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# Environmental Assessment Report

John Sevier Fossil Plant  
Rogersville, Tennessee  
Tennessee Valley Authority


## Title and Approval Page

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John Sevier Fossil Plant  
Tennessee Valley Authority  
Rogersville, Tennessee

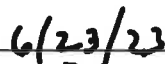
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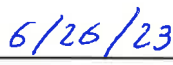
  
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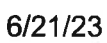
  
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# Table of Contents

<b>EXECUTIVE SUMMARY</b> .....	<b>VIII</b>
<b>ACRONYMS AND ABBREVIATIONS</b> .....	<b>XI</b>
<b>CHAPTER 1 INTRODUCTION</b> .....	<b>1</b>
1.1 BACKGROUND, SCOPE, AND OBJECTIVES.....	1
1.2 REGULATORY FRAMEWORK.....	3
1.2.1 TDEC Order.....	3
1.2.2 CCR Rule.....	3
1.2.3 State Programs.....	3
1.3 ENVIRONMENTAL INVESTIGATION OVERVIEW.....	4
1.3.1 Investigation Activities.....	4
1.3.1.1 Screening Levels.....	6
1.3.2 Data Management and Quality Assessment.....	8
1.4 KEY MILESTONES.....	9
1.5 REPORT ORGANIZATION.....	10
<b>CHAPTER 2 SITE HISTORY AND PHYSICAL CHARACTERISTICS</b> .....	<b>12</b>
2.1 SITE OPERATIONS.....	12
2.2 CCR MANAGEMENT UNIT HISTORY AND LAND USE.....	13
2.2.1 Dry Fly Ash Stack.....	13
2.2.2 Ash Disposal Area J.....	14
2.2.3 Bottom Ash Pond.....	14
2.2.4 Highway 70 Borrow Area.....	15
2.2.5 Other Plant Operations.....	15
2.3 OWNERSHIP AND SURROUNDING LAND USE.....	16
2.4 PHYSICAL CHARACTERISTICS.....	17
2.4.1 Regional and Site Physiography.....	17
2.4.2 Regional Geology, Hydrogeology and Surface Water Hydrology.....	18
2.4.2.1 Geology.....	18
2.4.2.2 Surface Water Hydrology.....	18
2.4.2.3 Regional Hydrogeology.....	18
2.4.3 Local Climate.....	19
2.4.4 Cultural and Historical Resources.....	19
<b>CHAPTER 3 BACKGROUND SOIL INVESTIGATION</b> .....	<b>21</b>
3.1 PREVIOUS STUDIES AND ASSESSMENTS.....	21
3.2 TDEC ORDER INVESTIGATION ACTIVITIES.....	21
3.3 LITHOLOGY.....	22
3.4 BACKGROUND SOIL INVESTIGATION RESULTS SUMMARY.....	22
<b>CHAPTER 4 CCR MATERIAL INVESTIGATIONS</b> .....	<b>23</b>
4.1 GEOTECHNICAL INVESTIGATION.....	23
4.1.1 Exploratory Drilling.....	23
4.1.1.1 Previous Representative Studies and Assessments.....	23
4.1.1.2 TDEC Order Investigation Activities.....	23

4.1.1.3	Results and Discussion .....	24
4.1.2	Slope Stability .....	24
4.1.2.1	Results and Discussion .....	25
4.1.3	Structural Integrity.....	25
4.1.3.1	Results and Discussion .....	25
4.1.4	Structural Stability (Bedrock) .....	26
4.1.4.1	Results and Discussion .....	26
4.2	CCR MATERIAL CHARACTERISTICS .....	26
4.2.1	Previous Studies and Assessments.....	26
4.2.2	TDEC Order Investigation Activities.....	26
4.2.3	CCR Material Characteristics Evaluation .....	27
4.2.3.1	Total Metals and SPLP Evaluation Results .....	27
4.2.3.2	Pore Water Phreatic Surface .....	27
4.2.3.3	Pore Water Quality Evaluation .....	28
4.2.4	CCR Material Characteristics Results .....	30
4.3	CCR MATERIAL QUANTITY ASSESSMENT .....	30
4.3.1	Previous Studies and Assessments.....	30
4.3.2	TDEC Order Investigation Activities.....	30
4.3.3	Material Quantity Assessment Results.....	31
4.3.3.1	Cross Sections .....	31
4.3.3.2	CCR Material Limits and Thickness .....	31
4.3.3.3	CCR Material Volumes .....	31
4.3.3.4	Comparison to Previous MQA .....	31
4.3.3.5	Secondary Volume Estimates and Verification Method.....	32
4.4	CCR MATERIAL INVESTIGATIONS SUMMARY.....	32
<b>CHAPTER 5 HYDROGEOLOGICAL INVESTIGATIONS.....</b>		<b>34</b>
5.1	GROUNDWATER AND HYDROGEOLOGICAL INVESTIGATIONS .....	34
5.1.1	Previous Studies and Assessments.....	34
5.1.2	TDEC Order Investigation Activities.....	34
5.1.3	Hydrogeological Investigation Results .....	35
5.1.3.1	Well Construction and Presence of CCR Material.....	35
5.1.3.2	Lithology and Hydrostratigraphic Units.....	35
5.1.3.3	Groundwater Elevations, Flow, and Relationship to Pore Water .....	40
5.1.3.4	Groundwater Quality Evaluation .....	41
5.2	GEOCHEMISTRY OF SOILS-GROUNDWATER INTERACTION .....	45
5.3	WATER USE SURVEY .....	46
5.3.1	Desktop Survey .....	46
5.3.1.1	Desktop Survey Results.....	46
5.3.1.2	Usable Water Well and/or Spring Identification .....	46
5.4	HYDROGEOLOGICAL INVESTIGATION SUMMARY .....	48
<b>CHAPTER 6 SUMMARY OF HISTORICAL SEEP INFORMATION .....</b>		<b>51</b>
<b>CHAPTER 7 SURFACE STREAMS, SEDIMENT AND ECOLOGICAL INVESTIGATIONS.....</b>		<b>52</b>
7.1	PREVIOUS STUDIES AND ASSESSMENTS .....	52
7.1.1	Surface Stream Studies and Ongoing Monitoring Activities .....	52
7.1.2	Sediment and Benthic Invertebrate Studies .....	52
7.1.3	Fish Community and Fish Tissue Studies .....	53

7.2	TDEC ORDER INVESTIGATION ACTIVITIES.....	54
7.3	RESULTS AND DISCUSSION.....	56
7.3.1	Holston River.....	56
7.3.2	Polly Branch.....	58
7.3.3	Benthic Macroinvertebrate Community Analysis.....	60
7.4	SURFACE STREAMS, SEDIMENT, AND ECOLOGICAL INVESTIGATION SUMMARY.....	60
<b>CHAPTER 8 TDEC ORDER INVESTIGATION SUMMARY AND CONCEPTUAL SITE MODELS ....</b>		<b>62</b>
8.1	COMMON FINDINGS.....	64
8.2	DRY FLY ASH STACK.....	65
8.3	ASH DISPOSAL AREA J.....	66
<b>CHAPTER 9 CONCLUSIONS AND NEXT STEPS .....</b>		<b>69</b>
9.1	CONCLUSIONS.....	69
9.2	NEXT STEPS .....	71
<b>CHAPTER 10 REFERENCES.....</b>		<b>72</b>

## List of Tables

Table 1-1	Human Health Screening Levels for Groundwater - Environmental Assessment Report
Table 1-2	Human Health and Ecological Site-Specific Screening Levels for Surface Water - Environmental Assessment Report
Table 1-3	Ecological Screening Levels for Freshwater Sediment - Environmental Assessment Report
Table 1-4	Screening Levels for Mayfly Tissue Critical Body Residues - Environmental Assessment Report
Table 1-5	Screening Levels for Fish Tissue Critical Body Residues - Environmental Assessment Report
Table 3-1	Background Soils Lithologic Summary
Table 4-1	Pore Water Level Measurements
Table 4-2	Estimated CCR Material Areas and Volumes

## List of Exhibits

Exhibit ES-1	Summary of Environmental Assessment Report Findings
Exhibit 1-1	Site Location Map
Exhibit 2-1	JSF Plant Overview
Exhibit 2-2	JSF Plant Operations 2017
Exhibit 2-3a	Topographic Map – USGS (1935)
Exhibit 2-3b	Topographic Map – USGS (1940)
Exhibit 2-4	Geologic Map
Exhibit 2-5	Reported Spring and Historic Stream Alignments
Exhibit 2-6	Holston River Basin Faults and Topographic Relief
Exhibit 3-1	Background Soil Boring Location Map
Exhibit 3-2	Rock Outcrop Survey Area
Exhibit 4-1	Phase 1 Boring Locations Ash Disposal Area J
Exhibit 4-2	Phase 1 Boring Locations Bottom Ash Pond and Highway 70 Borrow Area
Exhibit 4-3	Phase 1 Boring Locations Dry Fly Ash Stack
Exhibit 4-4	Phase 2 Boring Locations Ash Disposal Area J and Highway 70 Borrow Area
Exhibit 4-5	Phase 2 Boring Locations Dry Fly Ash Stack
Exhibit 4-6	Temporary Well and Boring Location Map
Exhibit 4-7	Pore Water Elevation Contour Map, Event #4 (February 3, 2020)
Exhibit 4-8	Pore Water Elevation Contour Map, Event #3 (December 2, 2019)
Exhibit 4-9a	Estimated Limits and Thickness of CCR Material – Dry Fly Ash Stack
Exhibit 4-9b	Estimated Limits and Thickness of CCR Material – Bottom Ash Pond

Exhibit 4-9c	Estimated Limits and Thickness of CCR Material – Ash Disposal Area J
Exhibit 4-9d	Estimated Limits and Thickness of CCR Material – Highway 70 Borrow Area
Exhibit 5-1	Groundwater Elevation Contour Map, Event #4 – Unconsolidated Material (February 3, 2020)
Exhibit 5-2	Groundwater Elevation Contour Map, Event #4 - Bedrock (February 3, 2020)
Exhibit 7-1	Sediment Sampling Results Above Ecological Screening Values
Exhibit 7-2	Mayfly Sampling Results Above Critical Body Residue Values
Exhibit 7-3	Fish Tissue Sampling Results Above Critical Body Residue Values
Exhibit 8-1	Dry Fly Ash Stack Cross Section B-B' Conceptual Site Model
Exhibit 8-2	Ash Disposal Area J Cross Section A-A' Conceptual Site Model
Exhibit 8-3	Bottom Ash Pond Cross Section D-D' Conceptual Site Model
Exhibit 8-4	Highway 70 Borrow Area Cross Section C-C' Conceptual Site Model
Exhibit 8-5	Overall Study Area Findings
Exhibit 8-6	Overall Findings near JSF Plant CCR Management Units



## List of Appendices

<b>APPENDIX A</b>	<b>REGULATORY INFORMATION AND CORRESPONDENCE</b>
APPENDIX A.1	TDEC ORDER
APPENDIX A.2	REGULATORY CORRESPONDENCE
<b>APPENDIX B</b>	<b>BORING LOGS</b>
APPENDIX B.1	BACKGROUND SOIL BORINGS
APPENDIX B.2	GEOTECHNICAL BORINGS
APPENDIX B.3	TEMPORARY WELLS
APPENDIX B.4	PIEZOMETERS
APPENDIX B.5	PERMANENT WELLS
<b>APPENDIX C</b>	<b>WELL INSTALLATION LOGS</b>
APPENDIX C.1	TEMPORARY WELLS
APPENDIX C.2	PIEZOMETERS
APPENDIX C.3	PERMANENT WELLS
<b>APPENDIX D</b>	<b>CCR MANAGEMENT UNIT CROSS SECTIONS</b>
<b>APPENDIX E</b>	<b>STATISTICAL ANALYSES</b>
APPENDIX E.1	STATISTICAL ANALYSIS OF BACKGROUND SOIL DATA
APPENDIX E.2	STATISTICAL ANALYSIS OF CCR MATERIAL CHARACTERISTICS DATA
APPENDIX E.3	STATISTICAL ANALYSIS OF GROUNDWATER ANALYTICAL RESULTS
APPENDIX E.4	STATISTICAL ANALYSIS OF SURFACE STREAM DATA
APPENDIX E.5	STATISTICAL ANALYSIS OF SEDIMENT DATA
APPENDIX E.6	DATA EVALUATION OF MAYFLY TISSUE SAMPLE DATA
APPENDIX E.7	DATA EVALUATION OF FISH TISSUE SAMPLE DATA
<b>APPENDIX F</b>	<b>BACKGROUND SOIL INVESTIGATION</b>
APPENDIX F.1	BACKGROUND SOIL INVESTIGATION SAMPLING AND ANALYSIS REPORT
<b>APPENDIX G</b>	<b>CCR MATERIAL INVESTIGATIONS</b>
APPENDIX G.1	TECHNICAL EVALUATION OF GEOTECHNICAL DATA
APPENDIX G.2	EXPLORATORY DRILLING SAMPLING AND ANALYSIS REPORT
APPENDIX G.3	STATIC STABILITY SAMPLING AND ANALYSIS REPORT
APPENDIX G.4	SEISMIC STABILITY SAMPLING AND ANALYSIS REPORT
APPENDIX G.5	CCR MATERIAL CHARACTERISTICS INVESTIGATION SAMPLING AND ANALYSIS REPORT
APPENDIX G.6	MATERIAL QUANTITY ASSESSMENT HISTORIC INFORMATION AND SECONDARY VOLUME ESTIMATES
APPENDIX G.7	MATERIAL QUANTITY ASSESSMENT SAMPLING AND ANALYSIS REPORT

