



TENNESSEE
VALLEY
AUTHORITY

WATTS BAR STEAM PLANT



Corrective Action/Risk Assessment Plan – DRAFT

Watts Bar Fossil Plant

Spring City, Tennessee

Tennessee Valley Authority

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 Watts Bar Fossil Plant
 Tennessee Valley Authority
 Spring City, Tennessee

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Table of Contents

EXECUTIVE SUMMARY	VI
ABBREVIATIONS.....	IX
CHAPTER 1 INTRODUCTION	1
1.1 TVA MISSION.....	1
1.2 BACKGROUND, SCOPE, AND OBJECTIVES.....	2
1.3 REGULATORY FRAMEWORK.....	3
1.3.1 TDEC Order.....	3
1.3.2 CCR Rule	4
1.3.3 State Programs.....	4
1.3.3.1 Harvesting for Beneficial Use.....	5
1.4 SUPPLEMENTAL INVESTIGATIONS AND ASSESSMENTS	5
1.5 KEY MILESTONES.....	7
1.6 REPORT ORGANIZATION	8
CHAPTER 2 SITE BACKGROUND	12
2.1 SITE OPERATIONS, CCR UNITS, AND LAND USE	12
2.1.1 CCR Unit Summary	12
2.1.1.1 Ash Pond.....	12
2.1.1.2 Slag Disposal Area	13
2.2 GEOLOGY, SURFACE WATER HYDROLOGY, AND HYDROGEOLOGY	13
2.2.1 Geology	13
2.2.2 Surface Water Hydrology.....	14
2.2.3 Regional Hydrogeology	14
2.2.4 Plant Hydrogeology	14
2.2.4.1 Hydrogeological Terms.....	14
2.2.4.2 WBF Plant Hydrogeology.....	16
2.2.5 Uppermost Aquifer and Groundwater Flow	21
CHAPTER 3 TDEC ORDER INVESTIGATION SUMMARY AND CONCEPTUAL SITE MODELS	24
3.1 CONCEPTUAL SITE MODEL	24
3.2 OVERALL ENVIRONMENTAL INVESTIGATION FINDINGS.....	24
CHAPTER 4 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT SUMMARY....	29
4.1 HUMAN HEALTH RISK ASSESSMENT	29
4.1.1 Onsite Worker.....	30
4.1.2 Offsite Resident	30
4.1.3 Offsite Recreational User.....	31
4.2 ECOLOGICAL RISK ASSESSMENT	32
4.2.1 Community Receptors	32
4.2.1.1 Tennessee River	32
4.2.2 Bird and Mammal Receptors	32
4.2.2.1 Tennessee River	33
4.3 SUMMARY OF HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT RESULTS	33

CHAPTER 5	BASIS AND METHODS OF CCR UNIT CLOSURE	34
5.1	GENERAL DESCRIPTION OF CLOSURE METHODS	35
5.1.1	Closure-In-Place	35
5.1.2	Closure-By-Removal	37
5.1.3	CCR Material Harvesting for Beneficial Use	38
5.2	STATE REGULATORY REQUIREMENTS	39
5.2.1	TDEC Order	39
5.2.2	TDEC DSWM	39
5.3	PEIS FINDINGS AND CONCLUSIONS	40
5.4	SITE-SPECIFIC ASSESSMENT OF CLOSURE METHODS	43
5.4.1	Prior CCR Unit Closure Evaluations	43
5.4.2	Two-Step Evaluation Approach	43
5.4.3	Key Site-Specific Considerations	43
5.4.4	Summary of Site-Specific Closure Method Assessment	45
5.5	PLANNED CCR UNIT CLOSURE METHOD	45
5.5.1	General Approach for Planned Closure Actions and Compliance with State Regulations	47
5.5.1.1	Compliance with State Regulations for Closure	49
5.5.2	CCR Unit-Specific Closure Actions	50
5.5.2.1	Ash Pond Closure-in-Place	51
5.5.2.2	Slag Disposal Area Closure-in-Place	53
5.6	CCR UNIT CLOSURE METHOD SUMMARY	57
CHAPTER 6	BASIS AND METHODS OF CCR UNIT CORRECTIVE ACTION	59
6.1	BASIS FOR GROUNDWATER CORRECTIVE MEASURES	59
6.2	GENERAL DESCRIPTION OF CORRECTIVE MEASURES	60
6.3	STATE REGULATORY REQUIREMENTS	61
6.3.1	TDEC Order	61
6.3.2	TDEC DSWM	61
6.4	SITE-SPECIFIC ASSESSMENT OF CORRECTIVE MEASURES	62
6.5	PLANNED CCR UNIT CORRECTIVE ACTIONS	63
6.5.1	Slag Disposal Area	65
6.5.1.1	Corrective Measures Considered and Assessed	65
6.5.1.2	Planned Corrective Action	66
6.6	CCR UNIT CORRECTIVE ACTION SUMMARY	69
CHAPTER 7	SUPPORTING PLANS	71
7.1	NATURAL RESOURCE RESTORATION PLAN	71
7.2	AIR AND WATER MONITORING PLANS	71
7.2.1	Groundwater Monitoring Plan	71
7.2.1.1	Sample Analyses and Frequency	72
7.2.1.2	Sampling Locations	72
7.2.1.3	Data Evaluation and Reporting	72
7.2.2	Performance Monitoring Plan and Adaptive Management Process	72
7.2.3	Surface Water Monitoring Plan	74
7.2.4	Air Monitoring Plan	74
7.2.5	AOI Monitoring Plan	74
7.3	WATER SUPPLY PROTECTION PLAN	74

7.4	SHORT- AND LONG-TERM MANAGEMENT OF CCR MATERIAL	74
7.4.1	Short-Term CCR Material Management Plan.....	74
7.4.2	Long-Term Management of CCR Material	75
CHAPTER 8	SUMMARY AND NEXT STEPS	76
8.1	SUMMARY OF PLANNED ACTIONS AND THEIR BASIS	76
8.2	PUBLIC INVOLVEMENT	80
8.3	CARA PLAN IMPLEMENTATION SCHEDULE	81
CHAPTER 9	REFERENCES	84

List of Tables

Table 1-1	Groundwater Protection Standards Established for the Corrective Action / Risk Assessment Plan
Table 5-1	TDEC Division of Solid Waste Management Closure Requirements
Table 5-2	Qualitative Assessment of Impacts of CIP vs CBR for the Ash Pond
Table 5-3	Qualitative Assessment of Impacts of CIP vs CBR for the Slag Disposal Area
Table 5-4	TDEC Division of Solid Waste Management Regulatory Compliance for Closure
Table 6-1	TDEC Division of Solid Waste Management Groundwater Requirements
Table 6-2	TDEC Division of Solid Waste Management Regulatory Compliance for Groundwater Corrective Action

List of Exhibits

Exhibit ES-1	Planned WBF Plant CCR Unit Closure and Corrective Actions, and Implementation Schedule
Exhibit 1-1	Site Location Plan and Topographic Map
Exhibit 2-1	WBF Plant Overview
Exhibit 2-2	Geologic Map
Exhibit 2-3	Faults and Topographic Relief
Exhibit 2-4a	Historical Stream Alignment (1935)
Exhibit 2-4b	Historical Stream Alignment (1942)
Exhibit 2-5	Groundwater Elevation Contour Map, Event #6 (July 6, 2020)
Exhibit 3-1	Ash Pond Cross Section B-B' Conceptual Site Model
Exhibit 3-2	Slag Disposal Area Cross Section A-A' Conceptual Site Model
Exhibit 3-3	Overall Study Area Findings
Exhibit 3-4	Overall Findings near WBF Plant CCR Units
Exhibit 5-1	Planned WBF Plant CCR Unit Closure Actions
Exhibit 5-2	Cross Section Transects of Modeled Long-Term Thickness of CCR Material Below Pore Water Phreatic Surface
Exhibit 5-3	Measured and Modeled Long-Term Pore Water Phreatic Surface Levels at the Slag Disposal Area
Exhibit 6-1	Planned WBF Plant CCR Unit Groundwater Corrective Actions
Exhibit 7-1	Planned Groundwater Monitoring System – Plant Wide
Exhibit 8-1	CARA Plan Implementation Schedule

List of Appendices

APPENDIX A	REGULATORY INFORMATION AND CORRESPONDENCE
APPENDIX A.1	TDEC ORDER
APPENDIX A.2	REGULATORY CORRESPONDENCE
APPENDIX B	HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT
APPENDIX C	CLOSURE METHOD ASSESSMENT
APPENDIX D	CORRECTIVE MEASURES ASSESSMENT
APPENDIX E	GROUNDWATER MONITORING PLAN
APPENDIX F	DESIGN DRAWINGS AND CLOSURE/POST-CLOSURE PLANS
APPENDIX F.1	DESIGN DRAWINGS
APPENDIX F.2	CLOSURE AND POST-CLOSURE PLANS
APPENDIX G	GROUNDWATER FLOW MODELING
APPENDIX H	GEOCHEMICAL MODELING
APPENDIX H.1	GEOCHEMICAL MODELING TECHNICAL MEMORANDUM
APPENDIX H.2	GEOCHEMISTRY INVESTIGATION FIELDWORK SUMMARY AND EVALUATION
APPENDIX I	<i>IN SITU</i> TREATMENT EVALUATION
APPENDIX I.1	BENCH SCALE <i>IN SITU</i> TREATMENT TESTING TECHNICAL MEMORANDUM
APPENDIX I.2	<i>IN SITU</i> TREATMENT INVESTIGATION FIELDWORK SUMMARY
APPENDIX I.3	<i>IN SITU</i> TREATMENT PILOT TESTING SUMMARY
APPENDIX J	GROUNDWATER EXTRACTION EVALUATION
APPENDIX K	PORE WATER EXTRACTION EVALUATION
APPENDIX L	WATER TREATMENT AND DISCHARGE EVALUATION
APPENDIX M	SEISMIC STABILITY MITIGATION EVALUATION

Executive Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

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. There are two CCR units at the Watts Bar Fossil Plant (WBF Plant) that were used for the management of CCR material included in the TDEC Order: the Ash Pond and Slag Disposal Area. Each of the WBF Plant CCR units was previously closed in accordance with applicable regulations in effect at the time of closure.

This Corrective Action / Risk Assessment (CARA) Plan has been prepared pursuant to the TDEC Order and specifies the basis and actions TVA plans to take at the WBF Plant CCR units, including actions related to closure of the CCR units and groundwater corrective action. The TDEC Order provides that the actions to be taken may include “(1) soil, surface water, and ground water remediation, (2) risk assessment and institutional controls, or (3) no further corrective action.”

The CARA Plan builds upon information gained during TVA's ongoing environmental monitoring programs as well as a comprehensive environmental investigation overseen by TDEC that included characterizing the site hydrogeology; collecting more than 300 samples of CCR material, groundwater, background soils, surface stream water, sediment, and ecological communities (e.g., fish); identifying and assessing potential seeps (herein referred to as Areas of Interest [AOIs]); and conducting a water use survey of offsite wells. Using these data, a risk assessment based on United States Environmental Protection Agency guidance was performed to evaluate potential risks to human and ecological receptors (e.g., fish) from potential exposures to CCR constituents related to the WBF Plant CCR units. Additionally, the investigation results were used to conduct site-specific assessments of CCR unit closure methods and groundwater corrective measure technologies to form the basis for TVA's planned closure approach and groundwater corrective actions identified in this CARA Plan.

TVA's mission is to supply affordable and reliable power to the people of the Tennessee Valley while protecting the natural resources of this region and supporting the communities we serve. TVA's goal within this CARA Plan is to make the best, most appropriate choices for closure and corrective action to ensure that the CCR units at the WBF Plant are safe, secure, and protective of human health and the environment, consistent with TVA's mission.

TVA evaluated two options in this CARA Plan for closure of the CCR units, Closure-in-Place (CIP) and Closure-by-Removal (CBR). CIP is performed by installing a cover system to isolate the underlying CCR material from exposure to surface runoff and infiltration, human and animal contact, and wind. CBR involves excavating and relocating the CCR material from the landfill or former impoundment to an approved onsite or offsite disposal facility. TVA also evaluated several alternatives to address groundwater quality at one CCR unit.

Executive Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Based on the comprehensive investigations and conclusions of the site-specific evaluations, TVA will complete CIP of the CCR units at the WBF Plant, with targeted groundwater corrective actions.

TVA believes that CIP of the CCR units, along with targeted groundwater corrective actions is the best way to safely and securely close the CCR units, achieve its mission, and comply with the TDEC Order and State regulations. TVA's plans, along with an implementation schedule, are shown in Exhibit ES-1 at the end of this summary. While not currently planned for the WBF Plant CCR units, TVA continues to evaluate means to beneficially use CCR material in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley.

Because each of the WBF Plant CCR units was previously closed in accordance with applicable regulations in effect at the time of closure, TVA will implement a collective set of additional closure actions to enhance the existing closures. To meet slope stability factors of safety, a toe berm buttress of rock riprap will be constructed along the riverbank of the Slag Disposal Area and Ash Pond. At the Slag Disposal Area and adjacent Drainage Improvements Area, TVA will install an engineered geosynthetic cover system over both areas and implement drainage modifications. To further limit infiltration into the Slag Disposal Area and Drainage Improvements Area, TVA plans additional actions at two upgradient locations. At the Former Coal Yard Storage Area, remnant coal was removed by TVA in 2024/2025, and the area will be regraded and revegetated. At an upgradient ponded area, the area will be filled, regraded and a geosynthetic liner will be installed. Installation of geosynthetic cover systems and implementation of upgradient drainage modifications are expected to mitigate the three AOIs identified along the bank of the Tennessee River. Based on the demonstrated effectiveness of the existing geosynthetic cover system at the Ash Pond, TVA is not planning additional cover system or drainage modifications at this CCR unit.

In addition to these closure actions, TVA will implement corrective actions to meet groundwater protection standards (GWPS) at the Slag Disposal Area. The human health and ecological risk assessment concluded that there are no unacceptable risks to offsite human or ecological receptors at the WBF Plant; therefore, corrective action is only required for groundwater to attain GWPS consistent with regulatory requirements. No corrective action is needed or required at the Ash Pond because groundwater quality at this CCR unit already meets GWPS. Based on the evaluations conducted as part of this CARA Plan, hydraulic control using groundwater extraction and treatment will be conducted at the Slag Disposal Area at two locations along its eastern downgradient perimeter.

The wide-ranging, site-specific evaluations presented in this CARA Plan provide a clear basis for TVA's planned continuation of CIP with targeted groundwater corrective actions for the WBF Plant CCR units. CIP and the planned corrective actions are consistent with TVA's mission, protect the people and resources of the Tennessee Valley, are compliant with State regulations, and are the most appropriate actions when considering and balancing all relevant factors.

Executive Summary

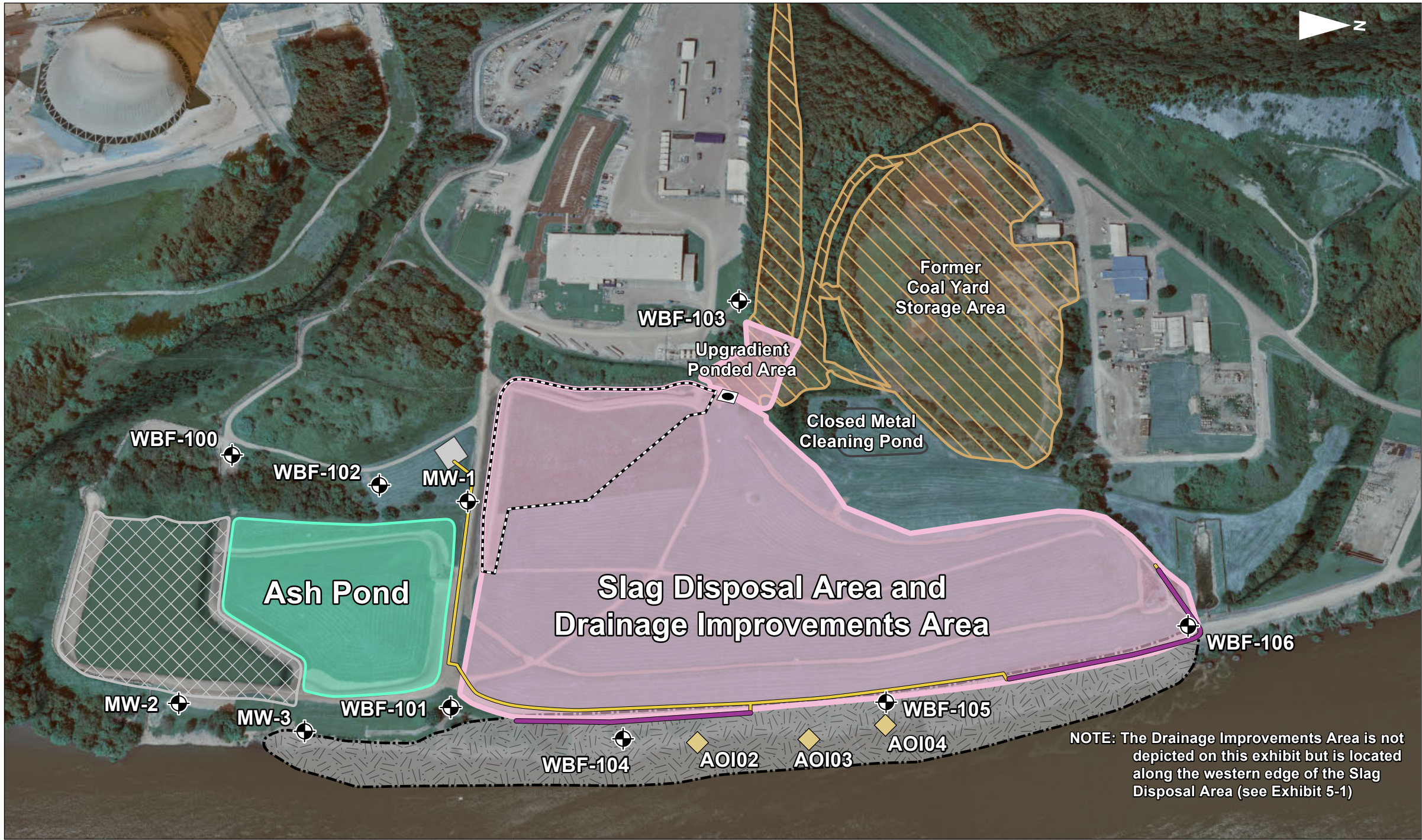
Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

The reasons why TVA is planning these closure and corrective actions (i.e., the basis for closure and corrective action) are provided below:

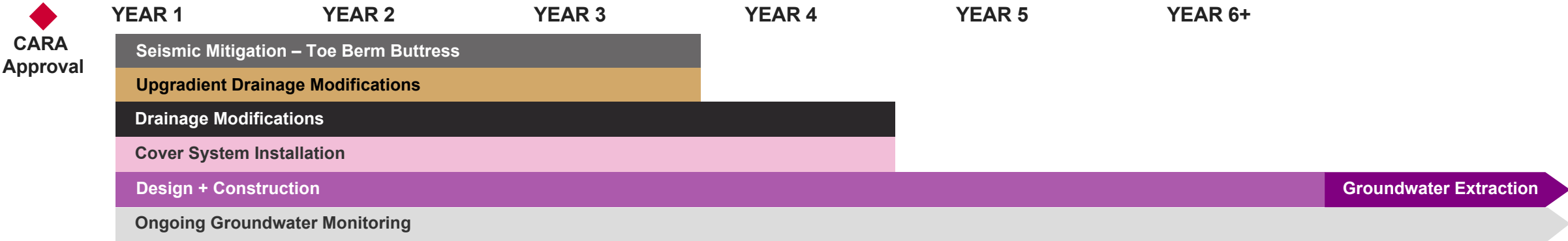
- **CIP is environmentally more beneficial than CBR**, particularly for the WBF Plant CCR units where nearly 760,000 cubic yards of CCR material would have to be removed and transported to an offsite landfill.
- **Compared to CIP, CBR results in greater adverse impacts** related to transportation and construction, particularly climate change and greenhouse gas emissions, worker and transportation safety, and potential impacts to nearby communities with environmental justice concerns.
- **Once closure begins, CBR would require five to six years to complete compared to three years required for CIP** for the two CCR units.
- **CIP meets or exceeds the closure performance standards** required by TDEC regulations.
- **Geosynthetic cover systems are effective** in controlling, minimizing or eliminating infiltration through the cover system as demonstrated at the Ash Pond.
- **Once the toe berm buttress is constructed, the CCR units will meet the established slope stability factors of safety** during closure, the post-closure period, and beyond.
- **Groundwater extraction and treatment is a reliable, proven technology** for hydraulic control that is expected to attain GWPS within a few years after implementation and would maintain this condition until effects of source control make it unnecessary.
- **There are no onsite or downgradient offsite uses of groundwater as a drinking water source.**
- **There are currently no unacceptable risks to offsite human or ecological receptors, and this will continue during closure, corrective action, and beyond.**

With no unacceptable risks related to Closure-in-Place, Closure-by-Removal is not necessary or justified with its longer timeline to complete closure, greater overall environmental impacts, and higher cost.

Closure-in-Place along with targeted groundwater corrective actions is the best solution to protect the people and resources of the communities near the WBF Plant consistent with TVA's mission.



CARA Plan Implementation Timeline



Legend

- Dewatering Pump
- Area of Interest
- Groundwater Monitoring Well
- Drainage Modifications
- Groundwater Extraction and Treatment
- Water Treatment Pipeline
- Water Treatment System Design To Be Determined
- Existing Geosynthetic Cover System
- Planned Geosynthetic Cover System Modification or Extension
- CCR Material Removed
- Seismic Mitigation - Toe Berm Buttress
- Upgradient Drainage Modifications

NOTE: Closure actions and groundwater corrective actions are based on design drawings in Appendix F.1.



Abbreviations

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Abbreviations

AOI	Area of Interest
CARA	Corrective Action/Risk Assessment
CBR	Closure-by-Removal
CCR	Coal Combustion Residuals
CCR Rule	USEPA Final Rule on Disposal of Coal Combustion Residuals from Electric Utilities
CIP	Closure-in-Place
CPT	Cone Penetrometer Test
CSM	Conceptual Site Model
DSWM	TDEC Division of Solid Waste Management
EAR	Environmental Assessment Report
EI	Environmental Investigation
EIP	Environmental Investigation Plan
EPRI	Electric Power Research Institute
GHG	Greenhouse Gas
GWPS	Groundwater Protection Standard(s)
HHERA	Human Health and Ecological Risk Assessment
KRP	Kingston Recovery Project
LLPDE	Linear Low-Density Polyethylene
LOE	Lines of Evidence
MCL	Maximum Contaminant Level
MNA	Monitored Natural Attenuation
NEPA	National Environmental Policy Act
NPDES	National Pollutant Discharge Elimination System
NRS	Non-Registered Site
PEIS	Programmatic Environmental Impact Statement
%	Percent
SSLs	Statistically Significant Levels
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	TDEC Commissioner's Order OGC15-0177
TMSP	Tennessee Storm Water Multi-Sector General Permit
TRV	Toxicity Reference Value
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
WBF Plant	Watts Bar Fossil Plant

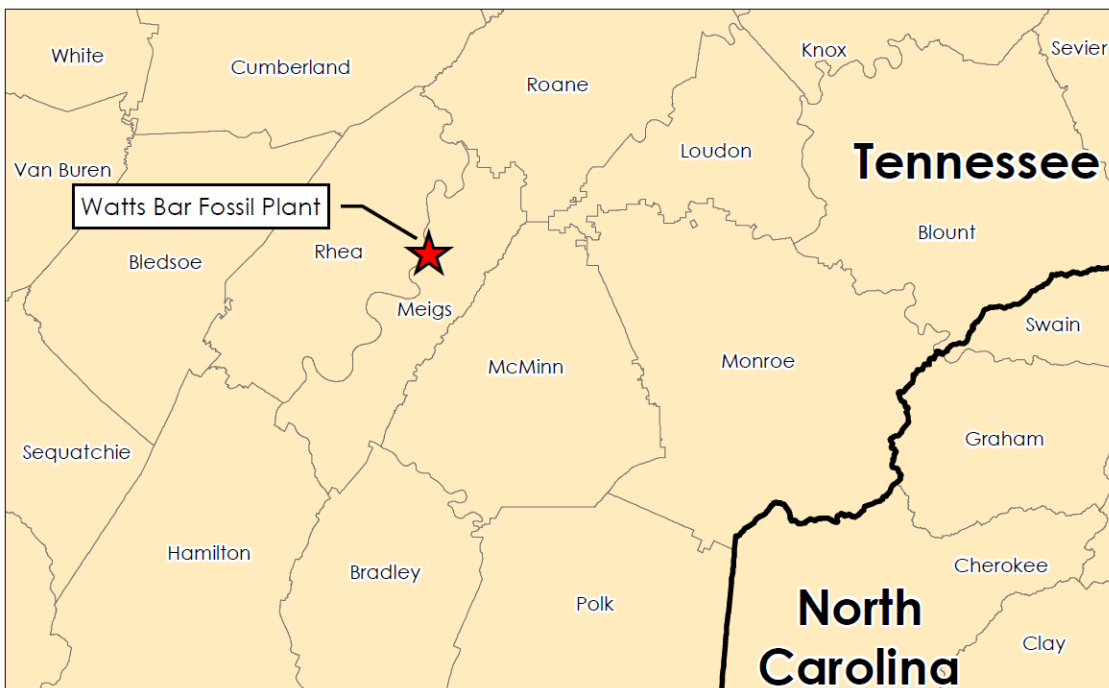
Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 1 Introduction

The Tennessee Valley Authority (TVA) and Stantec Consulting Services Inc. (Stantec), on behalf of TVA, prepared this Corrective Action / Risk Assessment (CARA) Plan to specify the basis and actions TVA plans to take related to closure and groundwater corrective action for the coal combustion residuals (CCR) units at the Watts Bar Fossil Plant (WBF Plant) in Spring City, Tennessee. The WBF Plant is a retired TVA coal-fired power plant in Rhea County, located in east Tennessee (see below and Exhibit 1-1).

WBF Plant Location



1.1 TVA Mission

TVA's mission is just as relevant today as it was nine decades ago when Congress created TVA: harness the potential of the rich resources in the Tennessee Valley region to make life better for the people who call it home. We are inspired daily to pursue new ideas and innovative solutions to improve our service to the people of the Valley. The 10,000 employees of TVA form an experienced, talented team committed every day to improve the quality of life for the approximately 10 million people we serve.

Energy:

- TVA generates safe, clean, reliable and affordable power for the region's homes and businesses, working with local power companies to keep service steady and reliable.
- We deliver power at the lowest feasible cost for all our customers while keeping TVA power safe and reliable.

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Our mission is unchanged from its 1933 roots—we serve the people of the Tennessee Valley to help the region thrive and grow.

Environment:

- TVA’s mission of service includes being stewards of the region’s natural resources, including its waterways and surrounding lands.
- We manage the thriving Tennessee River system to provide multiple benefits to the people we serve—including flood control, recreation and power production—and ensure that our region will be a safe, healthy and beautiful place to live and play for years to come.

Economic Development:

- From the beginning, TVA was charged with giving the people of the Tennessee Valley region a better opportunity to prosper.
- Today, we work with partners across the region to help bring new investments and good jobs to the region and keep them here.
- Our reliable, low-cost safe, and clean electricity helps the region recruit industry and keeps power bills lower for our homes, businesses and industries.

These core principles guide decision making for all facets of TVA, including management of CCR material, while providing affordable and reliable power to the people of the Tennessee Valley.

1.2 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 2015a, in Appendix A.1). There are two CCR units at the WBF Plant that were used for the management of CCR material included in the TDEC Order: the Ash Pond and Slag Disposal Area. In accordance with the TDEC Order, TVA prepared an Environmental Investigation Plan (EIP) for the WBF Plant (TVA 2018) 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 unit structural stability and integrity. Between 2019 and 2021, TVA and Stantec implemented environmental investigation (EI) activities in accordance with the approved EIP. The EI included characterization of the site hydrogeology and investigations of CCR material, groundwater, background soils, potential seeps (herein referred to as Areas of Interest [AOIs]), surface streams, sediments, and ecology.

The WBF Plant Environmental Assessment Report (EAR) ([Watts Bar Environmental Assessment Report \(tva.com\)](https://www.tva.com/watts-bar-environmental-assessment-report)) presents the results of those investigations, describes the extent of surface stream water, sediment, and groundwater impacts, if any, from the WBF Plant CCR units, and provides the information, data, and evaluations used to make those assessments. The EAR identifies geotechnical analysis findings, and environmental sampling results above TDEC-approved screening levels in specific media, that require further evaluation in the CARA Plan to determine whether unacceptable risks exist that require corrective action. Most TDEC-approved EAR screening levels are not regulatory standards and are conservatively based on published health studies (Stantec 2021). Following completion of the EI, TVA

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

conducted supplemental investigations and assessments to support the information presented herein. As such, information in this CARA Plan is based on EI data, TDEC Order groundwater investigations, results from other ongoing environmental programs through October 2022, and additional data from supplemental investigations through 2024.

This CARA Plan has been prepared pursuant to the TDEC Order and specifies the basis for and actions TVA plans to take at the WBF Plant CCR units. These actions include those related to unit closure, improving groundwater quality where needed, and mitigating unacceptable risks to human health and the environment, if present. Improving groundwater quality and mitigating unacceptable risks are accomplished by implementing a corrective action. More simply, a ‘corrective action’ is how TVA proposes to improve soil, surface water, or groundwater quality to address unacceptable risks, or to comply with groundwater regulatory requirements.

The actions included in this CARA Plan have been developed and evaluated based on regulatory requirements that govern CCR unit closure activities and groundwater protection, herein respectively called ‘performance standards’ and ‘groundwater protection standards’ (GWPS). The GWPS established for the CARA Plan are based on regulatory standards (see Chapter 6) and are presented in Table 1-1. The regulatory framework applicable to the CARA Plan is described in Chapter 1.3 below. To determine the need for corrective action in sediment and surface water, the CARA Plan also includes an evaluation of potential risks to human health and ecological receptors at and near the WBF Plant. The WBF Plant Human Health and Ecological Risk Assessment (HHERA) (Appendix B) was prepared based on guidance published by the United States Environmental Protection Agency (USEPA), and is included as Appendix B.

Finally, as specified in the TDEC Order, the CARA Plan is subject to a public review and comment process and will not be finalized for TDEC approval until consideration of public comments is complete.

1.3 Regulatory Framework

The onsite management of CCR material and closure of the CCR units at the WBF Plant are subject to the following regulatory standards and requirements. Specific requirements in applicable regulations and orders governing CCR unit closure and corrective actions are presented in Chapters 5 and 6, respectively.

1.3.1 TDEC Order

The TDEC Order was issued under the authority of the Tennessee Solid Waste Disposal Act to establish a process for investigating, assessing, and remediating unacceptable risks from management of CCR material at TVA coal-fired plants in the state of Tennessee. TDEC Order requirements for unit closure and remediation of unacceptable risks are applied to the two CCR units at the WBF Plant in this CARA Plan. The TDEC Order states:

“The CARA Plan shall specify all actions TVA plans to take at the site and the basis of those actions. Corrective measures may include (1) soil, surface water, and ground water remediation, (2) risk assessment and institutional controls, or (3) no further corrective action. As appropriate for the site, the final approved CARA Plan shall include:

- i. The method(s) TVA will employ to remove and/or close in place CCR material at the site;
- ii. The method(s) TVA will employ to remediate CCR contaminated soil, surface water, and ground water at the site;
- iii. The method(s) TVA proposes to restore any natural resources damaged as a result of the CCR waste water treatment and on-site CCR disposal:

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- iv. A plan for monitoring the air and water in the area during the cleanup process;
- v. A plan to ensure that public and private water supplies are protected from CCR contamination and that alternative water supplies are provided to local citizens if CCR contamination above ground water protection standards is detected in ground water drinking wells; and,
- vi. A plan addressing both the short term and long term management of CCR at the site, including remediation and stabilization of the CCR surface impoundment(s) and/or landfill and/or non-registered disposal site(s), to include design drawings and appropriate supporting engineering calculations.”

Also, the TDEC Order requires that the CARA Plan include a schedule of activities to be completed, and that there is a public input process on the draft CARA Plan before it is approved by TDEC.

1.3.2 CCR Rule

The CCR Rule sets forth national criteria for the management of CCR material, was published by the USEPA on April 17, 2015, and can be found in Title 40, Code of Federal Regulations (40 CFR) Part 257, Subpart D (CCR Rule, USEPA 2015a). The two CCR 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 material and were closed prior to October 19, 2015, which was the effective date of the CCR Rule requirements.

On May 8, 2024, USEPA published a rule amending the CCR Rule and setting national criteria for two additional categories of CCR units: legacy CCR surface impoundments and CCR management units (CCR Legacy Rule, USEPA 2024). This new rule is effective on November 8, 2024. TVA is in the beginning stages of determining its compliance obligations under the CCR Legacy Rule. Any requirements in the CCR Legacy Rule that apply to the CCR units at the WBF Plant will be executed in accordance with the rule.

CCR Rule and CCR Legacy Rule closure and groundwater protection requirements are not specifically addressed in this CARA Plan, which is governed by the TDEC Order and State law. The closure performance standards and groundwater requirements addressed by the TDEC Order and State law are generally consistent with, and similar to, those in the CCR Rule and CCR Legacy Rule. Both sets of regulations are focused on protecting human health and the environment, ensuring that groundwater protection standards are met, and safely closing CCR units.

1.3.3 State Programs

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

- Tennessee Storm Water Multi-Sector General Permit (TMSP) Tracking No. TNR058427. Notice of Coverage under the General National Pollutant Discharge Elimination System (NPDES) Permit for stormwater discharges associated with industrial activity. Stormwater discharges are to the Chickamauga Reservoir via Outfalls F02 and F03 (which includes discharges from the Equipment Support Services facility, the closed Slag Disposal Area, the closed Ash Pond, and Stormwater Pond).

TDEC Division of Solid Waste Management (DSWM) designated the Ash Pond as Non-Registered Site No. 72-0010.

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

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

NPDES Permit No. TN0005461 for the Ash Pond required the completion of the *Ash Pond Closure Plan* (TVA 2013). This plan included post-closure care activities such as regular inspections of cover and drainage systems and implementation of a groundwater monitoring program to be conducted in accordance with DSWM regulations.

Groundwater monitoring results are currently reported to TDEC at the intervals specified in the *Ash Pond Closure Plan* (TVA 2013).

Under TMSP permit tracking No. TNR058427, outfall monitoring results are recorded and submitted annually to TDEC's Division of Water Resources.

1.3.3.1 Harvesting for Beneficial Use

The USEPA encourages the beneficial use of CCR material because the practice can result in environmental, economic, and product benefits. CCR material use replaces the need for virgin materials removed from the earth, thereby conserving natural resources and lowering greenhouse gas (GHG) emissions. CCR material can also improve the strength and durability of materials and reduce economic costs for CCR material disposal (USEPA 2023). Companies purchase and use CCR material as a replacement for Portland cement in concrete and to manufacture products like wallboard and roofing shingles that are used in construction projects across the United States. CCR material is also used for the construction of buildings, roads, driveways, airport runways, bridges, and dams. Notable national monuments and infrastructure built with construction materials that included CCR material are the Oakland Bay Bridge, Hoover Dam, One World Trade Center, and the Washington DC Metro.

Beneficial use of CCR material in Tennessee is regulated by TDEC. Companies located in the Tennessee Valley that currently purchase TVA CCR material to incorporate into their products include Smyrna Ready Mix and Georgia-Pacific. These companies have strategically located their manufacturing plants near TVA plants resulting in jobs and other economic benefits to the Tennessee Valley. CCR material produced by TVA has been used in the construction materials for multiple projects in the Tennessee Valley including the concrete for the Riverwalk parking garage in Knoxville and the University of Tennessee Student Union building.

1.4 Supplemental Investigations and Assessments

Supplemental investigations, approved by TDEC, were conducted after completion of EI activities to provide additional data or information to support the CARA Plan. Additional investigations under separate regulatory programs also provided useful data for the CARA Plan. Additional assessments, including potential technology evaluations and groundwater flow and geochemical modeling, were performed to identify closure actions and corrective measure technologies that would meet or exceed regulatory performance standards and attain GWPS (Table 1-1).

Closure Method Assessment: The objective of this assessment was to provide a relative impact analysis of Closure-in-Place (CIP) and Closure-by-Removal (CBR) to support the closure plans provided for each CCR unit in this CARA Plan. The assessment qualitatively evaluated 22 resource areas (e.g., air quality, surface water, transportation) as well as cumulative impacts and cost, and summarized the conclusions for each CCR unit. TVA's 2016 Programmatic Environmental Impact Statement (PEIS) identified these 22 resource areas as potentially being impacted by the closure

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

alternatives considered. The evaluations of the potential impacts to each resource area are high-level qualitative analyses of existing environmental information from reports referenced in this CARA Plan, and where available, demographic, socioeconomic, environmental justice, and transportation information.

Corrective Measures Assessment: The overall objective of the corrective measures assessment was to identify corrective measure(s) to address unacceptable risks or regulatory compliance requirements within environmental media affected by WBF Plant CCR units. The corrective measures assessment used information obtained from the EI and other ongoing programs, including information gained through the supplemental investigations described below, to evaluate corrective measure technologies that can potentially meet applicable regulatory standards (i.e., attainment of GWPS, as discussed in Chapter 6.1). Retained technologies were developed into corrective measure alternatives. Generally, to select a corrective measure alternative, the alternatives were evaluated based on a range of factors such as effectiveness, certainty of success, implementability, and community concerns. Planned corrective measures must also satisfy regulatory standards.

Groundwater Flow Modeling: The overall objective of the modeling activities was to create a quantitative tool capable of predicting groundwater flow under varying conditions to evaluate groundwater management scenarios and corrective measure strategies for the WBF Plant. Specific objectives included developing and calibrating a numerical groundwater flow model, simulating baseline groundwater flow conditions to reflect the hydrogeologic conceptual site model (CSM) and providing a framework for predictive modeling simulations to support the CARA Plan.

Geochemical Modeling: The purpose of the geochemical modeling activities was to evaluate potential source control measures and inform potential groundwater corrective measures using site-specific geochemical data from the WBF Plant. To support the geochemical modeling, an investigation was conducted to collect additional site-specific data to supplement the dataset collected during the EI. The scope of work included collection of soil and groundwater samples for analysis of geochemical constituents and parameters, evaluation of analytical data for use in the geochemical model, and evaluation of geochemical model outputs for groundwater corrective measure options.

In Situ Treatment Evaluation: Treatability testing was performed to evaluate the viability of using *in situ* treatment as a corrective measure technology to address cobalt and cadmium in groundwater at concentrations above GWPS. The testing evaluated various reagents and processes to promote cobalt and cadmium attenuation in a laboratory setting prior to a field application. Additionally, *in situ* delivery methods were evaluated for the reagents based on types of reagents, treatment configurations, site conditions, and operational constraints. As part of this evaluation, supplemental *in situ* groundwater treatment investigations were conducted to augment the dataset collected during the EI. The scope of work included drilling and sampling of soil and the collection of bulk groundwater samples for use in treatability testing. *In situ* treatment pilot testing activities were conducted as part of the CARA Plan to determine if full-scale implementation of the *in situ* treatment technology would be feasible and effective at the Slag Disposal Area CCR unit. Results of the pilot testing are included in Appendix I.3 of the CARA Plan.

Groundwater Extraction Evaluation: The objective of the groundwater extraction evaluation was to assess available groundwater extraction technologies that can hydraulically control groundwater in the uppermost aquifer in areas with CCR constituents at statistically significant concentrations above the GWPS. The evaluation included the rationale and design of the groundwater extraction systems being considered.

Pore Water Extraction Evaluation: The purpose of the pore water extraction evaluation was to assess pore water removal (extraction) technologies that may lower the phreatic surface (as defined in Chapter 2.2.4) within and adjacent to one WBF Plant CCR unit. The evaluation included a summary of the design considerations used to identify suitable active

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

pore water extraction systems and a review and comparison of the technologies considered to be suitable for the long-term pore water extraction at the CCR unit. Based on site-specific conditions at the CCR unit, specific active pore water extraction technologies were identified, where applicable.

Seismic Stability Mitigation Evaluation: The purpose of this evaluation was to identify viable seismic mitigation measures to meet or exceed slope stability criteria for post-earthquake, global stability at the Ash Pond and Slag Disposal Area. Several alternatives were evaluated based on multiple criteria, and four of the most promising alternatives were further evaluated by developing conceptual designs. These evaluations form the basis for TVA's planned seismic mitigation measure included in the additional closure actions identified in this CARA Plan.

