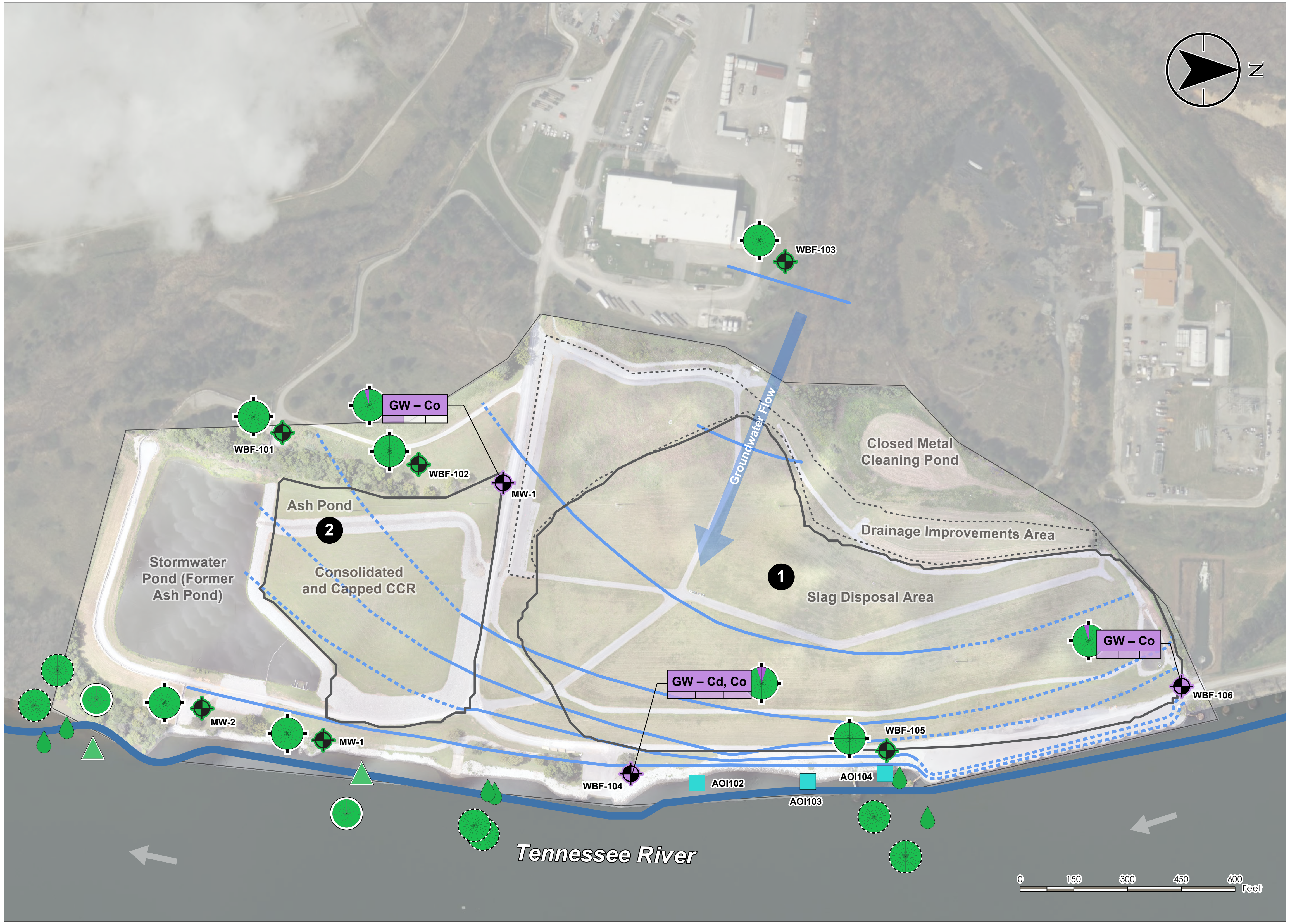

Potential groundwater and areas of interest described below will be further evaluated in the CARA Plan.

1 Slag Disposal Area

CCR Material:

- CCR material in this unit, which is capped, is comingled CCR (sluiced and stacked fly ash, bottom ash, and slag), and the estimated total volume of CCR based on the EI is about 570,000 cubic yards, which also includes the volume estimate for the Drainage Improvements Area.
- The global slope stability and the veneer slope stability for the Slag Disposal Area meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. As part of the CARA phase of the TDEC Order program, TVA will be evaluating mitigation alternatives.

Groundwater Quality:

- Cadmium in well WBF-104 and cobalt in wells WBF-104 and WBF-106 were detected above Groundwater Screening Levels.

Potential Seep:

- Three AOIs (AOI02, AOI03, and AOI04) were identified east of the Slag Disposal Area along the Tennessee River bank. Based on the EI data, and using the supplemental investigation results, these three AOIs will be further evaluated in the CARA Plan to determine if corrective actions are needed.

2 Ash Pond

CCR Material:

- CCR material in this unit, which is capped, is comingled CCR (stacked fly ash placed as part of closure, sluiced fly ash), and the estimated total volume of CCR based on the EI is about 190,000 cubic yards.
- The global slope stability and the veneer slope stability for the Ash Pond meet the established factor of safety criteria for the static load cases. For the seismic load cases, the evaluation indicates that the pseudostatic global and veneer slope stability meets the established factor of safety criteria, but that the post-earthquake global load cases do not meet the criteria. As part of the CARA phase of the TDEC Order program, TVA will be evaluating mitigation alternatives.

Groundwater Quality:

- Cobalt in well MW-1 was detected above the Groundwater Screening Level.

Potential Seep:

- No AOIs were identified during the EI.

Legend

Groundwater results below Groundwater Screening Levels

Groundwater results above Groundwater Screening Levels

Sediment / Surface water sample results below chronic Ecological Screening Values (ESVs)

Area of Interest (AOI)

GW – Groundwater
Cd – Cadmium
Co – Cobalt

Sections colored in the chart indicate the number of constituents at a sampling location above screening levels

Number of constituents compared:

Groundwater: 20

Tennessee River Sediment: 19

Tennessee River Surface Stream Water: 26

Counts represent total metals sample results. Total metals sample results less than screening levels (see Appendix J.1)

Interpolated Groundwater Contour

Groundwater Contour (5 ft interval; elevations are in ft amsl)

Surface stream that bounds groundwater flow

Hydrogeological Divide

Generalized groundwater flow direction

2019 Imagery Boundary

CCR Unit Area (Approximate)

CCR: Coal combustion residuals

1–4 X above screening levels

5–9 X above screening levels

>10 X above screening levels

Note: Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 5-2, Groundwater Elevation Contour Map Event #6 (July 6, 2020), for actual groundwater elevations and groundwater contours.

Imagery Provided by TVA (9/12/2018) and BING Imagery

Stantec TVA

Exhibit No.
8-4

Title
Overall Findings Near WBF Plant CCR Management Units

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

Project Location
Spring City, Tennessee
175668050
Prepared by KB on 2023-06-06

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