<b>APPENDIX H</b>	<b>HYDROGEOLOGICAL INVESTIGATIONS</b>
APPENDIX H.1	TECHNICAL EVALUATION OF HYDROGEOLOGY
APPENDIX H.2	HYDROGEOLOGY INVESTIGATION SAMPLING AND ANALYSIS REPORT
APPENDIX H.3	GROUNDWATER INVESTIGATION EVENT #1 SAMPLING AND ANALYSIS REPORT
APPENDIX H.4	GROUNDWATER INVESTIGATION EVENT #2 SAMPLING AND ANALYSIS REPORT
APPENDIX H.5	GROUNDWATER INVESTIGATION EVENT #3 SAMPLING AND ANALYSIS REPORT
APPENDIX H.6	GROUNDWATER INVESTIGATION EVENT #4 SAMPLING AND ANALYSIS REPORT
APPENDIX H.7	GROUNDWATER INVESTIGATION EVENT #5 SAMPLING AND ANALYSIS REPORT
APPENDIX H.8	GROUNDWATER INVESTIGATION EVENT #6 SAMPLING AND ANALYSIS REPORT
APPENDIX H.9	TECHNICAL EVALUATION OF WATER USE SURVEY
<b>APPENDIX I</b>	<b>SEEP INVESTIGATION</b>
APPENDIX I.1	SEEP SUMMARY REPORT
<b>APPENDIX J</b>	<b>SURFACE STREAM, SEDIMENT AND BENTHIC, AND FISH TISSUE INVESTIGATIONS</b>
APPENDIX J.1	TECHNICAL EVALUATION OF SURFACE STREAM DATA
APPENDIX J.2	SURFACE STREAM SAMPLING AND ANALYSIS REPORT
APPENDIX J.3	TECHNICAL EVALUATION OF SEDIMENT AND BENTHIC INVERTEBRATE DATA
APPENDIX J.4	BENTHIC INVESTIGATION SAMPLING AND ANALYSIS REPORT
APPENDIX J.5	TECHNICAL EVALUATION OF FISH TISSUE DATA
APPENDIX J.6	FISH TISSUE SAMPLING AND ANALYSIS REPORT

## Executive Summary

Environmental Assessment Report – Rev. 1  
John Sevier 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. TVA constructed the JSF Plant between 1952 and 1957, commencing power generation in 1955, and decommissioned the plant in 2012. There are four CCR management units<sup>1</sup> at the John Sevier Fossil (JSF) Plant included in the TDEC Order: the Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond, and Highway 70 Borrow Area. The Bottom Ash Pond is the only CCR management unit subject to Title 40, Code of Federal Regulations Part 257, Subpart D (CCR Rule). The Dry Fly Ash Stack is the only CCR management unit with a landfill permit (Chapter 0400-11-01). Each of the CCR management units were previously closed in accordance with applicable regulations in effect at the time of closure.

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

Between 2019 and 2021, TVA and Stantec conducted the TDEC Order environmental investigations (EI) for the JSF Plant CCR management units. The EI included characterization of the site hydrogeology and investigations of CCR material, groundwater, background soils, seeps, surface streams, sediments, and ecology, as well as a Water Use Survey. EI activities were implemented in accordance with the approved Sampling and Analysis Plans and Quality Assurance Project Plans, including TVA- and TDEC-approved programmatic and project-specific changes made following approval of the EIP. Based on a comprehensive quality assurance review, the EI data are usable and meet the objectives of the TDEC Order.

The EI data were evaluated along with information collected as part of previous investigations and other ongoing regulatory monitoring programs conducted between the 1970s and 2022. The objectives of the TDEC Order are similar to these other programs, including TDEC landfill permit requirements (Chapter 0400-11-01) and the CCR Rule, that cover certain CCR management units. Collectively, these data provide a broad-based characterization of the CCR management units to meet the objectives of the EIP. Geotechnical data were used for CCR management unit stability and integrity evaluations. Environmental sample data were used to characterize the extent of potential impacts and were compared to constituent-specific TDEC-approved levels to identify CCR constituents that require further evaluation in the next phase of the TDEC Order, the Corrective Action / Risk Assessment (CARA) Plan.

This Environmental Assessment Report (EAR) describes the extent of surface stream water, sediment, and groundwater contamination from the JSF Plant CCR management units and provides the information, data, and evaluations used to make those assessments. As described herein, more than 99% of the environmental sample results from over 600 samples were below the approved levels. The EI data indicate impacts to limited onsite groundwater areas, and that the CCR management units have had minimal, if any, potential impacts to sediment and surface stream water quality in the

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<sup>1</sup> The term “CCR management unit” is used in this document generally and is not intended to be a designation under federal or state regulations.

## Executive Summary

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Holston River and Polly Branch, and ecological communities in the Holston River. The EI data will be used to evaluate the basis and methods for CCR management unit closure in the CARA Plan, including an evaluation of the performance of existing closure methods; modifications to closure methodology will be identified, as needed, in the CARA Plan.

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

- Surface stream water quality is within ranges protective of human health and aquatic life in the Holston River and Polly Branch.
- Sediment quality is generally within ranges protective of aquatic life in the Holston River and Polly Branch adjacent to and downstream of the CCR management units. Mercury results in Holston River sediments are related to a documented source of mercury upstream of the JSF Plant and are not a result of operations of the CCR management units. Additional evaluation of potential risks associated with sediment at one location in the Holston River and two locations in Polly Branch are warranted in the CARA Plan to determine if corrective actions are needed.
- The EI data indicate that fish and benthic communities are healthy in the Holston River adjacent to and downstream of the CCR management units (sport fish and benthic communities are not sufficiently present in Polly Branch for sampling).
- The CCR management units have adequate structural stability, and slopes are stable under current static and seismic loading conditions.
- There were no known active seeps onsite during the EI.
- Most TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater are below TDEC-approved groundwater screening levels (GSLs), and groundwater impacts are limited to onsite areas downgradient along the perimeter of the CCR management units. However, additional assessments will be included in the CARA Plan to evaluate the need for corrective action for targeted onsite groundwater remediation at locations where statistically significant concentrations of CCR constituents above GSLs exist.
- Drainage improvements or potential corrective actions are expected to reduce concentrations of CCR constituents to below GSLs in groundwater at downgradient monitoring locations.
- Groundwater flow in the unconsolidated materials and upper bedrock is bounded to the north by the Holston River and to the west by Dodson Creek. Near the southern boundary of the JSF Plant, the groundwater flow direction was consistently from the southern boundary of the JSF Plant to the north toward the Holston River. Based on this finding, potable water wells located south and upgradient of the CCR management units would not be impacted by groundwater associated with the JSF Plant CCR management units.
- Based on the overall results of the water use survey, current and historical CCR management associated with the JSF Plant have not affected water supply wells or springs located in the vicinity of the JSF Plant.

Exhibit ES-1 shows overall findings of the investigation and the locations where the environmental assessments concluded that no further evaluation is needed. It also shows where further evaluation is needed in the CARA Plan for sediment results and onsite groundwater. The onsite groundwater impacts will require further evaluation regardless of the CCR management unit closure method, and groundwater remediation can be accomplished along with closure in place or

**Executive Summary**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

closure by removal. TVA continues to evaluate means to beneficially use CCR material in a manner consistent with regulatory requirements while maximizing value to the Tennessee Valley.

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

## Acronyms and Abbreviations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

## Acronyms and Abbreviations

BTV	Background Threshold Value
CARA	Corrective Action/Risk Assessment
CBR	Critical Body Residue
CCR	Coal Combustion Residuals
CCR Parameters	CCR Constituents listed in 40 CFR 257, Appendices III and IV, and the five inorganic constituents listed in Appendix I of Tennessee Rule 0400-11-01-.04
CCR Rule	USEPA Final Rule on Disposal of Coal Combustion Residuals from Electric Utilities
CFR	Code of Federal Regulations
CPT	Cone Penetration Test
CSM	Conceptual Site Model
Cy	Cubic Yards
°F	Degrees Fahrenheit
DMP	Data Management Plan
DSWM	Division of Solid Waste Management
EAR	Environmental Assessment Report
EI	Environmental Investigation
EIP	Environmental Investigation Plan
EnvStds	Environmental Standards, Inc.
ESV	Ecological Screening Value
EXD	Exploratory Drilling
ft amsl	Feet Above Mean Sea Level
ft bgs	Feet Below Ground Surface
GEL	GEL Laboratories, LLC
GSL	Groundwater Screening Level
GWPS	Groundwater Protection Standard(s)
HBI	Hilsenhoff Biotic Index
HERT	High Energy Reduction Technology
JCC Plant	John Sevier Combined-Cycle/Combustion Turbine Plant
JSF Plant	John Sevier Fossil Plant
LLDPE	Linear Low Density Polyethylene
Mil	Millimeter
MQA	Material Quantity Assessment
NOAA	National Oceanic & Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NRS	Non-Registered Site
Pace	Pace Analytical® Services, LLC
%	Percent
PLM	Polarized Light Microscopy
PWP	Process Water Pond

**Acronyms and Abbreviations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAPP	Quality Assurance Project Plan
QC	Quality Control
RBI	Reservoir Benthic Index
Redox	Reduction Oxidation Potential
RFAI	Reservoir Fish Assemblage Index
RJ Lee	RJ Lee Group
SAP	Sampling and Analysis Plan
SAR	Sampling and Analysis Report
SPLP	Synthetic Precipitation Leaching Procedure
SSLs	Statistically Significant Levels
Stantec	Stantec Consulting Services Inc.
TDEC	Tennessee Department of Environment and Conservation
TDEC Order	Commissioner's Order OGC15-0177
TestAmerica	Eurofins Environment Testing America
TN	Tennessee
TOC	Total Organic Carbon
TriAD	TriAD Environmental Consultants, Inc.
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTLs	Upper Tolerance Limits

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 1 Introduction

The Tennessee Valley Authority (TVA) and Stantec Consulting Services Inc. (Stantec), on behalf of TVA, prepared this Environmental Assessment Report (EAR) to provide an evaluation of the environmental conditions at the John Sevier Fossil Plant (JSF Plant) in Rogersville, Tennessee, that may have been related to management of coal combustion residuals (CCR) in onsite impoundments and landfills. The JSF Plant is a retired and decommissioned TVA coal-fired power plant in Hawkins County, located in the northeastern portion of Tennessee (see below and Exhibit 1-1).

## JSF Plant Location



## 1.1 Background, Scope, and Objectives

On August 6, 2015, the Tennessee Department of Environment and Conservation (TDEC) issued Commissioner's Order No. OGC15-0177 (TDEC Order) to TVA (TDEC 2015b, in Appendix A.1). The four closed CCR management units<sup>2</sup> at the JSF Plant included in the TDEC Order are: Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond, and Highway 70 Borrow Area (see below).

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



## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

## JSF CCR Management Units



In accordance with the TDEC Order, TVA prepared an Environmental Investigation Plan (EIP) for the JSF Plant (TVA 2018) to obtain and provide information requested by TDEC. Following public review and comment on the draft, the EIP was approved by TDEC on November 2, 2018, and TVA implemented the investigation activities between 2019 and 2021 in accordance with the approved EIP. As specified in the TDEC Order, the objective of the EIP was to “identify the extent of soil, surface water, and groundwater contamination by CCR” from onsite management of CCR in impoundments and landfills. In addition, per TDEC’s information requests, the EIP included assessment of CCR management unit structural stability and integrity.

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

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

## 1.2 Regulatory Framework

The onsite management of CCR material at the JSF Plant is subject to the following regulatory programs relevant to this investigation. Data from these programs was considered in the development of the EAR.