1.5 Key Milestones

A chronology of key milestones and events related to the TDEC Order CARA Plan 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 29, 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 Sampling and Analysis Report submitted to TDEC
June 7, 2021	Phase 2 EI field activities commenced
December 10, 2021	Phase 2 EI field activities complete
September 8, 2023	Last Sampling and Analysis Report accepted by TDEC
November 7, 2023	Submittal of WBF Plant EAR Revision 0 to TDEC
January 31, 2024	TDEC comments on WBF Plant EAR Revision 0
March 1, 2024	Submittal of WBF In Situ Treatment Pilot Test Work Plan to TDEC
March 31, 2024	Submittal of WBF Plant EAR Revision 1 to TDEC
April 3, 2024	Submittal of Draft WBF Plant HHERA Revision 0 to TDEC
April 5, 2024	TDEC acceptance of In Situ Treatment Pilot Test Work Plan
April 30, 2024	In Situ Treatment Pilot Test field activities commenced
May 14, 2024	TDEC acceptance of WBF Plant EAR Revision 1
June 18, 2024	TDEC comments on WBF Plant HHERA Revision 0
June 13 – December 6, 2024	In Situ Pilot Testing – Phase 1
July 8, 2024	TDEC approval of CARA Revision 0 submittal extension
September 6, 2024	Submittal of Draft WBF Plant CARA Plan Revision 0 to TDEC
September 26, 2024	Submittal of WBF In Situ Treatment Pilot Test Work Plan Revision 1 to TDEC
October 11, 2024	TDEC acceptance of In Situ Treatment Pilot Test Work Plan Revision 1
December 17, 2024	TDEC comments on WBF Plant CARA Revision 0
March 17, 2025	Submittal of Draft WBF Plant CARA Plan Revision 1 to TDEC
June 5 – August 25, 2025	In Situ Pilot Testing – Phase 2
December 5, 2025	Submittal of Draft WBF Plant CARA Plan Revision 2 to TDEC

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

1.6 Report Organization

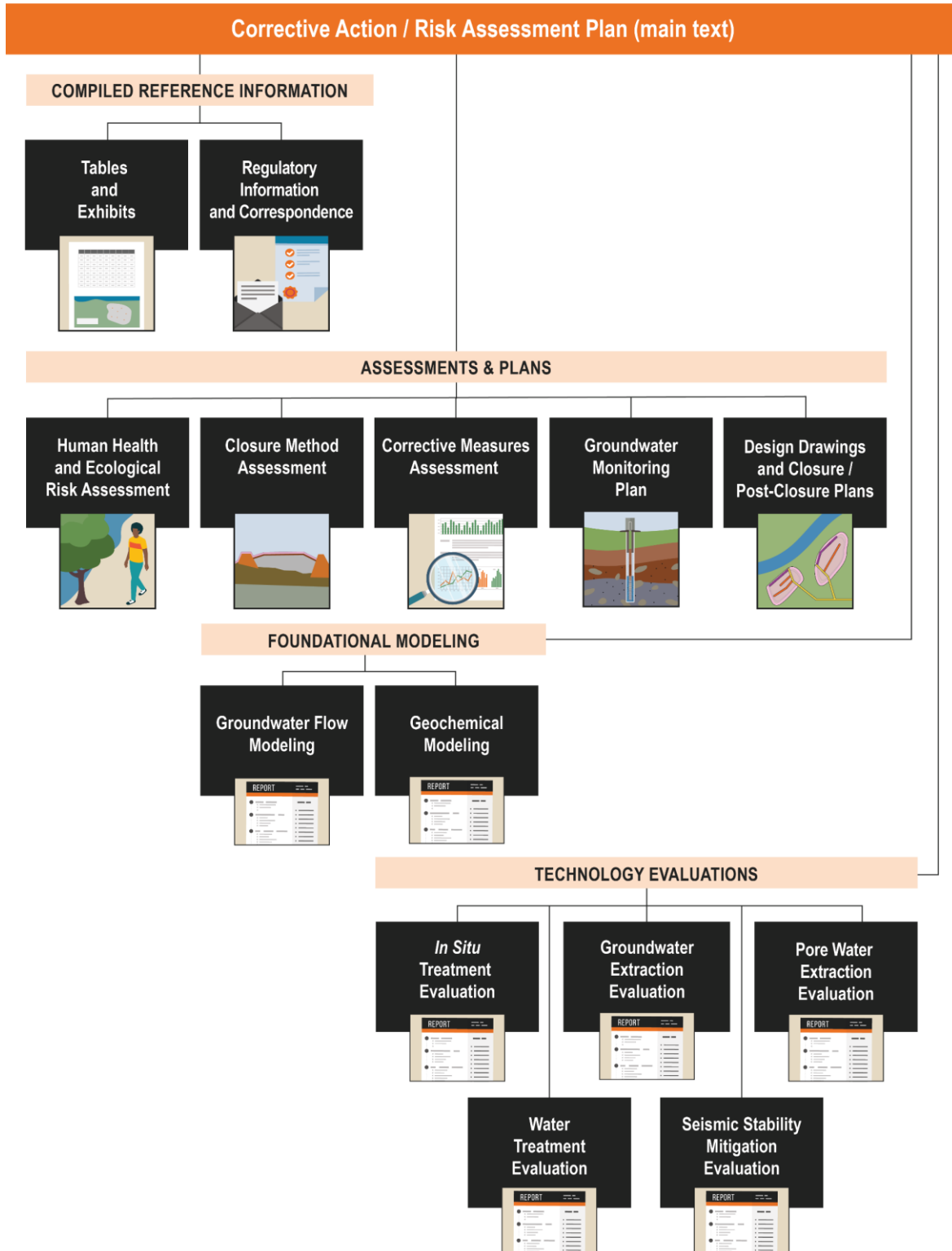
This CARA Plan is based on EI data, TDEC Order groundwater investigations, and results from other ongoing environmental programs obtained for the WBF Plant CCR units through October 2022 and additional data from supplemental investigations through 2024. The CARA Plan presents the basis for and planned methods of CCR unit closure and corrective action of contaminated media.

This main document of the CARA Plan provides a summary of WBF Plant site background information, EI sampling results, and risk assessment findings. Following these summary materials, it presents the applicable State requirements that govern CCR unit closure and corrective action, and the evaluation processes used to identify the closure method and corrective action(s) (if warranted) for each of the WBF Plant CCR units. As required by the TDEC Order, information regarding natural resource restoration, air and water management, water supply protection, and long- and short-term management of CCR material is also provided. Appendices to this CARA Plan provide modeling and supplemental investigation information used to support TVA's planned closure method and corrective actions for the WBF Plant CCR units to address TDEC Order and TDEC DSWM requirements.

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

The structure of the overall document is provided in the diagram below:



Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

This CARA Plan is organized as follows:

- **Executive Summary:** Describes the principal elements of the closure and corrective actions presented in the CARA Plan and the basis for these actions.
- **Chapter 1 – Introduction:** Describes the background of the TDEC Order and purpose of the CARA Plan, regulatory framework, public and agency involvement, an overview of the supplemental investigations, and assessments completed to support the CARA Plan, and document organization.
- **Chapter 2 – Site Background:** Presents the historical and current operational activities, regional and plant-specific geology, surface water hydrology, and hydrogeology of the WBF Plant.
- **Chapter 3 – TDEC Order Investigation Summary and Conceptual Site Models:** Summarizes the TDEC Order investigation findings and CSMs for the CCR units based on the EI and associated historical and ongoing program results.
- **Chapter 4 – Human Health and Ecological Risk Assessment Summary:** Summarizes the components that form the basis and the results of the HHERA. The results of the risk assessment are used in the CARA Plan to evaluate whether corrective action(s) are needed, and if so, provide information for the schedule for implementation. Based on the results of the HHERA, this chapter provides a summary of the environmental media, locations, and CCR constituents requiring further evaluation for corrective action in this CARA Plan.
- **Chapter 5 – Basis and Methods of CCR Unit Closure:** Provides an overview of CIP and CBR methods, the applicable State requirements that govern CCR unit closure, and programmatic National Environmental Policy Act (NEPA) findings and site-specific evaluations regarding both closure methods for the WBF Plant CCR units. Based on these evaluations, the planned closure method and applicable additional closure actions for each of the two CCR units at the WBF Plant are presented.
- **Chapter 6 – Basis and Methods of CCR Unit Corrective Action:** Describes the applicable State requirements that govern CCR unit corrective action, the process used to evaluate corrective measures considered for corrective action(s), and the planned corrective action(s) as applicable for the CCR units at the WBF Plant.
- **Chapter 7 – Supporting Plans:** Describes the scope of the supporting plans to meet the requirements presented in the TDEC Order related to natural resources restoration, air and water monitoring during implementation of corrective actions, a site-wide groundwater monitoring plan, water supply protection, and short-term and long-term management of CCR material, as appropriate for the WBF Plant.
- **Chapter 8 – Summary and Next Steps:** Presents a summary of TVA's basis for the planned CCR unit closure and groundwater corrective action at the WBF Plant. Next steps, including TVA's public involvement approach to finalize this plan, and the implementation schedule for the CARA Plan are also discussed.
- **Chapter 9 – References:** List of documents referenced in the CARA Plan main text.
- **Tables and Exhibits:** Tables and Exhibits are presented following the main text of this report and are numbered according to the chapter in which they are first presented.

Introduction

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- **Appendices:** The Appendices include regulatory information and correspondence, the HHERA Report, and technical memoranda which inform the evaluation of additional closure activities and potential corrective measures. Also included as an appendix are design drawings for the closure and corrective actions identified in this CARA Plan, and a groundwater monitoring plan that would be implemented following approval of the CARA Plan. Below is the list of appendices:
 - Appendix A – Regulatory Information and Correspondence
 - Appendix B – Human Health and Ecological Risk Assessment
 - Appendix C – Closure Method Assessment
 - Appendix D – Corrective Measures Assessment
 - Appendix E – Groundwater Monitoring Plan
 - Appendix F – Design Drawings and Closure/Post-Closure Plans
 - Appendix G – Groundwater Flow Modeling
 - Appendix H – Geochemical Modeling
 - Appendix I – *In situ* Treatment Evaluation
 - Appendix J – Groundwater Extraction Evaluation
 - Appendix K – Pore Water Extraction Evaluation
 - Appendix L – Water Treatment and Discharge Evaluation
 - Appendix M – Seismic Stability Mitigation Evaluation

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 2 Site Background

This chapter describes WBF Plant CCR unit background information, including historical and current operational activities, regional and plant-specific geology, surface water hydrology, and hydrogeology.

2.1 Site Operations, CCR Units, and Land Use

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 units, as shown on Exhibit 2-1: the Ash Pond and the Slag Disposal Area. Each of the CCR units was previously closed in accordance with applicable regulations in effect at the time of closure. The total area of the CCR 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 (also referred to as Chickamauga Lake or Chickamauga Reservoir). 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.

Land use surrounding the WBF Plant is primarily undeveloped and includes forest, agriculture areas, and rural residential areas.

Public water 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.

2.1.1 CCR Unit Summary

A description of each WBF Plant CCR unit, including current operational information, is provided below.

2.1.1.1 Ash Pond

The Ash Pond is a closed surface impoundment that covers about seven acres and is bounded by a perimeter dike. CCR material present in the Ash Pond is comingled stacked fly ash placed as part of closure and sluiced fly ash. The estimated total volume of CCR material is about 190,000 cubic yards (TVA 2024).

The Ash Pond was closed in 2015 under TDEC Permit TN0005461 in accordance with State regulations applicable 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 cover system (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

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

a permitted stormwater pond (Permit No. TNR058427) for the site. As part of overall facility planning, TVA is evaluating the need to retain or modify the stormwater pond to support future plant operations and water management.

2.1.1.2 Slag Disposal Area

The Slag Disposal Area is a closed CCR unit that covers about 27 acres and 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 (TVA 1969). CCR material present in the Slag Disposal Area is comingled sluiced and stacked fly ash, bottom ash, and slag, and the estimated total volume of CCR material is about 570,000 cubic yards (TVA 2024). 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).

Following the 1982 plant retirement, approximately 161,000 tons of slag were reclaimed for beneficial use in manufacturing products. This activity occurred from 1996 to 2005, until a majority of the material usable at that time was recovered.

The Slag Disposal Area was closed with a soil cover system in 2009 under TDEC Permit TNR190741 in accordance with State regulations applicable at the time of closure. The Slag Disposal Area cover system consisted of a one-foot thick vegetative cover over a one-foot thick compacted clay layer.

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 to address historical seepage at the WBF Plant (AECOM 2016). The Drainage Improvements Area is located immediately adjacent to, and upgradient of, the Slag Disposal Area as shown in Exhibit 2-1. The Drainage Improvements Area was investigated during the EI and based on those findings, was recommended for further evaluation in the CARA Plan (see Chapter 3). As such, the Slag Disposal Area and Drainage Improvements Area are discussed together in this CARA Plan.

2.2 Geology, Surface Water Hydrology, and Hydrogeology

Regionally, the Valley and Ridge province is a series of northeast trending Paleozoic sedimentary rocks that form the alternating valleys and ridges (United States Geological Survey [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).

2.2.1 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 2-2. 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 2-3 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).

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

2.2.2 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.

A former surface stream on the 1935 USGS topographic map was shown to flow through the footprint of the Slag Disposal Area (Exhibit 2-4a), but the 1942 USGS topographic map, which included ground surface elevations based on stereophotogrammetric methods, showed a different alignment that did not flow through the footprint of the Slag Disposal Area (Exhibit 2-4b). Also, during the EI, cone penetration tests (CPT) were conducted at the approximate intersection of the former surface stream as shown on the 1935 USGS topographic map with the boundary of the Slag Disposal Area. The conclusion of the CPT evaluation was that soils in the vicinity of the stream alignment were similar to soils in other nearby areas (see Appendix G.1 of the EAR). Based on this information, it is concluded that the surface stream shown on the 1935 USGS topographic map was mislocated, and the 1942 USGS topographic map provides the correct location.

2.2.3 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 because of the thrust faulting in eastern Tennessee.

2.2.4 Plant Hydrogeology

This subchapter describes the hydrogeology of the WBF Plant. Prior to discussing the plant hydrogeology, the following provides definitions and illustrations of hydrogeological terms.

2.2.4.1 Hydrogeological Terms

For purposes of this document, 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.

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- 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

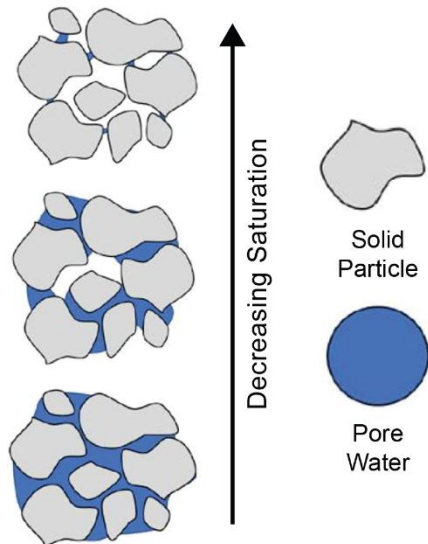
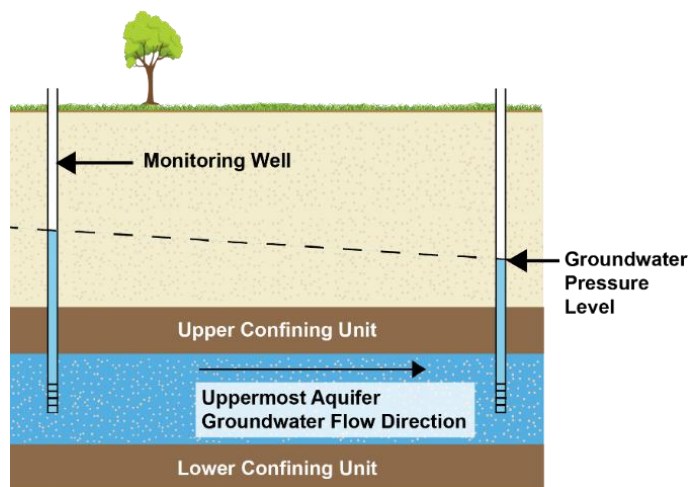


Figure Reference: Benson, C., *Water Flow in Coal Combustion Products and Drainage of Free Water*, Report No. 3002021963, Electric Power Research Institute, Palo Alto, CA.

This figure depicts how subsurface water occurs in the pore spaces in CCR material (referred to as “pore water” in this CARA Plan), 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.

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

2.2.4.2 WBF Plant Hydrogeology

Groundwater flows by gravity 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.

Hydrostratigraphic units are geological formations that are 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 following figures show three-dimensional representations of the various geological deposits and CCR material at the WBF Plant. In the first figure, the CCR material is colored gray with striping, and the fine-grained unconsolidated materials are colored brown. The second figure shows the unconsolidated materials with the CCR material removed. In the third and fourth figures, the coarse-grained unconsolidated materials are colored light rose, and the bedrock surface is colored gray. The clay dikes surrounding the CCR units are colored orange.

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

WBF Plant CCR and Unconsolidated Materials

Legend

- | | |
|--|---|
|  Building Structure |  Unconsolidated Materials (Primarily Alluvial Silts and Clays) |
|  CCR Material |  Unconsolidated Materials (Primarily Alluvial Sand) |
|  Clay Dike |  Bedrock |
| |  Waterbody |

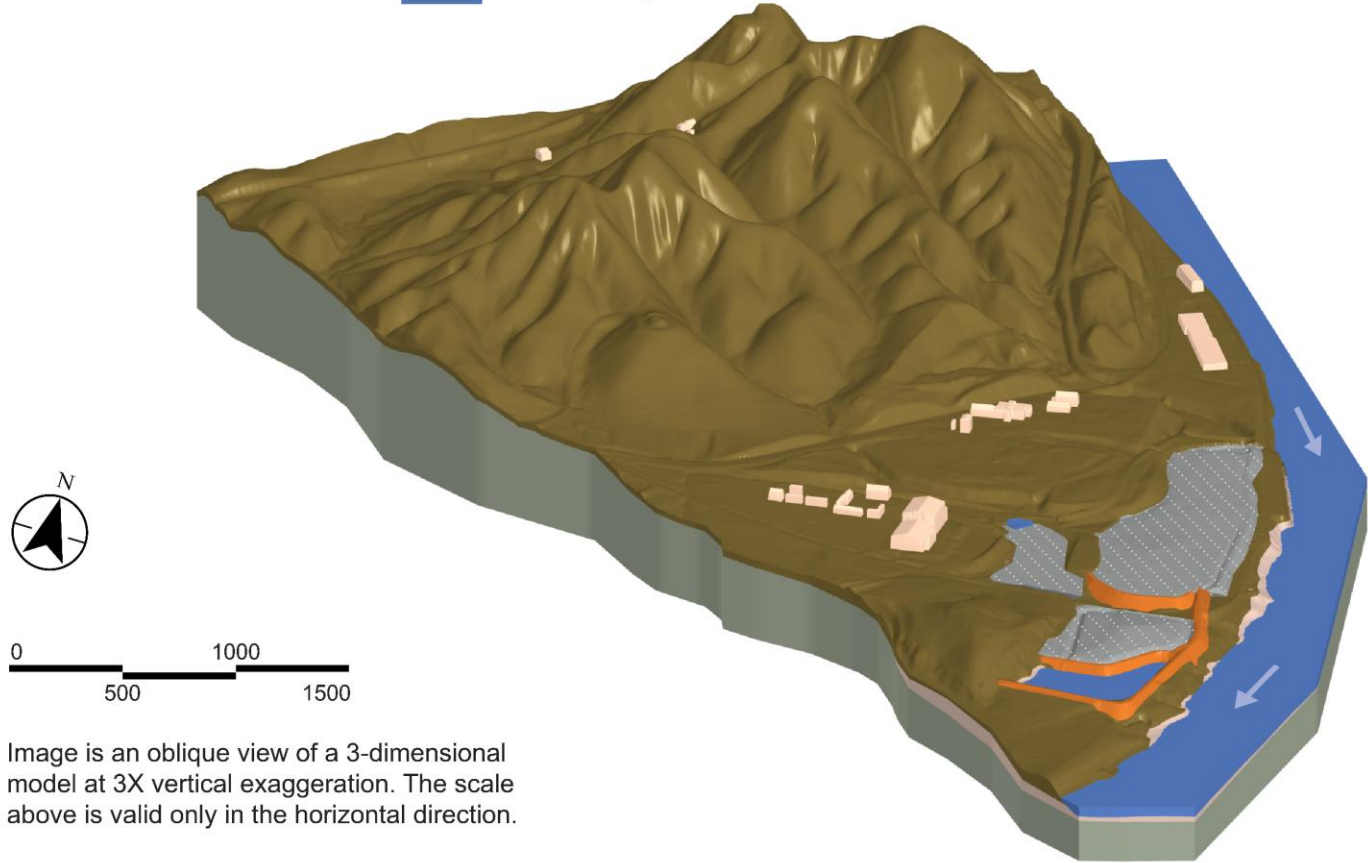


Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

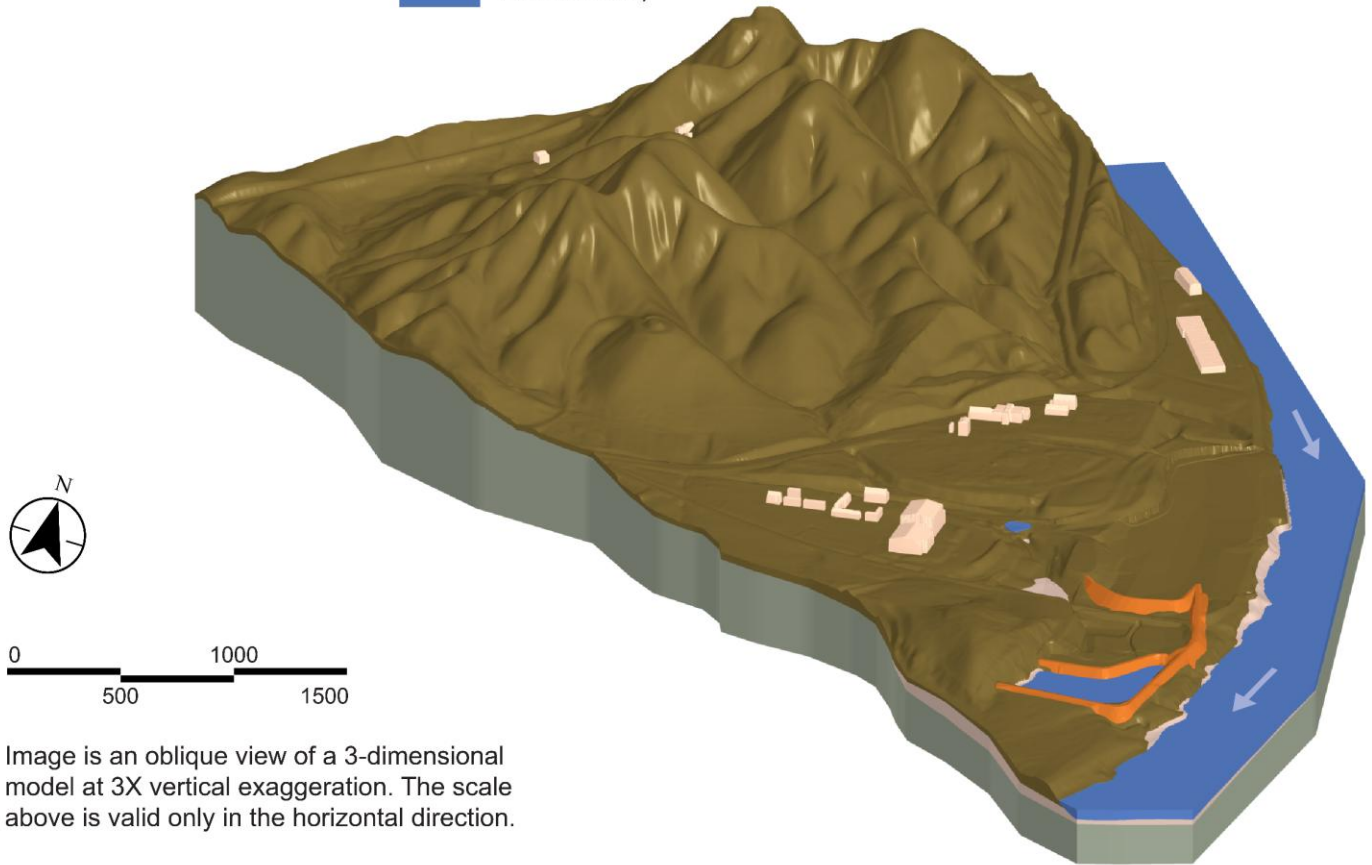
Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

WBF Plant Fine-Grained Unconsolidated Materials (Primarily Clay and Silty Clays)

Legend

	Building Structure		Unconsolidated Materials (Primarily Alluvial Silts and Clays)
	Clay Dike		Unconsolidated Materials (Primarily Alluvial Sand)
			Bedrock
			Waterbody



Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

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

Legend

- | | | | |
|---|--------------------|---|--|
|  | Building Structure |  | Unconsolidated Materials (Primarily Alluvial Sand) |
|  | Clay Dike |  | Bedrock |
| | |  | Waterbody |

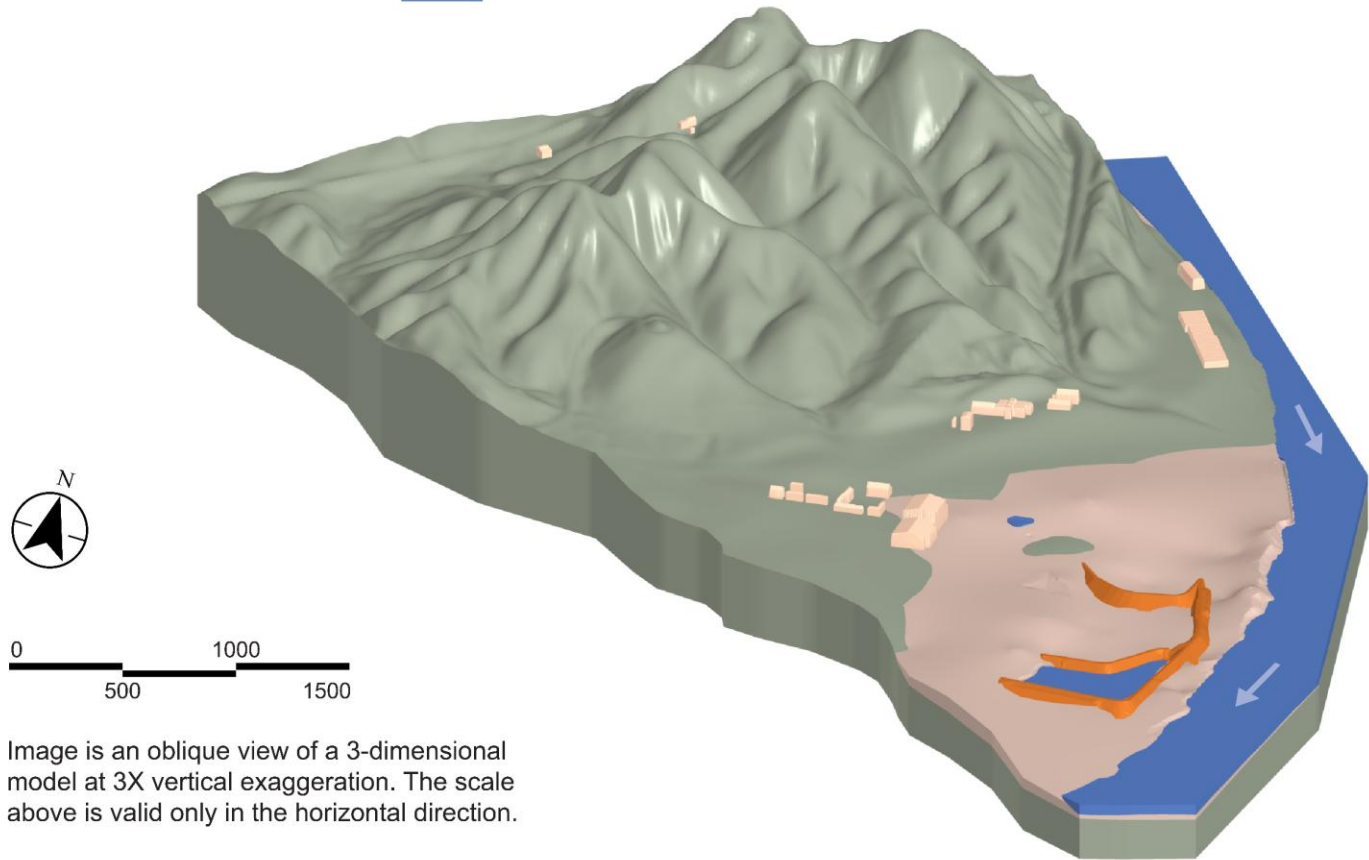


Image is an oblique view of a 3-dimensional model at 3X vertical exaggeration. The scale above is valid only in the horizontal direction.

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

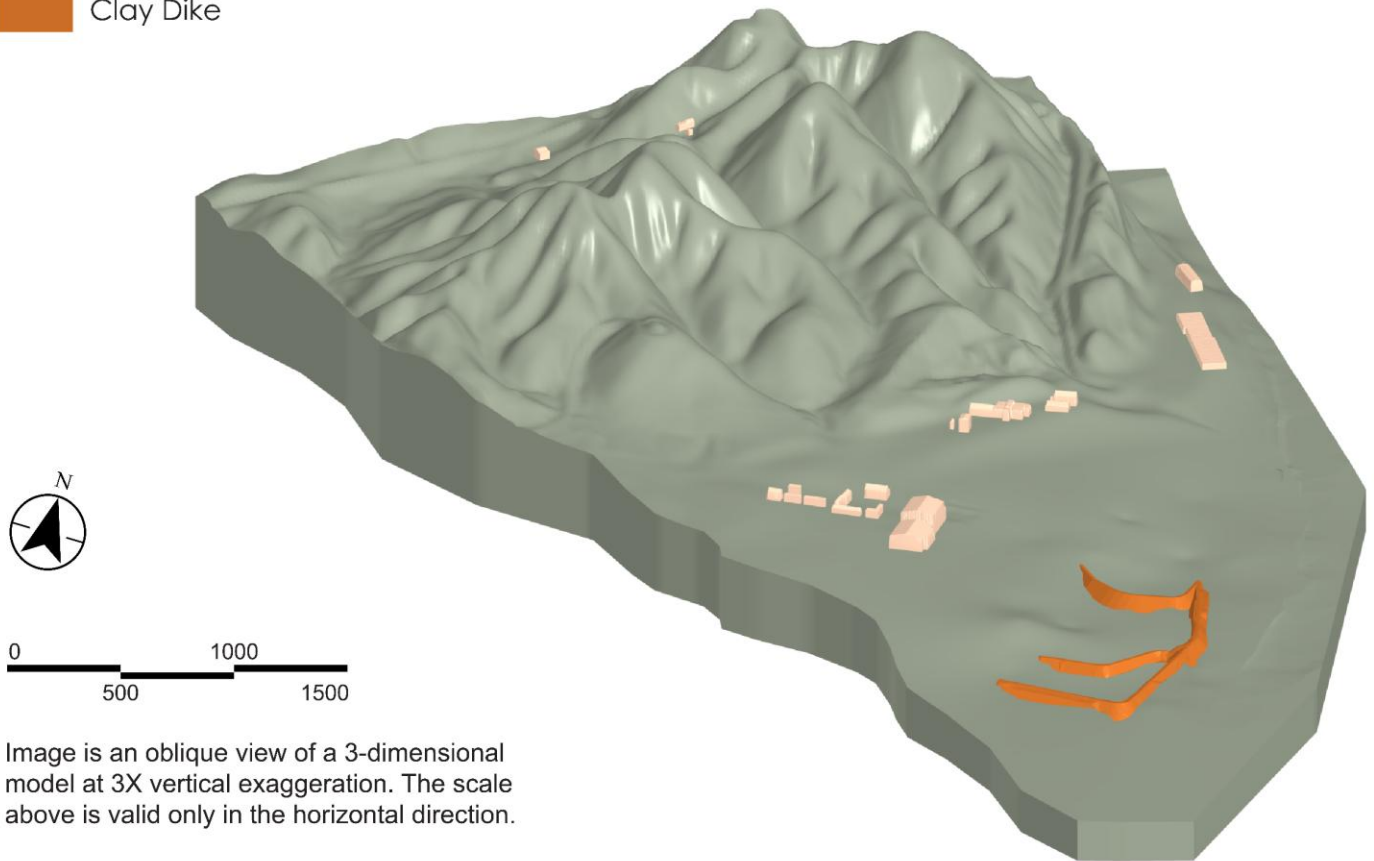
WBF Plant Bedrock Surface**Legend**

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

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

2.2.5 Uppermost Aquifer and Groundwater Flow

The alluvial sands above bedrock (also referred to as coarse-grained unconsolidated materials) are defined as the uppermost aquifer. The uppermost aquifer is overlain by less permeable silts and clays that are defined as an aquitard; therefore, the uppermost aquifer is a confined aquifer.

During the EI, groundwater levels were measured within the uppermost aquifer, the overlying clays and silts, and the underlying bedrock prior to each of 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 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 2-5 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. In the vicinity of the CCR 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.

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Groundwater Flow Directions, Boundaries, and Divides



Legend

- Interpolated Groundwater Contour
- Groundwater Contour (5 foot interval)
- Surface stream that bounds groundwater flow
- Hydrogeological Divide
- ➔ Generalized groundwater flow direction

- ← Surface Stream Flow
- CCR Unit Area (Approximate)
- 2023 Image Boundary

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

Imagery Provided by TVA (2023) and BING Imagery

Site Background

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Groundwater Monitoring Systems

Groundwater monitoring wells have been installed at the WBF Plant for the TDEC Division of Solid Waste Management program for non-registered sites (consisting of the Ash Pond) and the TDEC Order. The current groundwater monitoring system associated with each CCR unit is shown on Exhibit 2-5.

There is one groundwater monitoring system as described in the *Ash Pond Closure Plan* (TVA 2013) for the Ash Pond including two downgradient wells (MW-2 and MW-3), one background well (MW-1), and one upgradient well (WBF-100).

TDEC Order Investigation Summary and Conceptual Site Models

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 3 TDEC Order Investigation Summary and Conceptual Site Models

This chapter summarizes the TDEC Order investigation findings and CSMs for the CCR units based on the EI and associated historical and ongoing program results. CSMs describe sources of CCR constituents, pathways by which they can move, and environmental media potentially affected if they are released.

For the EAR, analytical results were compared to TDEC-approved screening levels to identify areas that required further evaluation in this CARA Plan. Most screening levels are more protective than regulatory standards and are based on published scientific 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 this CARA Plan to determine if an unacceptable risk exists and if corrective action is required. Potential slope stability impacts 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.

For the CARA Plan, groundwater data are compared to GWPS (Table 1-1).

CSMs for each CCR unit are presented as Exhibits 3-1 and 3-2. These exhibits depict findings discussed in the EAR on a representative cross-section of subsurface conditions for each CCR unit. Results of the EI are presented for the overall investigation area on Exhibit 3-3 and near the CCR units on Exhibit 3-4. A summary of assessment findings is also presented below.

3.1 Conceptual Site Model

WBF Plant Hydrogeological CSM

The coarse-grained unconsolidated alluvial deposits above bedrock have been defined as the uppermost aquifer, which is considered to be under confined conditions and is monitored downgradient of the CCR units. The horizontal groundwater flow direction within the uppermost aquifer is from the west-northwest to the east-southeast toward the Tennessee River. Groundwater flow in the vicinity of the CCR 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 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 reduce dissolved groundwater concentrations, can explain the observed differences between the characteristics of pore water and groundwater quality. The geochemical processes can also result in the mobilization of constituents (e.g., cobalt) from the natural geological materials. Hydrogeologic modeling of groundwater flow conditions and geochemical processes are further evaluated within this CARA Plan to support groundwater corrective measure evaluations at the CCR units.

3.2 Overall Environmental Investigation Findings

The EAR presented the results of the EI investigations, described the extent of surface stream water, sediment, and groundwater impacts, if any, from the WBF Plant CCR units, and provided the information, data, and evaluations used to make those assessments. As part of the EI, AOIs were identified and characterized to assess the potential presence of a

TDEC Order Investigation Summary and Conceptual Site Models

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

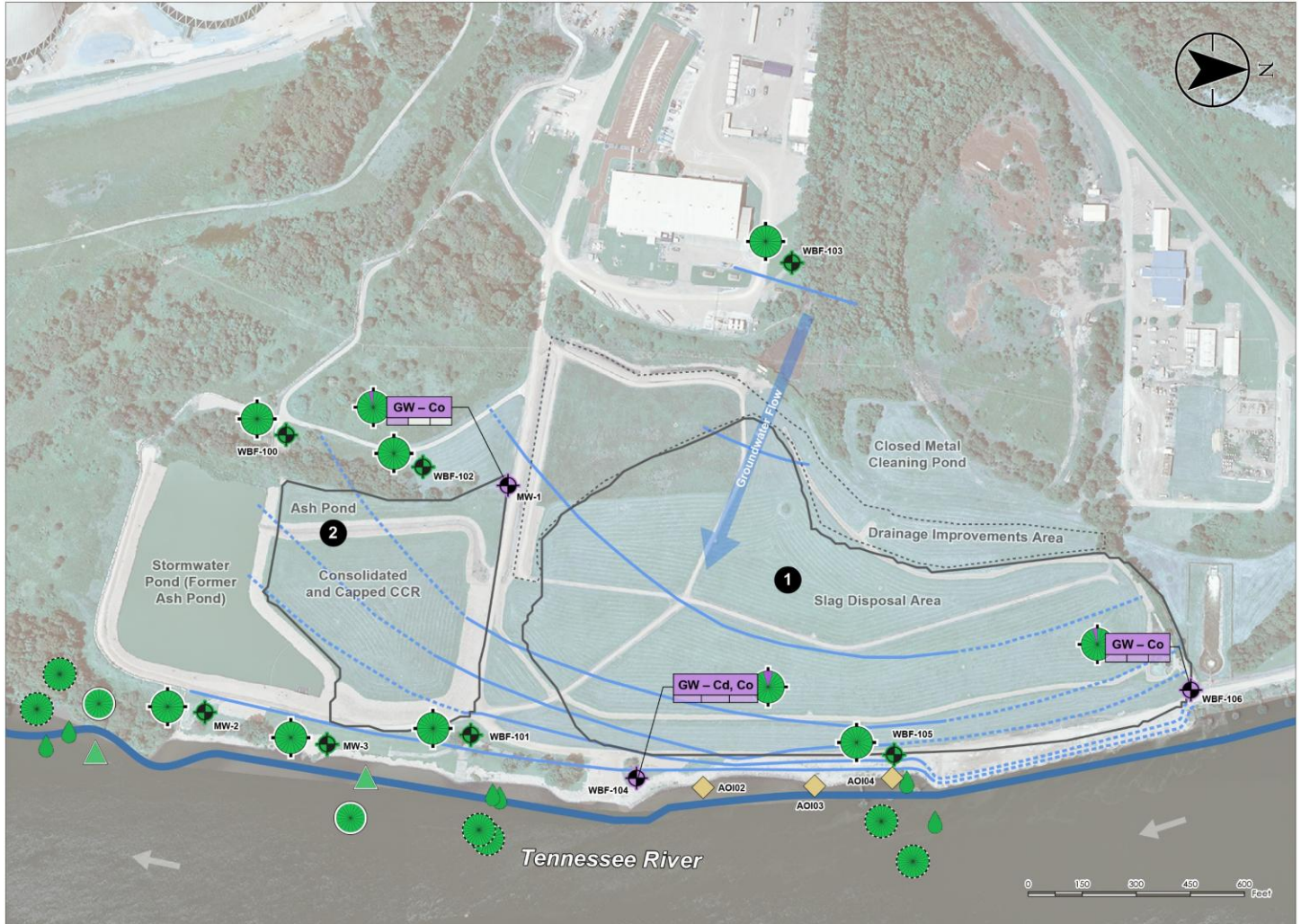
seep. Geotechnical analysis findings, and environmental sampling results above TDEC-approved screening levels in specific media, are further evaluated in this CARA Plan to determine whether unacceptable risks existed that required corrective action. Reported groundwater analytical results were compared to the screening levels by conducting a statistical evaluation of sample results reported over time following USEPA guidance (see Appendix E.3 of the EAR). The evaluation was not based on comparing individual reported groundwater sample results to the screening levels.

The graphic below shows a summary of findings presented in the EAR near the WBF Plant CCR units. On this graphic, the sediment and surface water sampling locations are shown within the water bodies, groundwater sampling locations are at the identified wells, and sampling results are depicted adjacent to the sampling locations.

TDEC Order Investigation Summary and Conceptual Site Models

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Overall Findings Near WBF Plant CCR Units



Legend

- Groundwater results below Groundwater Protection Standards (GWPS)
- Groundwater results above Groundwater Protection Standards (GWPS)
- 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 GWPS and ESVs

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 GWPS or ESVs.