### 1.2.1 TDEC Order

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

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

### 1.2.2 CCR Rule

The USEPA CCR Rule sets forth national criteria for the management of CCR, was published on April 17, 2015, and can be found in Title 40, Code of Federal Regulations (40 CFR) Part 257, Subpart D (CCR Rule). The rule includes criteria for monitoring groundwater and assessing corrective measures if constituents listed in Appendix IV of the CCR Rule are detected in samples collected from downgradient groundwater monitoring wells at statistically significant levels (SSLs) greater than established groundwater protection standards (GWPS). Groundwater monitoring results and assessment of corrective measures are reported as required by the CCR Rule. The Bottom Ash Pond is the only CCR management unit at the JSF Plant that is subject to the CCR Rule. TVA's CCR Rule Compliance Data and Information website is available for the public to view CCR Rule-required documents, including groundwater monitoring reports for the JSF Plant CCR management unit, at the following location: [John Sevier Coal Combustion Residuals \(tva.com\)](http://www.tva.com/JohnSevierCoalCombustionResiduals).

Additional CCR Rule criteria include closure and post-closure plans, design (including structural stability), location demonstrations, and operating criteria demonstrations which are certified by a qualified professional engineer.

### 1.2.3 State Programs

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

- TDEC Rule 0400-11-01-.04 Division of Solid Waste Management (DSWM) - Class II Landfill Permit No. IDL 37-0097 for the Dry Fly Ash Stack CCR Landfill
- National Pollutant Discharge Elimination System (NPDES) Permit No. TN0005436. Permitted wastewater discharges are to the Holston River via Outfalls 006 and 008 (which include all of the CCR management unit discharges).

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

- Borrow Area Ash Stack, Non-Registered Site (NRS) 37-104-0028
- Ash Disposal Area J Pond, NRS 37-104-0062

TDEC manages NRS units through its solid waste management rules.

As part of permit IDL 37-0097, records are maintained for groundwater monitoring well sample results and groundwater elevations throughout the life of the unit, including the post-closure care period. Groundwater monitoring results are reported to TDEC at the intervals specified in the permit.

Under the NPDES permit, outfall monitoring results are recorded and submitted monthly to TDEC's Division of Water Resources. Wastewater samples are collected weekly, and toxicity testing is performed once every four years.

## 1.3 Environmental Investigation Overview

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

### 1.3.1 Investigation Activities

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

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

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

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

**Notes:** <sup>1</sup>Fluoride is both a CCR Rule Appendix III and CCR Rule Appendix IV CCR parameter. In this table, and in the results figures and tables for this report, fluoride has been grouped with the Appendix III CCR parameters only to avoid duplication

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

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

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

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

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

### 1.3.1.1 Screening Levels

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

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

The statistical evaluation conducted for groundwater analytical results in this EAR was for investigatory purposes to characterize the extent of CCR impacts as required by the TDEC Order. It was not conducted for compliance with the CCR Rule or TDEC permitted landfill monitoring programs. Reports for compliance with the CCR Rule can be found on TVA's CCR Rule Compliance Data and Information website. Groundwater monitoring reports for the TDEC permitted landfill monitoring program are submitted to TDEC within 60 days of sampling events.

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 1.3.1.2 Hydrogeological Terms

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

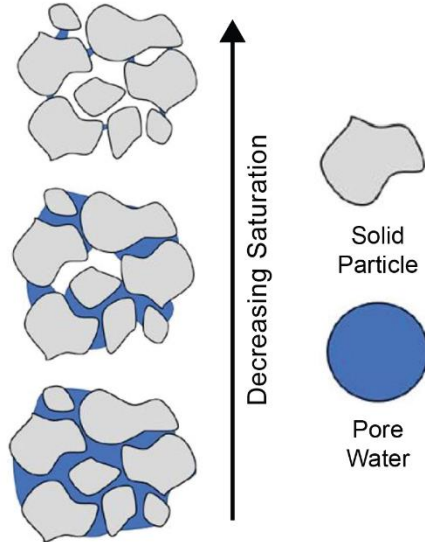
- Pore water – subsurface water that occurs in pore spaces in CCR material
- Groundwater – subsurface water that occurs in pore spaces in unconsolidated or geologic materials (e.g., soil, bedrock)
- Aquifer – a geologic formation capable of yielding usable quantities of groundwater
- Unconfined aquifer – an aquifer in which the water table forms the upper boundary
- 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.
- 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.
- Water table – the surface of groundwater at which pressure is atmospheric and below which geologic materials (e.g., soil or bedrock) may be saturated with groundwater. The measured groundwater levels are used to infer groundwater levels between the wells and piezometers to develop the water table surface. Groundwater levels are measured at locations where wells or piezometers were installed at depths near the depth of the water table surface.

Groundwater level measurements from wells or piezometers installed around the CCR management units and at multiple depths below the water table provide information about the direction of groundwater movement.

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

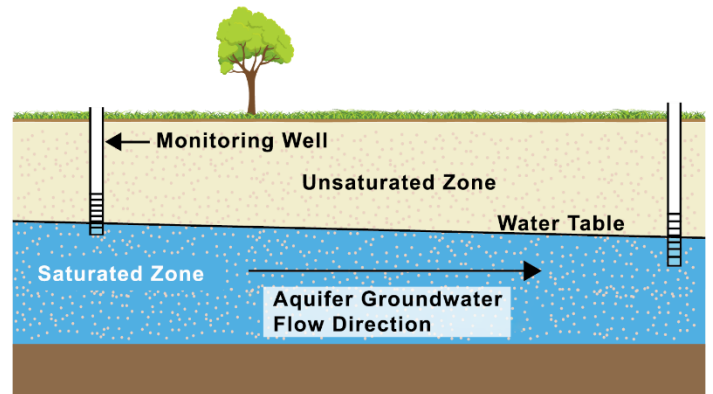
### Pore Water



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

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

### Unconfined Aquifer



Groundwater is subsurface water that occurs in pore spaces in soil or bedrock. Groundwater level measurements taken in a well screened near the water table in an unconfined aquifer represent the water level in the aquifer. Groundwater level measurements are used to estimate directions of groundwater movement. Groundwater generally flows much more slowly than water in a surface stream or river.

## 1.3.2 Data Management and Quality Assessment

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

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

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

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

## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

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

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

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

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

## 1.4 Key Milestones

A chronology of key milestones and events related to the TDEC Order and implementation of the EIP that occurred following approval of the EIP is provided below. This JSF Plant EAR Revision 0 has been prepared to provide information to TDEC prior to TVA finishing the Water Use Survey. This approach was approved by TDEC to allow initiation of the Water Use Survey.

Date	Event
November 2, 2018	TDEC approval of JSF Plant EIP Revision 3
November 30, 2018	Kickoff meeting held with TVA and TDEC to discuss implementation of EIP
December 17, 2018	Phase 1 EI field activities commence
June 12, 2020	Phase 1 EI field activities substantially complete (excluding Phase 2 Sampling and Water Use Survey)
August 18, 2020	Initial SAR submitted to TDEC
November 3, 2020	Phase 2 field activities complete
November 3, 2022	Last SAR accepted by TDEC
<b>*January 10, 2023</b>	Submittal of JSF Plant EAR Revision 0 to TDEC
April 4, 2023	Initiation of Water Use Survey (following TDEC approval of approach)
<b>* As established via email from TDEC on November 3, 2022.</b>	

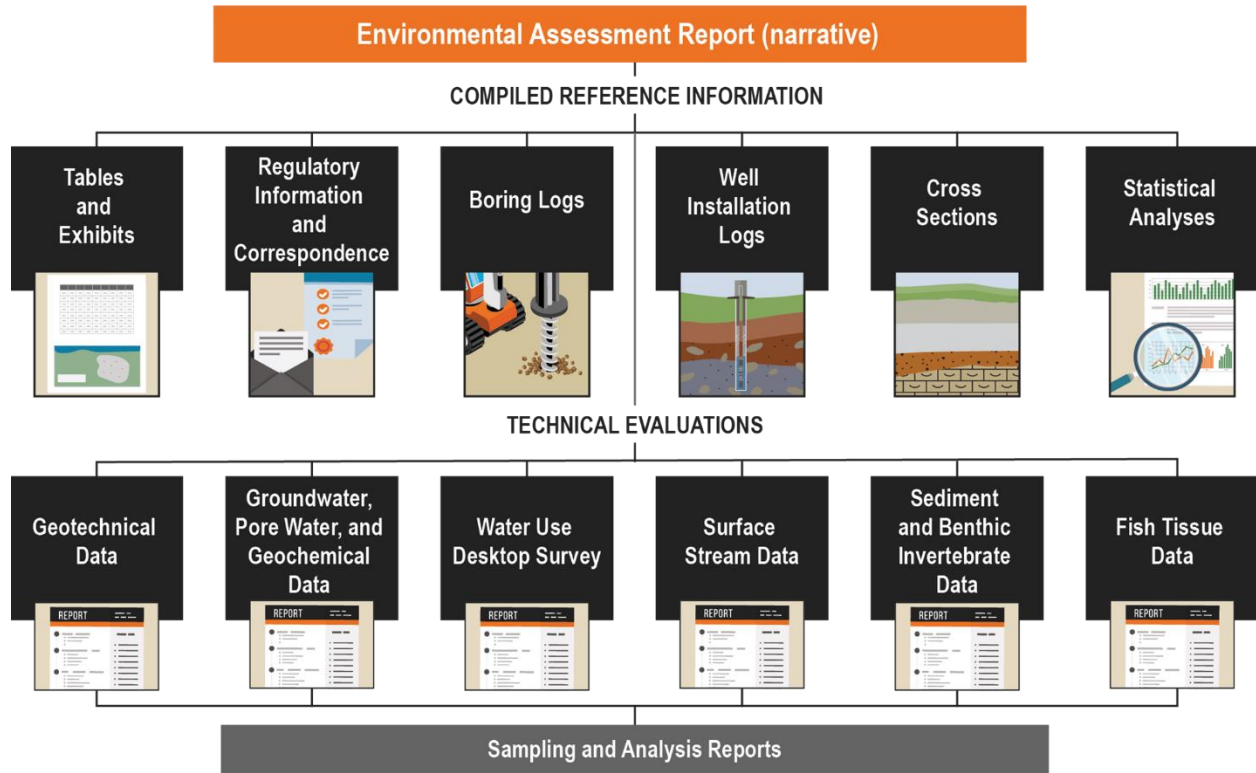


**Introduction**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# 1.5 Report Organization

This EAR is based on EI data and results from other ongoing environmental programs obtained for the JSF Plant CCR management units through 2021. To facilitate discussion of the interrelationships of the data collected during the EI, the EAR presents evaluation of findings organized in the following principal investigation components: background soils, CCR materials, hydrogeology, seeps, and ecology. Chapters 3 through 8 herein provide a summary of each investigation's scope and presents the evaluation of those data, along with relevant historical or other environmental program data. The summary of findings presented in Chapters 3 through 8 are supported by detailed technical information and analyses presented in appendices as diagrammed below. Details of technical evaluations and information supporting those evaluations are included in appendices organized by subject matter. Field investigation and sampling activities are provided in SARs associated with each subject matter. The structure of the overall document is provided in the diagram below.



## Introduction

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

This EAR is organized as follows:

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

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

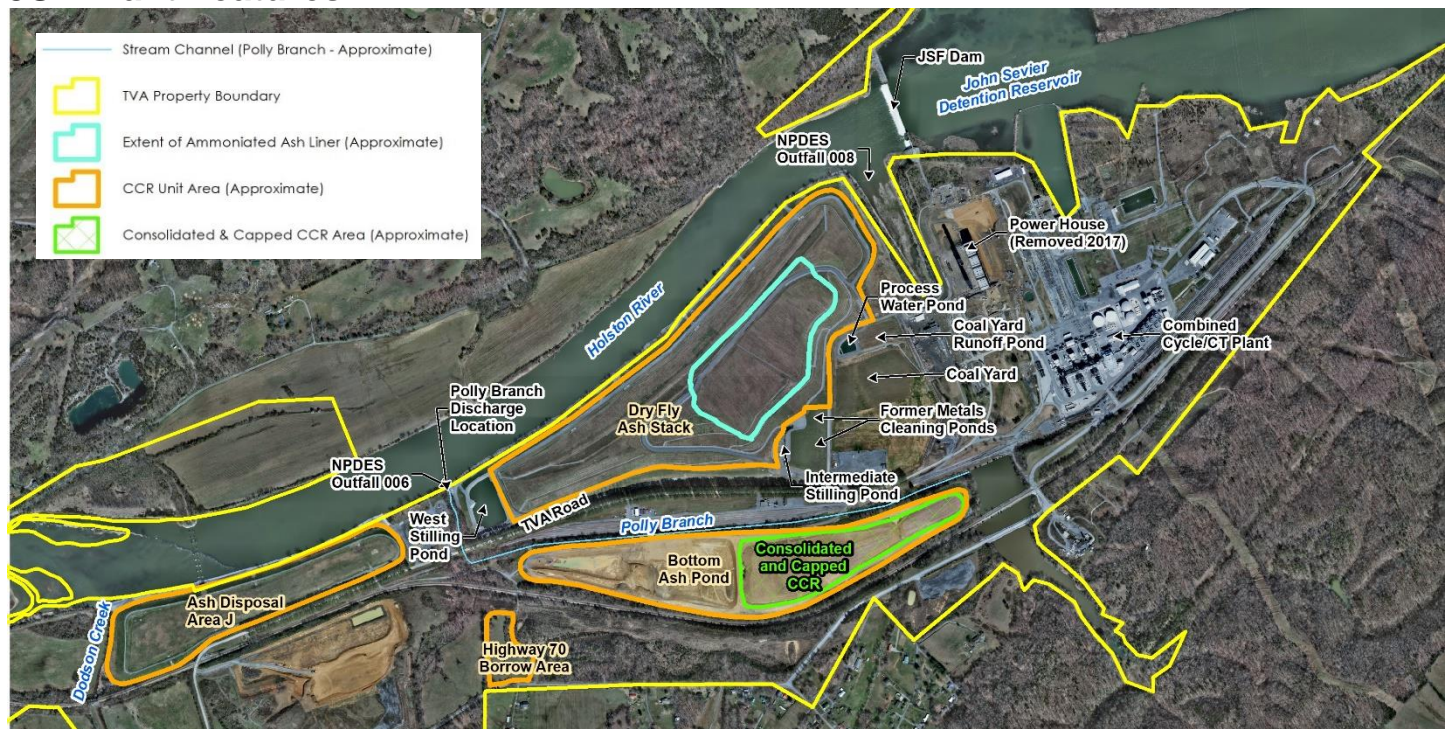
# Chapter 2 Site History and Physical Characteristics

## 2.1 Site Operations

TVA constructed the JSF Plant between 1952 and 1957, commencing power generation in 1955. It is located entirely on TVA-owned property near Rogersville, Tennessee. TVA operated the four coal-fired unit JSF Plant continuously until the units were idled in 2012 and retired by 2014. It generated approximately 704 megawatts of electricity per day. At peak operation, the JSF Plant used an average of 5,700 tons of coal per day, producing about 235,000 tons of fly ash per year and 20,000 tons of bottom ash (TVA 2012a). In 1979, the JSF Plant converted to a dry fly ash system to, in part, increase the marketability of fly ash as a construction material. Approximately 100,000 dry tons of fly ash per year was marketed offsite to the concrete industry (Stantec 2010). In 1999, a bottom ash collection facility was constructed in the eastern part of the Bottom Ash Pond and operated by Appalachian Products for offsite marketing (Stantec 2010).

The JSF Plant has four CCR management units, as shown below and on Exhibit 2-1: the Bottom Ash Pond, the Dry Fly Ash Stack, the Ash Disposal Area J, and the Highway 70 Borrow Area. Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The total area of the CCR management units is approximately 135 acres.

### JSF Plant Features



Drainage collection from the Dry Fly Ash Stack and stormwater flows are conveyed to a non-CCR Process Water Pond for treatment prior to discharging through NPDES permitted Outfall 008 to the Holston River.

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

TVA maintains a detention dam on the Holston River adjacent to the JSF Plant. TVA also operates the John Sevier Combined-Cycle/Combustion Turbine Plant (JCC Plant), a natural gas-fired generating plant.

## 2.2 CCR Management Unit History and Land Use

### 2.2.1 Dry Fly Ash Stack

As shown in Exhibit 2-1, the Dry Fly Ash Stack is located on the south bank of the Holston River. An approximately 17-foot tall, 4,400-foot-long earthen perimeter dike (starter dike) was constructed to form the original ash disposal area, which was in the footprint of the current Dry Fly Ash Stack. TVA constructed the original ash disposal area in the early 1950s for use as a receiving facility for sluiced fly and bottom ash generated during JSF Plant operations. The 17-foot perimeter dike was later raised, bringing the dike elevation from 1,087 to 1,110 feet above mean sea level (ft amsl). The disposal area was subdivided into nine impoundments (Areas A through I) separated by interior divider dikes. The original perimeter dike was constructed of clay, and portions of the raised perimeter dike were constructed using compacted fly ash. This facility was later converted to a dry fly ash stacking facility and permitted in 1998 by TDEC as a Class II Landfill (IDL 37-0097). In 1984, a portion of the western end of the Dry Fly Ash Stack was turned into a 0.9-acre pond that was initially referred to as the West Stilling Pond but is currently known as the West Stormwater Pond. Stormwater collected at the West Stormwater Pond is discharged through NPDES Outfall 006.

In 1973, a slope failure occurred along a 200- to 300-foot-long segment of the raised, north perimeter dike. An evaluation concluded that a combination of overly steep outslopes, use of poorly compacted ash in the raised dike, saturated outslopes (due to elevated river levels), and elevated operating pool levels contributed to the dike failure (TVA 1973). An estimated 125,000 cubic yards of ash were released into the Holston River as a result of the spring flood (TVA 1973). The slope failure was repaired by flattening the dike outslopes, reconstructing the raised dike using compacted clay fill, and installing scour protection along the starter dike outslope. The failure also resulted in operational improvements including lowering operating pool levels and ceasing sluicing and converting the unit to a dry fly ash stacking facility (TVA 1974b). Dike slides were also observed in 1989, 1990, 1995, and 1999 along the northern and northwestern Dry Fly Ash Stack dike. These slides were noted as repaired in subsequent TVA facility inspection reports. Additional slope flattening projects were conducted in 2002-2004 and 2011-2012. The 2002-2004 project included the installation of a clay veneer to cover the perimeter dike, including areas constructed from compacted fly ash, and the 2011-2012 project included a toe drain system installation near the west end of the north dike (Stantec 2012).

In 2001-2002, TVA installed an extraction and collection system at the Dry Fly Ash Stack. Additional improvements were later installed including collection trench extension, three new pump stations, and associated discharge lines (TVA 2013a). The collection system discharged to the Coal Yard Pond initially and was later transitioned to the process water basin after the Coal Yard Pond was closed in 2015.

In 2008 and 2009, as part of the landfill operations, a geomembrane and leachate collection system were permitted and installed over 25 acres of the Dry Fly Ash Stack for ammoniated ash generated by plant operations. The liner system was designed to separate the underlying, existing stacked ash from the new ammoniated ash (TVA 2013a). The approximate outline of the ammoniated ash liner limit is shown on Exhibit 2-2. The top of the ammoniated ash liner varies in elevation between 1,140 and 1,150 feet. The ground surface for this area of the Dry Fly Ash Stack is at approximate elevation 1,180 feet.

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

The Dry Fly Ash Stack stopped receiving CCR material by the end of calendar year 2012 and was closed in accordance with TDEC requirements for Class II Landfills. The closure was approved by TDEC. This closure was performed in three phases and included capping with a 40-millimeter (mil) Linear Low Density Polyethylene (LLPDE) geomembrane and geocomposite drainage layer covered by 18 inches of protective soil and 6 inches of vegetative supportive soil. The soil and geosynthetic cap also include erosion and sediment control features and stormwater collection systems (HDR 2016). Approval for Phases I, II, and III of closure from TDEC were received in October 2014 (TDEC 2014a), April 2015 (TDEC 2015a), and April 2016 (TDEC 2016), respectively. Final closure of the Dry Fly Ash Stack was completed in Spring 2016.

### 2.2.2 Ash Disposal Area J

As shown in Exhibit 2-1, Ash Disposal Area J is located on the south bank of the Holston River. It was constructed with a perimeter soil dike to be used as a fly ash settlement pond. Design and construction records along with exploratory borings demonstrate that Ash Disposal Area J perimeter dikes are constructed of clay and do not contain CCR material. It initially received sluiced fly ash beginning in late 1982. During initial operations, ash was sluiced to the east side of Ash Disposal Area J. The west side acted as a stilling pond and contained two concrete riser structures which discharged to the Holston River.

In 1985, the west side exterior dike was flattened and rip-rap was placed along 700 feet of the Holston River to protect the dike toe on the western end of the north dike slope. These alterations were in response to a portion of the dike toe sloughing into the river, and a resulting discharge of ash-laden water eroding the spillway outlet. This incident occurred during skimmer and weir removal in 1984. In 1988, Ash Disposal Area J was decanted and the area was converted to a dry stacking facility. In 1990 after the disposal area was inactivated and ceased receiving CCR material directly from the plant, ash reclaimed from the Bottom Ash Pond was placed in Ash Disposal Area J.

The Ash Disposal Area J closure plan was prepared in 1993. As part of closure, approximately 50,000 cubic yards of fly ash was used in contouring the facility to final grade. Ash Disposal Area J was then capped with 12 inches of compacted soil and an additional 12 inches of soil to support vegetation (Tribble & Richardson and Law Engineering 1993). TDEC approved the closure of Ash Disposal Area J in 1997 (TDEC 1997a).

Drainage improvements were made at the Ash Disposal Area J in 2021. Improvements included the repair of pipe inlets and general maintenance grading to improve site drainage. This work also included the installation of a concrete lined channel along the southern toe of Ash Disposal Area J. The Final CQA Report was approved by TDEC on August 31, 2021 (TDEC 2021).

### 2.2.3 Bottom Ash Pond

The Bottom Ash Pond is located south of the Dry Fly Ash Stack (see Exhibit 2-1) and received sluiced bottom ash from 1979 until the JSF Plant was idled in 2012. The Bottom Ash Pond was closed in 2017. The Bottom Ash Pond covers approximately 42 acres defined by an 8,600-ft long earthen dike approximately 20 feet high. Design and construction records along with exploratory borings demonstrate that the Bottom Ash Pond perimeter dikes are constructed of clay and do not contain CCR material. During the JSF Plant operation, the pond received sluiced bottom ash, intermittent fly ash sluice water, effluent from the Coal Yard Pond and Former Metals Cleaning Ponds (previously Chemical Treatment Ponds), and process flows from the JSF Plant (Exhibit 2-2). Flows entered the Bottom Ash Pond in the northeast corner and continued west to the Intermediate Pond and then into the Stilling Pond formerly located at the west end of the

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Bottom Ash Pond (not shown on Exhibit 2-1). The discharge from the Stilling Pond flowed into Polly Branch which outlets into the Holston River at NPDES permitted Outfall 006.

In 1987, sluicing to the Bottom Ash Pond stopped and the ash was disposed offsite; sluicing resumed sometime between 1990 and 1993. In 1999, a bottom ash collection facility was constructed in the eastern part of the Bottom Ash Pond. This facility was operated by Appalachian Products for offsite marketing (Stantec 2010).

Preliminary Bottom Ash Pond closure plans were submitted to TDEC on July 15, 2015 (Stantec 2015b). As part of closure, decanting of the western portion of the Bottom Ash Pond (Intermediate and Stilling Ponds) was completed and the ash was removed, conditioned, and compacted in the eastern portion. After ash removal, a clay containment berm was constructed between the eastern and western sides, borrow soil was excavated from the perimeter dike for use as structural fill in the western portion to achieve final grade and promote positive drainage, and CCR material in the eastern half was capped (Exhibit 2-1). The engineered cap system contains (from bottom to top) a 40-mil LLDPE geomembrane and geocomposite drainage media, an 18-inch cover soil layer, and a six-inch vegetated cover (Stantec 2016b). Closure of the Bottom Ash Pond was completed in 2017 in accordance with CCR Rule requirements and notification of closure completion was provided to TDEC in December 2017 (Stantec 2017).

### 2.2.4 Highway 70 Borrow Area

The Highway 70 Borrow Area, located in the central portion of the JSF Plant adjacent to Highway 70 (Exhibit 2-1), was initially a soil borrow area for dike construction at the Dry Fly Ash Stack. The extent of the borrow area was defined by the extent of the excavation; no dikes were constructed around this area. In 1984, approximately 120,000 cubic yards of CCR material was removed from the Bottom Ash Pond and placed within a 300 by 600-foot portion of the borrow area excavation. The Highway 70 Borrow Area stopped receiving CCR material in 1985. A closure plan for the area was prepared in 1995 (Tribble & Richardson and Law Engineering 1995). The area was covered with a soil cap and the cap was vegetated. TDEC approved the closure of Highway 70 Borrow Area in 1997 (TDEC 1997b).

### 2.2.5 Other Plant Operations

As of October 19, 2015, the effective date of the CCR Rule, the Dry Fly Ash Stack, Ash Disposal Area J, and Highway 70 Borrow Area were closed or otherwise maintained and are not subject to the CCR Rule. However, the Bottom Ash Pond is subject to the CCR Rule as an inactive surface impoundment. This is the only unit at JSF which is subject to the CCR Rule.