- Interpolated Groundwater Contour
- Groundwater Contour (5 foot interval; elevations are in feet above mean sea level)
- Surface stream that bounds groundwater flow
- Generalized groundwater flow direction
- CCR Unit Area (Approximate)
- CCR: Coal combustion residuals

- 1-4 X above GWPS and ESVs
- 5-9 X above GWPS and ESVs
- >10 X above GWPS and ESVs

- Notes:**
- Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 2-5, Groundwater Elevation Contour Map Event #4 (July 4, 2020), for actual groundwater elevations and groundwater contours.
 - GWPS identified in Table 1-1
 - ESVs identified in the WBF EAR
 - Imagery Provided by TVA (2023)

TDEC Order Investigation Summary and Conceptual Site Models

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

As presented in the EAR, more than 99 percent (%) of the environmental sample results from approximately 300 samples were below screening levels. The EI and supplemental data indicated groundwater concentrations above GWPS are limited to onsite groundwater areas and that the CCR units have had minimal, if any, potential impacts to sediment and surface stream water quality, and ecological communities in the Tennessee River. The following are the overall assessment findings from the EI presented in the 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 units.
- The EI data indicate that fish and benthic communities are healthy in the Tennessee River adjacent to and downstream of the CCR units.
- The EI data indicate that ecological communities are healthy in the Tennessee River adjacent to and downstream of the CCR units and demonstrate more favorable ecological conditions than upstream locations.
- The CCR 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. Seismic stability mitigation alternatives have been evaluated as part of this 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 piezometer investigation results (completed prior to the EAR submittal), additional evaluation of these AOIs was recommended and is included in this CARA Plan to determine if corrective actions are needed. No AOIs were identified near the Ash Pond. The three AOIs identified for further evaluation (AOI02, AOI03, and AOI04) were inaccessible for direct sampling during the EI because they were located in areas covered by riprap. Water quality parameter sampling was performed adjacent to these locations and those sampling results indicated statistically significant differences when compared to upstream sampling locations.
- Most CCR constituent concentrations in onsite groundwater were below GWPS, and groundwater impacts are limited to onsite areas downgradient along the perimeter of the CCR units. However, further evaluation was recommended and is included in this CARA Plan to evaluate methods and design for targeted corrective action for onsite groundwater at well locations where statistically significant concentrations of CCR constituents above GWPS existed.
- Within the Slag Disposal Area, the pore water phreatic surface may be affected by infiltration of stormwater upgradient of the CCR unit. The pore water levels within Slag Disposal Area would be expected to decrease in elevation if stormwater drainage or cover system modifications were to be implemented. Within the Ash Pond, there is no phreatic surface.
- Drainage modifications within the former Drainage Improvements Area adjacent to the Slag Disposal Area were recommended in the EAR and are addressed in this CARA Plan.
- Groundwater flow in the coarse-grained unconsolidated alluvial deposits above bedrock is bounded to the east by the Tennessee River.

TDEC Order Investigation Summary and Conceptual Site Models

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Based on the overall results of the water use survey, current and historical CCR management associated with the WBF Plant have not affected water supply wells or springs located in the vicinity of the WBF Plant and are not anticipated to do so in the future.

The following summary provides the specific findings of the EI that required further evaluation in this CARA Plan.

Summary of Findings Requiring Further Evaluation in the CARA Plan					
CCR Unit	Stability	Groundwater	AOIs	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

The groundwater corrective measure evaluations in this CARA Plan are based on the conclusions of a statistical evaluation of groundwater data available as of October 2022. Groundwater data continues to be collected at the CCR units in accordance with existing monitoring plans, and the extent, type, or need for groundwater corrective actions will be reevaluated in response to changing groundwater conditions. If concentrations of the target constituents were to fall below GWPS during approval and final design of the groundwater corrective measures such that groundwater corrective action is no longer required, then the corrective measures identified in the CARA Plan would not be implemented. The groundwater corrective measures to be implemented will be driven by the groundwater data and trends at the time of implementation. Proposed changes to the groundwater corrective measures would be coordinated with TDEC.

As described in this CARA Plan (see Chapter 5.5.2), additional seismic stability assessments are included in the closure design of the Ash Pond and Slag Disposal Area, and drainage modifications are included in the Drainage Improvements Area adjacent and upgradient of the Slag Disposal Area. Additionally, the three AOIs were evaluated for potential exposures in the HHERA (see Chapter 4) and considered when identifying the planned additional closure actions for the Slag Disposal Area (see Chapter 5.5.2.2).

Human Health and Ecological Risk Assessment Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 4 Human Health and Ecological Risk Assessment Summary

The HHERA process was used to evaluate potential risks to human and ecological receptors from potential exposures to CCR constituents that may have been released from the two CCR units at the WBF Plant (Appendix B). Current land use is industrial and there are no planned changes in land use. Results of this HHERA are used in the CARA Plan to evaluate whether corrective action(s) are needed to address unacceptable risk, and if so, provide information for the schedule for corrective action implementation. The three AOIs identified for further evaluation in this CARA Plan (AOI02, AOI03 and AOI04) were located in areas covered by riprap, making them inaccessible. Consequently, the exposure pathways in the HHERA were incomplete.

When evaluating human and ecological exposures to environmental stressors, acceptable versus unacceptable risk is frequently defined by regulation and public policy. The HHERA methodology is based on guidance published by the USEPA, who makes clear that determining “acceptable/unacceptable” risk should go beyond solely calculating numerical risk estimates. As such, the objective of the HHERA is to provide quantitative and qualitative statements of potential risks (i.e., “acceptable/unacceptable levels”) to human and ecological receptors, based on multiple lines of evidence (LOE). Qualitative LOE include the findings from sampling and studies conducted as part of the Kingston Recovery Project (KRP) (also known as the Kingston Ash Recovery Project), including environmental sampling, biological studies, human health risk assessments and ecological risk assessments.

At a minimum, the planned closure and corrective actions as described in this CARA Plan are expected to improve current conditions. However, the risk estimates to human and ecological receptors from exposure to CCR constituents protectively assume that current offsite environmental conditions, as reported in the EAR, reflect post-closure conditions. As described below, assessment of onsite exposures assumes post-closure conditions, including an existing or future installation of a geosynthetic cover system at each of the two CCR units.

4.1 Human Health Risk Assessment

A human receptor is a hypothetical person (e.g., young child, adult) who resides, visits, or works on or near the WBF Plant and is, or could potentially be, exposed to CCR constituents from the CCR units. General physical and behavioral characteristics specific to the receptor type (e.g., body weight, breathing rate, and amount of fish consumed) were used to estimate the amount of chemical exposure received by each receptor. Hypothetical receptors with exaggerated behaviors and activity patterns were used in the HHERA. If no unacceptable human health risk is identified for these more exposed and more sensitive hypothetical people, then no adverse health effects would be expected for less exposed, less sensitive people.

The HHERA focuses on the CCR units, not the historical operations of the WBF Plant or the closure activities. There are no potable groundwater wells at the WBF Plant, and there are no plans to install potable groundwater wells in the future. Potential risks associated with onsite exposures to CCR material are limited to exposure scenarios where people could reasonably be expected to penetrate the geosynthetic cover system. The HHERA evaluated an onsite worker, an offsite resident, and an offsite recreational user.

Human Health and Ecological Risk Assessment Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

4.1.1 Onsite Worker

As indicated in Chapter 2.1, the CCR units were previously closed. An onsite worker is defined as an adult engaged in short-term repair work on the infrastructure of the CCR units. This onsite worker could have limited, direct contact with CCR material for short duration (20 days or less). They could be exposed to CCR constituents in CCR material via incidental ingestion and dermal contact with CCR material, inhalation of particulates released from CCR material, and external exposure to ionizing radiation from CCR material. To determine whether the human health risk for a CCR constituent should be evaluated further, maximum measured concentrations of constituents in the CCR material were compared to human health receptor-specific screening levels for CCR material that have been reviewed and accepted by TDEC (Stantec 2021). The maximum concentrations of several CCR constituents were greater than these screening levels and were analyzed in more detail in the HHERA.

Using the estimated exposures and published toxicity data, risk estimates for the onsite worker are below acceptable state thresholds for cancer and noncancer risk, except for an onsite worker potentially exposed to CCR material within the Ash Pond through incidental ingestion and dermal contact while making short-term repairs. Estimated risks to an onsite worker potentially exposed to CCR material within the Ash Pond are greater than the noncancer threshold of one, and were attributable to arsenic (1.2) and thallium (0.49). However, these risks are likely overestimated because their effects are not likely to be additive and chronic toxicity values protective of long-term exposures were conservatively used for arsenic to estimate the sub-chronic effects of short-term exposures. Further, when TVA's standard health and safety protocols are applied, such as wearing appropriate protective clothing, potential risks to onsite workers are expected to be lower than estimated.

These findings support the conclusion that there are no unacceptable risks for an onsite worker potentially exposed to CCR material while making short-term repairs to the Slag Disposal Area and that the potential risk to a worker exposed to CCR material within the Ash Pond can be managed through standard health and safety protocols.

4.1.2 Offsite Resident

An offsite resident is defined as an adult, adolescent, young child, or infant who uses potable water from municipal water departments that withdraw water from the Tennessee River in the vicinity of the WBF Plant or who resides within a 0.5-mile radius of the WBF Plant parcel boundary and uses groundwater or springs as a potable water source. The water use survey results found that groundwater flow direction near the CCR units is generally from the west-northwest to the east-southeast towards the Tennessee River, groundwater flow in the vicinity of the CCR units is bounded to the east by the Tennessee River, and no wells or springs for water supply were found on parcels that could be affected by the management of CCR material. **Based on these findings, current and historical CCR material associated with the WBF Plant has not affected water supply wells or springs near the WBF Plant; therefore, an offsite resident would not be exposed to CCR constituents via ingestion of groundwater or spring waters.**

To assess the potential that an offsite resident could be exposed to CCR constituents via ingestion of and dermal contact with potable water from municipal water departments that withdraw water from the Tennessee River, data for surface stream water samples from the Tennessee River adjacent and downstream of the WBF Plant were compared to human health screening levels for domestic water supply. The TDEC-approved human health screening levels for domestic water supply are protective of residents for the potentially complete pathways (i.e., ingestion of potable water and dermal

Human Health and Ecological Risk Assessment Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

contact with potable water) (Stantec 2021). **No CCR constituents were detected in the surface stream samples above these screening levels; thus, there are no unacceptable risks for an offsite resident.**

4.1.3 Offsite Recreational User

A recreational user is an adult, adolescent, or young child who is engaged in recreational activities within and along the Tennessee River near the WBF Plant. The recreational users were further grouped by their primary activities – swimmer, beachcombers, and consumers of locally-caught sport fish.

A swimmer may incidentally ingest or come into direct contact with surface stream water while swimming, wading or engaging in other water-related activities. The frequency and intensity of exposure to surface stream water used as domestic water supply by receptors of all age groups are greater than exposure to surface stream water through recreational contact; thus, the screening levels for domestic water supply are protective of a recreational user who is a swimmer for the potentially complete exposure pathways noted. **No CCR constituents were detected above these TDEC-approved screening levels; thus, there are no unacceptable risks for a recreational swimmer.**

A recreational user who is a beachcomber may come in contact with seasonally exposed sediment while hiking or beachcombing for driftwood, rocks, or other objects near the WBF Plant. **No seasonally exposed sediment locations adjacent or downstream of the WBF Plant were identified for the Tennessee River; therefore, exposure to sediment is incomplete and there are no risks for a recreational beachcomber.**

A recreational user who is a consumer of locally caught fish may be exposed via consumption of fish taken from the Tennessee River near the WBF Plant. Maximum measured concentrations of CCR constituents in sport fish filet samples were compared to human health receptor-specific screening levels for fish tissue that were reviewed and accepted by TDEC (Stantec 2021). The maximum concentrations of arsenic and mercury were greater than these screening levels and were carried forward in the HHERA for more detailed analysis. Using the estimated exposures and published toxicity data, risk estimates meet the accepted state threshold for cancer. The noncancer risk estimate of two is greater than the noncancer threshold of one and is attributable to mercury. Therefore, additional LOE were evaluated to characterize the human health risk associated with mercury in fish tissue from the Tennessee River.

Concentrations of mercury (total) detected in fish from the Tennessee River are similar upstream, adjacent, and downstream of the WBF Plant. This similarity in mercury concentrations detected in fish among reaches is consistent with the results of studies by Arnwine et al. (2014) and Denton (2007) that suggest mercury is a widely occurring regional contaminant. These findings indicate that mercury in fish tissue samples from the Tennessee River are likely not related to the WBF Plant CCR units. Further, the fish consumption rates used in the HHERA were based on total freshwater and estuarine finfish and shellfish consumption, including consumption of both locally caught and store-bought fish, which likely over-estimated consumption rates of locally caught fish. For comparison, the adult fish intake rate of 32.7 grams of fish per day assumed in the HHERA is higher than the current USEPA national-level consumption rate of 22 grams per day (USEPA 2015b). Thus, the fish consumption rates used in this HHERA most likely over-estimate human health risks associated with fish consumption.

These LOE (i.e., mercury is a regional contaminant and consumption rates used in the HHERA were likely an over-estimate) support the conclusion that there are no unacceptable risks associated with the WBF Plant CCR units for recreational users who consume locally caught fish.

Human Health and Ecological Risk Assessment Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

4.2 Ecological Risk Assessment

It was not necessary or feasible for the HHERA to individually assess each receptor that could potentially inhabit, breed, or forage at or in the vicinity of the WBF Plant. Instead, the potential for adverse effects was evaluated for a subset of receptors (i.e., surrogate species) representing the various feeding guilds and ecological communities that may be exposed to CCR constituents. The ecological receptor groups evaluated in the HHERA for the Tennessee River were community receptors (benthic invertebrate, aquatic vegetation, fish, and aquatic/riparian feeding amphibian and reptile communities) and representative bird and mammal receptors (aquatic and riparian feeding birds, aquatic and riparian feeding mammals and aerial feeding birds and mammals).

4.2.1 Community Receptors

Freshwater aquatic life (i.e., benthic invertebrates, aquatic plants and fish) can be exposed to CCR constituents within the environmental media that they inhabit. Adsorption and ingestion of CCR constituents from surface stream water and sediment can occur, and some CCR constituents in these media can bioaccumulate in aquatic life via food chain uptake. Amphibians and reptiles also can be exposed to CCR constituents through ingestion and food chain uptake, as well as from dermal contact with, and ingestion of sediment and surface stream water.

For these community receptors, the environmental value that is to be protected (i.e., the assessment endpoint) is the abundance and diversity of freshwater aquatic life (i.e., benthic invertebrate, aquatic plant, and fish communities) and aquatic/riparian feeding amphibians and reptiles in the Tennessee River.

4.2.1.1 Tennessee River

Data for surface stream water and sediment samples from the Tennessee River adjacent to and downstream of the WBF Plant were compared to TDEC-approved ecological screening levels (Stantec 2021). The maximum concentrations in the Tennessee River samples were less than the screening levels. Benthic invertebrate community indices for the Tennessee River indicate that benthic communities within adjacent and downstream areas of the Tennessee River appear to be at least as healthy, rich, and sensitive as locations upstream of the WBF Plant CCR units. Biological monitoring indicates a balanced indigenous fish population for the Tennessee River downstream of the WBF Plant CCR units and no fish species were affected in sufficient numbers to impact fish communities.

These LOE indicate that there are no unacceptable risks to the abundance and diversity of freshwater aquatic life in the Tennessee River from exposures to site-related CCR constituents.

4.2.2 Bird and Mammal Receptors

For birds and mammals, their life histories dictate the primary exposure pathways. For example, consumption of vegetation, fish, and invertebrates makes up the primary complete exposure pathways for mammalian and avian herbivores, piscivores, and insectivores, respectively. The assessment endpoint for the birds and mammals is protection of populations of birds and mammals using the Tennessee River.

Human Health and Ecological Risk Assessment Summary

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant



Aquatic/Riparian Feeding Birds

Wood duck (herbivorous birds)
Mallard duck (omnivorous birds)
Killdeer (insectivorous birds)
Great blue heron (piscivorous/omnivorous birds)
Osprey (piscivorous birds, incl. Bald eagle*)

* Species of conservation concern



Aquatic/Riparian Feeding Mammals

Muskrat (piscivorous mammals)
Raccoon (omnivorous mammals)
Mink (piscivorous mammals)



Aerial-Feeding Birds and Mammals

Tree swallow (aerial-feeding insectivorous birds)
Gray bat (aerial-feeding insectivorous mammals)

4.2.2.1 Tennessee River

Data for surface stream water and sediment samples from the Tennessee River adjacent to and downstream of the WBF Plant were compared to TDEC-approved ecological screening levels (Stantec 2021). The maximum concentrations in the Tennessee River samples were less than the screening levels. Although there are no guidelines for boron or lithium in sediment, there is minimal variability in boron and lithium sediment concentrations between reaches adjacent and downstream of the WBF Plant. In addition, boron and lithium were either non-detected in fish and clam tissue samples from adjacent and downstream reaches or there was minimal variability between the upstream reach and the adjacent and downstream reaches. Further, the environmental data (surface stream water, sediment, clam tissues and fish tissues) show no evidence of increased bioaccumulation of selenium or mercury. **The results indicate that there are no unacceptable risks to populations of birds or mammals at the Tennessee River from exposures to site-related CCR constituents.**

4.3 Summary of Human Health and Ecological Risk Assessment Results

The HHERA process was used to evaluate potential risks to human and ecological receptors from potential exposures to CCR constituents that may have been released from the two CCR units at the WBF Plant. Confidence in the conclusions of the HHERA is supported by the use of multiple LOE in a weight-of-evidence approach and by incorporation of protective assumptions. The potential human receptors evaluated in the HHERA were an onsite worker, an offsite resident, and a recreational user of the Tennessee River. **The HHERA evaluation shows that there are no unacceptable risks to offsite human receptors related to the CCR units, and potential risks to onsite workers making minor repairs to the Ash Pond would be lowered and mitigated by implementing standard health and safety protocols.**

The ecological receptor groups evaluated in the HHERA for the Tennessee River were community receptors (benthic invertebrate, aquatic vegetation, fish, and aquatic/riparian feeding amphibian and reptile communities) and bird and mammal receptors (aquatic/riparian feeding birds, aquatic/riparian feeding mammals and aerial feeding birds and mammals). **The HHERA evaluation shows that there are no unacceptable risks to ecological receptors related to the WBF Plant CCR units.**

The additional closure and corrective actions identified in this CARA Plan are expected to improve the current acceptable conditions, as concluded in the HHERA.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 5 Basis and Methods of CCR Unit Closure

This chapter describes the basis and methods TVA has identified for closure actions at each of the two CCR units at the WBF Plant, including discussion of the applicable State requirements that govern the CCR unit closure and the evaluation process used to identify the closure methods for each unit. As described in Chapter 2.1, each of the CCR units was previously closed in accordance with applicable regulations in effect at the time of closure. Although previously closed, TVA has conducted both programmatic closure method evaluations and site-specific evaluations for each of the CCR units, and based on those evaluations is planning additional closure actions for these units under the TDEC Order, including to ensure the closures meet or exceed current State regulatory requirements as described in this chapter. While not currently planned for the WBF Plant CCR units, TVA continues to evaluate means to beneficially use CCR material in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley. If implemented, the schedule and volume of harvested CCR material for beneficial use will depend on a number of factors, such as the end market demand, processing requirements, and amount of material unsuitable for harvesting.

The two primary closure methods considered in this plan are CIP, where the CCR material is covered and left in place, and CBR, where CCR material is removed and disposed at an approved disposal facility. It is important to note that, regardless of closure method, State regulations require corrective action to be implemented to meet GWPS, which is discussed in Chapter 6. This chapter discusses TVA's plans for CCR unit closure pursuant to the TDEC Order and State regulations.

As presented in this CARA Plan, TVA plans to implement CIP for each of the CCR units at the WBF Plant. CIP is consistent with TDEC regulations and supported by both programmatic and site-specific evaluations and the HHERA results described in Chapter 4. The following subchapters describe the information evaluated by TVA that forms the basis for, and the methods to implement, the planned additional closure actions at the WBF Plant CCR units:

- Chapter 5.1 provides an overview of how CIP and CBR would typically be implemented for impoundments and landfills and provides a brief description of how CCR material harvesting for beneficial use could be performed.
- Chapter 5.2 summarizes the State regulatory requirements for closure.
- Chapter 5.3 provides a summary of the programmatic 2016 PEIS evaluation findings for effectiveness and potential environmental impacts associated with each closure method (TVA 2016a and 2016b).
- Chapter 5.4 describes site-specific considerations for each of the WBF Plant CCR units.
- Chapter 5.5 summarizes TVA's overall basis for the planned CCR unit closure methods, describes the general approach TVA used to identify the planned actions and how they comply with State regulations, and provides the CCR unit-specific basis for, and descriptions of, the planned actions.
- Chapter 5.6 provides a high-level summary of the basis and methods identified for CCR unit closure.

Finally, as described in Chapter 1.2, the closure methods identified in this CARA Plan will not be finalized prior to public review and input on this document. As applicable for each CCR unit, TVA is including draft closure and post-closure plans in this CARA Plan (Appendix F.2) for TDEC review and approval as part of the CARA Plan review process.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

5.1 General Description of Closure Methods

The following provides an overview of how CIP and CBR would typically be implemented for impoundments and landfills and provides a brief description of how CCR material harvesting for beneficial use could be performed. These descriptions are general in nature and do not reflect specific actions in progress or planned at the WBF Plant, which are discussed in Chapter 5.5.

5.1.1 Closure-In-Place

CIP is performed for a landfill by installing a cover system when the unit stops receiving waste or when CCR material harvesting activities are completed (see Chapter 5.1.3). These cover systems are utilized to isolate the underlying waste from exposure to surface runoff and infiltration, human and animal contact, and wind. For a former surface impoundment, CIP involves stabilizing the CCR material as required by field conditions prior to installing the cover system. Regrading for the purpose of recontouring and creating positive drainage may be performed prior to installation of the cover system. The three typical cover system alternatives include:

- Soil cover system: Consists of a low permeability compacted clay barrier layer and vegetative cover
- Geosynthetic soil cover system: Consists of a flexible membrane or geomembrane liner, geocomposite drainage layer, protective cover soil, and vegetative cover
- Geosynthetic-engineered turf cover system: Consists of a structured geomembrane, sand infill ballast, and engineered turf.

Cover system and post-closure requirements are specified by the TDEC DSWM (see Chapter 5.2 below). Based on the size of current surface impoundments and landfills included in the TDEC Order, TVA estimates that the time to complete CIP for surface impoundments generally would be less than five years, and for landfills, generally less than three years depending on weather conditions, and other site-specific conditions.

Common actions associated with CIP may include:

- Ensuring containment dike structural integrity and slope stability
- Considering harvesting of CCR material for beneficial use (see Chapter 5.1.3 below)
- Decanting liquids from impoundments (if present) to the extent needed to support construction of a final cover system. As applicable for site-specific conditions, additional actions such as pore water extraction may be implemented.
- Identifying laydown and cover borrow areas
- Grading to consolidate CCR material, reduce footprint, and promote site drainage. Grading could include the use of additional fill materials or reuse of existing topsoil, as needed.
- Installing cover system components (i.e., liners, drainage layers, cover soils, vegetation)
- Constructing stormwater drainage systems and other water management systems as needed

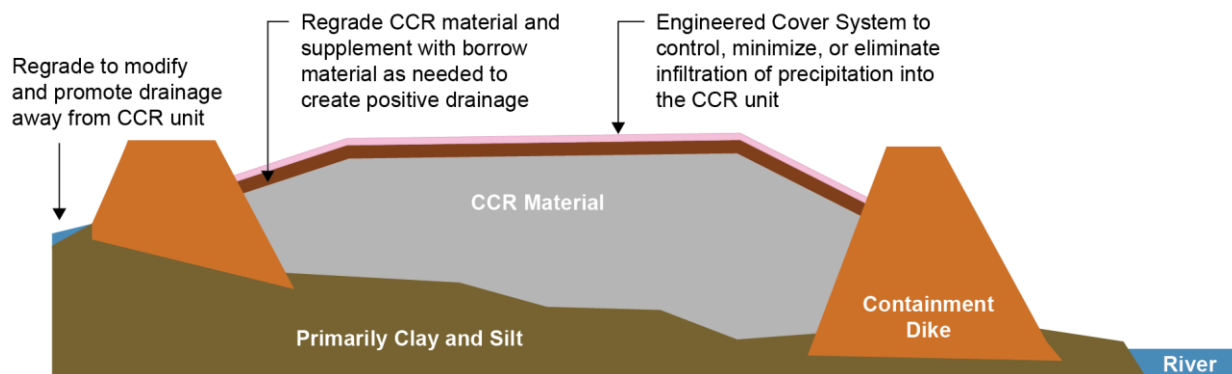
Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
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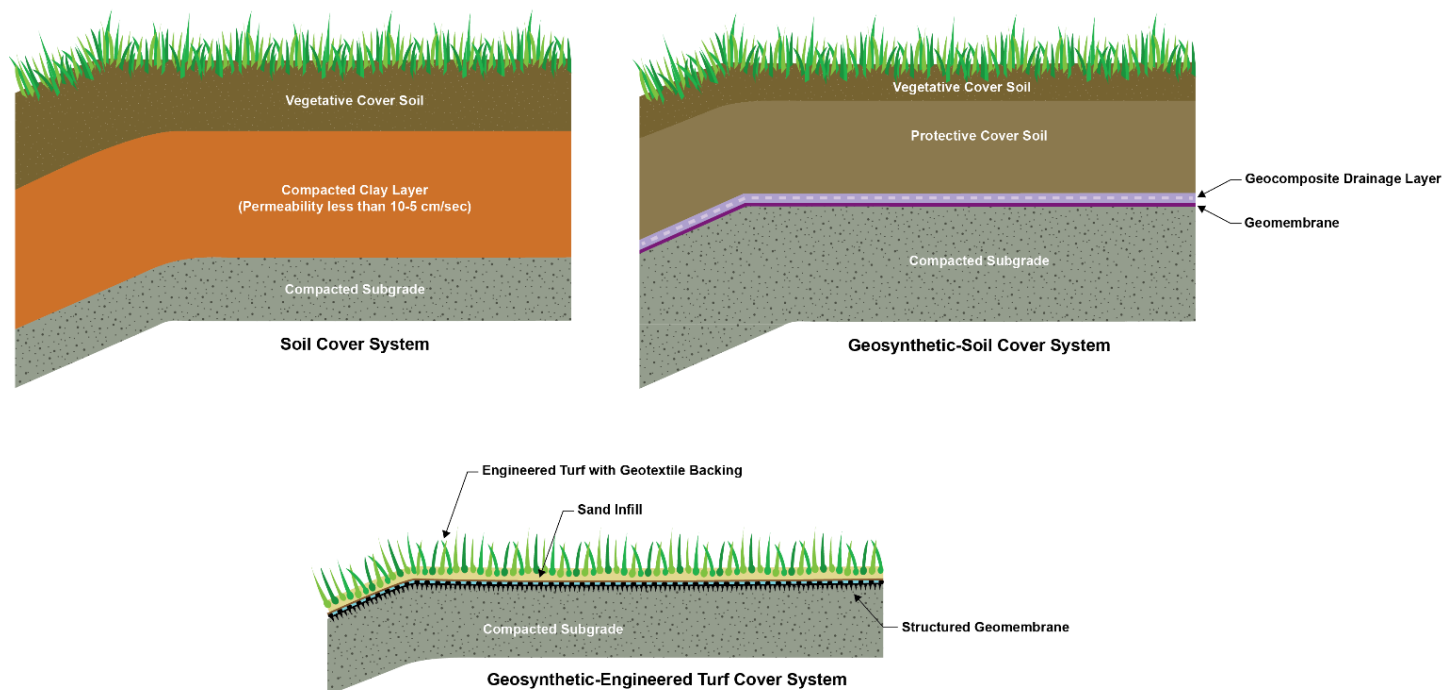
- Preparing closure documentation
- Conducting post-closure care (including performing routine inspections, monitoring, and maintenance activities) and potential use for other purposes (including potential renewable power generation).

Typical approaches for CIP, including cover systems for CCR units, are shown below:

Typical Closure-in-Place Actions



Typical Closure-in-Place Cover Systems



Basis and Methods of CCR Unit Closure

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5.1.2 Closure-By-Removal

CBR involves excavating and relocating the CCR material from the landfill or former impoundment to an approved onsite or offsite disposal facility. Once final closure activities begin, the time required to complete closure depends on a number of factors including, primarily, the amount of CCR material needing to be removed from the impoundment or landfill, the location of the approved disposal facility, and the amount of borrow material required to fill in the excavation. Based on the size of the CCR unit, CBR could take years to decades to complete. Key construction actions associated with CBR may include:

- Considering harvesting of CCR material for beneficial use (see Chapter 5.1.3 below)
- Identifying onsite or offsite permitted management facilities for CCR material disposal (at most locations, this is likely to include a proposal to construct a new onsite or offsite permitted landfill, or additional disposal cells of an existing permitted landfill, which would require design, permitting and construction of the new landfill/cell and associated facilities—this process would typically take two to five years)
- Determining borrow material options
- Designing, permitting, and constructing appropriate load-out facilities
- Coordinating and planning with adjacent communities both before and throughout the construction and transport activities near the closing landfill/former impoundment and the approved permitted landfill receiving the removed CCR material
- Removing CCR material and liner (if any) and transporting to the receiving landfill, including:
 - Decanting liquids from impoundments (if present) to the extent necessary to support removal construction activities. Additional actions including pore water extraction may be implemented to assist in moisture conditioning
 - Removing existing cover soil or geosynthetic cover system (as applicable)
 - Constructing a stormwater management pond, or utilizing an existing pond (if available), to handle stormwater runoff during excavation of CCR material within the unit
 - Coordinating and planning for modifications to existing, or approval of a new discharge location for stormwater runoff
 - Excavating, temporary staging, and moisture conditioning of the CCR material onsite, including dust and stormwater management controls
 - Loading CCR material into transportation vehicles (trucks, rail cars, barges, etc.), and transporting to the receiving landfill
 - Conducting associated maintenance to transportation infrastructure (roads, load-out facilities, etc.) as needed throughout the life of the hauling

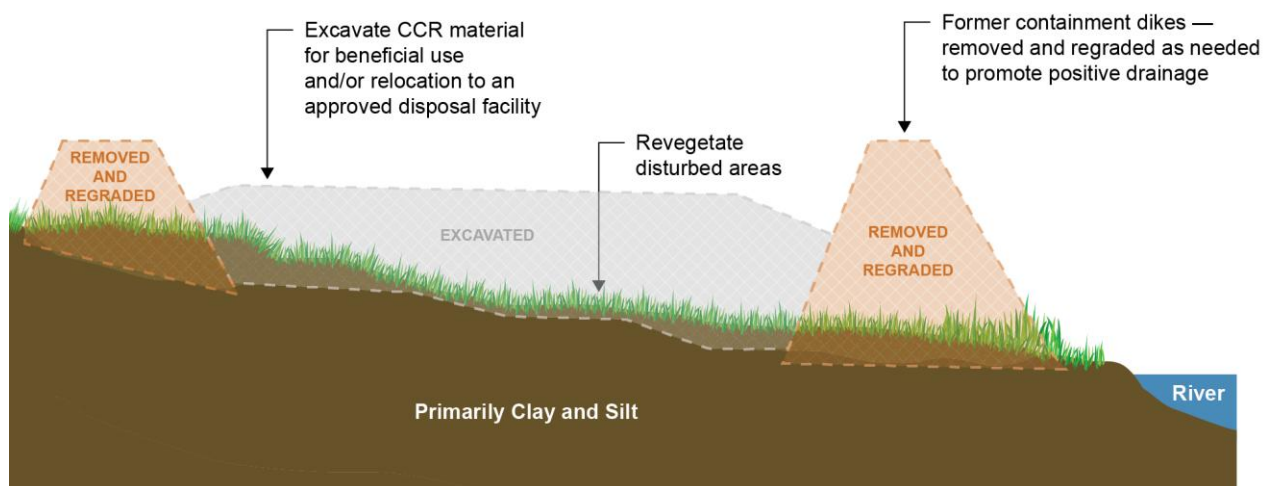
Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Unloading, placing and compacting CCR material at the receiving landfill, including dust and stormwater management controls
- Closing the receiving landfill as required by State regulations.
- Filling, grading, and revegetating the site or re-purposing it for other uses
- Preparing closure documentation.

A typical approach for CBR for CCR units is shown below:

Typical Closure-By-Removal Actions



5.1.3 CCR Material Harvesting for Beneficial Use

CCR material can be harvested for beneficial use regardless of the planned CCR unit closure method. Harvesting CCR material for beneficial use can be performed as an operational activity prior to, or following, CCR unit closure. Beneficial use involves removing the CCR material from the existing CCR unit and using those materials as a substitute for virgin, raw materials in a commercial product. The CCR material may be used in the condition it is harvested from the CCR unit or may require additional processing before being applied to its new end use. Harvesting CCR material for beneficial use can result in net positive effects including but not limited to environmental and economic benefits by reducing the mining and use of virgin materials, lowering greenhouse emissions, and reduced maintenance and costs for final CCR material management. Under many conditions, CCR material harvested and beneficially used in products can also provide the additional benefit of providing improved strength and durability to end materials.

Once beneficial use is included as part of the overall site strategy, the time required to complete harvesting is driven by several factors including: the amount of CCR material that needs to be harvested, the nearest facility to process the CCR material, the rate at which the facility can process the material for its ultimate end use, and the end market demand for the material.

Where harvesting for beneficial use is performed, the amount of CCR material remaining for either closure method is reduced. When harvesting is performed prior to CCR unit closure, it occurs before the final cover system is in place. As

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

CCR material harvesting is completed in each phased area, closure activities for the CCR unit may be completed in an incremental manner. Harvesting can also be performed following installation of a final cover system and CCR unit closure. In this case, harvesting may be performed in discrete phases by opening cover materials to expose pre-determined areas of CCR material. Turf-based cover materials (see Chapter 5.1.1) can be designed to be modular and moveable to accommodate harvesting activities, where applicable, to expedite access and implementation of CCR material excavation. Harvesting (either before or after CCR unit closure) typically involves excavation of the CCR material, potential onsite initial processing, transport to the processing facility (either onsite or offsite), processing the CCR material, and then transporting to the end use facility. When harvested CCR material does not meet the specifications for beneficial use, that CCR material can be replaced in the CCR unit to be handled as a part of closure activities or managed elsewhere.

Following harvesting, the closure process continues as described above for either option. The actual schedule and volume of harvested CCR material for beneficial use will depend on a number of factors, such as the end market demand, processing requirements, amount of material unsuitable for harvesting, and plant operational timelines. Therefore, the final closure configuration and closure schedule will be based on the actual grades and elevations following completion of harvesting activities.

5.2 State Regulatory Requirements

The following describes the TDEC Order requirements and TDEC DSWM regulations regarding CCR unit closure.

5.2.1 TDEC Order

The TDEC Order was issued to establish a process for investigating, assessing, and remediating unacceptable risks from management of CCR material at TVA coal-fired plants. The TDEC Order specifies that the CARA Plan must include the actions TVA plans to take for closure of the CCR units and the basis for those actions. As appropriate for the site, the final approved CARA Plan shall include “[t]he method(s) TVA will employ to remove and/or close in place CCR material at the site.”

Also, the TDEC Order requires that the CARA Plan include a schedule of activities to be completed along with a public input process on the draft CARA Plan before it is finalized by TVA and approved by TDEC. The CARA Plan schedule, public notice and input process, and finalization of the CARA Plan are discussed further in Chapter 8.

5.2.2 TDEC DSWM

TDEC DSWM regulations at 0400-11-01.04(8) specify closure and post-closure requirements. The general performance standard for closure per 0400-11-01.04(8)(a) is:

- (1) The operator must close the disposal facility in a manner that:
 - i) Minimizes the need for further maintenance; and
 - ii) Controls, minimizes, or eliminates, to the extent necessary to prevent threats to public health and the environment, post-closure escape of solid waste, solid waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground or surface waters or to the atmosphere.
- (2) The operator must care for a disposal facility or disposal facility parcel for the period of time after closure in a manner that assures that the performance objectives of part 1 (provided above) are continuously met.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Additional CIP requirements specified in these regulations include information for the cover system design, surface grading and drainage systems, erosion prevention measures, and leachate collection systems. Additional detail regarding closure requirements specified in the TDEC DSWM regulations is provided in Table 5-1.

In accordance with TDEC regulations, the operator must initiate and complete closure activities and conduct post-closure care in accordance with the approved closure/post-closure plan if such a plan has been prepared and approved for the disposal facility being closed. Also, for active portions of the facility, the operator must complete closure activities including grading and establishing vegetative cover in the shortest practicable time, not to exceed 180 days, after any fill areas or any portion of the fill areas have achieved final grade, unless the TDEC Commissioner allows otherwise.

5.3 PEIS Findings and Conclusions

This subchapter provides a summary of the PEIS prepared by TVA in 2016 for CCR surface impoundment closures (TVA 2016a and 2016b). Information in the PEIS and associated Electric Power Research Institute (EPRI) reports described below serves as a foundation for TVA's site-specific evaluation of closure methods for the CCR units at the WBF Plant presented in Chapter 5.4.

The purpose of the PEIS was to support elimination of wet CCR material storage at TVA's coal plants by closing the surface impoundments across the TVA system by either CIP or CBR. The PEIS was divided into two parts: Part I was a TVA-wide analysis and Part II was a site-specific analysis for ten selected surface impoundments that incorporated the analysis methodology presented in three EPRI reports (EPRI 2016a, 2016b, and 2016c). The EPRI reports present a science-based relative impact framework that comprehensively considers the possible human health and environmental impacts of the two closure options: CIP and CBR.

Part I of the PEIS provided a programmatic evaluation of closure of a hypothetical surface impoundment and identified the screening and evaluation factors that would be applicable for TVA's evaluation of future closure of other CCR surface impoundments at its coal-fired power plants. Part II of the PEIS applied the screening and evaluation factors identified in the programmatic evaluation to site-specific CCR units. In Part II, the PEIS relied on EPRI's 2016 qualitative application of relative impact framework to ten TVA surface impoundments located at TVA facilities (TVA 2016a, EPRI 2016c). The report qualitatively compares these impoundments to a hypothetical site that was previously quantitatively modeled by EPRI. Based on the programmatic and site-specific analyses, TVA identified CIP as its preferred alternative for the ten facilities evaluated.

In the PEIS, **TVA identified that CIP would have fewer overall adverse environmental impacts than the CBR alternative and generally would be environmentally preferable.** The observations from EPRI's relative impact framework assessment support TVA's conclusion. The following provides additional detail regarding the environmental review of natural and socioeconomic resource areas that could be affected by each closure method alternative presented in the PEIS. As presented in Appendix C, TVA analyzed potential impacts on the following 22 resource areas, as well as cumulative effects:

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Air Quality
- Climate Change
- Land Use
- Prime Farmland
- Geology and Seismology
- Groundwater
- Surface Water
- Floodplains
- Vegetation
- Wildlife
- Aquatic Ecology
- Solid Waste and Hazardous Waste and Hazardous Materials
- Threatened and Endangered Species
- Wetlands
- Socioeconomics
- Environmental Justice
- Natural Areas, Parks, and Recreation
- Transportation
- Visual Resources
- Cultural and Historic Resources
- Noise
- Public Health and Safety

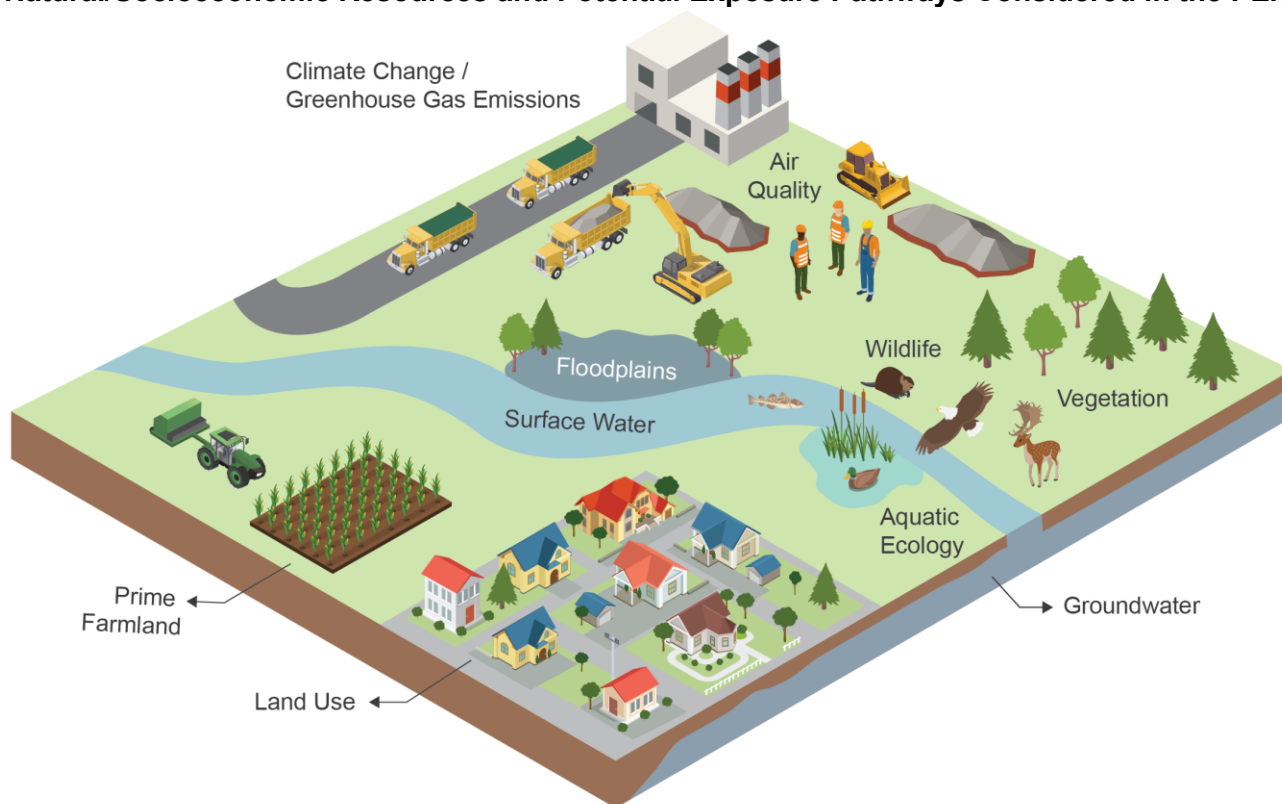
As indicated in the PEIS cumulative effects evaluation, both CIP and CBR can result in “beneficial cumulative impact to groundwater quality.” However, for the CBR alternative, the PEIS states that there would be: **“Adverse cumulative impact to traffic operations within the TVA region. Cumulative impacts to air quality, noise, land use, natural resources, socioeconomics, [Environmental Justice] communities and public health and safety would be expected and greater than [CIP] due to greater trucking and secondary effects on regional landfill capacity.”**

The PEIS and EPRI assessments also identified potential exposure pathways related to CCR unit closures. The natural and socioeconomic resources and exposure pathways considered in the PEIS and EPRI assessments are illustrated below:

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
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Natural/Socioeconomic Resources and Potential Exposure Pathways Considered in the PEIS



As noted above, Part I of the PEIS and the EPRI analysis identified the following key screening and evaluation factors to be considered when determining the closure method. These factors provide information about a range of issues relative to the feasibility and reasonableness of the two closure method alternatives.