In addition to the four CCR management units, historical JSF Plant operations included several non-CCR process water ponds, stormwater runoff ponds, and metal ponds (Exhibit 2-2). The ponds included the Coal Yard Pond which was later replaced by the Process Water Pond (PWP), Former Metals Cleaning Ponds, West Stilling Pond (also known as the West Stormwater Pond), Intermediate Stilling Pond, and leachate pond (Exhibit 2-2).

The Coal Yard Pond was a 2.5-acre pond located north of the coal yard and was active from the beginning of JSF Plant operations until 2015. The pond's primary purpose was to collect stormwater runoff from the coal yard and plant parking areas. During its operational history, the Coal Yard Pond also collected discharges including Dry Fly Ash Stack leachate, plant sanitary waste, red water (i.e., high in iron oxides), and water discharge from the Dry Fly Ash Stack toe drainage system. Coal Yard Pond effluent was pumped to the Bottom Ash Pond and ultimately discharged through NPDES Outfall 006. As part of Coal Yard Pond closure, the operational pool level was lowered, incoming process and stormwater flows were managed, sediment was removed from the bottom and side walls and transported to the Dry Fly Ash Stack between

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

January and May 2015, and associated structures and equipment (e.g., pumps, pipes) were removed. After closure activities were complete, the Coal Yard Pond was backfilled with soil from an onsite borrow area and graded (Stantec 2016a). Notification of closure completion was provided to TDEC in February 2016.

In 2015, to manage ongoing JSF Plant non-CCR process water flows after closure of the Coal Yard Pond, a lined settling pond (the Process Water Pond [PWP]) was constructed at the former Coal Yard Pond. This pond collects Dry Fly Ash Stack leachate and toe drain flows. Wastewaters collected at the PWP are discharged through NPDES Outfall 008.

The Former Metals Cleaning Ponds (total 3.6 acres) primarily collected JSF Plant boiler cleaning water and air pre-heater wash water from the late 1970s until idling of JSF Plant operations in 2012. These two ponds were located adjacent to one another in the southeastern corner of the Dry Fly Ash Stack area. The Former Metals Cleaning Ponds included an Iron Pond which was located south of a Copper Pond, and the two were separated by an earthen dike. The ponds were lined with 18 inches of rip-rap and six inches of filter material. Collected wastewater was treated, discharged to the Bottom Ash Pond via NPDES Internal Monitoring Point 005, and ultimately discharged to the Holston River via Outfall 006 under NPDES Permit No. TN0005436. The last process discharge to the Former Metals Cleaning Ponds occurred in 1997; however, additional flows including ammoniated ash leachate were discharged to the Iron Pond in 2011 (Stantec 2014a, b). Closure activities were completed in 2015 and included decanting the pond, sediment stabilization with lime kiln dust, demolition of associated pipes, structures, and equipment, and pond capping. The pond cap was comprised of a 40-mil LLDPE geomembrane, geocomposite drainage layer, 18-inch cover soil, and six-inch vegetative cover (Stantec 2015a).

Area G of the Dry Fly Ash Stack began receiving sluiced fly ash in 1976 until it was discontinued in 1979. In 1984, the west portion of Area G was turned into a 0.9-acre stilling pond for the Dry Fly Ash Stack and became known as the West Stilling Pond. During this time, the West Stilling Pond also received stormwater runoff from a drainage along the north side of the Dry Fly Ash Stack and later, the Intermediate Stilling Pond (described below) via a channel parallel to TVA Road. In 2014, the West Stilling Pond was decanted, dredged, and converted to a stormwater runoff collection pond known as the West Stormwater Pond.

The Intermediate Stilling Pond, also known as the Sediment Pond East, was a 1.2-acre pond located west of the Former Metals Cleaning Ponds. The pond was brought online in 1997 to receive stormwater runoff from the Dry Fly Ash Stack. The pond shared dikes with the Former Metals Cleaning Ponds to the east, with the Dry Fly Ash Stack toe forming the northern and western banks. Closure activities were completed in 2015.

In 2009, a leachate pond was constructed to collect discharge from the Dry Fly Ash Stack leachate collection system. The leachate pond discharged to the Coal Yard Pond and later PWP. In 2015, the leachate pond was filled with large aggregate and covered with a geomembrane and soil cap.

## 2.3 Ownership and Surrounding Land Use

The JSF Plant is owned and operated by TVA, a corporate agency of the United States. It is located entirely on the TVA-owned property near Rogersville, Tennessee. It was constructed along the southern bank of the Holston River, which ultimately flows into the Cherokee Reservoir (Exhibit 2-1).

Land use surrounding the JSF Plant is primarily agriculture and rural residential areas.

Public water is provided by the Rogersville and Persia Utility Districts. The Persia Utility District water is sourced from a quarry adjacent to the Holston River near River Mile Marker 102 which is 1.25 miles downstream of the JSF Plant. The

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Rogersville Utility District water is sourced primarily from Big Creek at a water withdrawal location approximately two miles north and upstream of the JSF Plant. Additional information about these public water supplies is provided in Appendix H.9.

## 2.4 Physical Characteristics

### 2.4.1 Regional and Site Physiography

The JSF Plant is located within the Valley and Ridge physiographic province of the Appalachian Highlands physiographic division (United States Geological Survey [USGS] 1946). The Valley and Ridge province includes a series of long, linear, alternating ridges and parallel lowland valleys that trend in a northeast to southwest direction (USEPA 2010) and is composed of three sections: Tennessee, Middle, and Hudson Valley (USGS 2020). The JSF Plant is located within the northern portion of the Tennessee section (USGS 1946), where the ridges and valleys are generally more elevated than in the southern part of the province (USEPA 2010).

Major drainages in northeast Tennessee are the Clinch and French Broad Rivers (tributaries of the Tennessee River), and the southwest flowing Holston River. Exhibits 2-3a and 2-3b overlay the footprints of CCR management units on the 1935 and 1940 USGS topographic maps, respectively, for the area where the JSF Plant is located. The figure below provides a current aerial photograph overlain on the topography of and near the JSF Plant. The plant is located in a topographically low area between higher elevation ridges to the south and the Holston River on the north. The JSF Plant pre-construction elevation ranged from approximately 1,060 to 1,150 feet above mean sea level (ft amsl).

### JSF Physiographic Features



← Typical surface stream flow direction



## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 2.4.2 Regional Geology, Hydrogeology and Surface Water Hydrology

Regionally, the Valley and Ridge province is comprised of a series of northeast trending folded and faulted lithology composed of Paleozoic sedimentary rocks (USGS 1995) that form the alternating valleys and ridges. Compressive forces from the southeast have caused the rocks to yield first by folding and subsequently by repeated breaking along a series of thrust faults (USGS 1995). In eastern Tennessee, the faults are closely spaced and generally responsible for the present distribution of the rocks. Following the folding and faulting, erosion produced the sequence of ridges and valleys on the present land surface (USGS 1995). Soluble carbonate rocks and more easily eroded shales underlie the valleys in the province, and more erosion-resistant siltstone, sandstone and some cherty dolomites underlie the ridges (USGS 1995).

#### 2.4.2.1 Geology

Locally, the JSF Plant sits on the northwest limb of a broad syncline that is associated with the Bays Mountain Synclinorium (i.e., an elongated syncline with its strata further folded into anticlines and synclines) (Law Engineering and Environmental Services [Law] 1994). Onsite geologic mapping indicates that the JSF Plant is underlain by Ordovician age bedrock of the Sevier shale formation (Rodgers 1953). The Sevier shale is primarily bluish-gray, silty to sandy calcareous shale and may contain layers or lenses of limestone and siltstone (Law 1999). Unconsolidated deposits onsite overlay the bedrock and consist of artificial fill, and a mixture of native alluvium deposited by the Holston River. Beneath the artificial fill and alluvium are residual soils derived from the decomposition of the underlying bedrock (Law 1994). Also, there is a mapped fault located north of the Holston River. A map showing the bedrock geologic units for the JSF Plant is provided on Exhibit 2-4.

#### 2.4.2.2 Surface Water Hydrology

The most prominent regional surface water drainage feature is the southwest-flowing Holston River (Exhibit 1-1). Prior to the JSF Plant construction, six historical stream channels existed within the footprint of the plant, as shown on the 1935 USGS Surgoinsville Quadrangle topographic map (USGS 1935; Exhibit 2-3a). The six historical streams (four un-named, Polly Branch and Dodson Creek) flowed north where they joined the Holston River along its southern bank. The 1940 USGS topographic map (USGS 1940; Exhibit 2-3b) only shows three of the historical stream channels (one un-named, Polly Branch and Dodson Creek) within the footprint of the current JSF Plant. A portion of the 1940 USGS map is presented in Exhibit 2-5 showing the JSF Plant footprint in relation to the historical stream channels.

The northern boundary of the JSF Plant is formed by the John Sevier Detention Reservoir and the Holston River. The John Sevier Detention Reservoir is an impoundment within the Holston River located along the eastern part of the JSF Plant. A concrete gravity overflow detention dam is located along the northern boundary of the JSF Plant and separates the John Sevier Detention Reservoir to the east from the Holston River downgradient of the dam to the west (see Exhibit 2-1). Dodson Creek flows along the western edge of the TVA property and joins the Holston River west of Ash Disposal Area J as shown on Exhibit 2-5. Polly Branch originally flowed north through the Dry Fly Ash Stack area to the Holston River but was rerouted as part of the early Dry Fly Ash Stack construction to flow along the north side of the Bottom Ash Pond before entering the Holston River west of the Dry Fly Ash Stack.

#### 2.4.2.3 Regional Hydrogeology

The Valley and Ridge province is underlain by carbonate rock aquifers in Cambrian, Ordovician, and Mississippian age rocks. In Tennessee, these aquifers underlie more than one-half of the province and are typically present in valleys and

## Site History and Physical Characteristics

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

rarely present on the broad, dissected ridges. The bedrock is covered by alluvium or residuum. The alluvium and residuum can store large quantities of water that subsequently percolate slowly downward to recharge the bedrock aquifers (Law 1994).

Groundwater in the Valley and Ridge aquifers primarily is stored in and moves through fractures, bedding planes, and solution openings in the bedrock. Groundwater movement in the province in eastern Tennessee is localized in part by the repeating lithology created by faulting and in part by repeating valleys due to erosion of less resistant rocks by surface streams. Faulting formed a repeating sequence of permeable and less permeable hydrostratigraphic units. The repeating sequence of hydrostratigraphic units, along with the resulting differential erosion of less resistant rocks by surface streams, divided the area into a series of adjacent, isolated, shallow groundwater flow systems. Within these local flow systems, most of the groundwater movement takes place within 300 feet of land surface. The water moves from the ridges toward the valleys. The majority of the groundwater moves to local springs or streams that flow parallel to the long axes of the valleys. A summary of the hydrogeological characterization of the JSF Plant in the vicinity of the CCR management units is presented in Chapter 5. More detailed discussion of the uppermost aquifer beneath the CCR management units is provided in Appendix H.1.

### 2.4.3 Local Climate

Locally near the JSF Plant, the average monthly high temperature at weather station USC00407884, Rogersville, Tennessee (National Oceanic & Atmospheric Administration [NOAA] 2020) located approximately three miles northwest of the JSF Plant, ranges between 34 degrees Fahrenheit (°F) in January to 75°F in July. Daily temperature extremes reach as high as 85°F in summer and as low as 25°F in winter. Average annual precipitation at this location is 44.7 inches, with July being the wettest month, averaging 4.57 inches, and October being the driest month, averaging 2.57 inches.

### 2.4.4 Cultural and Historical Resources

TVA, in consultation with the Tennessee State Historic Preservation Officer, determined that the JSF Plant was eligible for inclusion in the National Register of Historic Places for its significance in electrical development following World War II, and as a representative example of International Style Architecture (TVA 2010 and 2014). Based on this determination in 2013, TVA and the State Historic Preservation Officer entered into a memorandum of agreement that addressed measures for the avoidance, minimization, and mitigation of adverse effects from decommissioning of the JSF Plant (TVA 2014). As stipulated by the memorandum of agreement, TVA took the following steps to mitigate any adverse effects: (1) preparing documentation required for the Historic American Engineering Records and submitting the documentation to the National Park Service (NPS) for review; and (2) installing interpretive panels on TVA property at a location accessible to the public (TVA 2014). TVA submitted the final Historic American Engineering Records documentation to the NPS in June 2014 (TVA 2014).

Additionally, TVA identified a historical Native American fish weir located on the Holston River within the TDEC Order EI area. Due to the presence of the resource, sampling for the EI was not performed in the immediate area of the fish weir to reduce the risk of disturbance to the structure (TVA 2018).