- Volume of CCR material
- Schedule/duration of closure activities
- Stability
- Risks to human health and safety relating to closure activities
- Potential human health risks associated with CCR constituents
- Potential effects to water resources
- Potential effects to wetlands
- Risks to adjacent environmental resources
- Modes and durations of transport activities
- Risks to human health and safety related to transport of borrow and CCR material
- Cost.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Programmatically, the PEIS provided these screening and evaluation factors identified in Part I of the PEIS that would bound TVA’s evaluation of the potential environmental effects of future closure decisions of CCR surface impoundments at its coal-fired power plants. Activities associated with CBR and CIP are described in more detail above in Chapters 5.1.1 and 5.1.2.

5.4 Site-Specific Assessment of Closure Methods

In this CARA Plan, TVA has assessed site-specific information in two evaluation steps to support identification of the planned closure method for each CCR unit. The two-step evaluation process included consideration of findings from prior closure assessments performed for WBF Plant CCR units. As such, this chapter summarizes prior CCR unit closure evaluations performed by TVA, describes the two-step evaluation approach, identifies key site-specific considerations included in the CARA Plan closure assessments, and provides a summary of the overall assessment findings. Chapter 5.5 describes the basis for, and the methods to implement, the planned additional closure actions for each CCR unit at the WBF Plant.

5.4.1 Prior CCR Unit Closure Evaluations

Both CCR units evaluated in this CARA Plan were previously closed in accordance with the applicable laws and regulations at the time (see Chapters 1.3.3 and 2.1).

5.4.2 Two-Step Evaluation Approach

TVA employed a two-step evaluation approach to determine the appropriate closure methodology for each WBF Plant CCR unit.

First, for each CCR unit, relative potential impacts of CIP compared to CBR were evaluated for the 22 individual natural and socioeconomic resource areas listed in Chapter 5.3 (e.g., air quality, climate change and GHG emissions, surface waters) as well as cumulative impacts and cost. This assessment compared the relative impacts of CIP actions (e.g., installing an engineered geosynthetic cover system and drainage modifications) identified in this CARA Plan to CBR for the two CCR units. The assessment incorporated CCR unit information that would affect closure implementation as described below. The relative impact assessment used current surrounding demographic information and regulatory designations for protected resources. This detailed assessment of the relative potential impacts of the closure methods on the natural and socioeconomic resource areas for the WBF Plant CCR units is provided in Appendix C. Chapter 5.5 below also contains summaries of these assessments.

Second, a site-specific qualitative evaluation of the key screening and evaluation factors identified in the PEIS and EPRI reports (listed in Chapter 5.3) was also performed to compare the CIP actions identified in this CARA Plan to CBR. The PEIS programmatic analysis is also applicable to CCR landfills because of the similarity of the closure actions required for both decanted surface impoundments and landfills (e.g., excavation of CCR material for CBR or installation of a cover system for CIP). These factors focus on the feasibility and reasonableness of implementing the two closure methods for each of the CCR units. The key factor assessments for the WBF Plant CCR units are provided in Tables 5-2 and 5-3.

5.4.3 Key Site-Specific Considerations

The site-specific closure method assessments for the WBF Plant CCR units incorporated site- and CCR unit-specific information that would affect closure implementation. The assumptions below regarding implementation of CIP or CBR,

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

including identification of the landfill that would receive CCR material for CBR, are made solely for the purposes of the closure evaluation. These assumptions are based on information available to TVA at the time this CARA Plan was prepared, including information from entities outside of TVA, and may change due to unknown future conditions. TVA will continue to refine the assumptions used for the closure alternative evaluations as this CARA Plan is reviewed and finalized. Before implementation of this CARA Plan, TVA will comply with applicable regulations, including for disposal of waste and discharge of water, as appropriate, and obtain required permits. The following summarizes the site- and CCR unit-specific information considered, and the assumptions used, for the closure assessment provided in this CARA Plan.

- The CCR material volumes used are those identified in the EAR for each of the CCR units.
- Because there is no adequate land available to build a new landfill within the WBF Plant property, this evaluation assumes that the potential offsite landfill is located approximately 19 miles from the WBF Plant. If CBR were to be pursued, TVA would coordinate with TDEC to identify an approved, offsite permitted landfill before it is used.
- This evaluation assumes that the location for borrow soils would be the Mountainview Raceway Borrow Site located approximately eight miles northwest of the WBF Plant, and the rock riprap source would be the Rogers Group Inc., located approximately 13 miles to the northeast.
- Both CIP and CBR alternatives for the Slag Disposal Area assume that the Former Coal Yard Storage Area would be regraded and revegetated (TVA completed removal of the remnant coal in 2024/2025). Additionally, both closure alternatives assume regrading of an upgradient drainage modification area to promote positive drainage.
- CIP for the Slag Disposal Area includes planned actions at the Drainage Improvements Area and a ponded area to the west.
- CIP includes construction of a toe berm buttress of rock riprap along the riverbank of the Slag Disposal Area and Ash Pond to improve the slope stability of these CCR units. Installation of the buttress may require excavation of sediment from the Tennessee River to be able to place the rock riprap directly on bedrock. This evaluation assumes sediment would be excavated and placed within the Slag Disposal Area prior to cover system installation. TVA will evaluate alternative installation approaches once additional geotechnical data are obtained during final design of this closure action.
- The duration of CIP activities in this analysis assumes that CIP of the CCR units would be performed relatively concurrently for applicable units.
- The duration of CBR activities in this analysis assumes that CBR would be conducted sequentially for the two CCR units due to physical constraints for access and egress at the site and construction activities at each CCR unit. Operational considerations for the CBR duration estimate included available work area, traffic associated with adjacent facility operations, wheel washing, and possible offsite landfill daily acceptance limits.
- The analysis provides both a site-wide duration and estimated duration of either CIP or CBR closure activities for each applicable CCR unit at the WBF Plant. The duration of CBR closure activities may be longer if the receiving landfill needs additional permitting or construction activities prior to receiving CCR material.

Specific operational and closure implementation considerations and assumptions are discussed in more detail in Appendix C and, as applicable, described for each CCR unit in Chapters 5.5.2.1 and 5.5.2.2.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

5.4.4 Summary of Site-Specific Closure Method Assessment

Based on the relative site-specific evaluation presented in Appendix C, CIP is more environmentally beneficial than CBR for the WBF Plant CCR units. Both closure alternatives would be implemented with corrective actions to achieve GWPS and engineering control measures to reduce or minimize erosion, sedimentation, and fugitive dust impacts during implementation.

For many resources evaluated, the relative impacts of CIP and CBR were similar, and for a few, CBR resulted in more beneficial impacts than CIP. These benefits were driven by eliminating the residual potential for CCR material release at the CCR unit and the development of natural habitat through revegetation with native plants (see Appendix C for additional information). However, the similar and more beneficial impacts were outweighed by the adverse impacts associated with CBR that are not associated with CIP. This is primarily due to the volume of CCR material to be removed and transported to the offsite permitted landfill. The adverse impacts associated with CBR, particularly associated with the excavation and transport of CCR material, are greater than the adverse impacts associated with CIP for installation of a geosynthetic cover system and implementing upgradient drainage modifications at the Slag Disposal Area and construction of the rock riprap toe berm buttress for both CCR units. Compared to CIP, CBR results in greater adverse impacts related to transportation and construction, using more than twice as many truckloads as would be required for CIP and resulting in potentially higher worker and public safety risks. CBR also results in greater potential adverse impacts to surrounding environmental media and higher GHG emissions. CBR, with disposal of about 760,000 cubic yards of CCR material at an offsite landfill, also introduces potential adverse impacts to the surrounding communities with environmental justice concerns near the WBF Plant as well as those near the offsite landfill.

Cumulative impacts associated with the closure of both CCR units at the WBF Plant would amplify the adverse impacts for both closure methods at the WBF Plant CCR units. However, the adverse impacts associated with CBR would be expected to be greater than those for CIP and outweigh minor benefits of CBR actions.

Based on these site-specific assessments for the WBF Plant CCR units, there are additional adverse impacts associated with CBR that are not associated with CIP. These are primarily due to the volume of CCR material to be removed and transported to an offsite landfill to complete CBR for both the CCR units.

5.5 Planned CCR Unit Closure Method

TVA has identified CIP as the closure method for each WBF Plant CCR unit. Multiple lines of evidence provide the basis for this closure method, as outlined below.

1. **CIP meets or exceeds the performance standards required by TDEC regulations**, as well as the supporting requirements for cover system design, surface grading, and drainage systems and erosion prevention measures. The effectiveness of geosynthetic cover systems has been demonstrated previously at the Ash Pond and at other TVA sites, where downward trends in the pore water phreatic surface are observed following their installation. Additionally, these types of cover systems are the widely accepted industry standard for closures of solid waste management units and have been identified by USEPA as a 'green remediation best management practice' (USEPA 2023). Chapter 5.5.5.1 and Table 5-4 explains how the planned CIP actions collectively meet or exceed the required closure performance standard and other requirements in the TDEC DSWM regulations, which also fulfills the requirements in the TDEC Order. In addition, TVA will be implementing post-closure care, monitoring, and reporting as specified in the closure and post-closure plans approved by TDEC.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

2. **The CCR units will meet the established slope stability factors of safety during closure, the post-closure period, and beyond.** As documented in the EAR, the CCR units have adequate structural stability and slopes are stable under current static and seismic loading conditions, except for the post-earthquake, global stability. TVA plans to construct a toe berm buttress of rock riprap along the riverbank as a seismic mitigation measure, such that the CCR units will meet or exceed slope stability criteria for post-earthquake, global stability. Each of the CCR units has 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 materials.
3. **Programmatically, CIP is environmentally more beneficial than CBR, particularly when large volumes of CCR material are to be removed.** As described in Chapter 5.3, based on programmatic evaluations, CIP has fewer overall adverse impacts than CBR and, when considering the resource areas, is environmentally preferable. CBR takes longer to implement, results in more environmental and potential safety exposures related to construction/transportation activities (GHG emissions, worker and public safety impacts), and is more costly.
4. **At the WBF Plant, there are adverse impacts associated with CBR that are not associated with CIP due to the volume of CCR material to be removed and transported to an offsite landfill, potentially impacting 13 communities with environmental justice concerns.** As explained in Chapter 5.4, the programmatic findings are specifically borne out for the WBF Plant CCR units. Compared to CIP, CBR of approximately 760,000 cubic yards of CCR material results in greater adverse impacts related to transportation and construction, particularly climate change and GHG emissions, and worker and transportation safety. CBR also results in higher potential impacts to surrounding surface stream waters and sensitive habitats and species due to the material handling associated with CCR material removal activities. While a few resource areas would have slightly more beneficial impacts from CBR compared to CIP (such as vegetation and wildlife due to the development of natural habitat through revegetation with native plants), these are outweighed by the adverse impacts associated with CBR.
5. **CIP, in conjunction with upgradient drainage modifications, is anticipated to mitigate three AOIs** identified along the eastern edge of the Slag Disposal Area. Installation of a geosynthetic cover system over the Slag Disposal Area, the adjacent Drainage Improvements Area, and western ponded area, along with upgradient drainage modifications will promote positive drainage around the Slag Disposal Area and further control and minimize infiltration through the cover system into this CCR unit, thereby further minimizing post-closure escape of CCR constituents.
6. **There are no unacceptable risks for offsite human or ecological receptors from the CCR units at the WBF Plant,** and potential risks to future onsite workers at the Ash Pond would be mitigated by implementing standard health and safety protocols. As presented in Chapter 4, the results of the HHERA, performed based on USEPA guidance using extensive EI sampling data for the WBF Plant, support CIP as the closure method. This conclusion is consistent with **TVA's long-term monitoring results and the EAR findings that ecological communities in the surrounding water bodies are healthy and are not being adversely impacted by the CCR units.**

With no unacceptable risks related to CIP, and greater overall environmental impacts and higher cost, CBR of the CCR units is not necessary nor justified. With CIP, the current conditions of no unacceptable risks will be maintained by TVA's implementation of construction and erosion controls during closure activities.

An overall comparison of the key factors depicting the most substantial differences between CIP and CBR methods considering the two CCR units together at the WBF Plant is presented below:

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Qualitative Impacts of CIP vs CBR (All Units)

Key Factors	CIP	CBR
Volume of CCR material to be removed ⁽¹⁾	None	Approximately 760,000 cubic yards
Duration of closure activities ⁽²⁾⁽³⁾	Approximately three years to complete (assumes closure conducted relatively concurrently)	Approximately five to six years to complete (assumes closure conducted sequentially)
Impacts to nearby communities related to closure activities	Lower	Higher (longer duration, increased traffic-related accidents/injuries)
Mode/Duration of CCR material transport activities	None	Higher (duration longer)
Impacts to wetlands/sensitive habitat	Lower	Higher (potential release during removal)
Impacts to environment/climate change	Lower	Higher (air and GHG emissions from longer construction/transport duration)
Cost ⁽⁴⁾	Lower (\$42 million to \$81 million)	Higher (\$110 million to \$210 million)

Conclusion: CIP is More Environmentally Beneficial than CBR ⁽⁵⁾
CBR would have higher construction/transportation-related impacts and takes longer than CIP

Notes:

1. CCR material volumes used in this evaluation are those identified in the EAR. See Chapter 5.4.3 and Appendix C for additional information regarding site-specific considerations and assumptions included in the closure comparative analysis.
2. The estimated duration of closure activities assumes that CIP of the CCR units would be performed relatively concurrently for both units.
3. CBR would be conducted sequentially for the two units due to physical constraints for access and egress at the site and construction activities at each CCR unit, and operational considerations described in Chapter 5.4.3. The duration of CBR closure activities may be longer if the offsite receiving landfill(s) needs additional permitting or construction activities prior to receiving CCR material.
4. Preliminary rough order of magnitude costs are based on an engineering estimate for construction activities for the two CCR units combined, including the rock riprap toe berm buttress. The rough order of magnitude costs include design, construction, engineering oversight during construction, and project/construction management activities.
5. The overall conclusion for the WBF Plant CCR units is consistent with findings in TVA's 2016 PEIS.

5.5.1 General Approach for Planned Closure Actions and Compliance with State Regulations

This subchapter describes TVA's general approach for the planned additional closure actions for the WBF Plant CCR units and explains how the planned actions meet or exceed State regulatory standards for CCR unit closure, which also fulfills the requirements in the TDEC Order.

TVA's approach to identify the additional closure actions presented in this CARA Plan was based on an evaluation of CCR unit-specific conditions, while also considering current or planned TVA facility operations and other TVA obligations, requirements, programs, or goals.

Across the TVA plant sites, CCR unit-specific closure considerations may include compliance with a regulatory closure schedule and/or planned beneficial use activities, in addition to the existing conditions and modeled future conditions at that CCR unit. For example, a CCR unit that already has an effective engineered geosynthetic cover system could require no additional closure action or limited additional closure actions (e.g., drainage modifications) to meet the closure

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

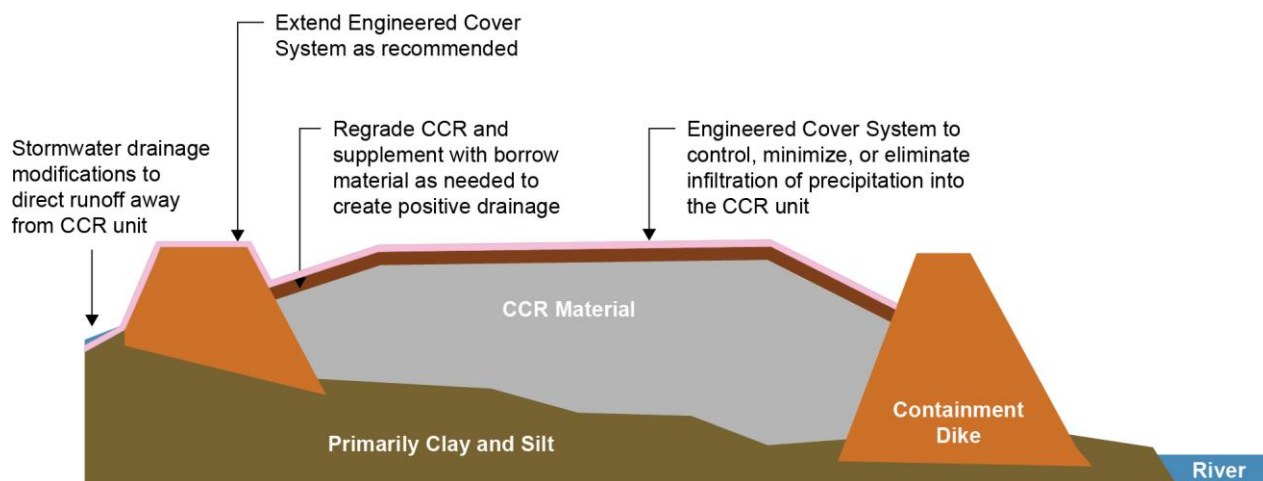
performance standard required by TDEC regulations. Depending on each of the CCR unit's existing and future modeled conditions, pore water extraction to augment the closure action to achieve long-term conditions sooner may be considered.

While planning a CCR unit closure, TVA also considers facility operational schedules, continued operating and maintenance requirements, overall risk mitigation, program management obligations, and long-range facility plans (e.g., plant retirement, future beneficial use planning, or potential site redevelopment). TVA is also obligated to comply with all local, State, or federal regulations, which may influence the type of actions included or the schedule required for closure. TVA also considers its core principles (see Chapter 1.1), such as providing clean, low-cost power, protecting the environment, and promoting economic development. These considerations may influence the need for and type of closure action (CIP or CBR), or ways to enhance the closure action to achieve long-term conditions sooner (e.g., pore water extraction).

Based on these considerations, TVA is planning a comprehensive set of additional closure actions for the Ash Pond and Slag Disposal Area as shown in Exhibit 5-1. The planned closure actions at certain areas include cover system modifications, including the installation of engineered geosynthetic cover systems and implementation of drainage modifications, as well as construction of a toe berm buttress of rock riprap along the eastern edge of both CCR units. Together, these planned additional actions, along with previous closure actions described in Chapter 2, will meet or exceed the closure performance standard as discussed further in Chapter 5.5.1.1 and presented in detail in Table 5-6 for each CCR unit. The basis for and implementation of the planned closure actions are described for each CCR unit in Chapter 5.5.2.

Generalized illustrations of TVA's closure action elements for the WBF Plant CCR units are depicted below.

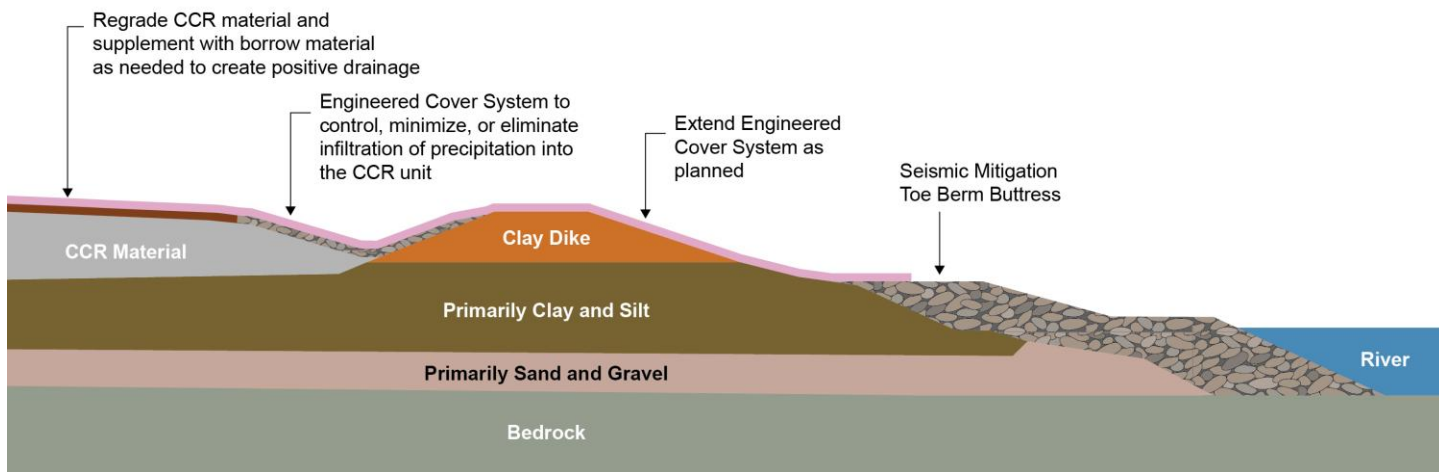
Planned Closure-in-Place Actions: Cover Systems and Drainage Modifications



Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Planned Closure-in-Place Actions: Seismic Mitigation Measure



5.5.1.1 Compliance with State Regulations for Closure

This subchapter describes how the planned additional closure actions, along with previous closure actions, collectively meet the general performance standard established by TDEC DSWM regulations at 0400-11-01.04(8)(a), described in Chapter 5.2.2, which also fulfills the requirements in the TDEC Order.

The general performance standard requires TVA to close the CCR units in a manner that:

- i) Minimizes the need for further maintenance; and
- ii) Controls, minimizes, or eliminates, to the extent necessary to prevent threats to public health and the environment, post-closure escape of solid waste, solid waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground or surface waters or to the atmosphere.

TVA has identified CIP using engineered geosynthetic cover systems and drainage modifications (e.g., regrading, lining ditches, installing culverts) where needed, and construction of a rock riprap toe berm buttress for both CCR units to meet the general performance standard. First, using geosynthetic cover systems, along with implementing upgradient drainage modifications to promote positive drainage, minimizes future maintenance activities by installing a low permeability barrier that reduces the potential for erosion, sloughing, and CCR material settlement. Second, these actions are effective in controlling and minimizing post-closure escape of CCR constituents because they limit infiltration through the cover system to lower the hydraulic head, in conjunction with the existing low permeability perimeter dikes and foundation soils. Similarly, construction of the toe berm buttress will meet post-earthquake, global stability requirements, thereby controlling and minimizing post-closure escape of CCR material.

Based on TVA's overall considerations as described earlier in this subchapter, TVA is not planning pore water extraction for the CCR units at this time given the current absence of pore water at the Ash Pond, and the comprehensive actions planned for the Slag Disposal Area, described above, that are expected to achieve long-term conditions within a reasonable period of time following completion of these actions based on modeling.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

In summary, the planned additional closure actions identified for each CCR unit have been identified to achieve long-term closure conditions, given the existing conditions at each CCR unit, to meet or exceed the closure performance standard described above (0400-11-01.04(8)(a)), and TVA's other planning considerations.

The general performance standard also requires TVA to care for the CCR unit after closure in a manner that assures that the general performance standard (provided above) is continuously met. Additionally, TDEC DSWM regulations at 0400-11-01.04(8)(b) require TVA to complete closure activities in accordance with a TDEC-approved closure plan. To meet these requirements, TVA will implement closure and post-closure monitoring and maintenance activities described in TDEC-approved closure and post-closure plans following CCR unit closure. These activities include conducting regularly scheduled inspections to evaluate the integrity of the cover system, stormwater management controls, drainage modifications, and making as-needed repairs.

Finally, TDEC DSWM regulations at 0400-11-01.04(8)(c) require TVA to meet specific requirements for the cover system design, surface grading and drainage systems, erosion prevention measures, and leachate collection systems. TVA will utilize existing cover systems that meet the cover system standards, or where new cover systems or extensions of existing systems must be installed, TVA will install new cover systems consistent with the existing cover systems, or install alternative final cover systems where necessary, that meet the cover system standards. Drainage and erosion will be controlled and minimized through a stormwater management system and site grading plan. Waters generated by the closure actions, including leachate where applicable, will be treated as required in the applicable unit permit(s), or as otherwise necessary to prevent threats to human health and the environment, to TDEC-approved levels prior to discharge.

5.5.2 CCR Unit-Specific Closure Actions

The following subchapters provide the basis for, and implementation of, the planned closure actions for each CCR unit at the WBF Plant. Exhibit 5-1 depicts a generalized plan for the closure actions for the WBF Plant CCR units. Exhibits 3-1, 5-2, and 5-3 display additional information in plan and cross section of each CCR unit that compares 2019 conditions to the predicted future long-term conditions following implementation of the additional closure actions at each CCR unit based on modeling (Appendix G). Additionally, design drawings for the planned additional closure actions are presented in Appendix F.1, and draft closure and post-closure plans are provided in Appendix F.2.

The groundwater modeling program used for this study was selected, in part, because it is thoroughly documented; widely used by consultants, government agencies, and researchers; and is consistently accepted by regulators. The model was developed and calibrated in general accordance with international standards. The groundwater model was used to develop Exhibits 5-2 and 5-3 that display the recent and future long-term conditions (following completion of additional closure implementation actions) represents a simplified version of the current understanding of hydrogeologic conditions at the WBF Plant using the data and information available at the time it was developed and used for evaluations in this CARA Plan. As such, there is a potential that the input parameters and underlying assumptions used to develop the model may not be fully representative of the complexities of the WBF Plant groundwater system, and thus may over-predict or under-predict existing or future conditions. However, the calibrated model is considered a reliable tool to meet objectives of the modeling study to support CCR unit closure (and groundwater corrective action) alternatives presented in this CARA Plan.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

5.5.2.1 Ash Pond Closure-in-Place

CIP, including construction of a toe berm buttress as a seismic stability mitigation measure, is planned for the Ash Pond based on:

- (1) There are no unacceptable risks to human or ecological receptors, and standard health and safety protocols would address potential risk to onsite workers. The HHERA was conducted using USEPA guidance and reached this conclusion based on extensive EI data related to this CCR unit. This conclusion is consistent with TVA's long-term monitoring results, the EAR findings, and supplemental investigation information that ecological communities in the surrounding water bodies are healthy and are not being adversely impacted by the CCR units. The planned additional CIP actions would maintain this condition in the future, compared to CBR which is likely to result in increased potential of onsite worker and public exposure to CCR material due to excavation and transport activities.
- (2) CBR has greater relative adverse impacts compared to CIP. The excavation and disposal of approximately 190,000 cubic yards of CCR material would require up to three years of closure-related activities and transport of about 11,000 truckloads approximately 19 miles to an offsite landfill, potentially impacting 11 communities with environmental justice concerns. Although the duration to complete CIP is similar to CBR, it would require less than 1,200 truckloads to bring in rock riprap to complete CIP, resulting in fewer potential community, worker and public safety impacts, as well as lower GHG emissions from transportation and construction activities than CBR.
- (3) Within the Ash Pond, there is no phreatic surface because a pore water level was not measured within the CCR material, and based on modeling of future conditions, this condition is expected to be maintained reflecting that long-term conditions have been reached. Exhibits 5-2 and 3-1 respectively provide plan and cross section views of the Ash Pond that depicts recent and predicted future long-term conditions based on modeling (Appendix G).
- (4). Groundwater monitoring for this CCR unit has repeatedly reported groundwater concentrations below the GWPS. This finding provides another line of evidence that the existing geosynthetic cover system is performing as expected.
- (5) CIP meets or exceeds the general performance standard for closure in the TDEC DSWM regulations. TVA will continue post-closure monitoring and maintenance activities as required in the existing *Ash Pond Closure Plan* (TVA 2013).

As described in Chapter 2.1.1.1, the Ash Pond was closed in 2015. As part of the closure project, CCR material was excavated from the southern area of the Ash Pond and consolidated in the northern area of the Ash Pond and covered with a geosynthetic and soil cover system. A clay divider dike was constructed between the covered portion of the Ash Pond and the remaining area of the Ash Pond. The southern portion of the former Ash Pond was converted into a permitted stormwater pond for the site. Based on the current performance of the existing cover system and predicted future long-term conditions, TVA is not planning modifications to the cover system or drainage at the Ash Pond. As noted in Chapter 2.1.1.1, TVA is evaluating the need to retain or modify the stormwater pond for future plant operations and water management. If TVA decides to remove or modify the stormwater pond, this action would be completed under future Operations and Maintenance activities with appropriate authorization from TDEC as needed.

TVA is planning to construct a toe berm buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure, such that the CCR unit will meet or exceed slope stability criteria for post-earthquake, global stability.

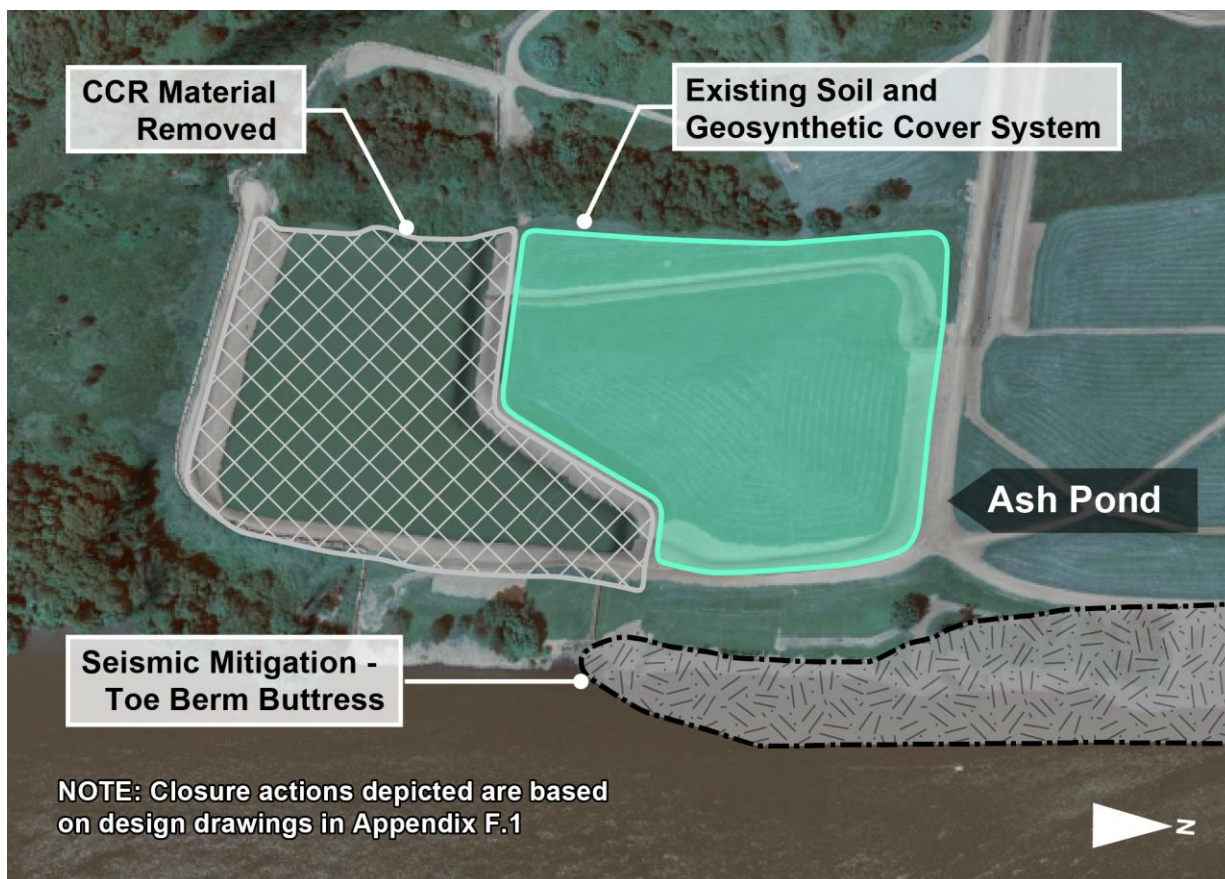
Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

The buttress will begin at the riverbank southeast of the existing cover system at the Ash Pond and extend north along the riverbank to the north end of the Slag Disposal Area. Targeted excavation of alluvial material within the river channel (along the toe of the riverbank) may be required to allow the riprap to be placed directly on the weathered bedrock. The riprap toe will act as a buttress across the liquefiable sand zone. After removing existing vegetation, the riprap will extend up the slope above the normal reservoir elevation and will include one or more flat benches, as needed to improve stability.

The comprehensive closure actions for this CCR unit are displayed in the illustrations below:

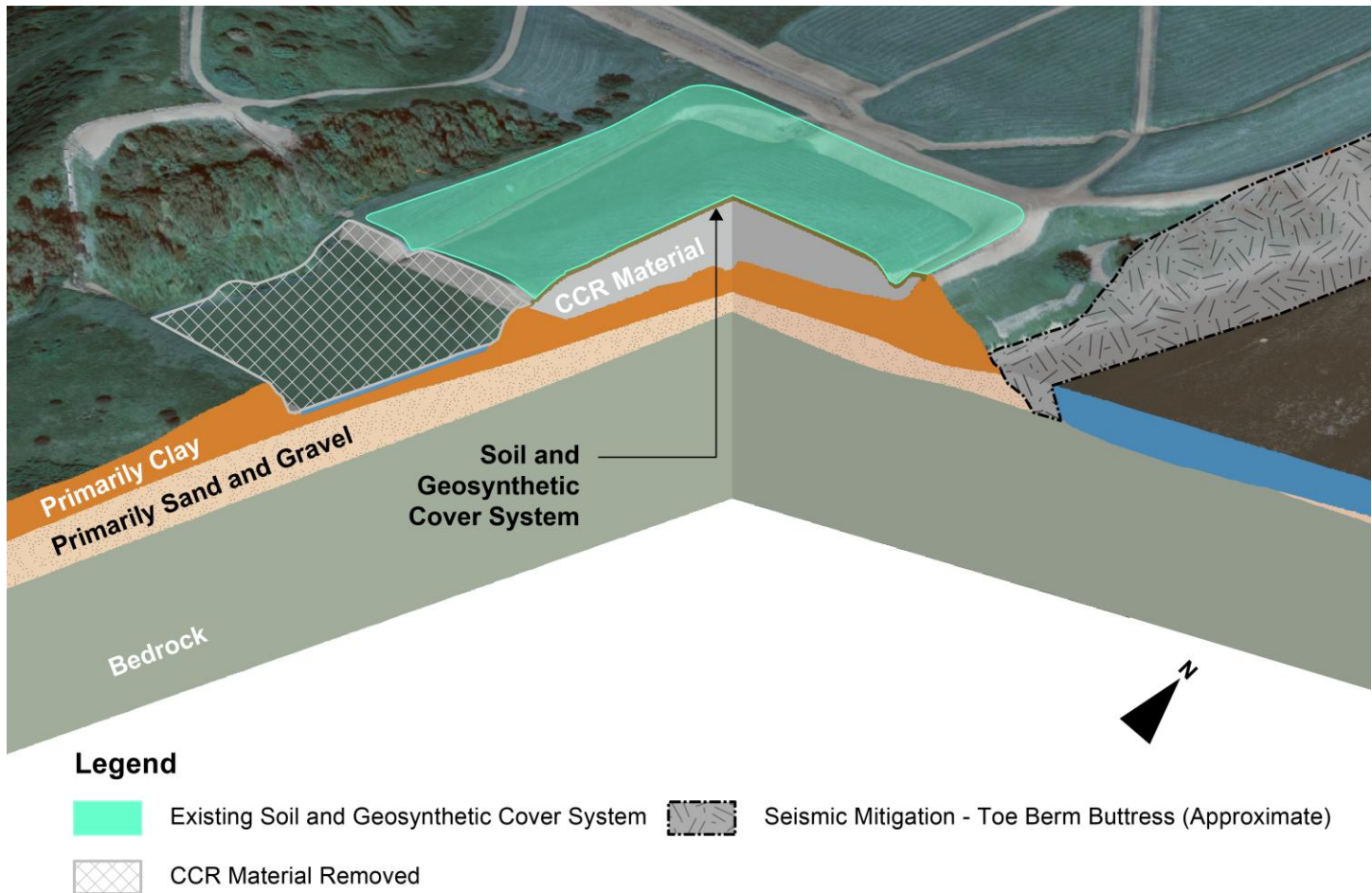
Ash Pond Planned Additional Closure Action, Plan View



Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Ash Pond Planned Additional Closure Action, Profile View



5.5.2.2 Slag Disposal Area Closure-in-Place

CIP, including consolidation of CCR material, additional cover system and drainage modifications, and construction of a toe berm buttress as a seismic stability mitigation measure, is planned for the Slag Disposal Area based on:

- (1) There are no unacceptable risks to human or ecological receptors. The HHERA was conducted using USEPA guidance and reached this conclusion based on extensive EI data related to this CCR unit. This conclusion is consistent with TVA's long-term monitoring results, the EAR findings, and supplemental investigation information that ecological communities in the surrounding water bodies are healthy and are not being adversely impacted by the CCR units. The planned CIP actions would maintain this condition in the future, compared to CBR which is likely to result in increased potential of onsite worker and public exposure to CCR material due to excavation and transport activities.
- (2) CBR has greater relative adverse impacts compared to CIP. The excavation and disposal of approximately 570,000 cubic yards of CCR material would require up to five years of closure-related activities and transport of about 34,000 truckloads of removed CCR material approximately 19 miles to the offsite landfill and to bring in

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

borrow soils, potentially impacting 13 communities with environmental justice concerns. Although the duration to complete CIP is similar to CBR, it would require about 19,000 truckloads to bring in borrow soils and rock riprap to complete CIP, resulting in fewer potential community, worker and public safety impacts, as well as lower GHG emissions from transportation and construction activities than CBR.

- (3) CIP using geosynthetic cover systems meets or exceeds regulatory requirements and is the widely accepted industry standard for in-place waste closures. The effectiveness of the geosynthetic cover systems has been demonstrated at the Ash Pond, as well as at other TVA sites. The planned additional closure actions at the Slag Disposal Area to install a similar geosynthetic cover system, along with drainage modifications in adjacent and upgradient areas, would control and minimize infiltration through the cover system into the CCR unit, thereby minimizing post-closure escape of CCR constituents. Based on modeling of future conditions, after the additional closure actions are completed the pore water phreatic surface is expected to decline until long-term conditions are reached. Exhibits 5-2 and 5-3 respectively provide plan and cross section views of the Slag Disposal Area that depict the recent and predicted future long-term conditions following implementation of the additional closure actions based on modeling (Appendix G).
- (4) CIP meets or exceeds the general performance standard for closure in the TDEC DSWM regulations. TVA will implement the additional closure actions and conduct post-closure care and maintenance activities as described in the closure and post-closure plans provided in Appendix F.2 following approval of this CARA Plan.

As described in Chapter 2.1.1.2, the Slag Disposal Area was closed in 2009 with a soil cover system in accordance with applicable regulations in effect at the time of closure. TVA plans to modify the existing soil cover system at this CCR unit with a geosynthetic cover system to further control and minimize infiltration through the cover system, thereby further reducing the post-closure escape of CCR constituents. This includes extending the cover system across the majority of the footprint of the Drainage Improvements Area as well as across an existing ponded area directly west of the CCR unit once it has been filled with excavated CCR material, alluvial material, or borrow soils and regraded. Areas within the proposed limits of the cover system extension will be regraded to promote site drainage using existing site material or borrow material.

Prior to installing the cover system, CCR material behind the former unloading dock sheet pile wall, located in the northeast corner of the Slag Disposal Area, will be excavated to accommodate installation of the toe berm buttress as described below. Excavated CCR material will be consolidated in the drainage modifications area (southwest corner) of the Slag Disposal Area and Drainage Improvements Area. If additional CCR material is exposed during regrading operations, the material will be placed within the proposed limits of capping. Once final grades are achieved, a geosynthetic-soil cover system or a geosynthetic-engineered turf cover system, as described in Chapter 5.1.1, will be installed.

Stormwater drainage modifications will include filling the ponded area directly west of the CCR unit and regrading the surrounding and upgradient areas to better drain through the perimeter ditches of the CCR unit, prior to the geosynthetic cover system installation. This cover system will also act as a barrier to reduce infiltration should the ponded areas flood during larger storm events. The stormwater modifications will include replacement of existing stormwater culverts disturbed during construction and installation of new stormwater culverts as necessary. The Former Coal Yard Storage Area that drains to this ponded area will also be regraded to support positive drainage around the Slag Disposal Area and Drainage Improvements Area. The area will be regraded to drain and exposed areas will be stabilized with seed or sod. Stormwater from the Former Coal Yard Storage Area, ponded area, and majority of the Slag Disposal Area will continue

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

to be directed towards the Stormwater Pond south of the Ash Pond. The northern portion of the Slag Disposal Area will continue to drain to a small pond on the north end of the CCR unit. Following completion of the drainage modifications, CCR unit regrading, and cover system extensions, exposed areas will be stabilized with seed or sod, and gravel roadways will be repaired or replaced as necessary.

In development of the planned closure actions at the Slag Disposal Area and adjacent Drainage Improvements Area, TVA evaluated the potential that a former surface stream shown on a 1935 topographic map (Exhibit 2-4a) may have been a preferential flow path beneath the Slag Disposal Area. Based on EI findings, the soil in the vicinity of the mapped stream alignment was similar to soil in nearby areas, and a comparison of 1942 topographic map (Exhibit 2-4b) indicates that the former stream alignment was mislocated in the 1935 map. As a result, a preferential pathway was not identified, and TVA did not include additional closure actions for the Slag Disposal Area and adjacent Drainage Improvements Area other than the planned actions described above. Also, as described in Chapter 2.1.1.2, the Drainage Improvements Area Project was previously conducted based on historical seepage identified at the WBF Plant. As noted in the EAR findings, following implementation of that project, the historical seepage was observed to cease. Based on the performance of these past drainage modifications and effectiveness of geosynthetic cover systems in limiting infiltration, it is anticipated that the planned closure and collective drainage modifications included in this CARA Plan will serve to mitigate AOI02, AOI03, and AOI04 located adjacent to the Slag Disposal Area.

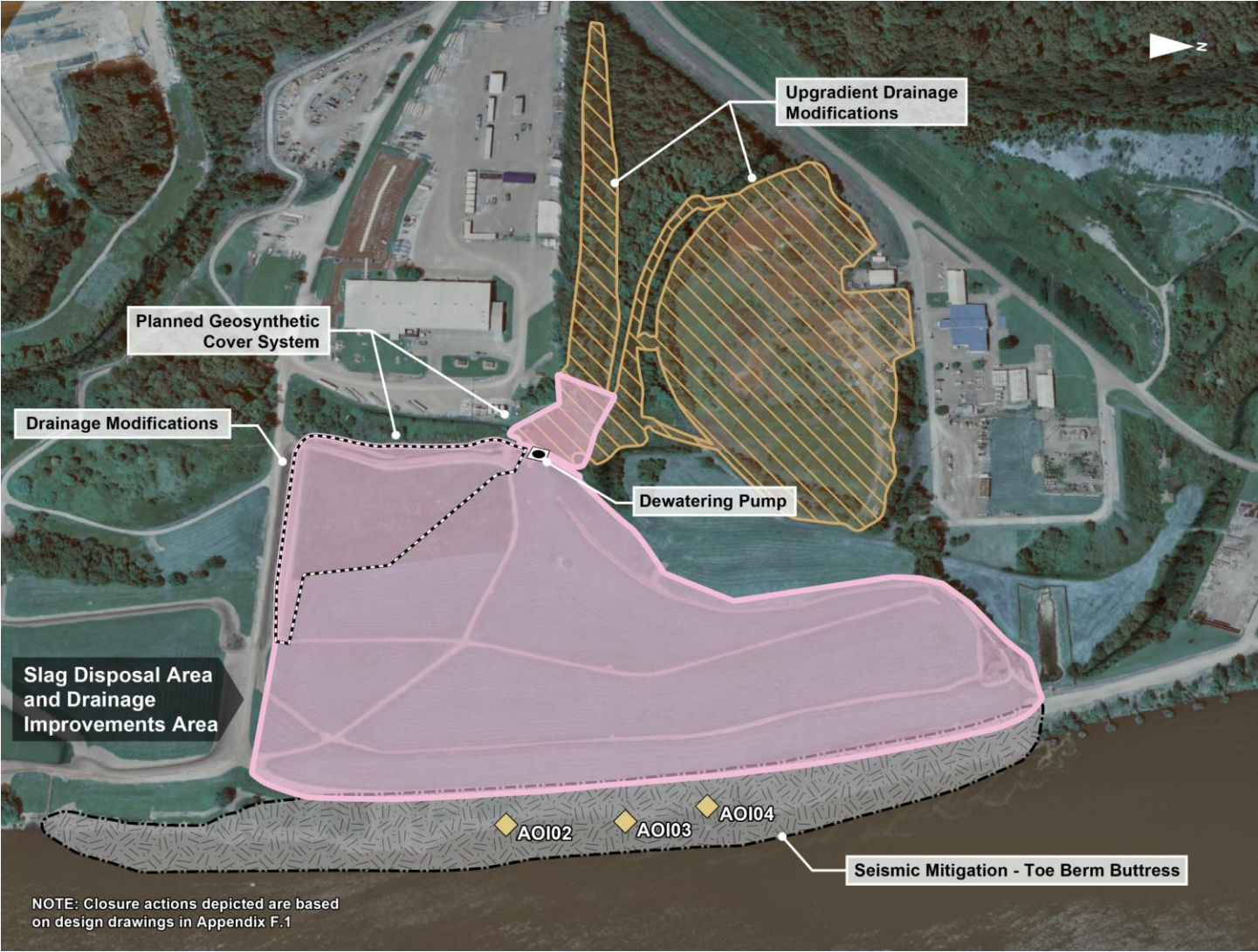
As described above, TVA will construct a toe berm buttress of rock riprap along the riverbank of the Slag Disposal Area as a seismic stability mitigation measure, such that the CCR unit will meet or exceed slope stability criteria for post-earthquake, global stability. The buttress will begin at the riverbank southeast of the existing cover system, integrate with the buttress at the Ash Pond as described in Section 5.5.2.1, and extend north along the riverbank to the north end of the Slag Disposal Area. Targeted excavation of alluvial material within the river channel (along the toe of the riverbank) may be required to allow the riprap to be placed directly on the weathered bedrock. The riprap toe will act as a buttress across the liquefiable sand zone. After removing existing vegetation, the riprap will extend up the slope above the normal reservoir elevation and will include one or more flat benches, as needed to improve stability. As part of this action, the existing sheet pile wall in the northern portion of the Slag Disposal Area will be modified to allow installation of the rock riprap buttress, and the planned geosynthetic cover system modification will cover the western edge of the buttress along this CCR unit.

The planned comprehensive closure actions for this CCR unit are displayed in the illustrations below:

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

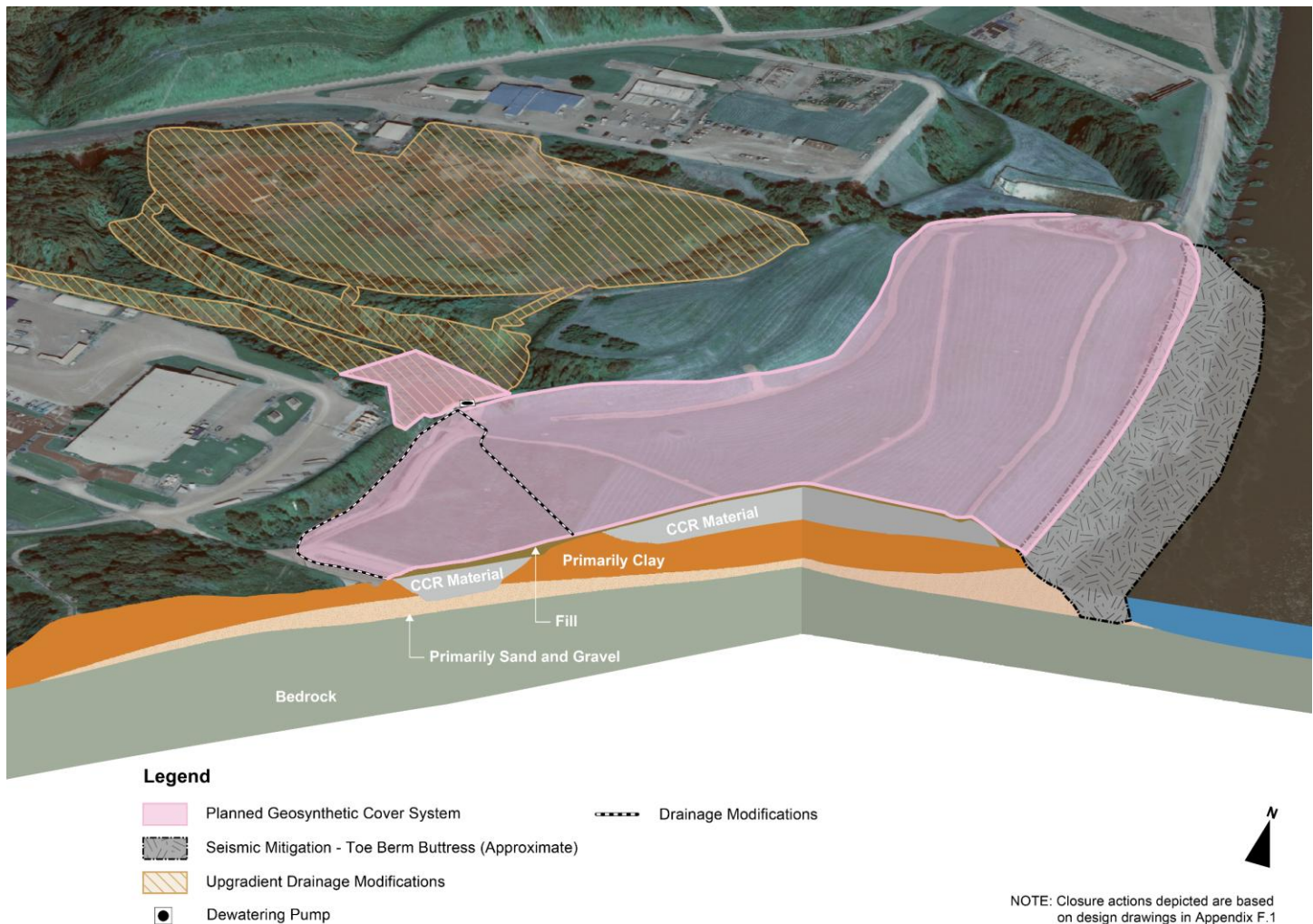
Slag Disposal Area Planned Additional Closure Actions, Plan View



Slag Disposal Area Planned Additional Closure Actions, Profile View

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant



5.6 CCR Unit Closure Method Summary

Based on the findings of the EI, the HHERA conclusions, comparison of closure method alternatives, and evaluation of regulatory standards, TVA is planning CIP as the closure method for each WBF Plant CCR unit. Multiple lines of evidence provide the basis for this closure method and support development of associated closure actions, as outlined below:

- CIP is environmentally more beneficial than CBR, particularly for the WBF Plant CCR units where over 760,000 cubic yards of CCR material would have to be removed and transported to an offsite landfill.
- Compared to CIP, CBR results in greater adverse impacts related to transportation and construction, particularly climate change and GHG emissions, worker and transportation safety, and potential impacts to nearby communities with environmental justice concerns.
- Once closure begins, CBR would require five to six years to complete compared to three years for CIP of the two WBF Plant CCR units.

Basis and Methods of CCR Unit Closure

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- TVA's long-term monitoring results and the EAR findings demonstrate that ecological communities are healthy, and that surface water and sediment quality in the Tennessee River is not being adversely impacted by the CCR units.
- There are no unacceptable risks for offsite human or ecological receptors from the CCR units at the WBF Plant based on the HHERA conducted using USEPA guidance.
- There are no onsite or downgradient offsite uses of groundwater as a drinking water source.
- CIP meets or exceeds the closure performance standards required by TDEC regulations and is consistent with industry standards for solid waste management closures.
- Geosynthetic cover systems are effective in controlling, minimizing or eliminating infiltration through the cover system, as previously demonstrated at the Ash Pond and other TVA sites, where downward trends in the pore water phreatic surface are observed following installation of geosynthetic cover systems.
- Once the toe berm buttress is constructed, the CCR units will meet the established slope stability factor of safety during closure, the post-closure period, and beyond.
- CIP, in conjunction with upgradient drainage modifications, is anticipated to mitigate three AOIs identified along the eastern edge of the Slag Disposal Area.

With no unacceptable risks related to CIP, CBR of the CCR units is not necessary nor justified with its greater overall environmental impacts and higher cost.

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 6 Basis and Methods of CCR Unit Corrective Action

This chapter describes the basis and methods of TVA's planned corrective actions at the WBF Plant CCR units, including discussion of the applicable State requirements that govern CCR unit corrective action. TVA has evaluated general corrective measure strategies, considered regulatory requirements, and assessed site-specific conditions to identify the corrective measure technologies planned for implementation. Corrective measures are the individual technologies considered and evaluated. Also, as described in this chapter, 'corrective action' simply means the approach TVA plans to use to improve groundwater quality consistent with regulatory requirements (also sometimes referred to as a "remedy").

As presented in this CARA Plan, TVA plans to implement corrective actions to address two well locations at the Slag Disposal Area CCR unit. These corrective actions are consistent with TDEC regulations and supported by site-specific evaluations of potential corrective measures. Details regarding the corrective measures assessment for the Slag Disposal Area are presented in Appendix D. The following subchapters describe the information evaluated by TVA that forms the basis for, and methods to implement, the planned groundwater corrective actions at the Slag Disposal Area:

- Chapter 6.1 provides the basis for groundwater corrective measures.
- Chapter 6.2 describes the general corrective measure strategies considered by TVA.
- Chapter 6.3 summarizes the TDEC Order and TDEC DSWM requirements for corrective action.
- Chapter 6.4 presents the overall assessment process and site-specific considerations of the potential corrective measures evaluated.
- Chapter 6.5 summarizes the assessment of corrective measures and describes the planned corrective actions for the Slag Disposal Area.
- Chapter 6.6 provides a high-level summary of the basis and methods for the planned groundwater corrective actions.

As presented in Chapters 3 and 4, respectively, environmental media evaluated in this CARA Plan are based on EAR findings and HHERA results. The EAR findings (summarized in Chapter 3.2) were based on comparison of groundwater, sediment, surface stream water, and ecological sample analytical results for CCR constituents to TDEC-approved screening levels. The HHERA included in this CARA Plan conducted further evaluation of these environmental media. As explained in Chapter 4, the HHERA concluded that there are no unacceptable risks to human or ecological receptors based on USEPA guidance for assessing potential exposures to sediment, surface stream water, or groundwater, and potential risks to future onsite workers would be mitigated by implementing standard health and safety protocols. Therefore, corrective action is only required for groundwater in order to attain GWPS at two well locations (WBF-104 and WBF-106) consistent with regulatory requirements.

6.1 Basis for Groundwater Corrective Measures

TVA is establishing a common list of CCR parameters as the basis for groundwater corrective measures for the CCR units included in the TDEC Order. To develop this list, TVA considered TDEC DSWM requirements for groundwater protection as well as other appropriate standards for groundwater protection. To provide alignment with standards beyond the TDEC

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

DSWM requirements, TVA developed GWPS for the parameters listed in Table 1-1 and is applying these GWPS for TVA sites within the Tennessee Valley. The GWPS is defined as the Maximum Contaminant Level (MCL) for CCR constituents that have an MCL. The MCLs included in the TDEC DSWM regulations are consistent with federal MCLs. For CCR constituents that do not have an MCL listed in Appendix III of TDEC DSWM regulations, including cobalt, lithium, molybdenum, and radium-226 and radium-228, human health risk-based values were adopted for this CARA Plan. Based on this approach, TVA has identified the GWPS in Table 1-1 for this CARA Plan.

As such, the specific CCR units, constituents, and wells requiring corrective action at the WBF Plant are presented below and depicted in Exhibit 3-4:

Summary of Findings That Require Corrective Action in the CARA Plan	
CCR Unit	Groundwater
Ash Pond	None
Slag Disposal Area	Cadmium (Well WBF-104) Cobalt (Wells WBF-104 and WBF-106)

The findings above, which require the assessment of corrective measures and identification of planned corrective actions in this CARA Plan, are based on the conclusions of a statistical evaluation of groundwater data collected through October 2022 as presented in the EAR. TVA is continuing to monitor groundwater at the WBF Plant CCR units, and these data will further inform the type and extent of, or need for, groundwater corrective action. For context, the statistical evaluation in the EAR asked the question, “Do the available data show that, at a statistically significant level, the concentration of a given CCR constituent is above a GWPS?” As additional groundwater data are collected during the CARA Plan finalization and corrective action final design processes, an additional question becomes important: “Do current groundwater monitoring data confirm that there continue to be statistically significant constituent concentrations above GWPS, and are those concentrations increasing, stable, or decreasing?” This question gets to the issue of changing groundwater conditions, and of whether implementation of an active, passive, or no corrective measure is ultimately needed.

Well MW-1 was identified in the EAR as requiring further evaluation because it exhibited statistically significant concentrations of cobalt above the TDEC-approved screening level. Based on the boring log information, the well was screened in clay, which does not represent the uppermost aquifer. In addition, well MW-1 is generally located between two adjacent CCR units that are essentially contiguous and is positioned upgradient of the Ash Pond. Groundwater passing well MW-1 continues to flow approximately east-southeast toward the downgradient boundary of the Ash Pond. There are no exceedances of GWPS in groundwater at wells screened in the uppermost aquifer along the downgradient (eastern) boundary of the Ash Pond. For the reasons described above, well MW-1 is not appropriately positioned to serve as a compliance well. Therefore, TVA has identified MW-1 as an observation well (Appendix E) that does not require evaluation for potential corrective action.

6.2 General Description of Corrective Measures

Three primary corrective measure strategies have been identified as potentially applicable to address groundwater exhibiting statistically significant concentrations above the GWPS at the WBF Plant:

- Hydraulic Control and Treatment: Hydraulic control (also often called hydraulic containment) is a technology that has been employed for decades to control movement of groundwater. Hydraulic control approaches that may be considered include groundwater collection galleries or trenches, groundwater extraction wells, or a combination of

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

these features. The applicability and design of a hydraulic control system is largely based on site-specific conditions such as aquifer dimensions and hydraulic conductivity, presence of confining layers, depth, gradient, characteristics of the target CCR constituents, and presence of receiving water bodies or groundwater production wells.

- **Enhanced *In Situ* Treatment:** *In situ* treatment of groundwater is an established technology for a variety of site conditions and contaminants. This approach includes measures implemented *in situ* (i.e., treatment is within the uppermost aquifer) to immobilize and reduce the concentrations of target CCR constituents. *In situ* technologies can be deployed in a variety of configurations depending on the extent of the target constituents and the groundwater geochemical conditions.
- **Monitored Natural Attenuation (MNA):** MNA is a corrective measure approach that involves establishing a program to monitor the physical, chemical, or biological processes that occur naturally at a site. These processes can often work to reduce the concentration and mobility of site CCR constituents present above GWPS in a time frame that is acceptable and can be comparable to other technologies.

Additional information regarding these corrective measure strategies is presented in Appendix D, Attachment A.

6.3 State Regulatory Requirements

TDEC Order and TDEC DSWM regulatory requirements for corrective action are described below.

6.3.1 TDEC Order

The TDEC Order specifies that the CARA Plan must include all actions TVA plans to take at the site and the basis for those actions. As appropriate for the site, the TDEC Order specifies that the final approved CARA Plan shall include “the method(s) TVA will employ to remediate CCR contaminated soil, surface water, and ground water at the site.” The GWPS established for this CARA Plan are based on regulatory requirements and are presented in Table 1-1.

The TDEC Order also requires that the CARA Plan include a schedule of activities to be completed along with a public input process on the draft CARA Plan before it is finalized by TVA and approved by TDEC. The CARA Plan schedule, public notice and input process, and finalization of the CARA Plan are discussed further in Chapter 8.

6.3.2 TDEC DSWM

Under the TDEC DSWM regulations, CCR units must meet the GWPS and monitoring requirements in 0400-11-01-.04(7). When a constituent has been detected at a statistically significant level above a GWPS, a corrective measures assessment must be performed to evaluate potential options to address the constituent and identify a remedy. In accordance with TDEC DSWM regulations, the assessment of corrective measures includes consideration of:

- (I) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies
- (II) The time required to begin and complete the remedy
- (III) The cost of remedy implementation

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- (IV) The institutional requirements such as State or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).

Similar to the TDEC Order, TDEC DSWM regulations require a public meeting with interested and affected parties to discuss the results of the assessment prior to selection of a remedy.

Based on the results of the final corrective measures assessment, the owner or operator must select a remedy that, at a minimum, meets the following performance standards. As specified in the regulation, remedies must:

- (I) Be protective of human health and the environment
- (II) Attain the GWPS
- (III) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent practicable, any further releases of constituents into the environment that may pose a threat to human health and the environment
- (IV) Comply with standards for management of wastes.

Pursuant to TDEC DSWM 0400-11-01-.04(7)(a)9(v), the corrective actions will be considered complete when the GWPS have been achieved for the constituents shown in Table 1-1, concentrations of those constituents have not exceeded the GWPS for three consecutive years, and the actions required to complete the corrective measures are satisfied. The Commissioner may specify an alternative length of time during which the owner or operator must demonstrate that concentrations of constituents listed in Table 1-1 have not exceeded the GWPS taking into consideration the extent of the release(s), behavior characteristics of the CCR constituents; accuracy of monitoring techniques; and characteristics of the groundwater.

Table 6-1 provides the complete citation of the assessment of corrective measures requirements, GWPS, evaluation factors, and completion of corrective actions discussed in this chapter.

6.4 Site-Specific Assessment of Corrective Measures

TVA has assessed site-specific information to identify the corrective measures presented in this CARA Plan for the Slag Disposal Area CCR unit. Details regarding the specific corrective measures assessment and basis for the planned corrective actions for the Slag Disposal Area are presented in Appendix D. This subchapter first provides an overview of the process used by TVA to perform those assessments, followed by a discussion of the types of site-specific information used to support the planned corrective actions. Chapter 6.5 provides a summary of the assessments and planned corrective actions.

The corrective actions identified in this CARA Plan encompass consideration of TDEC DSWM criteria in 0400-11-01-.04(7), which provides the following evaluation factors for consideration in making a remedy recommendation:

- Short- and long-term effectiveness and protectiveness, along with the degree of certainty that the remedy will prove successful
- Effectiveness of source control
- Ease or difficulty of implementation

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Consideration of community concerns.

Table 6-1 provides the complete citation of these evaluation factors when identifying a corrective action. TVA has considered these assessment and evaluation factors using site-specific information to identify both the types and deployment of corrective measures, as well as to develop groundwater flow and geochemical modeling simulations of corrective measure alternatives for the Slag Disposal Area. This approach provides a consistent evaluation process for the TDEC Order CCR units and fulfills the TDEC Order requirement to provide the basis for planned corrective measures.

TVA evaluated the three potential corrective measure strategies presented in Chapter 6.2 (hydraulic control and treatment, *in situ* treatment, and MNA) considering site-specific conditions at the Slag Disposal Area. Relevant site-specific conditions include, but are not limited to, the CCR constituents targeted for corrective measures; geochemistry of the unconsolidated materials; groundwater flow rate, gradient, and flux; hydraulic barriers; topographic, or other physical constraints; and as applicable, other planned operational or closure activities at the site. In the discussion of these evaluations, all references to the Slag Disposal Area include the Drainage Improvements Area (see Section 2.1.1.2 and Exhibit 6-1).

Corrective actions for groundwater include a requirement for the implementation of source control measures. The goal of source control is to reduce or eliminate, to the maximum extent practicable, further releases of CCR constituents into the environment. Typical source control measures work by limiting the infiltration of precipitation into a source area or extracting water from within a source to lower the hydraulic head and the potential for further releases. The key is to lower the hydraulic head within the source to facilitate the attainment of GWPS at compliance points along the downgradient edge of the source.

Corrective measures for groundwater at a given CCR unit are assessed in the context of the previously completed and planned additional CIP actions for that CCR unit because the CIP actions provide the source control to support the groundwater corrective actions. The planned additional closure actions are presented in Chapters 5.5.1.1 and 5.5.1.2 and include installation of a geosynthetic cover system and stormwater drainage modifications at the Slag Disposal Area.

6.5 PLANNED CCR UNIT CORRECTIVE ACTIONS

TVA is planning groundwater extraction and treatment as the groundwater corrective action to address cadmium and cobalt at the Slag Disposal Area (wells WBF-104 and WBF-106). These planned corrective actions are based on groundwater sampling results through October 2022 as presented in the EAR. TVA will continue to monitor groundwater while the CARA Plan is finalized and the corrective action final design is developed, and if warranted based on those new groundwater monitoring results, will coordinate any proposed modifications with, and obtain approval from, TDEC.

The HHERA concluded that there are no unacceptable risks to human or ecological receptors based on USEPA guidance for assessing potential exposures to sediment, surface stream water, or groundwater, and potential risks to future onsite workers would be mitigated by implementing standard health and safety protocols. Therefore, corrective action is only required for groundwater in order to attain GWPS at two wells (Slag Disposal Area wells WBF-104 and WBF-106) consistent with regulatory requirements. The following key factors provide the basis for TVA's planned corrective actions for the WBF Plant:

- Groundwater extraction and treatment will provide hydraulic control until GWPS are attained and maintained.

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Groundwater extraction and treatment is used worldwide as a reliable, proven technology for hydraulic control, and is easily implemented and sustainable. Site-specific groundwater flow modeling demonstrated that groundwater extraction results in hydraulic control until GWPS are attained and maintained, providing both short- and long-term effectiveness. Site-specific evaluation of the other considered corrective measure technologies showed that MNA is not currently applicable given the target CCR constituents and current groundwater conditions, and that additional bench and field pilot testing would be required to further evaluate the effectiveness of *in situ* treatment.
- Given the close proximity of the groundwater extraction system to the monitoring wells (i.e., immediately upgradient of the monitoring wells along the eastern and northeastern downgradient boundaries of the Slag Disposal Area), it is anticipated that GWPS would be attained at the monitoring wells within just a few years following groundwater extraction and treatment implementation.
- After GWPS are attained at wells WBF-104 and WBF-106, the groundwater extraction and treatment system would continue to operate, capturing groundwater and preventing it from moving downgradient of the Slag Disposal Area. Over time, the physical and geochemical processes that occur during the natural flow of groundwater through foundation soils, supported by the source control provided by the previously completed and planned additional closure actions (Chapter 5), will reduce the concentrations of target constituents in the uppermost aquifer such that concentrations at the monitoring wells will remain below GWPS after the corrective action concludes. The time required to achieve this condition where GWPS have been attained and would be maintained without continued corrective action is uncertain due to a variety of factors. However, routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a five- to 10-year timeframe.
- Table 6-2 explains how the planned groundwater corrective action meets the TDEC regulatory requirements, which also fulfills the requirements in the TDEC Order.

As noted above, the groundwater corrective measure evaluations in this CARA Plan are based on the conclusions of a statistical evaluation of groundwater data available as of October 2022. Groundwater data continue to be collected at the Ash Pond and Slag Disposal Area in accordance with an existing monitoring plan, and the extent and type of, or need for, groundwater corrective measures will be reevaluated in response to changing groundwater conditions. If concentrations of the target constituents were to fall below GWPS during approval and final design of the groundwater corrective measures such that groundwater corrective action is no longer required, then the planned corrective actions in the CARA Plan would not be implemented. The groundwater corrective measures to be implemented will be driven by the groundwater data and trends at the time of implementation. Any changes to the planned groundwater corrective actions would be coordinated with and approved by TDEC.

Based on the groundwater sampling results considered in this CARA Plan, the evaluation of corrective measure technologies and identification of planned corrective actions for the Slag Disposal Area are described in more detail in Chapter 6.5.1 below and presented in full in Appendix D. Exhibit 6-1 displays the locations of the planned groundwater extraction and treatment hydraulic control system used for evaluation in this CARA Plan for the Slag Disposal Area. The actual locations of groundwater extraction, groundwater extraction rates, the water treatment and discharge approach, and associated details would be developed in the corrective action final design process following the CARA Plan approval. Additional information regarding implementation of closure and corrective action activities and schedule is provided in Chapter 8.

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

In the future, as the implemented corrective actions progress and conditions change, other evaluated technologies may be applicable for further study and considered for targeted implementation as part of the groundwater corrective actions. The future integration of additional corrective measures or modifications of the implemented corrective actions would be completed using an adaptive management process in coordination with, and with approval by, TDEC and in accordance with applicable regulations.

Adaptive management is a systematic project management approach centered on incorporating flexibility in site activities to account for: uncertainty, changes in site conditions, new information, an expanded understanding of the site, or new technology. This technique uses a systematic re-evaluation of site activities to account for new information and changing site conditions and adjusting plans to assure that objectives are met. For the Slag Disposal Area groundwater, CARA Plan implementation will include monitoring groundwater quality in accordance with the TDEC-approved groundwater monitoring plan and preparing a corrective action performance monitoring plan that will include methods to evaluate the effectiveness of the groundwater corrective actions. Implementing the corrective action performance monitoring plan will provide data to determine when GWPS have been met and when the corrective action is no longer needed. The corrective action performance monitoring plan will also include criteria for evaluating the progress of the corrective action toward meeting final GWPS goals. Changing groundwater chemistry or adverse trends could indicate that site conditions have changed, or the corrective action is not performing as intended and that a modified corrective measure may be appropriate. Additional information regarding performance monitoring and adaptive management is provided in Chapter 7.2.2.

6.5.1 Slag Disposal Area

The following describes the corrective measures assessed for the Slag Disposal Area and the basis for identifying hydraulic control using groundwater extraction and treatment as the planned corrective action.

6.5.1.1 Corrective Measures Considered and Assessed

MNA, *in situ* treatment, and hydraulic control were evaluated as potential corrective measures to address cobalt (wells WBF-104 and WBF-106) and cadmium (well WBF-104) concentrations in groundwater above GWPS (Chapter 6.1) at the Slag Disposal Area.

MNA relies on the natural geochemical system to attenuate concentrations of target constituents by adsorption onto unconsolidated materials or by other geochemical or physical processes. Based on the cobalt concentrations in groundwater evaluated in this CARA Plan, MNA alone would not provide control of the groundwater moving downgradient of the Slag Disposal Area, and there is uncertainty as to the length of time required following completion of the additional planned closure actions for MNA to attain and maintain GWPS for cobalt (and cadmium). Therefore, based on these data, MNA was not retained as a primary groundwater corrective measure alternative for the Slag Disposal Area.

In situ treatment is an established technology that relies on the corrective measure to change geochemical conditions within the aquifer to immobilize and reduce the concentrations of the target constituents. As described in the Bench Scale *In situ* Treatment Testing Technical Memorandum (Appendix I.1), bench scale testing showed that appropriate dosing with sodium hydroxide reduced cobalt (and cadmium in the case of WBF-104) concentrations below GWPS in the final WBF-104 and WBF-106 test columns while maintaining concentrations of other metals below GWPS. A subsequent *in situ* treatment field pilot test was performed to provide further insight into dosing, dosing frequency, and responses at the field scale (Appendix I.3). The *in situ* treatment field pilot system was successful in delivering sodium hydroxide (NaOH) reagent to the subsurface, increasing the pH of groundwater close to the injection wells, and lowering cobalt

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

concentrations. However, uncertainty remains regarding the ability of *in situ* treatment to consistently maintain the target pH range and achieve GWPS throughout the targeted treatment zone without mobilizing other metals. Additional field pilot testing would be required to further evaluate combinations of reagents, dosing, dosing frequency, and responses to determine if *in situ* treatment can be consistently effective under the site-specific conditions at the WBF Plant pilot test area. For these reasons, *in situ* treatment was not retained as a primary groundwater corrective measure alternative for the Slag Disposal Area.

Hydraulic control relies on groundwater extraction to control impacted groundwater. Groundwater extraction and treatment is used worldwide as a reliable, proven technology for hydraulic control, and is easily implemented and sustainable. Groundwater extraction was evaluated using the calibrated numerical groundwater flow model to demonstrate that this approach would provide hydraulic control until GWPS are attained and maintained (Appendix G). Site-specific assessments indicate groundwater extraction and treatment provides both short- and long-term effectiveness as described in Table 6-2. Hydraulic control using groundwater extraction and treatment was retained as a primary groundwater corrective measure alternative for the Slag Disposal Area.

6.5.1.2 Planned Corrective Action

Based on the evaluation presented above of potential corrective measures to address target constituents in groundwater above GWPS at the downgradient boundary of the Slag Disposal Area, the planned groundwater corrective action is hydraulic control using groundwater extraction and treatment. A summary of the planned groundwater corrective action is provided below, and design drawings further describing the planned corrective action are provided in Appendix F.1.

The groundwater extraction and treatment system will be installed immediately upgradient of the monitoring wells (along portions of the eastern and northeastern downgradient boundaries of the Slag Disposal Area near wells WBF-104 and WBF-106) such that the normal flow of groundwater is intercepted by the extraction system, preventing it from moving downgradient of the Slag Disposal Area. Because of the close proximity of the groundwater extraction to the monitoring wells, the time to achieve the GWPS at these wells will be relatively short – anticipated to be on the order of just a few years. After GWPS are attained at Slag Disposal Area wells WBF-104 and WBF-106, the groundwater extraction and treatment system will continue to operate, capturing groundwater and preventing it from moving downgradient of the Slag Disposal Area.

Over time, the physical and geochemical processes that occur during the natural flow of groundwater through foundation soils, supported by the source control provided by the previously completed and planned additional closure actions (Chapter 5), will reduce the concentrations of target constituents in the uppermost aquifer such that concentrations at the downgradient monitoring wells will remain below GWPS after the corrective action concludes. Achieving this condition is the ultimate objective of the groundwater corrective action.

The time required to achieve this groundwater corrective action objective is uncertain due to a variety of factors. These factors include, for example, the initial magnitude of concentrations above the GWPS, the variable manner in which physical and geochemical processes act on different CCR constituents, the rate at which pore water hydraulic heads decrease following implementation of the planned additional closure actions, and the rate of groundwater flow within the uppermost aquifer. However, routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a five- to 10-year timeframe. Also, the groundwater corrective action objective may be achieved at some locations sooner than others, and corrective

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

action in such locations may conclude sooner as part of the routine monitoring, operation, and maintenance of the corrective action.

Extracted groundwater will be pumped through a conveyance pipeline and treated (if needed) prior to discharge under applicable permit(s). The water treatment system is further described in Appendix L.

During the final design of the corrective action, a corrective action performance monitoring plan that includes an adaptive management process will be developed to facilitate corrective action implementation and provide data to assess if the desired results are achieved. The performance monitoring plan and adaptive management process are further described in Chapter 7.2.2.

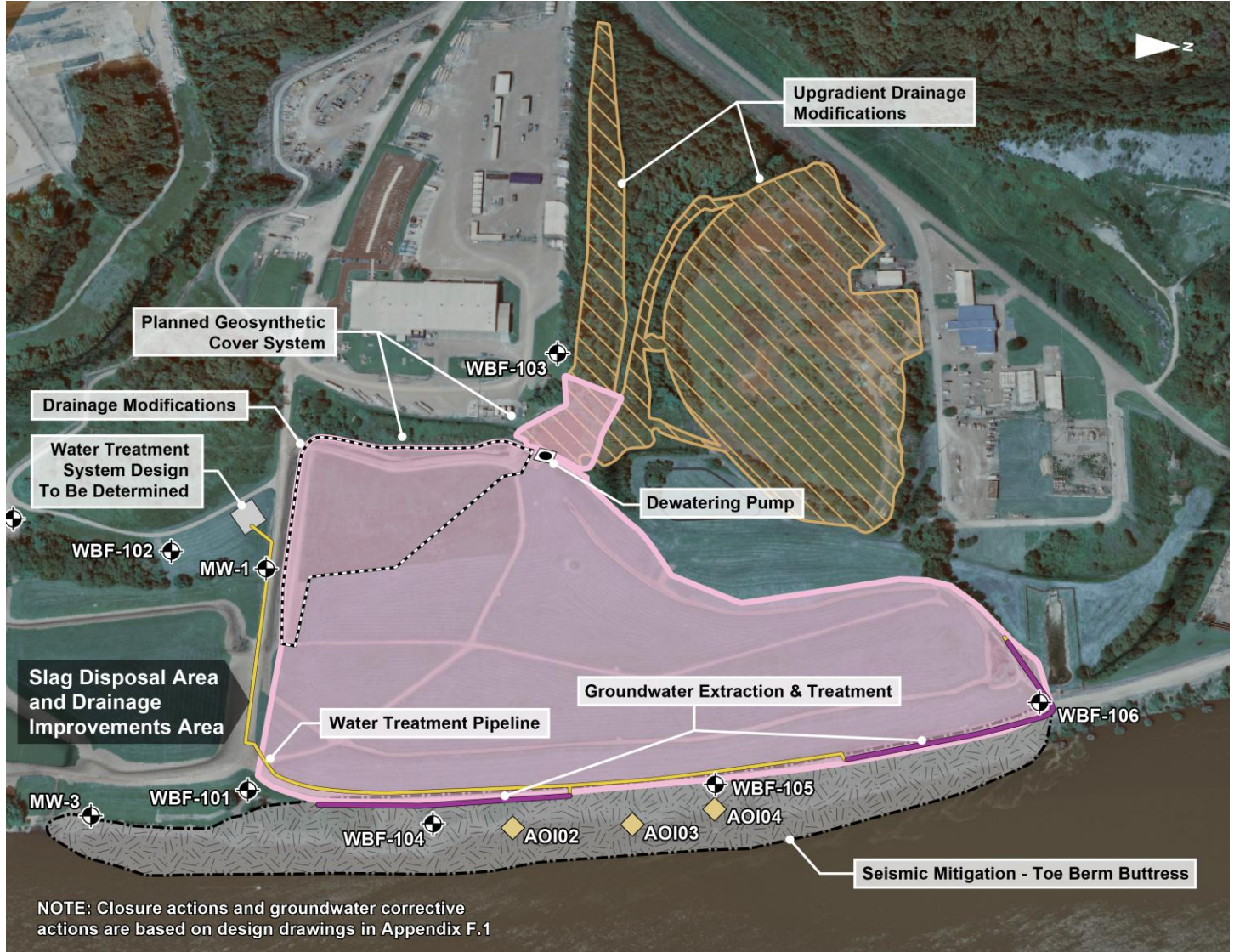
Table 6-2 explains how the corrective action requirements contained in TDEC DSWM regulations were considered and are addressed by the planned corrective action, which also fulfills the requirements in the TDEC Order.

The planned groundwater corrective action for the Slag Disposal Area, along with the additional closure actions that provide source control, are displayed in the illustrations below:

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

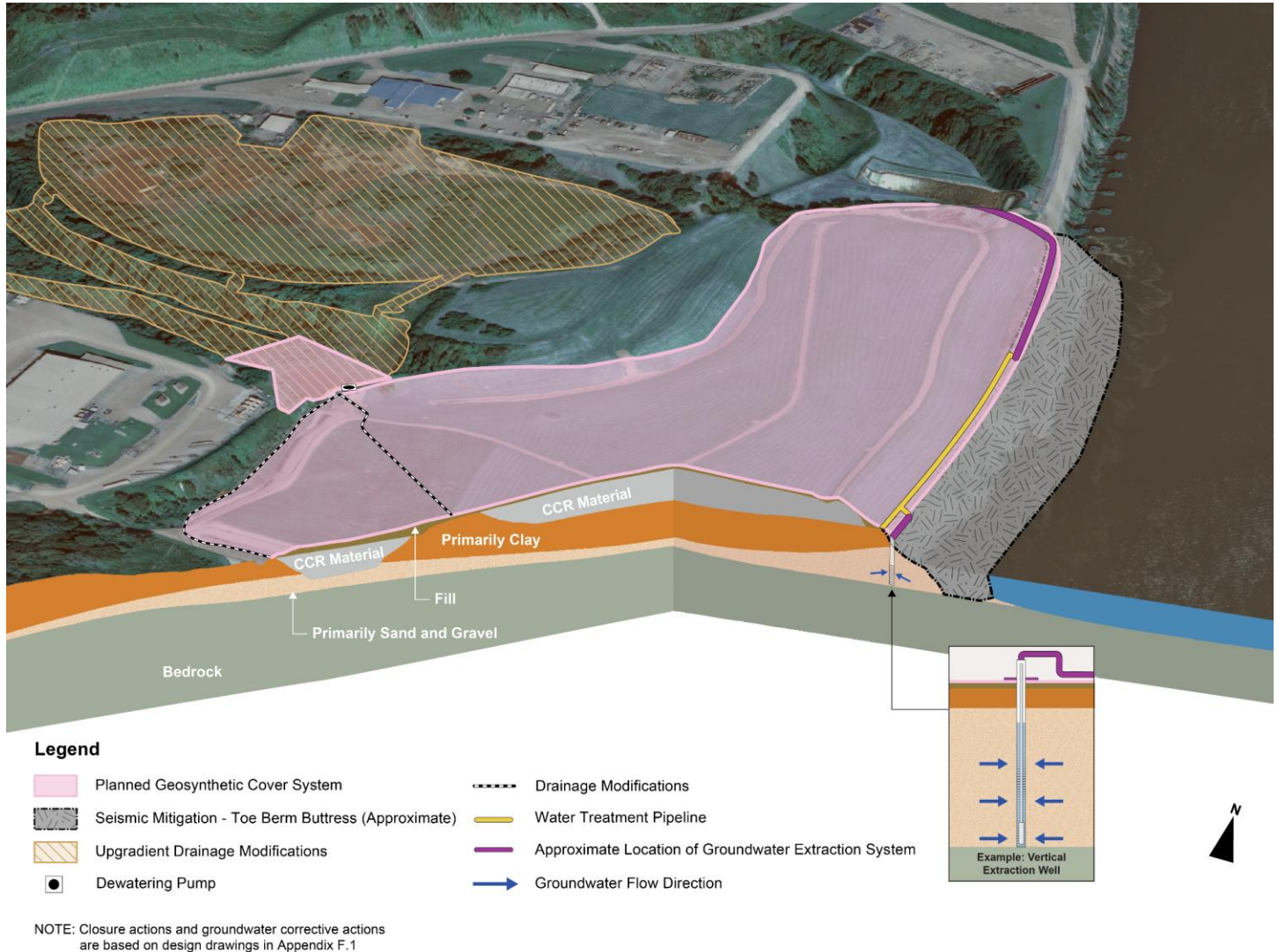
Slag Disposal Area Groundwater Extraction and Treatment Planned Corrective Action and Source Control, Plan View



Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Slag Disposal Area Groundwater Extraction and Treatment Planned Corrective Action and Source Control, Profile View



6.6 CCR UNIT CORRECTIVE ACTION SUMMARY

TVA is planning hydraulic control using groundwater extraction and treatment as the corrective action for groundwater at the Slag Disposal Area. This planned corrective action is based on groundwater sampling results through October 2022 as presented in the EAR. TVA will continue to monitor groundwater while the CARA Plan is finalized and the corrective action final design is developed, and if warranted based on those new groundwater monitoring results, will coordinate any proposed modifications with, and obtain approval from, TDEC.