TVA conducted environmental reviews during the planning phase of the EI to comply with the National Environmental Policy Act (NEPA). These reviews included an assessment through the NEPA categorical exclusion process of whether proposed activities, such as drilling soil borings and installing monitoring wells, would impact cultural and historical resources, natural resources, parks, recreation or refuge lands, wilderness areas, natural landmarks, wetlands and

**Site History and Physical Characteristics**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

floodplains, and other ecologically significant or critical areas No issues were identified during this process. Therefore, additional measures to minimize or avoid adverse environmental impacts were not needed.

## Background Soil Investigation

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 3 Background Soil Investigation

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

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

## 3.1 Previous Studies and Assessments

As part of the development of the EIP, historical background soil data were reviewed to evaluate the need for additional data. In October 2015, Stantec conducted site activities to install two potential background monitoring wells, JSF-101 and JSF-102, and collect two composite soil samples from each of the screened intervals for analytical testing of naturally occurring metals and other constituents. The analytical suite included most CCR Parameters; however, sulfate and radium were not included because the soil sample analysis predated the defined objectives of the EI. These historical data were reviewed in conjunction with the background soils data collected for the EI described in Chapter 3.4 below. The well installation and soil sampling activities are further detailed in the *Geotechnical Field Services for Well Installations and Closure* report dated May 4, 2016.

## 3.2 TDEC Order Investigation Activities

The objective of the TDEC Order background soil investigation was to characterize background soils on TVA property near the JSF Plant CCR management units by sampling locations where naturally occurring, undisturbed, native soils are present and unaffected by CCR material. A total of 74 samples were collected from 15 background soil borings, and from within the screened interval of two background well boring locations. For the background soil borings, the sampling team typically collected approximately two-foot grab samples from the mid-point of each five-foot soil run based on recovery. These sampling locations are depicted on Exhibit 3-1.

Background soil borings were advanced and sampled using a direct push technology rig and background well borings were advanced and sampled using a hollow stem auger drill rig. The average depth of the borings was approximately 17 feet below ground surface. Samples were analyzed for CCR Parameters. Surficial soil samples were collected from each background soil boring location and analyzed for the presence of ash (percent [%] ash) by polarized light microscopy (PLM) to evaluate the presence or absence of CCR material. Soil samples were also tested for pH in the field.

## Background Soil Investigation

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 3.3 Lithology

Boring logs for the background soil borings and background monitoring well borings are provided in Appendix B.1. Review of the Geologic Map of the Rodgers, Tennessee, 1953, indicated that the borings and monitoring wells were installed in three different geologic units. These units and the associated borings are summarized in Table 3-1.

### 3.4 Background Soil Investigation Results Summary

Field and lithologic data were reviewed for each EI boring location to evaluate whether collected samples accurately represent unsaturated background conditions. Four samples were excluded from the statistical evaluation because they were collected from a saturated interval and four samples were excluded because they were collected from non-native materials. Additionally, soil samples collected at two soil boring locations as part of the previous 2015 study were excluded from the evaluation because these samples had been collected from saturated intervals.

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

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

### 3.5 Rock Outcrop Survey

As a subtask of the background soil investigation, a rock outcrop survey was conducted to evaluate the rock types within the vicinity of the JSF Plant as potential sources of CCR constituents that may be present in the soil sampled during the background soil investigation. Seven different areas were chosen based on their locations in relation to the JSF Plant. Four were located on the JSF Plant property (Areas 02, 03, 06, and 07) and three were located on the north side of the Holston River (Areas 01, 04, and 05). Rock samples were collected from Areas 01, 02, 05, 06, and 07, whereas no samples were collected from Areas 03 and 04 due to the lack of outcrop exposure. The locations of the rock outcrop survey areas are depicted in Exhibit 3-2. Because significant mineralization was not visible on the rock samples collected during the rock outcrop survey, no samples were submitted for analysis. Details of the rock outcrop survey are presented in the *Background Soil Sampling Investigation Sampling and Analysis Report* in Appendix F.1.

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 4 CCR Material Investigations

To evaluate the extent, structural stability, characteristics, and quantities of CCR materials in the management units, TVA reviewed information from historical studies and performed investigations as part of the EI. EI field activities were performed in general accordance with the following documents: *Exploratory Drilling (EXD) SAP and Addendum to EXD SAP* (Stantec 2018c, Stantec 2020), *CCR Material Characteristics SAP* (Stantec 2018d), *Material Quantity SAP* (Stantec 2018e), and the *QAPP* (EnvStds 2018a), including TVA- and TDEC-approved programmatic and project-specific changes that were made after approval of the EIP. Field work included drilling 31 borings, installing 11 piezometers and 10 temporary wells, collecting 97 CCR material samples and seven pore water samples, and performing downhole geophysics.

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

## 4.1 Geotechnical Investigation

The purpose of the geotechnical investigation component of the EI was to further characterize and evaluate subsurface conditions for the four CCR management units at the JSF Plant: the Ash Disposal Area J, Bottom Ash Pond, Dry Fly Ash Stack, and Highway 70 Borrow Area. For this investigation, TVA reviewed information from previous representative studies and assessments, completed an exploratory drilling field program, and conducted evaluations for slope stability, structural integrity, and structural stability (bedrock).

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

### 4.1.1 Exploratory Drilling

#### 4.1.1.1 Previous Representative Studies and Assessments

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

#### 4.1.1.2 TDEC Order Investigation Activities

EXD field work was conducted in two phases (Phase 1 and Phase 2) and consisted of four primary activities – drilling and sampling, cross-hole seismic testing, installing temporary wells, and installing piezometers. The primary objective of the Phase 1 EXD was to perform borings and install temporary wells to further characterize subsurface conditions at the Ash Disposal Area J, Bottom Ash Pond, Dry Fly Ash Stack, and Highway 70 Borrow Area. The primary objective of the Phase

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

2 EXD was to perform borings, cross-hole seismic testing, and install piezometers to further characterize subsurface conditions at the Ash Disposal Area J, Dry Fly Ash Stack, and Highway 70 Borrow Area.

Boring and cone penetration testing (CPT) layouts are shown on Exhibits 4-1 through 4-5. For additional details on the EXD activities, refer to Appendices G.1 and G.2 (*Technical Evaluation of Geotechnical Data* and the *JSF EXD SAR*, respectively).

### 4.1.1.3 Results and Discussion

At each boring location at the Ash Disposal Area J, the uppermost foundation soil was predominantly lean to fat clay, with single occurrences of clayey gravel and silty gravel. At each boring location at the Bottom Ash Pond, the uppermost foundation soil was single occurrences of lean clay and silt. At each boring location at the Dry Fly Ash Stack, the uppermost foundation soil was predominantly lean to fat clay, with two occurrences of silt and a single occurrence of organic silt. At each boring location at the Highway 70 Borrow Area, the uppermost foundation soil was predominantly lean clay, with two occurrences of CCR material overlying shale bedrock. This is generally consistent with historical borings across the JSF Plant CCR management units.

At the Dry Fly Ash Stack, two shallower temporary wells were planned to be screened in ammoniated ash, above the Phase I and II liner system installed in a portion of the Dry Fly Ash Stack. The purpose was to allow for CCR pore water sampling within the ammoniated ash. However, upon reaching the planned termination criteria, water levels in these borings were found to have insufficient depth of water to facilitate CCR pore water sampling. Therefore, temporary wells were not installed in these two borings. The lack of sufficient pore water in these two borings was not unexpected, given that to reduce the risk of penetrating the liner, drilling was terminated approximately 10 feet above the as-built liner elevation at the boring locations.

CPT soundings were advanced along the perimeter (two segments) of the Dry Fly Ash Stack and along the perimeter (two segments) of the Bottom Ash Pond. These CPTs were performed to better characterize the uppermost foundation soils in the immediate vicinity of the mapped, pre-construction stream channels. The CPT data were correlated to existing nearby boring logs to differentiate relatively sandy (i.e., more pervious) foundation soils, if present. In each of the four segments of closely spaced CPTs, the stream crossings targeted by TVA were successfully explored. Based on the CPT data and correlation to nearby borings, no significant preferential seepage pathways were identified beneath the perimeter dike systems.

### 4.1.2 Slope Stability

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

- Static, long-term (i.e., normal operation conditions) global stability
- Static, long-term veneer (i.e., final cover) stability
- Seismic, pseudostatic global stability
- Seismic, pseudostatic veneer stability
- Seismic, post-earthquake global stability (includes a preceding liquefaction triggering assessment).

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

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

- 1) the Dry Fly Ash Stack static global and static veneer slope stability analyses for the current, closed geometry
- 2) the Bottom Ash Pond static global slope stability analyses for the current, closed geometry.

For the JSF Plant, the Stability SAP was necessary to address:

- 1) the Dry Fly Ash Stack seismic global and seismic veneer slope stability analyses for the current, closed geometry
- 2) the Bottom Ash Pond static veneer, seismic global, and seismic veneer slope stability analyses for the current, closed geometry
- 3) the Ash Disposal Area J static and seismic slope stability analyses for the current, closed geometry
- 4) the Highway 70 Borrow Area static and seismic slope stability analyses for the current, closed geometry.

### 4.1.2.1 Results and Discussion

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

### 4.1.3 Structural Integrity

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

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

#### 4.1.3.1 Results and Discussion

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



## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 4.1.4 Structural Stability (Bedrock)

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

For the JSF Plant CCR management units, the EIP, including the *Evaluation of Existing Geotechnical Data* (EIP Appendix K), summarized historical reports that would be leveraged to address structural stability of the bedrock. In addition, the *Hydrogeological Investigation SAR* (Appendix H.2) includes new information that, although not specifically required under the TDEC Order program to address this subject, is of interest for this subject.

#### 4.1.4.1 Results and Discussion

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

## 4.2 CCR Material Characteristics

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

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

### 4.2.1 Previous Studies and Assessments

Historical studies conducted by TVA did not include collecting CCR management unit pore water samples for laboratory analysis. Therefore, a more comprehensive investigation was conducted as part of the EI which included collection and analyses of pore water, as summarized in Chapter 4.2.2.

### 4.2.2 TDEC Order Investigation Activities

The objective of the TDEC Order CCR material characteristics investigation was to characterize the leachability of CCR Parameters by collecting pore water and CCR material samples (saturated and unsaturated) from within four CCR management units: the Dry Fly Ash Stack, the Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area.

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

97 CCR material samples were collected at varying depths from 12 boring locations. These were analyzed for CCR Parameters (defined in Chapter 1.3) and additional parameters of interest for the CCR material characteristics investigation. The additional parameters of interest and analyses included total organic carbon (TOC), iron, and manganese. TVA also performed Synthetic Precipitation Leaching Procedure (SPLP) analyses for metals and radiological parameters. During sampling, CCR material present at each boring was visually characterized using the Unified Soil Classification System, which classifies material by grain size distribution followed by the material's textural properties.

Following temporary well installation and development, pore water levels were measured prior to sampling, hydraulic conductivity testing was performed, and pore water samples were collected from each well. These sampling locations are depicted on Exhibit 4-6.

### 4.2.3 CCR Material Characteristics Evaluation

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

#### 4.2.3.1 Total Metals and SPLP Evaluation Results

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

TVA also compared pore water results to SPLP results for the CCR material to evaluate whether SPLP could be used as a predictor of pore water concentrations. CCR constituent concentrations were generally higher in pore water samples than in SPLP results. These findings indicate that SPLP analysis of CCR material is not a good predictor of pore water concentrations. The results indicated that direct measurement of pore water concentrations is the most accurate method of characterizing potential leachability of CCR constituents from CCR material. Additional discussion of the evaluations is provided in Appendices E.2 and G.1.

#### 4.2.3.2 Pore Water Phreatic Surface

TVA measured pore water levels in the temporary wells on a monthly frequency for six months. In addition, the wells were gauged during bi-monthly EI groundwater sampling events. This information was combined with available information from other instruments to develop phreatic surface maps for each CCR management unit. The phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be saturated with pore water. The use of the term "saturated" or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Saturated CCR material can have a range of moisture contents based on the characteristics of the material. A representative map developed for gauging information from EI Groundwater Sampling Event #4 (February 2020) is shown in Exhibit 4-7. Table 4-1 provides a summary of the pore water gauging data from the six consecutive pore water gauging events, including EI Groundwater Sampling Event #4. Additional data for other gauging events can be found in Appendices H.7 and H.8.

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Each of the CCR management units was closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions. Phreatic surfaces in the Bottom Ash Pond and Dry Fly Ash Stack have generally shown a declining trend since geosynthetic caps were constructed. The downward trend in pore water levels suggests that the caps are performing as expected and have effectively eliminated infiltration into the CCR material. In addition, the phreatic surface in the Ash Disposal Area J would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.

### 4.2.3.3 Pore Water Quality Evaluation

This section provides a summary of the analytical results for pore water samples collected from temporary wells installed as part of the EI and one previously existing manhole (MH-1G). The manhole was not constructed to be a pore water sampling location for laboratory analysis and is not a well with a screen.