Basis and Methods of CCR Unit Corrective Action

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

The HHERA concluded that there are no unacceptable risks to human or ecological receptors based on USEPA guidance for assessing potential exposures to sediment, surface stream water, or groundwater, and potential risks to future onsite workers would be mitigated by implementing standard health and safety protocols. Therefore, corrective action is only required for groundwater in order to attain GWPS at two wells (WBF-104 and WBF-106) consistent with regulatory requirements. The following key factors provide the basis for TVA's planned corrective actions for the WBF Plant:

- Groundwater extraction and treatment will provide hydraulic control until GWPS are attained and maintained.
- Groundwater extraction and treatment is used worldwide as a reliable, proven technology for hydraulic control, and is easily implemented and sustainable. Site-specific groundwater flow modeling demonstrated that groundwater extraction results in hydraulic control until GWPS are attained and maintained, providing both short- and long-term effectiveness. Site-specific evaluation of the other considered corrective measure technologies showed that MNA is not currently applicable given the target CCR constituents and current groundwater conditions, and that additional field pilot testing would be required to further evaluate the effectiveness of *in situ* treatment.
- Given the close proximity of the groundwater extraction system to the monitoring wells (i.e., immediately upgradient of the monitoring wells along the eastern and northeastern downgradient boundaries of the Slag Disposal Area), it is anticipated that GWPS would be attained at the monitoring wells within just a few years following *groundwater extraction and treatment* implementation.
- After GWPS are attained at wells WBF-104 and WBF-106, the *groundwater extraction and treatment* system would continue to operate, capturing groundwater and preventing it from moving downgradient of the Slag Disposal Area. Over time, the physical and geochemical processes that occur during the natural flow of groundwater through foundation soils, supported by the source control provided by the previously completed and planned additional closure actions (Chapter 5), will reduce the concentrations of target constituents in the uppermost aquifer such that concentrations at the monitoring wells will remain below GWPS after the corrective action concludes. The time required to achieve this condition where GWPS have been attained and would be maintained without continued corrective action is uncertain due to a variety of factors. However, routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a five- to 10-year timeframe.
- Table 6-2 explains how the planned groundwater corrective action meets the TDEC regulatory requirements, which also fulfills the requirements in the TDEC Order.

Supporting Plans

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 7 Supporting Plans

This chapter describes the scope of the supporting plans to meet the requirements presented in the TDEC Order related to natural resources restoration, air and water monitoring during implementation of corrective actions, the protection of public and private water supplies, and short-term and long-term management of CCR material, as appropriate for the WBF Plant.

Environmental sampling, closure, and corrective action activities described herein will be performed under an approved plant-specific health and safety plan and in accordance with TVA safety policies and procedures.

7.1 Natural Resource Restoration Plan

As described in Chapter 4, the results of the HHERA are based on EI sampling results and multiple lines of evidence incorporating historical and EI environmental data. The HHERA concluded there are no unacceptable risks for offsite human or ecological receptors exposed to natural resources (e.g., surface stream water, sediment, fish) in the Tennessee River from effects of CCR wastewater treatment or onsite CCR management at the WBF Plant. Similarly, the overall results of the water use survey concluded that current and historical CCR management associated with the WBF Plant has not affected offsite water supply wells or springs located in the vicinity of the WBF Plant. As such, corrective action for surface stream water, sediment or ecological communities is not warranted, and neither corrective action nor natural resource restoration of these media is included in this CARA Plan.

7.2 Air and Water Monitoring Plans

The following describes the overall approach for TVA's proposed groundwater, surface water, and air monitoring plans to support implementation of the CARA Plan. As described below, some plans will be prepared following approval of the final CARA Plan and provided to TDEC for review and approval once the final closure and corrective action designs are completed.

7.2.1 Groundwater Monitoring Plan

The Groundwater Monitoring Plan, provided in Appendix E, presents groundwater compliance monitoring and associated activities in fulfillment of the TDEC Order once the CARA Plan is approved. The scope of the document pertains to the groundwater monitoring systems at the Ash Pond and Slag Disposal Area CCR units at the WBF Plant. The Groundwater Monitoring Plan provides the procedures for groundwater monitoring activities according to TVA's quality assurance/quality control requirements and is intended to align and meet the different State and federal monitoring requirements in a single plan. Groundwater monitoring activities will be conducted in accordance with the Groundwater Monitoring Plan following TDEC approval of the CARA Plan.

TVA has identified a unified groundwater monitoring plan for the Ash Pond and Slag Disposal Area CCR units to meet the following objectives:

- Comply with regulatory requirements and permits issued under State programs (Chapter 1.3.3) prior to, during, and after the implementation of the groundwater corrective action, as applicable.

Supporting Plans

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Demonstrate that the current level of protection for water supplies, which were found to be protective in the site-specific HHERA and water use survey, will be maintained during implementation of the additional closure and corrective actions in the TDEC-approved CARA Plan.

7.2.1.1 Sample Analyses and Frequency

The planned constituent list for groundwater monitoring will include CCR Rule Appendix III and IV parameters. The GWPS for the groundwater monitoring plan are the same as those in this CARA Plan. The five additional TDEC Appendix I parameters are not included in the planned monitoring constituent list because they were below the TDEC-approved groundwater screening levels based on data presented in the WBF Plant EAR (TVA 2024). Additional details are provided in Appendix E.

The sampling frequency will be semiannual as presented in Appendix E. TVA plans to conduct two sampling events per year to characterize groundwater flow direction, groundwater flow rates, and groundwater quality in the uppermost aquifer.

7.2.1.2 Sampling Locations

The planned groundwater monitoring systems associated with the CCR units are shown on Exhibit 7-1 for the Ash Pond and Slag Disposal Area. The planned groundwater monitoring systems provide for a sufficient number of monitoring wells installed upgradient and downgradient of the CCR units at depths that yield groundwater from the uppermost aquifer. Details on the planned groundwater monitoring systems are provided in Appendix E.

In addition to the groundwater monitoring systems described in Appendix E, TVA may identify additional wells to be installed and monitored to evaluate the performance of the groundwater corrective action at the Slag Disposal Area as approved by TDEC in the CARA Plan. The corrective action performance monitoring plan is further described in Chapter 7.2.2. TVA will update the Groundwater Monitoring Plan as needed following final design or during implementation if changes to the monitoring network are required for the CCR units. Changes to the Groundwater Monitoring Plan will be coordinated with and approved by TDEC.

7.2.1.3 Data Evaluation and Reporting

Two semiannual groundwater monitoring reports will be prepared for the WBF Plant CCR units to summarize the results from the two semiannual sampling events each year. The reports will incorporate the requirements from TDEC DSWM 0400-11-01-.04. The statistical evaluations used to determine whether CCR-related constituents listed in Table 1-1 are detected at statistically significant concentrations above GWPS will be prepared after each semiannual reporting period. Each semiannual report will be submitted to TDEC within 120 days of completing the semiannual groundwater sampling events.

7.2.2 Performance Monitoring Plan and Adaptive Management Process

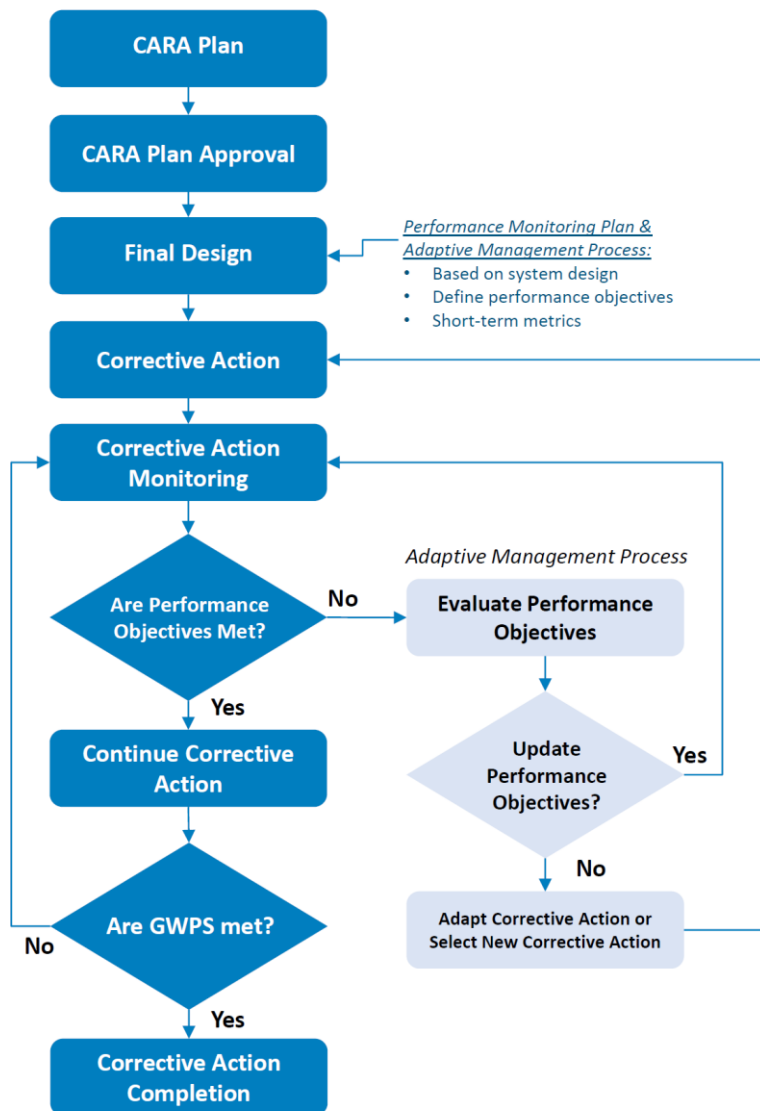
During the final design of the corrective action, a corrective action performance monitoring plan will be developed. The plan will specify monitoring locations and define the performance objectives for the corrective action (i.e., attain GWPS). The effectiveness of the corrective action will be evaluated by comparing the performance of the corrective action to the performance metrics and objectives. When the GWPS are met for the prescribed period, the corrective action will be complete. The corrective action performance monitoring plan will be coordinated with, and approved by, TDEC.

Supporting Plans

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

An adaptive management process will be incorporated into the corrective action performance monitoring program. Performance monitoring data will be systematically compared to interim performance standards (sometimes called “adaptive triggers”) to provide a basis for proactively responding to changing conditions. Monitoring locations will be identified, and interim performance standards will be established (e.g., statistically increasing trends) to evaluate corrective action progress. If an interim performance standard is not met, that will initiate a review of the system and the performance standards as depicted on the Performance Monitoring and Adaptive Management Process flowchart below. Not meeting an interim performance standard will not automatically result in an adaptation of the corrective action, but it will initiate a holistic evaluation of the system and performance standards. This approach results in ongoing evaluation of site activities to account for new information and changing site conditions or regulations. The following diagram outlines the performance monitoring and adaptive management process.

Performance Monitoring and Adaptive Management Process



Supporting Plans

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

7.2.3 Surface Water Monitoring Plan

TVA currently conducts effluent monitoring in accordance with the TMSP. Multiple parameters are monitored on a regular basis, including various metals and total suspended solids. Depending upon how future flows are routed (i.e., to the existing outfall or to a new outfall), permit modifications may be needed. TVA will continue monitoring in accordance with the current TMSP and related documents/approvals until an individual NPDES permit is issued, if one is required.

7.2.4 Air Monitoring Plan

An Air Monitoring Plan that complies with applicable state and federal environmental and health and safety regulations will be prepared to support the additional closure and corrective action activities. As applicable for the planned actions, the plan will include perimeter and work area air monitoring. The Air Monitoring Plan will be submitted to TDEC for review prior to implementation of the additional closure and corrective action activities.

7.2.5 AOI Monitoring Plan

An AOI Monitoring Plan will be prepared to support the planned additional closure actions. The plan will be developed based on the final design of the toe berm buttress and include visual inspections of the AOIs previously observed during the EI. In addition, TVA will collect water quality parameters from three AOI locations along the riverbank that were previously identified from statistical analysis in the EI. These activities will be conducted every two years. The AOI Monitoring Plan will be submitted to TDEC for review prior to implementation of the planned additional closure actions.

7.3 Water Supply Protection Plan

Based on the HHERA findings as discussed in Chapter 4.1.2, there are no unacceptable risks related to CCR management at the WBF Plant for offsite residents potentially exposed to potable water supplied by either a domestic water well or from water withdrawn by municipal water departments from the Tennessee River in the vicinity of the WBF Plant. As discussed in Chapter 7.2, TVA will execute groundwater and surface water monitoring plans to demonstrate that the current level of protection of water supplies will be maintained during implementation of the TDEC-approved corrective actions.

7.4 SHORT- AND LONG-TERM MANAGEMENT OF CCR MATERIAL

Plans for the short-term and long-term management of CCR material are discussed in Chapters 7.4.1 and 7.4.2, respectively.

7.4.1 Short-Term CCR Material Management Plan

As needed, TVA will develop and execute a short-term CCR material management plan to meet requirements of the TDEC Order. The plan will detail the short-term management of CCR material during implementation of the additional closure and corrective actions identified herein. The plan would include, as applicable, the following elements:

- Drawdown and dewatering plan
- Fugitive dust control
- Construction drawings

Supporting Plans

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Construction quality assurance plan
- Proposed sequence of construction
- Temporary staging of CCR material
- Management of contact water
- Stormwater management
- Erosion protection and sediment control measures
- Spill prevention and control plan.

This plan may be updated based on conditions encountered in the field with notification to TDEC for concurrence prior to implementation. Also, the plan will provide the guidelines that a contractor must follow regardless of the construction means and methods a contractor may use.

7.4.2 Long-Term Management of CCR Material

TVA is currently implementing post-closure plans for the Ash Pond and Slag Disposal Area which address the long-term management of CCR materials (TVA 2007 and 2013). The scope of the post-closure plans includes post-closure monitoring and maintenance activities for the existing cover and groundwater monitoring systems. TVA will implement the additional closure actions and conduct post-closure care and maintenance activities as described in the updated closure and post-closure plans provided in Appendix F.2 following approval of this CARA Plan.

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 8 Summary and Next Steps

This CARA Plan has been prepared to fulfill the requirements of the TDEC Order and specifies the basis and actions TVA plans to take for closure and groundwater corrective action at the WBF Plant CCR units. The following summarizes TVA's planned actions and the basis for those actions. Next steps, including TVA's planned public involvement approach to finalize the CARA Plan, and the implementation activities and schedule for the planned actions are also discussed.

8.1 Summary of Planned Actions and Their Basis

The CARA Plan builds upon information gained during TVA's ongoing environmental monitoring programs as well as a comprehensive environmental investigation overseen by TDEC that included characterizing the WBF Plant site hydrogeology; collecting more than 300 samples of CCR material, groundwater, background soils, surface stream water, sediments, and ecological communities (e.g., fish); and conducting a water use survey of offsite wells. Using these data, a risk assessment based on USEPA guidance was performed to evaluate potential risks to human and ecological receptors (e.g., fish) from potential exposures to CCR constituents related to the WBF Plant CCR units. Additionally, the investigation results were used to conduct site-specific assessments of CCR unit closure methods and groundwater corrective measure technologies to form the basis for TVA's planned closure approach and groundwater corrective actions identified in this CARA Plan.

As presented in Chapter 1, TVA's mission is to supply affordable and reliable power to the people of the Tennessee Valley while protecting the natural resources of this region and supporting the communities we serve. TVA's goal within this CARA Plan is to make the best, most appropriate choices for closure and corrective action to ensure that the CCR units at the WBF Plant are safe, secure, and protective of human health and the environment, consistent with TVA's mission.

TVA evaluated two options in this CARA Plan for closure of the CCR units, CIP and CBR, as well as several alternatives to address groundwater quality at one CCR unit. **Based on the comprehensive investigations and conclusions of the site-specific evaluations, TVA plans continued CIP of the CCR units at the WBF Plant with targeted groundwater corrective actions.** TVA believes that CIP of the CCR units, along with targeted groundwater corrective actions, is the best way to safely and securely close the CCR units, achieve its mission, and comply with the TDEC Order and State regulations. TVA's plans, along with an implementation schedule, are shown in Exhibit 8-1 and in the graphics at the end of this summary. While not currently planned for the WBF Plant CCR units, TVA continues to evaluate means to beneficially use CCR material in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley.

TVA will implement a collective set of additional closure actions to enhance the existing closures at the Slag Disposal Area and Ash Pond CCR units. To meet slope stability factors of safety, TVA will construct a toe berm buttress of rock riprap along the riverbank of the Slag Disposal Area and Ash Pond. At the Slag Disposal Area and adjacent Drainage Improvements Area, TVA will install an engineered geosynthetic cover system over both areas and implement drainage modifications. To further limit infiltration into the Slag Disposal Area and Drainage Improvements Area, TVA plans additional actions at two upgradient locations. At the Former Coal Yard Storage Area, remnant coal was removed by TVA in 2024/2025, and the area will be regraded and revegetated. At an upgradient ponded area, the area will be filled and regraded and a geosynthetic liner will be installed. Installation of geosynthetic cover systems and implementation of upgradient drainage modifications are expected to mitigate the three AOIs identified along the bank of the Tennessee

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

River. Based on the demonstrated effectiveness of the existing geosynthetic cover system at the Ash Pond, TVA is not planning additional cover system or drainage modifications at this CCR unit.

In addition to the closure actions, TVA will implement corrective actions to meet GWPS at the Slag Disposal Area. The human health and ecological risk assessment concluded that there are no unacceptable risks to offsite human or ecological receptors at the WBF Plant; therefore, corrective action is only required for groundwater to attain GWPS consistent with regulatory requirements. No corrective action is needed or required at the Ash Pond because groundwater quality at this CCR unit already meets GWPS. Based on the evaluations conducted as part of this CARA Plan, hydraulic control using groundwater extraction and treatment will be conducted at the Slag Disposal Area at two locations along its downgradient perimeter.

The wide-ranging, site-specific evaluations presented in this CARA Plan provide a clear basis for TVA's planned continuation of CIP with targeted groundwater corrective actions for the WBF Plant CCR units. CIP and the planned corrective actions are consistent with TVA's mission. protect the resources of the Tennessee Valley, comply with State regulations, and are the most appropriate actions when considering and balancing all relevant factors.

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

The reasons why TVA is planning these closure and corrective actions (i.e., the basis for closure and corrective action) are provided below:

- **CIP is environmentally more beneficial than CBR**, particularly for the WBF Plant CCR units where nearly 760,000 cubic yards of CCR material would have to be removed and transported to an offsite landfill.
- **Compared to CIP, CBR results in greater adverse impacts** related to transportation and construction, particularly climate change and greenhouse gas emissions, worker and transportation safety, and potential impacts to nearby communities with environmental justice concerns.
- **Once closure begins, CBR would require five to six years to complete compared to three years required for CIP** for the two CCR units.
- **CIP meets or exceeds the closure performance standards** required by TDEC regulations.
- **Geosynthetic cover systems are effective** in controlling, minimizing or eliminating infiltration through the cover system as demonstrated at the Ash Pond.
- **Once the toe berm buttress is constructed, the CCR units will meet the established slope stability factors of safety** during closure, the post-closure period, and beyond.
- **Ecological communities are healthy and are not being adversely impacted** by the CCR units.
- **Groundwater extraction and treatment is a reliable, proven technology** for hydraulic control that is expected to attain GWPS within a few years after implementation and would maintain this condition until effects of source control make it unnecessary.
- **There are no onsite or downgradient offsite uses of groundwater as a drinking water source.**
- **There are currently no unacceptable risks to offsite human or ecological receptors, and this will continue during closure, corrective action, and beyond.**

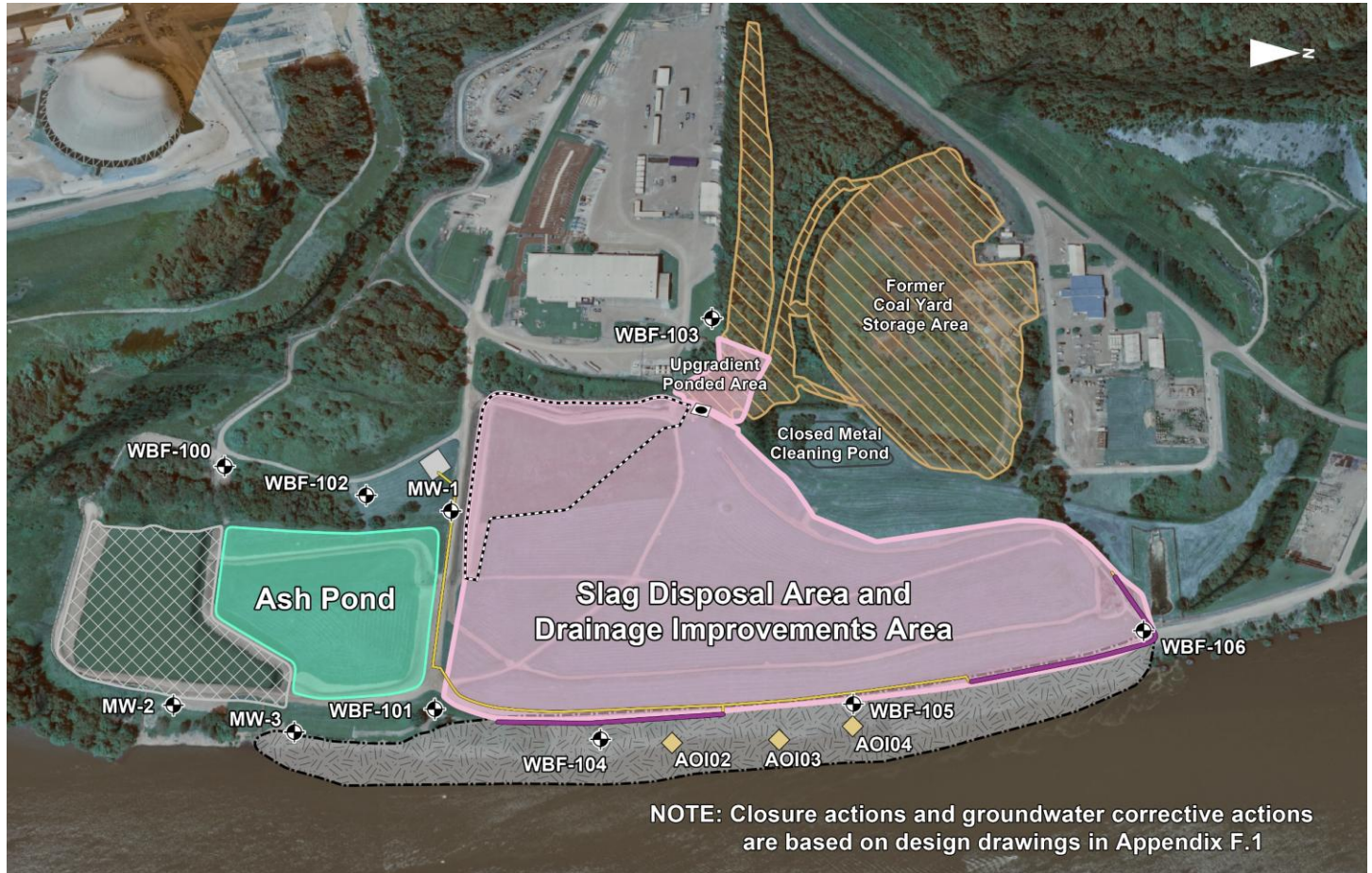
With no unacceptable risks related to Closure-in-Place, Closure-by-Removal is not necessary or justified with its longer timeline to complete closure, greater overall environmental impacts, and higher cost.

Closure-in-Place along with targeted groundwater corrective actions is the best solution to protect the people and resources of the communities near the WBF Plant consistent with TVA's mission.

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Planned WBF Plant CCR Unit Closure and Corrective Actions



Legend

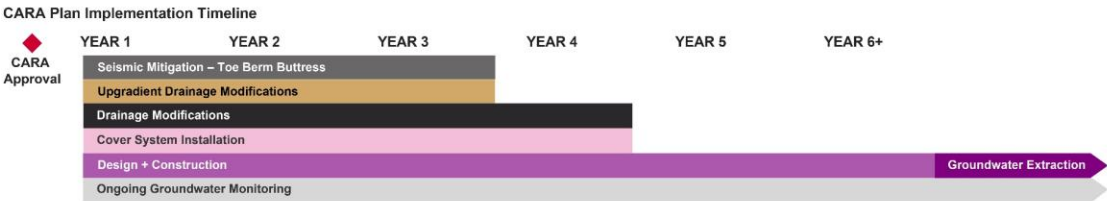
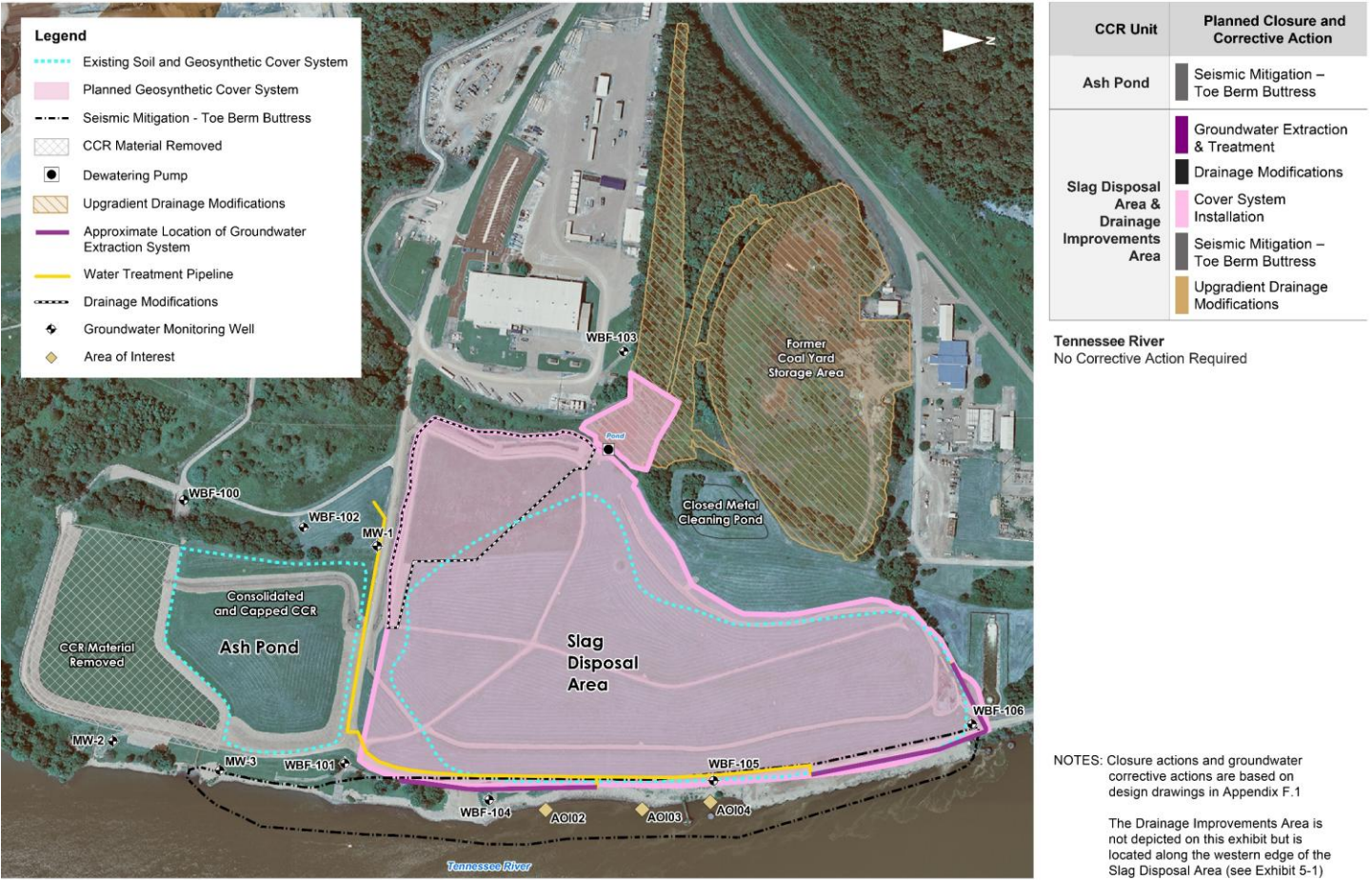
	Existing Soil and Geosynthetic Cover System		Groundwater Extraction and Treatment
	Planned Geosynthetic Cover System		Water Treatment Pipeline
	Seismic Mitigation - Toe Berm Buttress		Drainage Modifications
	CCR Material Removed		Groundwater Monitoring Well
	Upgradient Drainage Modifications		Area of Interest
	Dewatering Pump		Water Treatment System Design To Be Determined

NOTE: The Drainage Improvements Area is not depicted on this exhibit but is located along the western edge of the Slag Disposal Area (see Exhibit 5-1)

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Planned WBF Plant CCR Unit Closure and Corrective Actions and Implementation Schedule



8.2 Public Involvement

This draft CARA Plan will be revised to address TDEC comments until it is accepted by TDEC and considered ready for public review and input. TVA will engage with the public within the framework established by the TDEC Order and State regulations. Under the TDEC Order, the specified public engagement process includes providing public notice that the draft CARA Plan is available for review along with a summary of the proposed plan. The public will have a minimum of 30 days to comment on the draft CARA Plan, and if comments are received, then TVA will have 30 days to provide responses to the comments to TDEC. After consideration of the public comments and TVA’s responses, TVA will modify this draft CARA Plan if needed until it is finalized and approved by TDEC. Received public comments and TVA’s responses to those comments will be provided in an appendix to this plan.

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

8.3 CARA Plan Implementation Schedule

The illustration in Chapter 8.1 provides a summary schedule for the completion of the additional planned closure actions and implementation of corrective action identified in this CARA Plan. Exhibit 8-1 provides further details regarding the schedule for activities included during implementation.

TVA will substantially complete the additional cover system and drainage modifications for the Slag Disposal Area and Drainage Improvements Area, as well as the seismic stability mitigation for the Ash Pond and Slag Disposal Area, within four to five years of approval of the CARA Plan. TVA will continue to conduct current post-closure care activities for the Ash Pond as specified in existing closure plans for that CCR unit while the CARA Plan is finalized and then implement the closure and post-closure plans provided in Appendix F.2 once the CARA Plan is approved.

Due to the proposed seismic stability mitigation along the riverbank, TVA will begin design, permitting, and construction of the groundwater extraction system upon approval of the CARA Plan and following substantial completion of the seismic stability mitigation, cover system actions, and drainage modifications. Operations of these systems are expected to begin within six to eight years of CARA Plan approval, following design, permitting, and construction. As discussed in Chapter 6, if warranted based on newer groundwater monitoring results or changes related to other mitigative projects (e.g., seismic stability mitigation), proposed changes to the groundwater corrective measures would be coordinated with TDEC. TVA will continue to monitor groundwater in accordance with the existing plans while the CARA Plan is finalized and then implement the Groundwater Monitoring Program provided in Appendix E once the CARA Plan is approved.

The overall schedule for implementation of additional closure actions and completion of the groundwater corrective actions considers requirements and factors referenced in TDEC DSWM regulations. These factors are listed in Table 5-4 for CCR unit closure and Table 6-2 for groundwater corrective action.

Implementation will begin upon approval of the CARA Plan by TDEC. The activities will commence with the detailed design of the planned actions with permitting (if needed) generally proceeding simultaneously. Once the detailed design phase is complete, procurement and then construction will proceed. Following construction completion, TVA will implement post-closure care activities for the CCR units, operate the groundwater extraction system, and conduct groundwater monitoring and corrective action performance monitoring. Each of these phases are described below.

Design and Permitting

Detailed design will build upon the plans included within this document and provide detailed specifications for construction.

In some cases, additional delineation (installation of additional monitoring wells and subsequent monitoring) and/or additional pilot testing may be performed to refine the design of the groundwater extraction system. TVA will prepare permitting packages and plans for review and approval by TDEC, as appropriate, and other regulatory agencies using the information provided in this CARA Plan. As needed, TVA will complete other pre-construction environmental reviews necessary to implement the planned project.

Additionally, TVA will complete the following supporting program plans described in Chapter 7 as needed for implementation of the additional closure actions and groundwater corrective action:

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

- Surface Water Monitoring Plan
- Air Monitoring Plan
- Water Supply Protection Plan
- Short-Term and Long-Term CCR Material Management.

Procurement, Construction, and Operation

Procurement will include bidding, selection of contractor(s) to implement the construction phase, and associated contracting, as well as procurement of long-lead materials if needed. Following a procurement or contracting phase and once necessary permits are approved, the construction period will commence. Estimated construction periods for the additional closure actions and groundwater corrective action by CCR unit are shown on Exhibit 8-1.

Operation of the groundwater extraction system will begin following a commissioning phase during which operability of the water treatment and extraction processes will be confirmed.

Groundwater Monitoring Plan

Groundwater compliance monitoring activities will be conducted in accordance with the Groundwater Monitoring Plan following TDEC approval of the CARA Plan (see Chapter 7.2.1 and Appendix E). The Groundwater Monitoring Plan will be implemented during the design and implementation of corrective action, and during the closure and post-closure care and maintenance phases of the project. TVA will update the Groundwater Monitoring Plan as needed following final design or during implementation if changes to the monitoring network are required for the CCR units. Changes to the Groundwater Monitoring Plan will be coordinated with and approved by TDEC.

Performance Monitoring Plan

During the final design of the corrective action, a corrective action performance monitoring plan will be developed as discussed in Chapter 7.2.2. The effectiveness of the corrective action will be evaluated by comparing the performance of the corrective action to the performance metrics and objectives. An adaptive management process will be incorporated into the performance monitoring plan to systematically compare monitoring data to interim performance standards (adaptive triggers) to provide a basis for proactively responding to changing conditions and to evaluate the corrective action process. The corrective action performance monitoring plan will be coordinated with and approved by TDEC.

The performance monitoring plan will be implemented after the groundwater extraction system has been commissioned and until GWPS are attained for the Slag Disposal Area and would be maintained without continued corrective action.

Post-Closure Care Activities

TVA will conduct post-closure care and maintenance activities as described in the closure and post-closure plans provided in Appendix F.2. Post-closure care activities typically include: vegetative cover monitoring and maintenance; maintenance of the approved final contours; drainage and groundwater monitoring systems maintenance; groundwater sampling, analysis, and reporting; and post-closure inspections.

The following graphic depicts the future condition of the WBF Plant CCR units following implementation of the planned closure and groundwater corrective actions identified in this CARA Plan. Future conditions of the WBF Plant and other non-CCR unit infrastructure are not projected or depicted in the graphic.

Summary and Next Steps

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Future Conditions of the WBF Plant CCR Units Following CARA Plan Implementation



Legend

- Groundwater Extraction and Treatment
- Water Treatment Pipeline
- Monitoring Well

References

Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

Chapter 9 References

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Corrective Action/Risk Assessment Plan – DRAFT – Rev2
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Corrective Action/Risk Assessment Plan – DRAFT – Rev2
Watts Bar Fossil Plant

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TABLES

**Table 1-1. Groundwater Protection Standards
Established for the Corrective Action / Risk Assessment Plan**

CCR Constituents	Values	Units
Antimony	6	µg/L
Arsenic	10	µg/L
Barium	2,000	µg/L
Beryllium	4	µg/L
Cadmium	5	µg/L
Chromium (total)	100	µg/L
Cobalt	6	µg/L
Fluoride	4,000	µg/L
Lead	15	µg/L
Lithium	40	µg/L
Mercury	2	µg/L
Molybdenum	100	µg/L
Radium-226 & 228	5	pCi/L
Selenium	50	µg/L
Thallium	2	µg/L

Notes:

Compliance with a GWPS is determined not by comparison to any single sample result, but by comparison to multiple sample results collected over time using statistical methods.

µg/L: micrograms per liter

pCi/L: picoCuries per liter

**Table 5-1 – TDEC Division of Solid Waste Management Closure Requirements
Watts Bar Fossil Plant**

TDEC Solid Waste Management TDEC Rule (0400-11-01-.04)		
Action	Regulatory Citation(s)	Tennessee Rule Closure Criteria
Required Performance Standards for Closure	TDEC DSWM 0400-11-01-.04(8)(a)	1 The operator must close the disposal facility or disposal facility parcel in a manner that:
		i) Minimizes the need for further maintenance; and
		ii) Controls, minimizes, or eliminates, to the extent necessary to prevent threats to public health and the environment, post-closure escape of solid waste, solid waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground or surface waters or to the atmosphere.
		2 The operator must care for a disposal facility or disposal facility parcel for the period of time after closure in a manner that assures that the performance objectives of part 1. of this subparagraph are continuously met.
	TDEC DSWM 0400-11-01.04(8)(b)	The operator must initiate and complete closure activities and conduct post-closure care activities in accordance with the approved closure/post-closure plan if such a plan has been prepared and approved for the disposal facility or disposal facility parcel being closed.
	TDEC DSWM 0400-11-01.04(8)(c) - excerpts specific to design and schedule for CARA Plan	For active portions of the facility, the operator must complete closure activities including grading and establishing vegetative cover in the shortest practicable time, not to exceed 180 days, after any fill areas or any portion of the fill areas have achieved final grade, unless the Commissioner allows otherwise in the permit.
		At Class I and Class II facilities the depth of final cover system shall be at least 36 inches of soil of which a minimum of 12 inches shall be for the support of vegetative cover. An alternate final cover system may be used provided that it is demonstrated to the satisfaction of the Commissioner that the final cover system provides equivalent or superior performance to the minimum performance standard in this subpart.
		The design of the final cover system shall be such that the infiltration volume of water will be equal to or less than the percolation volume through the bottom liner system or a design which includes a compacted soil layer of at least 24 inches which has a permeability no greater than 1×10^{-7} cm/sec, whichever is less.
		The final surface of the disposal facility or disposal facility parcel shall be graded and/or provided with drainage facilities in a manner that:
		(i) Minimizes precipitation run-on from adjacent areas onto the disposal facility or disposal facility parcel;
		(ii) Minimizes erosion of cover material (e.g., no steep slopes);
		(iii) Optimizes drainage of precipitation falling on the disposal facility or disposal facility parcel (e.g., prevent pooling); and
		(iv) Provides a surface drainage system which is consistent with the surrounding area and in no way significantly adversely affects proper drainage from these adjacent lands.
		In order to minimize soil erosion, as soon as practicable after final grading, the operator shall take steps as necessary to establish a protective vegetative cover of acceptable grasses over disturbed areas of the site. These steps shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways if such are necessary.
		The operator shall take other measures as may be necessary to minimize and control erosion and sedimentation (e.g., soil stabilization, sediment ponds) at the site.
		As required in the CCR unit permit, or as otherwise necessary to prevent threats to human health and the environment, the operator shall establish and/or complete a system for collecting, removing, and treating leachate generated by the disposal facility or disposal facility parcel.

**Table 5-2 - Qualitative Assessment of Impacts of CIP vs CBR for the Ash Pond
Watts Bar Fossil Plant**

Key Factors	Closure-in-Place (CIP)	Closure-by-Removal (CBR)
Volume of CCR materials to be removed ⁽¹⁾	None	Approximately 190,000 cubic yards
Duration of closure activities ⁽²⁾⁽³⁾	Approximately 2 to 3 years to complete (assumes closure conducted relatively concurrently)	Approximately 3 years to complete (assumes closure conducted sequentially)
Impacts to nearby communities related to closure activities	Lower (impacts associated with installation of the rock buttress and continued operations/maintenance of cover system)	Higher (increased traffic-related accidents/injuries)
Mode/Duration of CCR material transport activities	None	Higher (trucking, duration longer)
Impacts to wetlands/sensitive habitat	None	Higher (impacts associated with potential release during removal)
Impacts to environment/climate change	Lower (impacts associated with installation of the rock buttress and continued operations/maintenance of cover system)	Higher (impacts associated with greenhouse gas emissions from longer construction/transport duration)
Cost ⁽⁴⁾	Lower (\$3.2 million to \$6.1 million)	Higher (\$26 million to \$49 million)
Conclusion: CIP More Environmentally Beneficial than CBR ⁽⁵⁾ CBR would have higher construction/transportation-related impacts and takes longer than CIP		

Notes:

- (1) CCR material volumes used in this evaluation are those identified in the EAR. See Chapter 5.4.3 and Appendix C for additional information regarding site-specific considerations and assumptions included in the closure comparative analysis.
- (2) The estimated duration of closure activities assumes that CIP would be performed relatively concurrently for this CCR unit at the WBF Plant.
- (3) CBR would be conducted sequentially for this CCR unit at the WBF Plant due to physical constraints for access and egress at the site and construction activities at each CCR unit, and operational considerations described in Chapter 5.4.3. The duration of CBR closure activities may be longer if the receiving landfill(s) need additional permitting or construction activities prior to receiving CCR material.
- (4) Preliminary rough order of magnitude costs are based on an engineering estimate for construction activities for this CCR unit, including the rock riprap toe berm buttress. The rough order of magnitude costs include design, construction, engineering oversight during construction, and project/construction management activities.
- (5) The overall conclusion for this WBF Plant CCR unit is consistent with TVA's PEIS conclusion (TVA 2016a and 2016b).

Acronyms:

CBR	Closure-by-Removal
CCR	Coal Combustion Residuals
CIP	Closure-in-Place
GWPS	Groundwater Protection Standards
PEIS	Programmatic Environmental Impact Statement
WBF Plant	Watts Bar Fossil Plant

**Table 5-3 - Qualitative Assessment of Impacts of CIP vs CBR for the Slag Disposal Area
Watts Bar Fossil Plant**

Key Factors	Closure-in-Place (CIP)	Closure-by-Removal (CBR)
Volume of CCR materials to be removed ⁽¹⁾	None	Approximately 570,000 cubic yards
Duration of closure activities ⁽²⁾⁽³⁾	Approximately 3 years to complete (assumes closure conducted relatively concurrently)	Approximately 4 to 5 years to complete (assumes closure conducted sequentially)
Impacts to nearby communities related to closure activities	Lower (impacts associated with installation of the rock buttress and installation and operations/maintenance of cover system)	Substantially higher (longer duration, increased traffic-related accidents/injuries)
Mode/Duration of CCR material transport activities	None	Higher (trucking, duration longer)
Impacts to wetlands/sensitive habitat	None	Higher (impacts associated with potential release during removal)
Impacts to environment/climate change	Lower (impacts associated with installation and rock buttress and installation and operations/maintenance of cover system)	Higher (impacts associated with greenhouse gas emissions from longer construction/transport duration)
Cost ⁽⁴⁾	Lower (\$15 million to \$28 million)	Higher (\$87 million to \$170 million)
Conclusion: CIP More Environmentally Beneficial than CBR ⁽⁵⁾ CBR would have higher construction/transportation-related impacts and takes longer than CIP		

Notes:

1. CCR material volumes used in this evaluation are those identified in the EAR. Both CIP and CBR of the Slag Disposal Area also assume regrading and revegetation of the Former Coal Yard Storage Area. See Chapter 5.4.3 and Appendix C for additional information regarding site-specific considerations and assumptions included in the closure comparative analysis.
2. The estimated duration of closure activities assumes that CIP would be performed relatively concurrently for this CCR unit at the WBF Plant.
3. CBR would be conducted sequentially for this CCR unit at the WBF Plant due to physical constraints for access and egress at the site and construction activities at each CCR unit, and operational considerations described in Chapter 5.4.3. The duration of CBR closure activities may be longer if the receiving landfill(s) need additional permitting or construction activities prior to receiving CCR material.
4. Preliminary rough order of magnitude costs are based on an engineering estimate for construction activities for this CCR unit, including the rock riprap toe berm buttress. The rough order of magnitude costs include design, construction, engineering oversight during construction, and project/construction management activities.
5. The overall conclusion for this WBF Plant CCR unit is consistent with TVA's PEIS conclusion (TVA 2016a and 2016b).

Acronyms:

CBR	Closure-by-Removal
CCR	Coal Combustion Residue
CIP	Closure-in-Place
GWPS	Groundwater Protection Standards
PEIS	Programmatic Environmental Impact Statement
WBF Plant	Watts Bar Fossil Plant

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**Table 5-4 - TDEC Division of Solid Waste Management Regulatory Compliance for Closure
Watts Bar Fossil Plant**

State Closure Performance Standards	Ash Pond	Slag Disposal Area
Operator must close the disposal facility in a manner that:	The Ash Pond was closed and capped in 2015 with an engineered geosynthetic and soil cover system that meets regulatory requirements. As part of the closure project, coal combustion residuals (CCR) material was excavated from the southern area of the Ash Pond and consolidated in the northern area of the Ash Pond prior to installation of the geosynthetic and soil cover system. A clay divider dike was constructed between the covered portion of the Ash Pond and the remaining area of the Ash Pond. The southern portion of the former Ash Pond was converted into a permitted stormwater pond for the site. Based on the current performance of the existing cover system and predicted future long-term conditions of the absence of a pore water phreatic surface, Tennessee Valley Authority (TVA) is not planning modifications to the cover system or drainage at the Ash Pond. TVA is also planning to construct a toe berm buttress of rock riprap along the riverbank of the Ash Pond as a seismic stability mitigation measure, such that the CCR unit will meet or exceed slope stability criteria for post-earthquake, global stability.	The Slag Disposal Area was closed in 2009 with a soil cover system. 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. TVA plans to modify the existing soil cover system at this CCR unit with a geosynthetic cover system to further control and minimize infiltration through the cover system, thereby further reducing the post-closure escape of CCR constituents. This includes extending the cover system across the majority of the footprint of the Drainage Improvements Area as well as across an existing ponded area directly west of the CCR unit once it has been filled. Areas within the planned limits of the cover system extension will be regraded to promote site drainage. Following completion of the drainage modifications, CCR unit regrading, and cover system extensions, exposed areas will be stabilized with seed or sod, and gravel roadways will be repaired or replaced as necessary. TVA is also planning to construct a toe berm buttress of rock riprap along the riverbank of the Slag Disposal Area as a seismic stability mitigation measure, such that the CCR unit will meet or exceed slope stability criteria for post-earthquake, global stability. As part of this action, the existing sheet pile wall in the northern portion of the Slag Disposal Area will be modified to allow installation of the rock riprap buttress, and the planned geosynthetic cover system modification will cover the western edge of the buttress along this CCR unit.
Minimizes the need for further maintenance	The cover system installed in 2015 minimizes the need for further maintenance. TVA will continue to conduct regularly scheduled inspections to evaluate post-closure conditions and conduct necessary repairs related to: - drainage and erosion - cover system integrity - pooling, wet areas, seeps - bare areas - sloughing and other structural defects The scheduled inspections and as-needed repairs will minimize the need for further maintenance on the CCR unit.	Prior to and following the installation of the geosynthetic cover system, TVA will continue to conduct regularly scheduled inspections to evaluate pre- and post-closure conditions and conduct necessary repairs related to: - drainage and erosion - cover system integrity - pooling, wet areas, seeps - bare areas - sloughing and other structural defects The scheduled inspections and as-needed repairs will minimize the need for further maintenance on the CCR unit during and after cover system installation.

**Table 5-4 - TDEC Division of Solid Waste Management Regulatory Compliance for Closure
Watts Bar Fossil Plant**

State Closure Performance Standards	Ash Pond	Slag Disposal Area
Controls, minimizes, or eliminates, to the extent necessary to prevent threats to public health and the environment, post-closure escape of solid waste, solid waste constituents, leachate, contaminated rainfall, or waste decomposition to the ground or surface waters or to the atmosphere	The completed closure actions included elements to control and minimize infiltration through the cover system of the CCR unit and post-closure escape of CCR constituents. These methods included installation of a geosynthetic cover system that meet Resource Conservation and Recovery Act (RCRA) standards, establishing vegetative covers, drainage modifications (e.g., regrading, lining ditches, installing culverts) where needed, construction of a rock riprap toe berm buttress, and converting the southern portion of the former Ash Pond into a permitted stormwater pond for the site. Control and minimization of post-closure escape of CCR constituents is achieved through: - site grading plan (positive drainage, no ponding) - compaction and settlement monitoring - engineered geosynthetic cover system (prevent precipitation infiltration and atmospheric exposure to CCR material) - stormwater management system (run-on and run-off controls) - fugitive dust control measures - periodic structural inspections	The planned additional closure actions include elements to control and minimize infiltration through the cover system of the CCR unit and post-closure escape of CCR constituents. These methods include installation of geosynthetic cover system that meets RCRA standards, establishing vegetative covers, drainage modifications (e.g., regrading, lining ditches, installing culverts) where needed, and construction of a rock riprap toe berm buttress. Coupled with the comprehensive measures planned for unit closure actions, control and minimization of post-closure escape of CCR constituents will be achieved through: - site grading plan (positive drainage, no ponding) - compaction and settlement monitoring - engineered geosynthetic cover system (prevent precipitation infiltration and atmospheric exposure to CCR material) - stormwater management system (run-on and run-off controls) - fugitive dust control measures - periodic structural inspections
The operator must complete closure activities including grading and establishing vegetative cover in the shortest practicable time, not to exceed 180 days, after any fill areas or any portion of the fill areas have achieved final grade, unless the Commissioner allows otherwise in the permit.	Not applicable - the cover system was installed in 2015.	Additional unit closure actions will be completed in a practicable timeframe consistent with recognized and generally accepted good engineering practices and with ensuring the safety of site workers, the public, and the environment. The Corrective Action/Risk Assessment (CARA) Plan includes a schedule for approval by the Commissioner.
Final Cover System:		
The depth of final cover system shall be at least 36 inches of soil of which a minimum of 12 inches shall be for the support of vegetative cover.		
The design of the final covers system shall be such that the infiltration volume of water will be equal to or less than the percolation volume through the bottom liner system or a design which includes a compacted soil layer of at least 24 inches which has a permeability no greater than 1×10^{-7} cm/sec, whichever is less. This design shall be supported by the use of the HELP model or other equivalent method approved by the Commissioner.	The existing final cover system meets the minimum standards in this subpart. The final cover system provides superior performance to the minimum regulatory performance standards. The permeability of the final cover system exceeds Tennessee Department of Environment and Conservation (TDEC) standards by ranging from 10-13 to 10-14 cm/sec. The final cover system includes: 40-mil textured linear low-density polyethylene (LLDPE) flexible geomembrane cover - geocomposite drainage layer 18-inches protective cover soil - Six-inches vegetative cover soil	TVA plans to install an alternative final cover system. The design of the final cover system provides superior performance to the minimum regulatory performance standards. The permeability of the alternative final cover system exceeds TDEC standards by ranging from 10-13 to 10-14 cm/sec. Cover system alternatives include a geosynthetic soil or geosynthetic-engineered turf cover system. The geosynthetic soil cover system to include: 40-mil textured LLDPE flexible geomembrane cover - geocomposite drainage layer 18-inches protective cover soil - Six-inches vegetative cover soil The geosynthetic-engineered turf cover system to include: - structured geomembrane cover - sand infill ballast - engineered turf with geotextile backing
An alternative final cover system may be used provided that it is demonstrated to the satisfaction of the Commissioner that the final cover system provides equivalent or superior performance to the minimum performance standard in this subpart.	Based on the performance of the existing cover system, TVA is not recommending additional closure actions at the Ash Pond.	

**Table 5-4 - TDEC Division of Solid Waste Management Regulatory Compliance for Closure
Watts Bar Fossil Plant**

State Closure Performance Standards	Ash Pond	Slag Disposal Area
The final surface of the disposal facility shall be graded and/or provided with drainage facilities in a manner that:		
Minimizes precipitation run-on from adjacent areas onto the disposal facility	Precipitation run-on from adjacent areas and erosion of cover material are controlled and minimized through a stormwater management system and site grading plan that prevent pooling and promote proper drainage from adjacent lands.	Precipitation run-on from adjacent areas and erosion of cover material will be controlled and minimized through a stormwater management system and site grading plan that will prevent pooling and promote proper drainage from adjacent lands.
Minimizes erosion of cover material (e.g., no steep slopes)		
Optimizes drainage of precipitation falling on the disposal facility (e.g., prevent pooling)		
Provides a surface drainage system which is consistent with the surrounding area and in no way significantly affects proper drainage from these adjacent lands		
In order to minimize soil erosion, as soon as practicable after final grading, the operator shall take steps as necessary to establish a protective vegetative cover of acceptable grasses over disturbed areas of the site. These steps shall include seeding, mulching, and any necessary fertilization at a minimum, and may include additional activities such as sodding of steeper slopes and drainage ways if such are necessary.	Not applicable - protective vegetative cover was established with the cover system installed in 2015.	Protective vegetative cover will be established as soon as practicable in disturbed and will include seeding, mulching, fertilizing, and necessary additional activities to minimize soil erosion.
In addition to the drainage and grading requirements and vegetative cover requirements, the operator shall take other measures as may be necessary to minimize and control erosion and sedimentation (e.g., soil stabilization, sediment ponds) at the site.	Post-closure inspections are conducted to identify settlement, subsidence, erosion, and other surface defects. Post-closure repairs are conducted to correct erosion and surface defects.	Post-closure inspections will be conducted to identify settlement, subsidence, erosion, and other surface defects. Post-closure repairs will be conducted to correct erosion and surface defects.
As required in the permit, or as otherwise necessary to prevent threats to human health and the environment, the operator shall establish and/or complete a system for collecting, removing, and treating leachate generated by the disposal facility.	Potential seeps are investigated and evaluated. A Seepage Action Plan will be prepared following CARA Plan approval. Visual inspections of the dikes and toe conducted quarterly, and areas of concern identified by a unique number, date of discovery, description, size, mitigation status and current status.	Potential seeps are investigated and evaluated. A Seepage Action Plan will be prepared following CARA Plan approval. Visual inspections of the dikes and toe conducted quarterly, and areas of concern identified by a unique number, date of discovery, description, size, mitigation status and current status.

Acronyms:

CARA	Corrective Action/Risk Assessment
CCR	Coal Combustion Residuals
cm/sec	centimeters per second
LLDPE	Linear Low-Density Polyethylene
mil	A mil equals one-thousandth of an inch, or 0.001 inch
RCRA	Resource Conservation and Recovery Act
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority

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**Table 6-1 – TDEC Division of Solid Waste Management Groundwater Requirements
Watts Bar Fossil Plant**

TDEC Solid Waste Management TDEC Rule (0400-11-01-.04)		
Action	Regulatory Citation(s)	Performance Standards and Evaluation Factors
Assessment of Corrective Measures	TDEC Rule 0400-11-01-.04(7)(a)7(iii)	The assessment shall include an analysis of the effectiveness of potential corrective measures to meet the requirements and objectives of a remedy as described in part 8 of this subparagraph. Analyses to assess and evaluate potential remedies shall address at least the following:
		(I) The performance, reliability, ease of implementation, and potential impacts of appropriate potential remedies, including safety impacts, cross-media impacts, and control of exposure to any residual contamination,
		(II) The time required to begin and complete the remedy,
		(III) The cost of remedy implementation, and
		(IV) The institutional requirements such as State or local permit requirements or other environmental or public health requirements that may substantially affect implementation of the remedy(s).
Required Performance Standards for Remedy	TDEC Rule 0400-11-01-.04(7)(a)8(ii)	Remedies must:
		(I) Be protective of human health and the environment,
		(II) Attain the groundwater protection standard as specified pursuant to part 1 of this subparagraph,
		(III) Control the source(s) of releases so as to reduce or eliminate, to the maximum extent practicable, further releases of constituents listed in [Table 1-1] ¹ into the environment that may pose a threat to human health or the environment, and
		(IV) Comply with standards for management of wastes as specified in subpart 9(iv) of this subparagraph.
Evaluation Factors for Selecting Remedy	TDEC Rule 0400-11-01-.04(7)(a)8(iii)(I)	The long-and short-term effectiveness and protectiveness of the potential remedy(s), along with the degree of certainty that the remedy will prove successful based on consideration of the following:
		I. Magnitude of reduction of existing risks,
		II. Magnitude of residual risks in terms of likelihood of further releases due to waste remaining following implementation of a remedy,
		III. The type and degree of long-term management required, including monitoring, operation, and maintenance,
		IV. Short-term risks that might be posed to the community, workers, or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, and re-disposal or containment,
		V. Time until full protection is achieved,
		VI. Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment,
		VII. Long-term reliability of the engineering and institutional controls, and
		VIII. Potential need for replacement of the remedy.
	TDEC Rule 0400-11-01-.04(7)(a)8(iii)(II)	The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:
		I. The extent to which containment practices will reduce further releases, and
		II. The extent to which treatment technologies may be used.

**Table 6-1 – TDEC Division of Solid Waste Management Groundwater Requirements
Watts Bar Fossil Plant**

TDEC Solid Waste Management TDEC Rule (0400-11-01-.04)		
Action	Regulatory Citation(s)	Performance Standards and Evaluation Factors
	TDEC Rule 0400-11-01-.04(7)(a)8(iii)(III)	The ease or difficulty of implementing a potential remedy(s) based on consideration of the following types of factors:
		I. Degree of difficulty associated with constructing the technology,
		II. Expected operational reliability of the technologies,
		III. Need to coordinate with and obtain necessary approvals and permits from other agencies,
		IV. Availability of necessary equipment and specialists, and
		V. Available capacity and location of needed treatment, storage, and disposal services.
	TDEC Rule 0400-11-01-.04(7)(a)8(iii)(IV)	The degree to which community concerns are addressed by a potential remedy(s).
Factors to Consider in Establishing a Remediation Schedule	TDEC Rule 0400-11-01-.04(7)(a)8(iv)	The owner or operator shall specify as part of the selected remedy a schedule(s) for initiating and completing remedial activities. Such a schedule must require the initiation of remedial activities within a reasonable period of time taking into consideration the factors set forth in items (I) through (VI) of this subpart. The owner or operator must consider the following factors in determining the schedule of remedial activities:
		(I) Extent and nature of contamination,
		(II) Practical capabilities of remedial technologies in achieving compliance with ground water protection standards established under part 1 of this subparagraph and other objectives of the remedy,
		(III) Availability of treatment or disposal capacity for wastes managed during implementation of the remedy,
		(IV) Desirability of utilizing technologies that are not currently available, but which may offer significant advantages over already available technologies in terms of effectiveness, reliability, safety, or ability to achieve remedial objectives,
		(V) Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy, and
		(VI) Resource value of the aquifer including:
		I. Current and future uses,
		II. Proximity and withdrawal rate of users,
		III. Ground water quantity and quality,
		IV. The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents,
		V. The hydrogeologic characteristic of the facility and surrounding land,
		VI. Ground water removal and treatment costs,
		VII. The cost and availability of alternative water supplies, and
		VIII. Other relevant factors.
Determination that Remediation of Release is not Necessary	TDEC Rule 0400-11-01-.04(7)(a)8(v)	The Commissioner may determine that remediation of a release of an Appendix II constituent from a Solid Waste Landfill unit is not necessary if the owner or operator demonstrates to the satisfaction of the Commissioner that:

**Table 6-1 – TDEC Division of Solid Waste Management Groundwater Requirements
Watts Bar Fossil Plant**

TDEC Solid Waste Management TDEC Rule (0400-11-01-.04)		
Action	Regulatory Citation(s)	Performance Standards and Evaluation Factors
		(I) The ground water is additionally contaminated by substances that have originated from a source other than a SWLF unit and those substances are present in concentrations such that cleanup of the release from the SWLF unit would provide no significant reduction in risk to actual or potential receptors, or
		(II) The constituent(s) is present in ground water that:
		I. Is not currently or reasonably expected to be a source of drinking water, and
		II. Is not migrating or is not likely to migrate in a concentration(s) that would exceed the GWPS to other hydraulically connected waters, or
		(III) Remediation of the release(s) is technically impracticable, or
		(IV) Remediation results in unacceptable cross-media impacts.
	TDEC Rule 0400-11-01-.04(7)(a)8(vi)	A determination by the Commissioner pursuant to subpart (v) of this part shall not affect the authority of the State to require the owner or operator to undertake source control measures or other measures that may be necessary to eliminate or minimize further releases to the ground water, to prevent exposure to the ground water, or to remediate the ground water to concentrations that are technically practicable and significantly reduce threats to human health or the environment.
Implementation of the Corrective Action Program	TDEC Rule 0400-11-01-.04(7)(a)9(v)	Remedies selected pursuant to part 8. of this subparagraph shall be considered complete when:
		(I) The owner or operator complies with the ground water protection standard at all points within the plume of contamination that lie beyond the ground water monitoring well system established under part 3 of this subparagraph.
		(II) Compliance with the ground water protection standard has been achieved by demonstrating that concentrations of constituents listed in [Table 1-1] ¹ of this rule have not exceeded the ground water protection standard(s) for a period of three consecutive years using approved statistical procedures and performance standards. The Commissioner may specify an alternative length of time during which the owner or operator must demonstrate that concentrations of constituents listed in [Table 1-1] ¹ of this rule have not exceeded the ground water protection standard(s) taking into consideration:
		I. Extent and concentration of the release(s);
		II. Behavior characteristics of the hazardous constituents in the ground water;
		III. Accuracy of monitoring or modeling techniques, including any seasonal, meteorological, or other environmental variables that may affect the accuracy; and
		IV. Characteristics of the ground water.
		(III) All actions required to complete the remedy have been satisfied.

¹ The citation has been modified to reflect the constituents listed in Table 1-1 of the CARA Plan. See Chapter 6.1 for further discussion regarding the basis of GWPS.

**Table 6-2 - TDEC Division of Solid Waste Management Regulatory Compliance for Groundwater
Corrective Action Watts Bar Fossil Plant**

State Groundwater Corrective Action Requirements	Slag Disposal Area
Remedies must:	
Be protective of human health and the environment	An evaluation of the risk to human health and the environment is provided in the Corrective Action / Risk Assessment (CARA) Plan, which details the review of sensitive receptors, analysis of exposure pathways, and evaluation of future conditions. As discussed in the CARA Plan, there are currently no unacceptable risks to human health and ecological receptors based on United States Environmental Protection Agency (USEPA) guidance for assessing potential exposures to sediment, surface stream water, or groundwater, and potential risks to future onsite workers would be mitigated by implementing standard health and safety protocols. Implementation of additional closure actions and source control actions, coupled with groundwater extraction and treatment, will continue to provide for the protection of human health and the environment.
Attain GWPS	Based on the results of groundwater modeling, a groundwater extraction and treatment system, coupled with planned closure activities and source control actions, can attain groundwater protection standards (GWPS). Groundwater extraction and treatment is a proven technology commonly used to hydraulically control groundwater until GWPS are attained and maintained. While the system is operating, Tennessee Valley Authority (TVA) will document groundwater quality improvements.
Control the sources of releases so as to reduce or eliminate, to the maximum extent practicable, further releases of constituents listed in Appendix II of this rule into the environment that may pose a threat to human health or the environment	The Slag Disposal Area was closed in 2009 with a soil cover system. Additional source control measures will be implemented to reduce or eliminate releases of constituents into the environment. Planned additional unit closure actions include installation of a geosynthetic cover system and stormwater drainage modifications. The geosynthetic cover system includes extending the existing cover system across the footprint of the area currently known as the Drainage Improvements Area as well as across an existing ponded area directly west of the Slag Disposal Area. The toe berm buttress will be constructed along the riverbank to improve stability. Other planned source control actions include stormwater drainage modifications by filling the ponded area directly west of the Slag Disposal Area and regrading the surrounding and upgradient areas to better drain through the perimeter ditches of the Slag Disposal Area, prior to the geosynthetic cover system installation. The stormwater modifications will include replacement of existing stormwater culverts disturbed during construction and installation of new stormwater culverts as necessary. The Former Coal Yard that drains to the ponded area will also be regraded to support positive drainage around the Slag Disposal Area and Drainage Improvements Area. Stormwater from the Former Coal Yard, ponded area, and majority of the Slag Disposal Area will continue to be directed towards the Stormwater Pond south of the Ash Pond. The northern portion of the Slag Disposal Area will continue to drain to a small pond on the north end of the unit.
Comply with standards for management of wastes	Extracted groundwater will be treated (if needed) and discharged under applicable permit(s). Solid treatment residues will be collected and disposed of offsite at a licensed landfill in accordance with applicable state laws and regulations.
In selecting a remedy, the owner/operator shall consider the following evaluation factors:	Evaluation criteria:
- The long- and short-term effectiveness and protectiveness of the potential remedy, along with the degree of certainty that the remedy will prove successful based on consideration of the following: - Magnitude of reduction of existing risks - Magnitude of residual risks in terms of likelihood of further releases due to waste remaining following implementation of a remedy	Short-term results will be achieved through implementation of groundwater extraction. Groundwater will be hydraulically controlled by the system, and coal combustion residuals (CCR) constituents will be removed from the aquifer for treatment. Hydraulic control assures that constituents in groundwater do not move into the environment, providing short-term effectiveness. The long-term effectiveness of additional unit source control actions coupled with groundwater extraction and treatment is a proven method to hydraulically control groundwater until GWPS are attained and maintained. There are no offsite unacceptable risks. The planned groundwater corrective action will address regulatory requirements to meet GWPS, regardless of whether unacceptable risks exist or not. There are no offsite unacceptable risks. The planned additional closure and source control actions will be implemented to reduce or eliminate releases of constituents into the environment.

**Table 6-2 - TDEC Division of Solid Waste Management Regulatory Compliance for Groundwater
Corrective Action Watts Bar Fossil Plant**

State Groundwater Corrective Action Requirements	Slag Disposal Area
○ The type and degree of long-term management required, including monitoring, operation, and maintenance	The groundwater extraction and treatment system will require regular monitoring, operation and maintenance (O&M), including treatment system monitoring, routine groundwater monitoring, and continual data evaluation. O&M will include upkeep of treatment system infrastructure components (pumps, pipes, tanks, instrumentation and controls) and handling of treatment residuals.
○ Short-term risks that might be posed to the community, workers, or the environment during implementation of such a remedy, including potential threats to human health and the environment associated with excavation, transportation, re-disposal or containment	Short-term risks associated with the selected groundwater corrective action during implementation are considered negligible and manageable given standard health and safety protocols regarding use of the treatment reagents. This technology poses little to no offsite risk to human health and the environment. Construction of the groundwater extraction and treatment system will occur within the site boundaries. The planned corrective actions do not include excavation, transportation, or re-disposal.
○ Time until full protection is achieved	As discussed in the CARA Plan, there are currently no unacceptable risks to human health and ecological receptors based on groundwater in the vicinity of the Slag Disposal Area. The time required to achieve a condition where GWPS have been attained and would be sustained without continued corrective action is uncertain due to a variety of factors, but routine groundwater monitoring at other TVA Plant CCR units has shown that implemented source control measures started to have a beneficial effect on groundwater quality within a five- to 10-year timeframe.
○ Potential for exposure of humans and environmental receptors to remaining wastes, considering the potential threat to human health and the environment associated with excavation, transportation, re-disposal, or containment	The remaining CCR material will be contained with a geosynthetic cover system that will prevent exposure to humans and the environment.
○ Long-term reliability of the engineering and institutional controls	As discussed in the CARA Plan, there are currently no unacceptable risks to human health and ecological receptors based on groundwater in the vicinity of the Slag Disposal Area. The engineered source control measures are designed to be appropriately durable, providing long-term reliability of source control.
○ Potential need for replacement of the remedy	Because groundwater extraction and treatment is a proven method for hydraulic control until GWPS are attained, the potential need for replacement of the corrective action is unlikely. In the event the extraction wells associated with the treatment system are either not maintaining complete hydraulic control or groundwater concentrations are not decreasing commensurate with anticipated timelines, TVA will evaluate the need for replacement of the extraction wells.

**Table 6-2 - TDEC Division of Solid Waste Management Regulatory Compliance for Groundwater
Corrective Action Watts Bar Fossil Plant**

State Groundwater Corrective Action Requirements	Slag Disposal Area
The effectiveness of the remedy in controlling the source to reduce further releases based on consideration of the following factors:	Evaluation criteria:
The extent to which containment practices will reduce further releases	Additional source control measures will be implemented to reduce or eliminate releases of constituents into the environment. Planned additional unit closure actions include installation of a geosynthetic cover system and drainage modifications to promote site drainage, and construction of a toe berm buttress to improve stability. Once final grades are attained, either a geosynthetic-soil or geosynthetic-engineered turf cover system will be installed. The planned geosynthetic cover system will extend from the toe berm buttress over the Slag Disposal Area, across the footprint of the area currently known as the Drainage Improvements Area, as well as across an existing ponded area directly west of the Slag Disposal Area. Other planned source control actions include stormwater drainage modifications by filling the ponded area and regrading the surrounding and upgradient areas to better drain through the perimeter ditches of the Slag Disposal Area, prior to the geosynthetic cover system installation. The stormwater modifications will include replacement of existing stormwater culverts disturbed during construction and installation of new stormwater culverts as necessary.
The extent to which treatment technologies may be used	The extracted groundwater will be treated (if needed) and discharged under applicable permit(s).
The ease or difficulty of implementing a potential remedy based on consideration of the following types of factors:	Evaluation criteria:
Degree of difficulty associated with constructing the technology	Coupled with the planned unit closure actions and additional unit source control actions, groundwater extraction and treatment systems are a proven technology that have been successfully constructed and reliably operated at many environmental sites. The system design and performance can be modified to account for site-specific or changing conditions during operation. A preliminary evaluation of site-specific conditions at these units did not reveal obstacles to implementation. The size, shape, and depth of the groundwater areas are amenable to an extraction and treatment system. Extracted groundwater will be treated (if needed) and discharged under applicable permit(s). If NPDES permit modifications are required, then TVA will make appropriate application to Tennessee Department of Environment and Conservation (TDEC) prior to implementing the corrective action. Based on this information, limitations to construction, operation, permitting, availability of equipment and specialists, and availability of disposal services were not identified.
Expected operational reliability of the technologies	
Need to coordinate with and obtain necessary approvals and permits from other agencies	
Availability of necessary equipment and specialists	
Available capacity and location of needed treatment, storage, and disposal services	

**Table 6-2 - TDEC Division of Solid Waste Management Regulatory Compliance for Groundwater
Corrective Action Watts Bar Fossil Plant**

State Groundwater Corrective Action Requirements	Slag Disposal Area
The degree to which community concerns are addressed by a potential remedy	As discussed in the CARA Plan, there are currently no unacceptable risks to human health and ecological receptors based on groundwater in the vicinity of the Slag Disposal Area. Coupled with the comprehensive measures planned for additional unit closure actions and additional unit source control actions, extraction and treatment systems are a proven technology that pose little to no offsite risk to the community. Community concerns raised during the public comment period will be addressed in a subsequent revision of this CARA Plan.
The owner/operator shall specify as part of the selected remedy a schedule for initiating and completing remedial activities. Such a schedule must require the initiation of remedial activities within a reasonable period of time taking into consideration the following factors. The owner/operator must consider the following factors in determining the schedule of remedial activities:	Chapter 8 of this CARA Plan provides a schedule for the completion of the additional closure actions and implementation of corrective action activities planned. Exhibit 8-1 provides further details regarding the schedule for implementation activities.
Extent and nature of contamination	The extent and nature of groundwater quality was considered when developing the selected corrective action schedule. The extent and nature of GWPS exceedances were evaluated in the Environmental Assessment Report and this CARA Plan
Practical capabilities of remedial technologies in achieving compliance with GWPS and other objectives of the remedy	As discussed in the CARA Plan, there are currently no unacceptable risks to human health and ecological receptors based on groundwater in the vicinity of the Slag Disposal Area. The time to attain GWPS is uncertain due to a variety of factors, such as the variable manner in which physical and geochemical processes act on different CCR constituents. Implementation of the performance monitoring plan will provide data to inform when GWPS have been met and when the corrective action is no longer needed.
Availability of treatment or disposal capacity for wastes managed during implementation of the remedy	The availability of treatment or disposal capacity was deemed not to be a factor affecting the selected corrective action schedule. Vendors are readily available to construct and operate the extraction and treatment system. Extracted groundwater will be treated (if needed) and discharged under applicable permit(s). Sludge and solids that accumulate in the groundwater system will be of small volume. Nearby landfills have the capacity to accept the volume of groundwater treatment wastes.
Desirability of utilizing technologies that are not currently available, but which may offer significant advantages over already available technologies in terms of effectiveness, reliability, safety or ability to achieve remedial objectives	There are no known technologies in development that would be more desirable than groundwater extraction and treatment systems. Technologies that are not currently available, but which may offer significant advantages over already available technologies in terms of effectiveness, reliability, safety or ability to attain remedial objectives, will be reviewed if they become available.

**Table 6-2 - TDEC Division of Solid Waste Management Regulatory Compliance for Groundwater
Corrective Action Watts Bar Fossil Plant**

State Groundwater Corrective Action Requirements	Slag Disposal Area
Potential risks to human health and the environment from exposure to contamination prior to completion of the remedy	There are currently no identified unacceptable risks to human health or the environment based on the groundwater in the vicinity of the Slag Disposal Area, as documented in the CARA Plan, and there are no human receptors of onsite or offsite groundwater use. Therefore, potential risks to human health and the environment from exposure to contamination prior to completion of the corrective actions was not a factor in the selected corrective action implementation schedule.
- Resource value of the aquifer including: - Current and future uses - Proximity and withdrawal rate of users - Ground water quantity and quality - The potential damage to wildlife, crops, vegetation, and physical structures caused by exposure to waste constituent - The hydrogeologic characteristic of the facility and surrounding land - Ground water removal and treatment costs - The cost and availability of alternative water supplies - Other relevant factors	Evaluation factors: There are no onsite or downgradient offsite uses of groundwater as a drinking water source. TVA may consider additional institutional controls in the future if needed to address future use of groundwater. There are no onsite or downgradient offsite uses of groundwater as a drinking water source. The uppermost aquifer at the WBF Plant is a minor water-bearing zone and cannot supply large quantities of water to wells. Based on the human health and ecological risk assessment, which concluded that no unacceptable risks exist at the WBF Plant as a result of CCR management, there is no expectation that damage to wildlife, crops, vegetation, or physical structures will occur. Therefore, these were not factors in developing the estimated remediation schedule. The uppermost aquifer at the WBF Plant and surrounding areas is a minor water-bearing zone and cannot supply large quantities of water to wells. Groundwater removal and treatment costs for the planned corrective action are higher than for other alternatives, but this criterion is less important for the WBF Plant because the other alternatives were determined to be ineffective for achieving GWPS at this time. Alternate water supplies are available from public water suppliers in Rhea County. Not applicable.

Acronyms:

CARA	Corrective Action/Risk Assessment
CCR	Coal combustion residual
GWPS	Groundwater protection standards
O&M	Operation and maintenance
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
WBF Plant	Watts Bar Fossil Plant

EXHIBITS

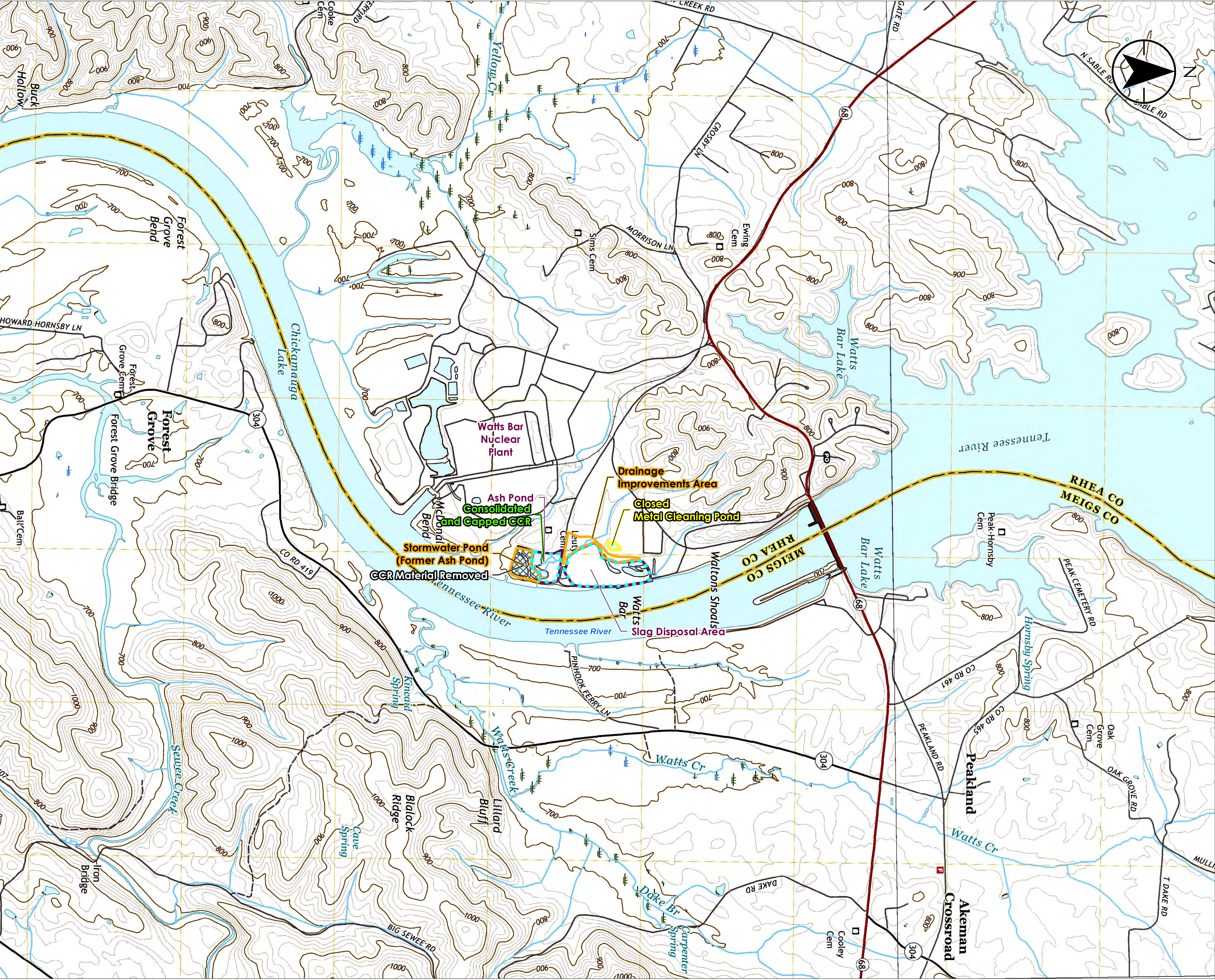


Exhibit No.
1-1

DRAFT

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 2024-04-11
Technical Review by BL on 2024-04-11

01,0002,0003,0004,000

Feet

1:12,000 (At original document size of 22x34)

Legend

Limit of Existing Cover System (Approximate – 2023)

CCR Unit Area (Approximate)

Closed Metal Cleaning Pond (Approximate)

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

CCR Material Removed (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)





Exhibit No.
2-1

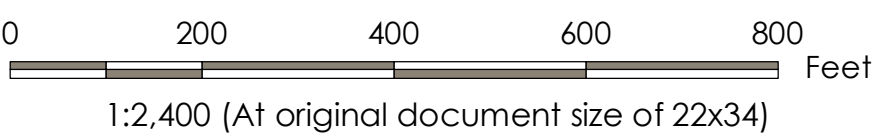
DRAFT

Title
WBF Plant Overview

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-04-11
Technical Review by BL on 2024-04-11



Legend

●

National Pollutant Discharge Elimination System (NPDES) Outfalls (Historical)

Limit of Existing Cover System (Approximate – 2023)

→

Surface Stream Flow

CCR Unit Area (Approximate)

Closed Metal Cleaning Pond (Approximate)

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

CCR Material Removed (Approximate)

CCR: Coal combustion residuals

- Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
2. Imagery Provided by TVA (2023)





Exhibit No.
2-2

DRAFT

Title

Geologic Map

Client/Project

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

Project Location

Spring City, Tennessee

175668050
Prepared by MB on 2024-04-11
Technical Review by SW on 2024-04-11

0150300450600

Feet

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

Legend

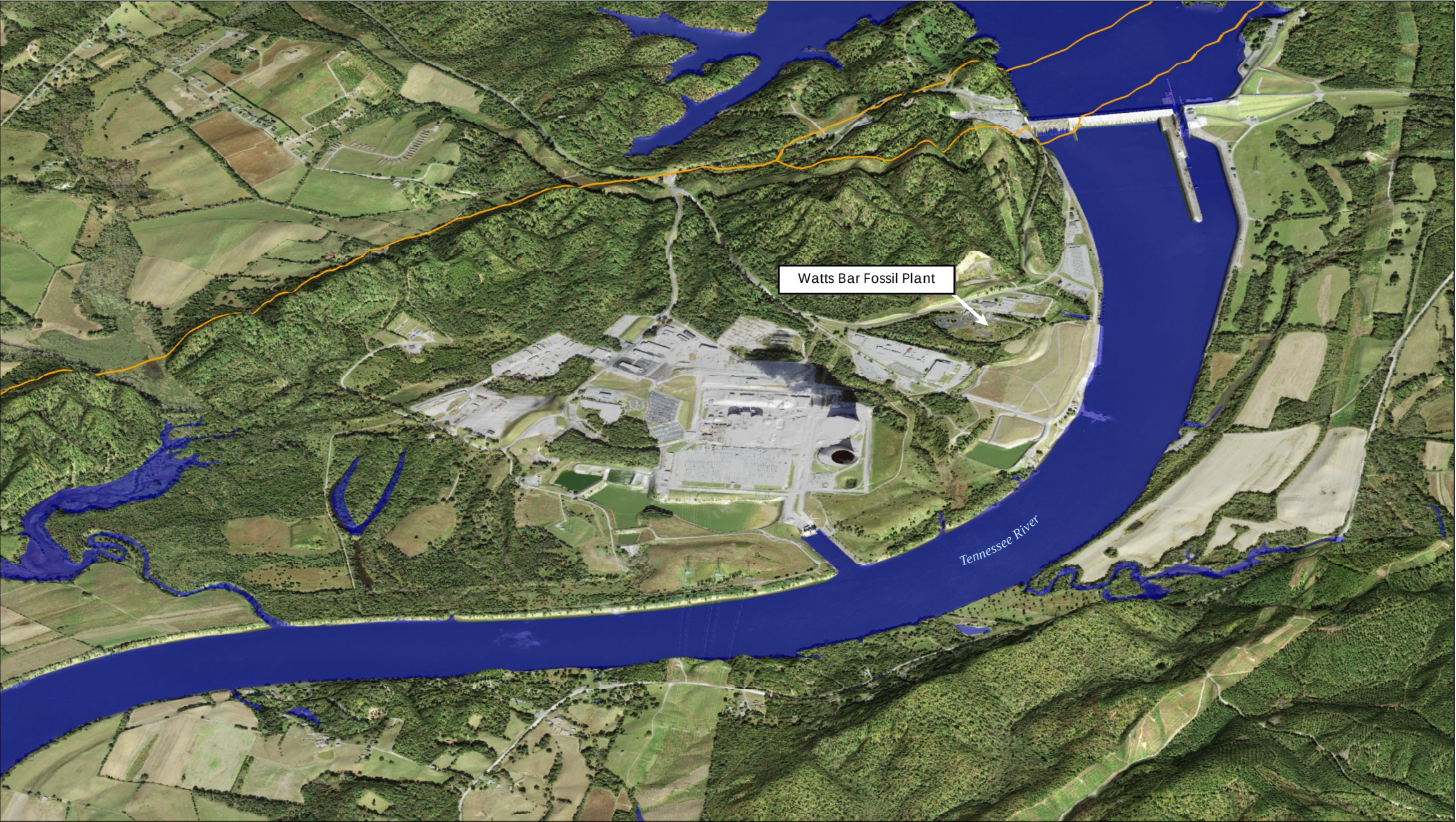
- Limit of Existing Cover System (Approximate – 2023)
 - CCR Unit Area (Approximate)
 - Closed Metal Cleaning Pond (Approximate)
 - Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
 - CCR Material Removed (Approximate)
- Geologic Formation**
- Af - Artificial Fill
 - Qal - Surficial Deposits
 - Ccm - Conasauga Group Middle
 - Cn - Nolichucky Shale

CCR: Coal combustion residuals

- Notes**
- Coordinate System: NAD 1927 StatePlane Tennessee FIPS 4100
 - Imagery Provided by TVA (2023)
 - Geologic Map: USGS TVA, Decatur Quadrangle, 1973



Q:\active\TVA\WBFI\MXD\20220602_topographic_exhibit\WBFI_exhibit_2-5_topography.mxd Revised: 2022-08-04 By: theiler



Oblique View

Exhibit No.
2-3

Title
Faults and Topographic Relief

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

1755668050

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

DRAFT

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.