Pore water samples were collected during three sampling events. The first sampling event was conducted as part of the EI in February 2020. The second and third sampling events were conducted as part of other investigative activities at the JSF Plant in March/April 2021 and May 2021.

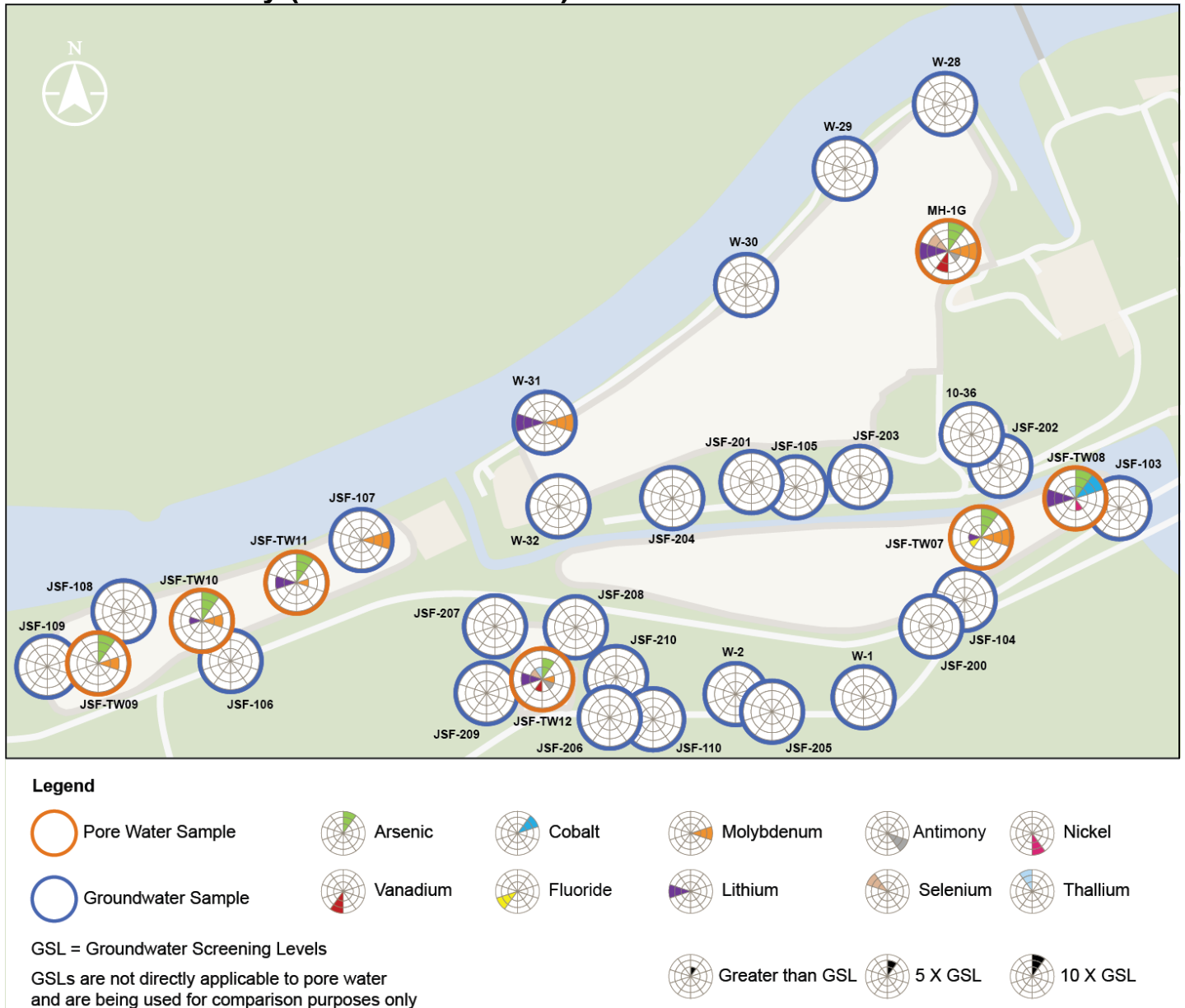
The pore water characterization evaluation is based on a comparison of porewater concentrations to groundwater concentrations and GSLs across the JSF Plant. GSLs are not applicable to pore water. The comparison to GSLs provides a basis to identify CCR constituents that have the potential to be detected in groundwater downgradient of the CCR management units at concentrations above a GSL if pore water were to impact groundwater. Comparison of pore water to GSLs was conducted for constituents listed in Appendix I of TDEC Rule 0400-11-01-.04 (TDEC Appendix I) and Appendix IV of the CCR Rule because these are the constituents that could cause the need for corrective measures to remediate groundwater.

Ten TDEC Appendix I or CCR Rule Appendix IV constituents (antimony, arsenic, cobalt, fluoride, lithium, molybdenum, nickel, selenium, thallium, and vanadium) had reported concentrations in one or more pore water samples above a GSL. Of these, only two constituents (lithium and molybdenum) had statistically significant concentrations in groundwater above a GSL. The figure below provides a summary of reported pore water analytical results and a comparison of them to reported groundwater analytical results. The locations of temporary wells are shown as symbols with an orange outer ring. The colored slices in each symbol indicate CCR constituents detected in pore water above a GSL in each temporary well. The number of colored rings represents the magnitude of the reported concentrations relative to the GSL. The legend on the exhibit provides further explanation of the colors and rings.

**CCR Material Investigations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

**Pore Water Quality (with Groundwater)**



Monitoring wells are represented by symbols with a blue outer ring. The two wells that had statistically significant concentrations above a GSL are represented by colored slices in the symbols. The colors and number of colored rings have the same meanings as for the pore water symbols discussed above. Most constituents detected above a GSL in pore water samples were below the applicable GSLs in groundwater samples. There is a distinct difference between pore water and groundwater quality.

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 4.2.3.4 CCR Material Characteristics Summary

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

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

- The total concentrations of metals in CCR material are not a reliable predictor of the magnitude of the potentially leached concentrations represented by SPLP results, and SPLP analysis was not a good predictor of pore water concentrations. The results indicate that direct measurement of pore water concentrations is the most accurate way of characterizing potential leachability of CCR constituents from CCR material.
- The downward trend in pore water levels suggests that the caps are performing as expected and have effectively eliminated infiltration into the CCR material.
- The phreatic surface in the Ash Disposal Area J would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.
- There is a distinct difference between pore water and groundwater quality.

## 4.3 CCR Material Quantity Assessment

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

### 4.3.1 Previous Studies and Assessments

Previous material quantity assessments were completed by TriAD Environmental Consultants, Inc. (TriAD) of Nashville, Tennessee, as part of their Historical Ash Volume Calculations (TriAD 2017). The Historical Ash Volume Calculations by TriAD were completed for the Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area. The TriAD historical ash volume calculations are provided in Appendix G.6.

### 4.3.2 TDEC Order Investigation Activities

The objectives of the MQA, conducted pursuant to the *Material Quantity SAP*, were to describe CCR management unit geometry, CCR material quantity, phreatic surface elevations, and subsurface conditions for the following CCR management units at the JSF Plant for the units subject to the TDEC Order: Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area (MQA Study Area).

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

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

The three-dimensional models were analyzed using AutoDesk® AutoCAD® Civil 3D surface volumes to estimate CCR material volumes. Pore water level and pore water pressure measurements recorded per the *Material Quantity, CCR Material Characteristics* and *Groundwater Investigation SAPs* and summarized in Table 4-1, were compared to the three-dimensional models to estimate the quantity of CCR below the phreatic surface in the CCR management units. Specifically, pore water level and pore water pressure measurements from Groundwater Investigation Event #3 shown on Exhibit 4-8 were used to estimate the quantity of CCR material below the phreatic surface in the CCR management units.

### 4.3.3 Material Quantity Assessment Results

#### 4.3.3.1 Cross Sections

Cross sections developed using the three-dimensional models are provided in Appendix D. As shown on Exhibits D-1, D-2, and D-3, JSF Section A-A' is a cross section of Ash Disposal Area J, JSF Section B-B' is a cross section of the Dry Fly Ash Stack, JSF Section C-C' is a cross section of the Highway 70 Borrow Area, and JSF Section D-D' is a cross section of the Bottom Ash Pond. These sections profile the CCR management units from the groundline based on 2017 aerial and topographic surveys to below the top of rock surface.

#### 4.3.3.2 CCR Material Limits and Thickness

Exhibits 4-9a through 4-9d show estimated limits and thickness ranges of CCR material within the MQA Study Area. The CCR limits shown on Exhibits 4-9a through 4-9d and the cross sections (Sections A-A', B-B', C-C', and D-D') correspond to the inside crest of the starter dike. Estimated CCR thickness ranges from 0 to 124 feet. Table 4-2 provides the range of estimated CCR material thickness and aerial extent for each CCR management unit.

#### 4.3.3.3 CCR Material Volumes

CCR material volumes summarized in Table 4-2 were estimated using the three-dimensional models and AutoDesk® AutoCAD® Civil 3D volume surfaces. The volumes were also compared to the pore water elevation contours shown on Exhibit 4-8 to estimate the volume of CCR material below the phreatic surface. As explained in Chapter 1.3.1, the phreatic surface is the level below which CCR material is saturated with pore water. The use of the term "saturated" and/or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Saturated CCR material can have a range of moisture contents based on the characteristics of the material.

The total acreage of the CCR limits is approximately 135 acres. The estimated total volume of CCR is approximately 9.9 million cubic yards. Approximately 16% of the estimated total volume of CCR is below the estimated phreatic surface.

Each of the CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions. Phreatic surfaces in the Bottom Ash Pond and Dry Fly Ash Stack have generally shown a declining trend since geosynthetic caps were constructed. In addition, the phreatic surface in the Ash Disposal Area J would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.

#### 4.3.3.4 Comparison to Previous MQA

TriAD previously computed material quantity volumes for the MQA Study Area, as discussed in Chapter 4.3.1. Triad's estimated total aerial extent and volume of CCR were approximately 173 acres and 9.6 million cubic yards, respectively. A

## CCR Material Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

comparison of the two volumetric models indicates that the EI CCR material volume estimate is approximately 36% higher for the Bottom Ash Pond. The EI CCR material volume estimates for the remaining CCR management units were within 0.5% to 12% of the TriAD CCR material volume estimates. These differences are likely because the EI volumetric models incorporated more recent as-built construction surveys of the CCR management units as well as additional data collected during EXD and CCR Material Characteristics activities conducted at the JSF Plant between 2018-2020. In addition, the TriAD volumetric model of the Bottom Ash Pond was completed before CCR was excavated from the footprints of the Intermediate Pond and Stilling Pond and consolidated and capped.

### 4.3.3.5 Secondary Volume Estimates and Verification Method

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

## 4.4 CCR Material Investigations Summary

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

- The global slope stability and the veneer slope stability for each of the four CCR management units meet the established factor of safety criteria for the static and seismic load cases.
- The four CCR management units have adequate structural integrity, and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR materials.
- CCR material and pore water have been characterized as specified in the EIP, and CCR material and phreatic surfaces have been estimated for each of the four CCR management units. CCR material and estimated thickness ranges are depicted in plan view on Exhibits 4-8a through 4-8d and in cross-sections in Appendix D.
- Estimated CCR material volumes and areas for the four CCR management units are provided in Table 4-2. The total area of the CCR material within the CCR management units is approximately 135 acres, and the estimated total volume is approximately 9.9 million cubic yards. Approximately 16% of the estimated total volume of CCR material within the four units is below the estimated phreatic surface which is explained in Section 4.3.3.3. The pore water levels reported herein may not represent steady-state conditions. Phreatic surfaces in the Bottom Ash Pond and Dry Fly Ash Stack have generally shown a declining trend since geosynthetic caps were constructed. In addition, the phreatic surface in the Ash Disposal Area J would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.
- Direct measurement of pore water concentrations is the most accurate way of characterizing potential leachability of CCR constituents from CCR material.
- The downward trend in pore water levels suggests that the geosynthetic caps for the Dry Fly Ash Stack and Bottom Ash Pond are performing as expected and have effectively eliminated infiltration into the CCR material.

**CCR Material Investigations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

- The phreatic surface in the Ash Disposal Area J would be expected to decrease in elevation if modifications to stormwater drainage or to the existing soil cap system were to be implemented.
- There is a distinct difference between pore water and groundwater quality. Generally, pore water concentrations were stable over the sampling period.



## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 5 Hydrogeological Investigations

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

The following sections summarize findings based on evaluation of the information collected from implementation of the EI and data collected under other TDEC permitted landfill and CCR Rule programs at and near the JSF Plant CCR management units. Additional details regarding these investigations and evaluations are provided in Appendices E.3 and H.1 through H.9.