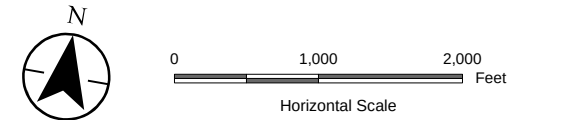




Exhibit No.
2-4a

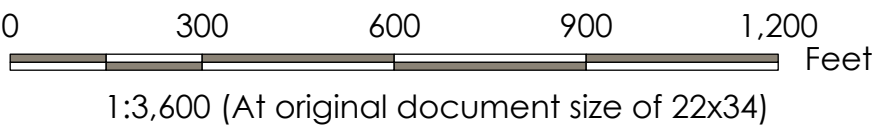
DRAFT

Title
Historical Stream Alignment (1935)

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-03-04
Technical Review by SW on 2025-03-04



Legend

- Historical Stream Alignment
- Limit of Existing Cover System (Approximate – 2023)
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

- Notes
- Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 - Imagery Provided by TVA (2023)
 - Historical stream alignments digitized from Topographic Map USGS TVA, Decatur Quadrangle, 1935





Exhibit No.
2-4b

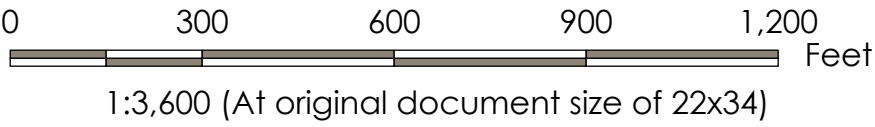
DRAFT

Title
Historical Stream Alignment (1942)

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-03-04
Technical Review by SW on 2025-03-04



Legend

Historical Stream Alignment

Limit of Existing Cover System (Approximate – 2023)

CCR Unit Area (Approximate)

Closed Metal Cleaning Pond (Approximate)

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

CCR Material Removed (Approximate)

CCR: Coal combustion residuals

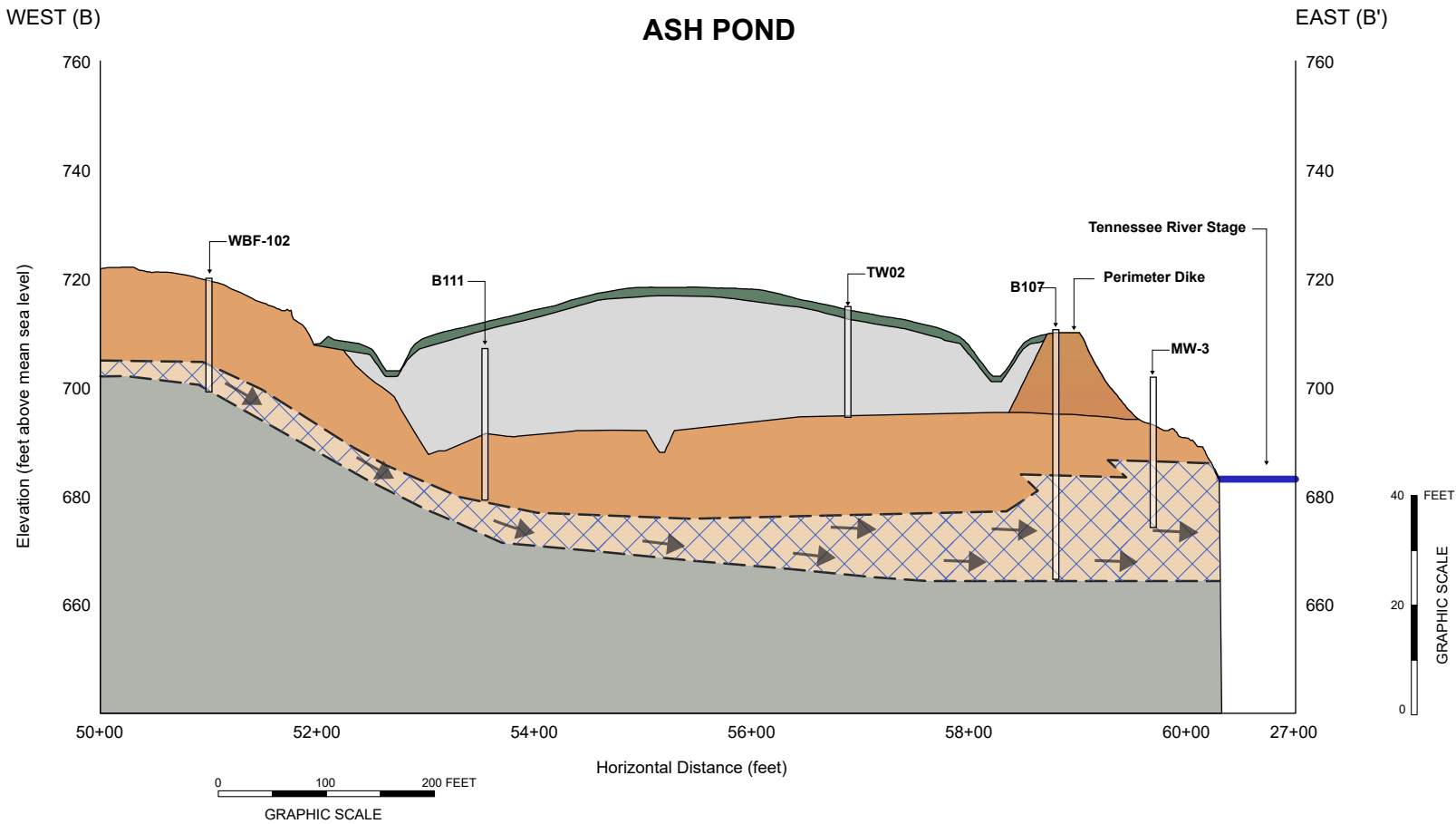
- Notes
1. Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet

2. Imagery Provided by TVA (2023)

3. Historical stream alignments digitized from Topographic Map USGS, Decatur Quadrangle, 1942 (edited 1962)



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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 is evaluating mitigation alternatives.
- The structural integrity of the CCR 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 GWPS. Cobalt in well MW-1 was detected above the GWPS. Potential groundwater impacts are further evaluated in the CARA Plan.

3 Area of Interest

- During the EI, no AOIs were identified.

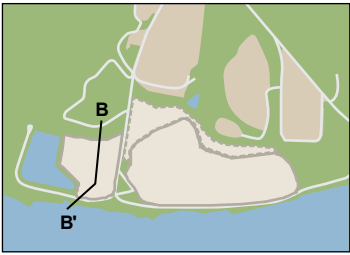
4 Surface Stream, Sediment and Ecology

- CCR Parameter concentrations in surface stream and sediment samples from the Tennessee River collected adjacent to and downstream of the CCR unit were below ESVs.
- Based on the results of the EI and other ongoing ecological monitoring programs, operations at this CCR 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

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

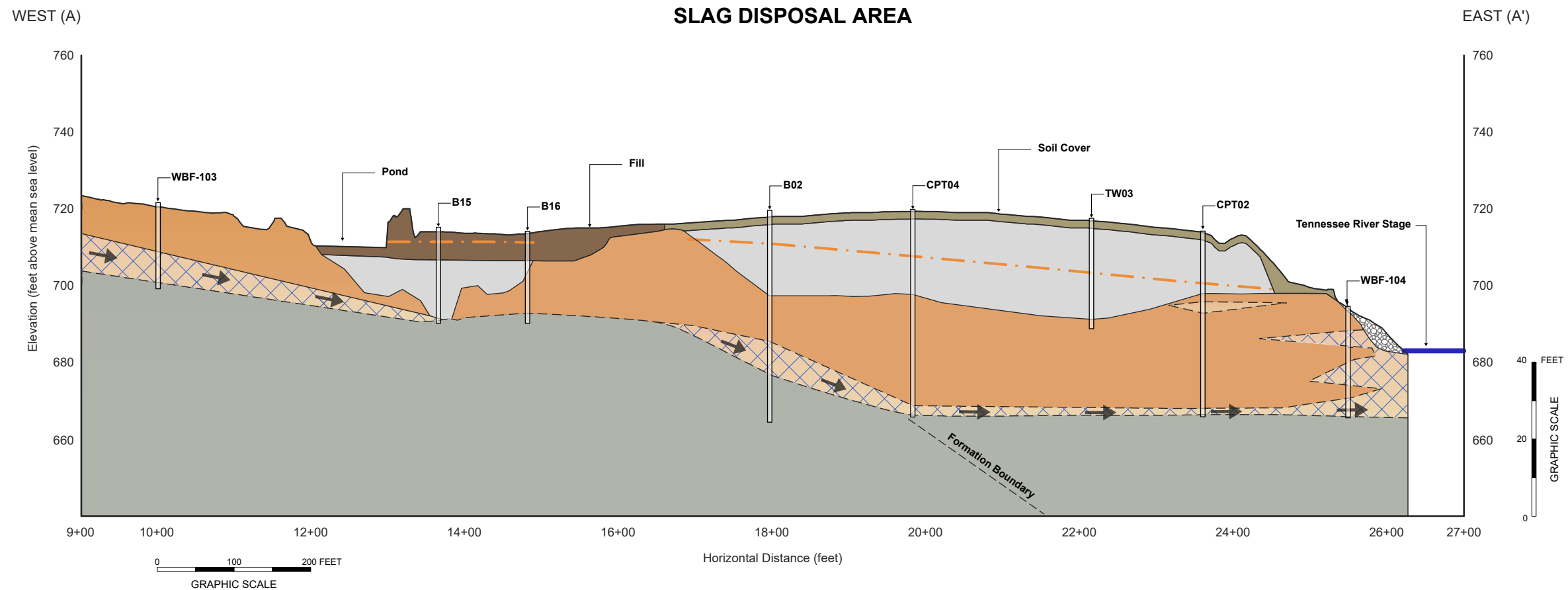
Notes:
AOI — Area of Interest
CCR — coal combustion residuals
EI — Environmental Investigation
ESV — Ecological Screening Value
GWPS — Groundwater Protection Standards



DRAFT



Exhibit No.	3-1
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
Prepared by KB on 2025-02-10	175668050



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 is evaluating mitigation alternatives.
- The structural integrity of the CCR 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 is 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 GWPS. Cadmium in well WBF-104 and cobalt in wells WBF-104 and WBF-106 were detected above the GWPS. Potential groundwater impacts are further evaluated in the CARA Plan.

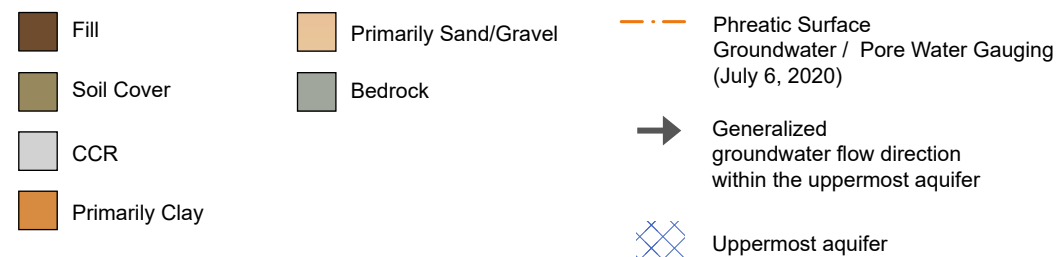
3 Area of Interest

- 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 are further evaluated in the CARA Plan.
- See Exhibit 3-4 for the locations of the three AOIs.

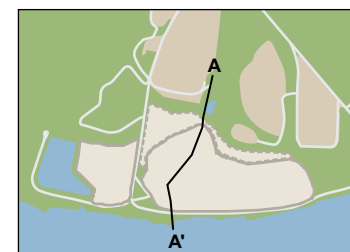
4 Surface Stream, Sediment and Ecology

- CCR Parameter concentrations in surface stream water and sediment samples from the Tennessee River collected adjacent to and downstream of the CCR unit were below ESVs.
- Based on the results of the EI and other ongoing ecological monitoring programs, operations at this CCR 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



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
GWPS — Groundwater Protection Standards



DRAFT



Exhibit No.
3-2

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 2025-02-10



Common EI Findings for CCR Units

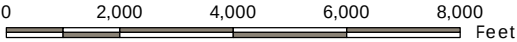
- Overall:**
- More than 98% of the environmental sample results from approximately 300 samples were below the approved levels.
- CCR Material:**
- The global slope stability and the veneer slope stability for each of the two CCR units meet the established factor of safety criteria for the static load 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 is evaluating mitigation alternatives.
 - The structural integrity of the CCR 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 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 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.

Refer to Exhibit 3-4 for more detail in this area.

Exhibit No.	
3-3	
Title	
Overall Study Area Findings	
Client/Project	
Tennessee Valley Authority Watts Bar Fossil (WBF) Plant TDEC Order	
Project Location	
Spring City, Tennessee	175668050 Prepared by KB on 2025-02-10



- 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
 - 2023 Imagery Boundary
 - CCR Unit Area (Approximate)

Abbreviations:
CCR: Coal combustion residuals
EI: Environmental Investigation

Imagery Provided by ESRI Imagery; 2023 Imagery Provided by TVA



Exhibit No.
5-1

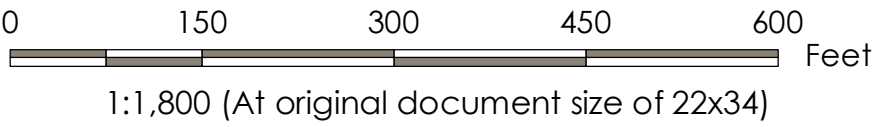
DRAFT

Title
Planned WBF Plant CCR Unit Closure Actions

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-26
Technical Review by BL on 2024-08-26



Legend

- Dewatering Pump
- Approximate Location of Areas of Interest (AOIs)
- Groundwater Monitoring Well
- Seismic Mitigation - Toe Berm Buttress (Approximate)
- Limit of Existing Cover System (Approximate - 2023)
- Drainage Modifications
- Planned Geosynthetic Cover System
- Upgradient Drainage Modifications
- CCR Unit Area (Approximate)
- Closed Metal Cleaning Pond (Approximate)
- Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
- CCR Material Removed (Approximate)

CCR: Coal combustion residuals

*Additional planned actions (see Chapter 5)

Closure actions depicted are based on design drawings in Appendix F.1

See Appendix E for Groundwater Monitoring Plan.

- Notes
- Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 - Imagery Provided by TVA (2023)

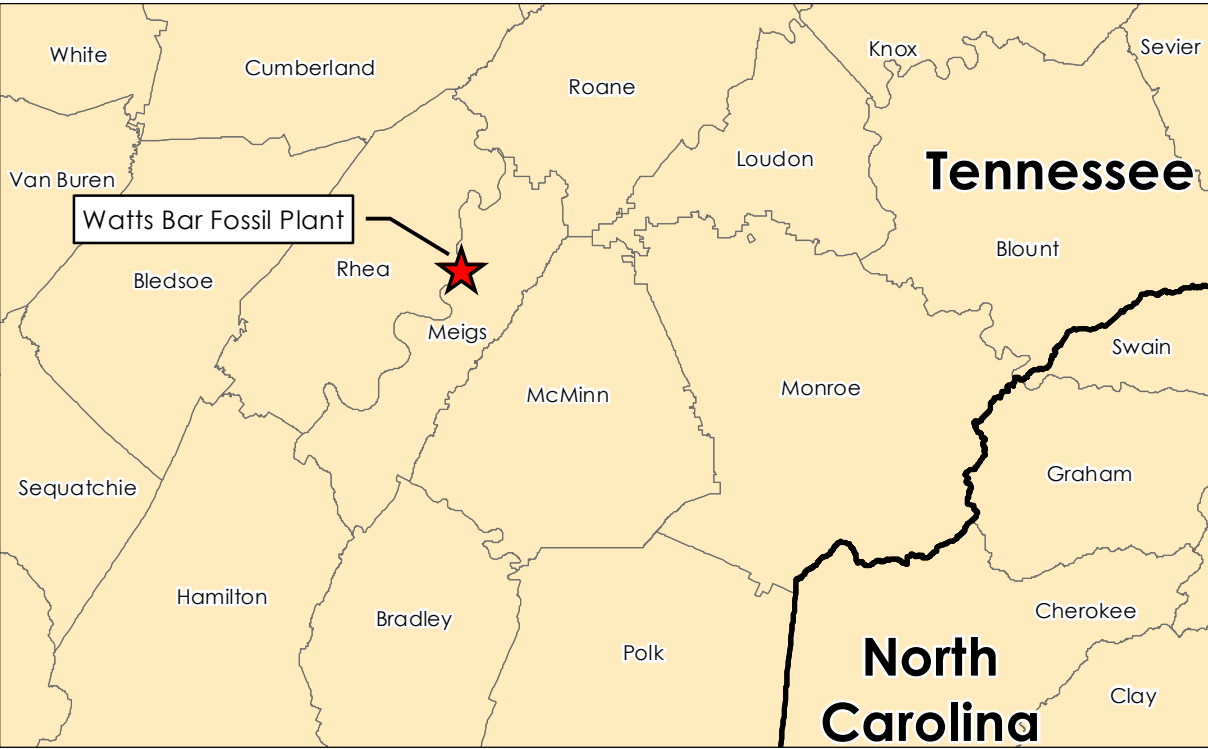




Exhibit No.
5-2

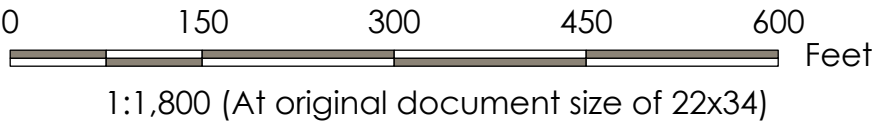
DRAFT

Title
Cross Section Transects of Modeled Long-Term Thickness of CCR Material Below Pore Water Phreatic Surface

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2024-08-27
Technical Review by BL on 2024-08-27



Legend

—

 Cross Section Transect Line

 Limit of Existing Cover System (Approximate – 2023)

CCR Unit Area (Approximate)

Closed Metal Cleaning Pond (Approximate)

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

CCR Material Removed (Approximate)

Thickness of CCR Material beneath Pore Water Phreatic Surface (in feet)

Absent (< 1)

1 - 2

2 - 4

4 - 6

6 - 8

8 - 10

10 - 12

12 - 14

14 - 16

16 - 18

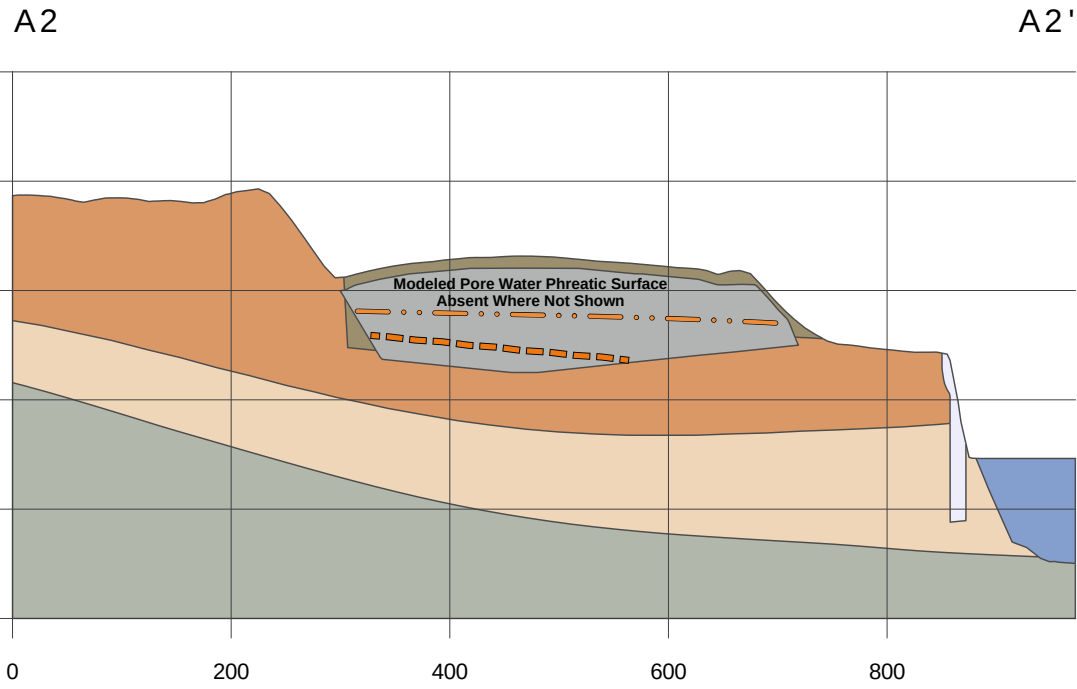
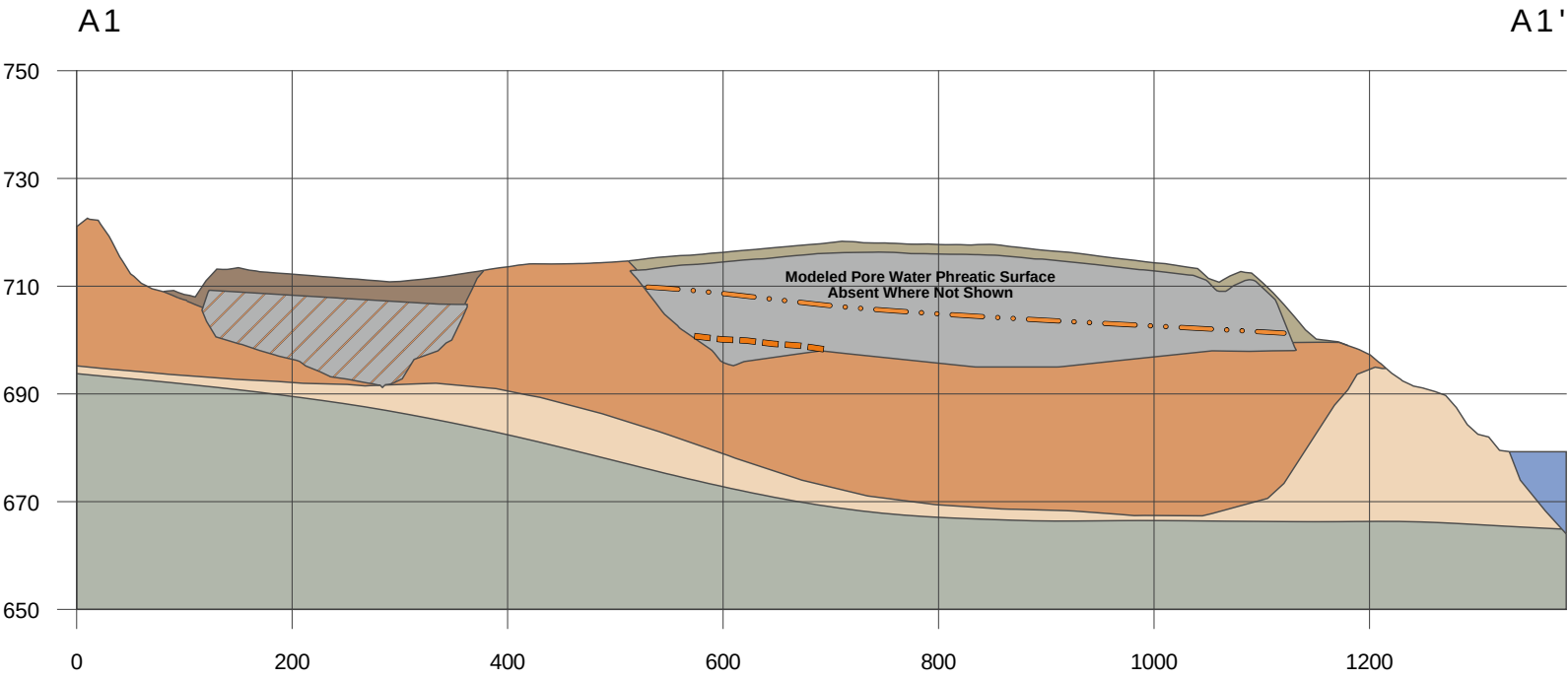
CCR: Coal combustion residuals

Notes

- Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
- Imagery Provided by TVA (2023)



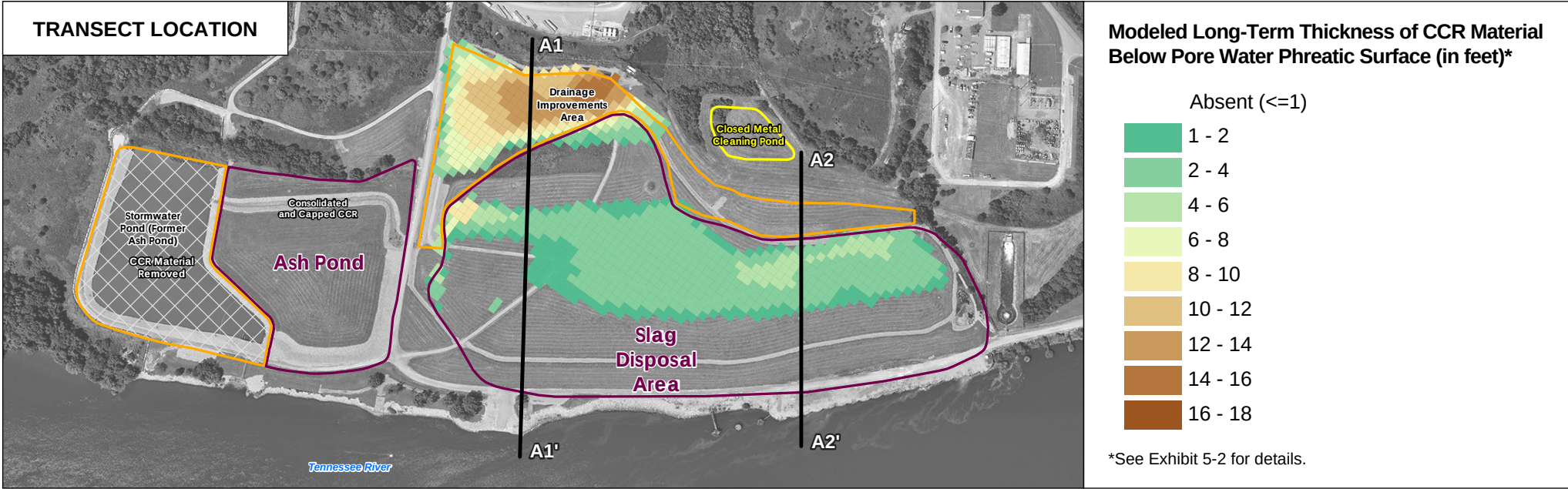
SLAG DISPOSAL AREA



Scale: 1:1,800
Vertical exaggeration: 5x

0ft 400ft

Note: Existing or planned closure actions are not shown on these cross sections but were included in the modeling.



Legend

Fill

Soil Cover

CCR Material

Primarily Clay

Primarily Sand/Gravel

Bedrock

Observed Pore Water Phreatic Surface (July 6, 2020 (EAR Event 6))

Modeled Long-term Pore Water Phreatic Surface (Modeled conditions of the Planned Closure and Corrective Actions) (see Appendix G)

Phreatic Surface Within Fill Above CCR Material (see Appendix G)

DRAFT



Exhibit No.
5-3

Title
Measured and Modeled Long-Term Pore Water Phreatic Surface Levels at the Slag Disposal Area

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

Project Location
Spring City, Tennessee

175668050

Prepared by KB on 2025-02-11

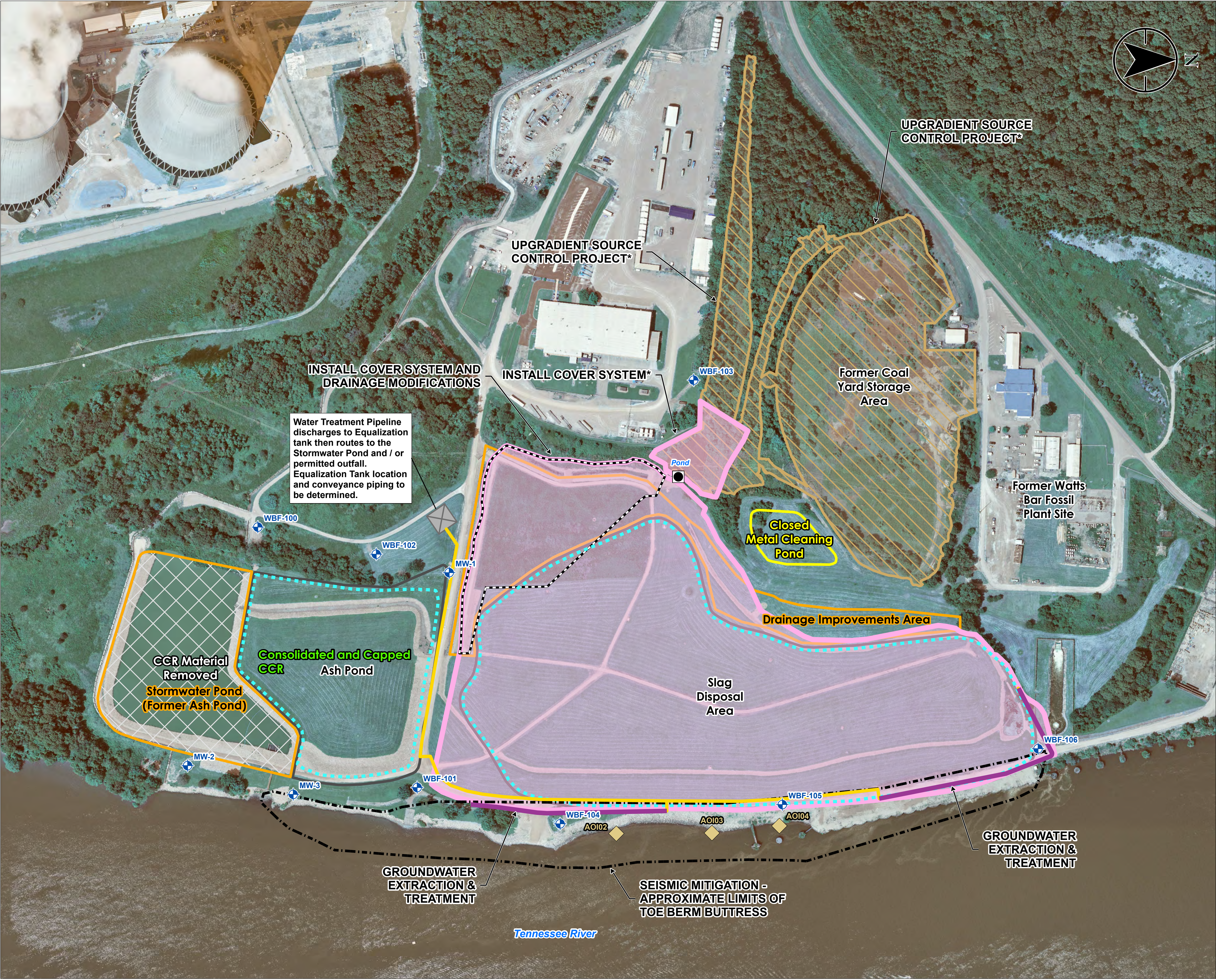


Exhibit No.
6-1

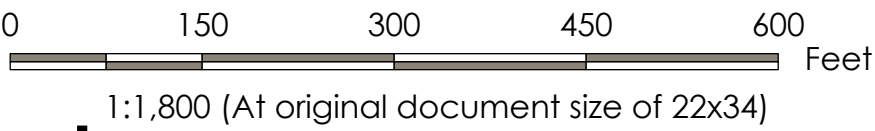
DRAFT

Title
**Planned WBF Plant CCR Unit
Groundwater Corrective Actions**

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

Project Location
Spring City, Tennessee

175668050
Prepared by MB on 2025-10-08
Technical Review by BL on 2025-10-08



- Legend
- Dewatering Pump
 - Approximate Location of Areas of Interest (AOIs)
 - Groundwater Monitoring Well
 - Approximate Location of Groundwater Extraction System
 - Seismic Mitigation - Toe Berm Buttress (Approximate)
 - Water Treatment Pipeline
 - Limit of Existing Cover System (Approximate - 2023)
 - Drainage Modifications
 - Planned Geosynthetic Cover System
 - Upgradient Drainage Modifications
 - Water Treatment System
 - CCR Unit Area (Approximate)
 - Closed Metal Cleaning Pond (Approximate)
 - Drainage Improvements Area; Stormwater Pond (Former Ash Pond) (Approximate)
 - CCR Material Removed (Approximate)

CCR: Coal combustion residuals

*Additional planned actions (see Chapter 5)

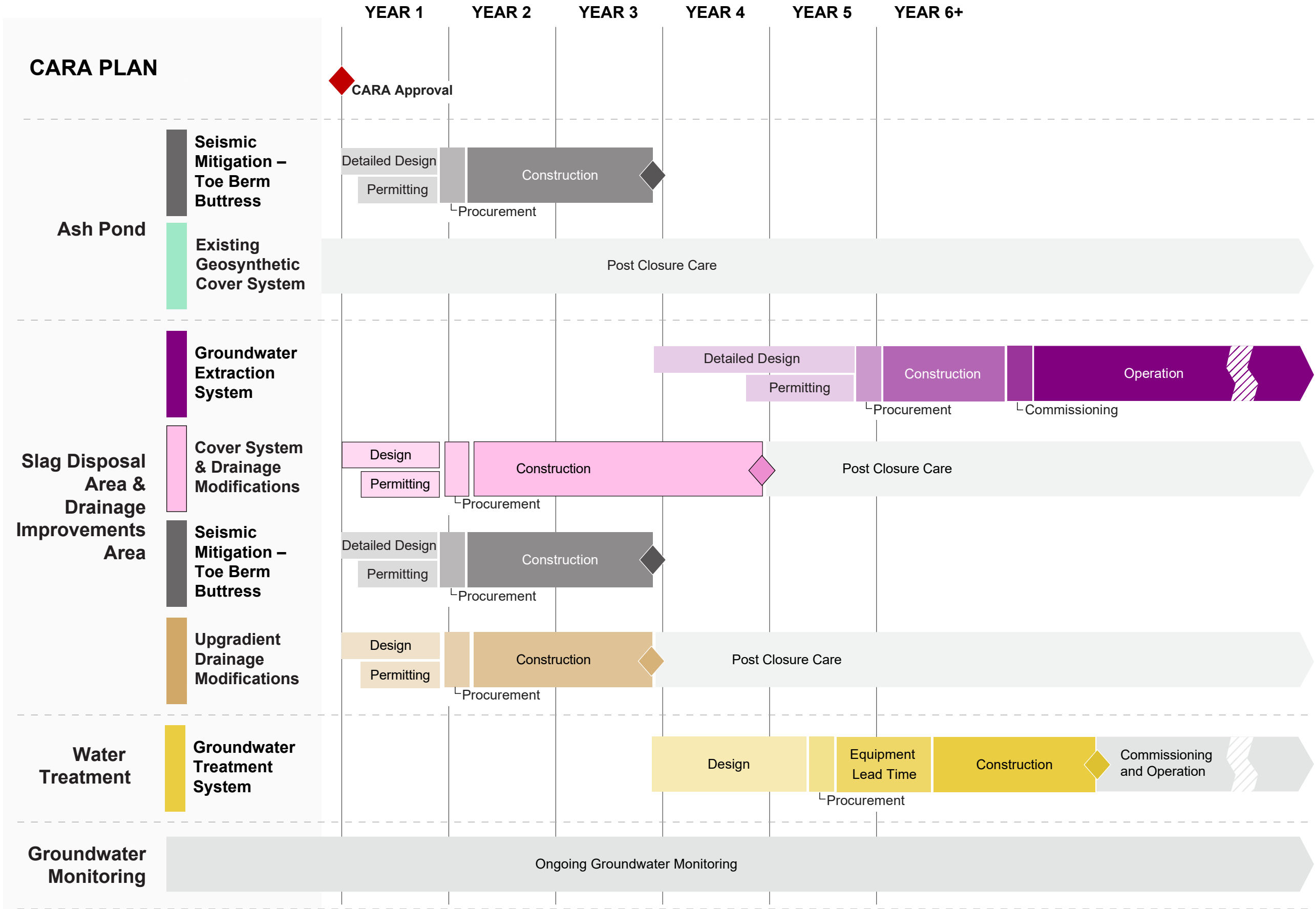
Closure actions are depicted on this exhibit because they provide source control for the planned groundwater corrective action.

Closure actions and groundwater corrective actions are based on design drawings in Appendix F.1

- See Appendix E for Groundwater Monitoring Plan.
- Notes**
- Coordinate System: NAD 1983 StatePlane Tennessee FIPS 4100 Feet
 - Imagery Provided by TVA (2023)



CARA Plan Implementation Schedule



Legend

Completion Milestone

DRAFT