## 5.1 Groundwater and Hydrogeological Investigations

The purpose of the groundwater and hydrogeological investigations was to further characterize and evaluate subsurface conditions in proximity to four CCR management units at the JSF Plant, including the Dry Fly Ash Stack, Bottom Ash Pond, Ash Disposal Area J, and Highway 70 Borrow Area. For this investigation, TVA reviewed information from previous representative studies and assessments, completed field sampling programs, and conducted evaluations related to geology, hydrogeology, and groundwater quality as part of the EI.

### 5.1.1 Previous Studies and Assessments

Exploratory drilling at the JSF Plant began in 1952 to evaluate the suitability for the foundation for a proposed power plant. Since that time, several exploratory drilling and hydrogeological investigations have been conducted. Groundwater monitoring has been underway at the JSF Plant since approximately 1986. Monitoring well networks were previously installed to evaluate groundwater conditions as part of the TDEC post-closure, TDEC permitted landfill and CCR Rule groundwater monitoring programs. Appendix H.1 provides summaries of informative studies related to the hydrogeology of the JSF Plant .

Groundwater data from the TDEC permitted landfill and CCR Rule programs follow quality assurance programs similar to that developed for the TDEC Order. Data from these historical and ongoing groundwater monitoring programs are included in the evaluation summarized below.

### 5.1.2 TDEC Order Investigation Activities

The objectives of the TDEC Order groundwater and hydrogeological investigations were to characterize groundwater quality and evaluate groundwater flow conditions in the vicinity of the JSF Plant CCR management units. Well installation and sample location selection, sample collection methodology, sample analyses, and QA/QC completed for the investigations are provided in the *Hydrogeological Investigation SAR* (Appendix H.2) and the *Groundwater Investigation*

## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

SARs for the six sampling events (Appendices H.3 through H.8). Exhibit 5-1 shows the locations of wells installed as part of the EI.

Two of four background monitoring wells, JSF-106 (upgradient of Ash Disposal Area J) and JSF-110 (upgradient of the Highway 70 Borrow Area), were installed in unconsolidated materials. Background monitoring wells JSF-206 and JSF-210 were installed in bedrock upgradient of the Highway 70 Borrow Area. These background wells were installed to provide groundwater samples that have not been affected by the CCR management units and to be representative of background conditions.

Soil samples were collected from the screened intervals of each of the background well borings for wells completed in unconsolidated materials (JSF-106 and JSF-110) for analysis of CCR Parameters.

Three permanent monitoring wells (JSF-107, JSF-108, and JSF-109) were installed in unconsolidated materials at locations downgradient of Ash Disposal Area J to provide locations to evaluate groundwater flow and quality in these areas. Groundwater was not observed in the unconsolidated materials at the three proposed locations (JSF-111, JSF-112, and JSF-113) downgradient of the Highway 70 Borrow Area; therefore, three bedrock monitoring wells (JSF-207, JSF-208, and JSF-209) were installed to provide downgradient sampling locations for the Highway 70 Borrow Area.

### 5.1.3 Hydrogeological Investigation Results

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

#### 5.1.3.1 Well Construction and Presence of CCR Material

Based on descriptions of encountered materials on a log for a boring drilled near well W-28, which is part of the groundwater monitoring system for the Dry Fly Ash Stack, the boring for well W-28 may have been advanced through CCR material above the well screen interval. While the screened interval of this monitoring well is not within the CCR material, the possible presence of CCR material near the boring in which well W-28 was installed creates uncertainty about the representativeness of groundwater samples collected from well W-28. This may lead to a re-evaluation of the groundwater monitoring system for compliance with the TDEC permitted landfill groundwater monitoring program. Consequently, a review of boring logs and additional PLM testing was conducted at four borings near well W-28 that had reported concentrations of CCR constituents in groundwater above the TDEC-approved GSLs. PLM is a laboratory method used to identify the potential presence of ash on a percentage basis. The results indicated that minimal, if any, CCR material is present at these boring locations. Laboratory reports are provided in Attachment H.1-A.

#### 5.1.3.2 Lithology and Hydrostratigraphic Units

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

The natural unconsolidated materials consist primarily of residuum and alluvium overlying bedrock. Residuum is the material that remains after bedrock has weathered to a point that it is no longer considered rock. Residuum commonly

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

consists of clay or silt but can have layers of coarser materials such as sand and gravel. Alluvium refers to native materials that are deposited by moving water. In the floodplain of the Holston River, there is fine-grained alluvium made up of mostly clay and silt. This surficial unit is underlain by coarser grained sand and gravel lenses in some areas (TVA 1952). The coarser grained materials are not laterally continuous. The overall thickness of unconsolidated materials ranges from near zero at the southern limits of the plant property to approximately 25 feet in interior areas (TVA 2002). The Sevier shale underlies the unconsolidated materials. Rock coring and geophysical testing were conducted in five borings drilled into the Sevier shale. The geophysical testing provided information about the strike (east-northeast) and dip (southeast) of the bedrock bedding planes and fracture sets. A fracture set was identified with approximately the same strike and dip as the bedding planes. A second fracture set was identified with a similar strike, but a dip to the northwest instead of the southeast. Voids or karst features, which would not be expected in a shale, were not observed. Some of the fractures were open and others had been infilled with calcite. Appendix H.1 has further description of the site-specific geology and lithology.

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

**JSF Plant CCR and Unconsolidated Materials**

**Legend**

- Building Structure
- CCR Material
- Clay Dike
- Unconsolidated Materials (Primarily Clay and Silt)
- Unconsolidated Materials (Primarily Sand and Gravel)
- Waterbody
- Bedrock

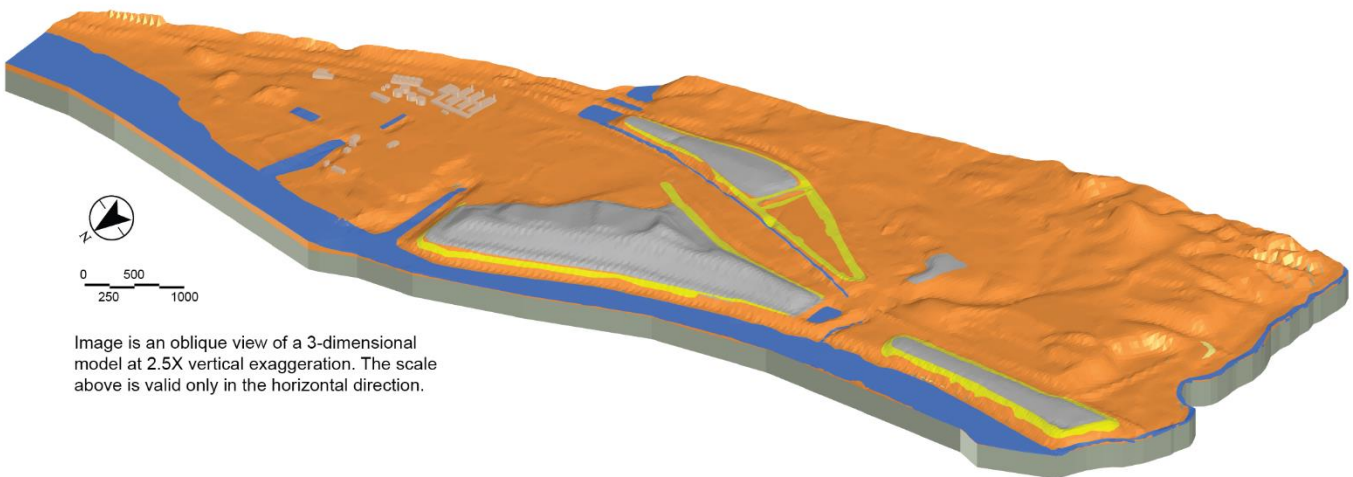


Image is an oblique view of a 3-dimensional model at 2.5X vertical exaggeration. The scale above is valid only in the horizontal direction.

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
 John Sevier Fossil Plant

**JSF Plant Unconsolidated Materials (Primarily Clay and Silt)**

**Legend**

- |   |                    |   |  |
|---|--------------------|---|--|
|  | Building Structure |  | Unconsolidated Materials (Primarily Clay and Silt)   |
|  | Clay Dike          |  | Unconsolidated Materials (Primarily Sand and Gravel) |
|   |                    |  | Waterbody  |
|   |                    |  | Bedrock  |

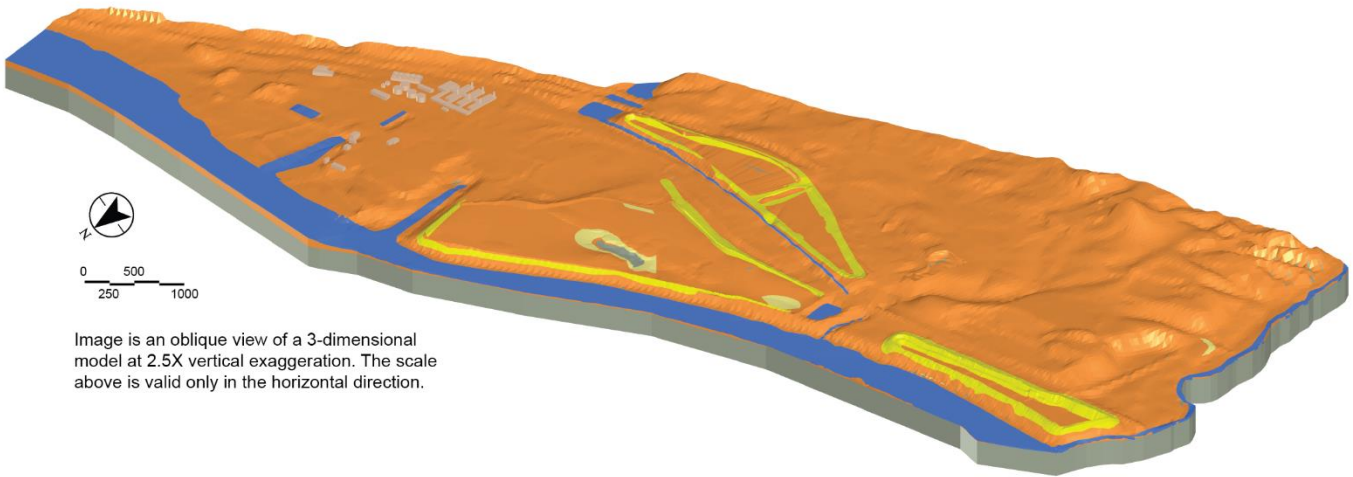







Image is an oblique view of a 3-dimensional model at 2.5X vertical exaggeration. The scale above is valid only in the horizontal direction.

**JSF Plant Unconsolidated Materials (Primarily Sand and Gravel)**

**Legend**

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

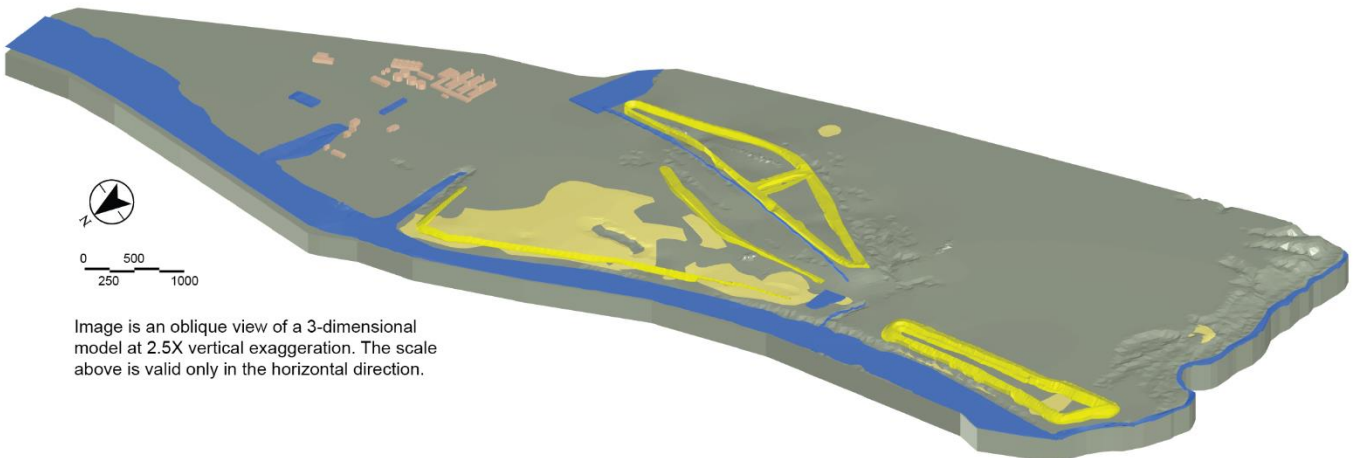


Image is an oblique view of a 3-dimensional model at 2.5X vertical exaggeration. The scale above is valid only in the horizontal direction.

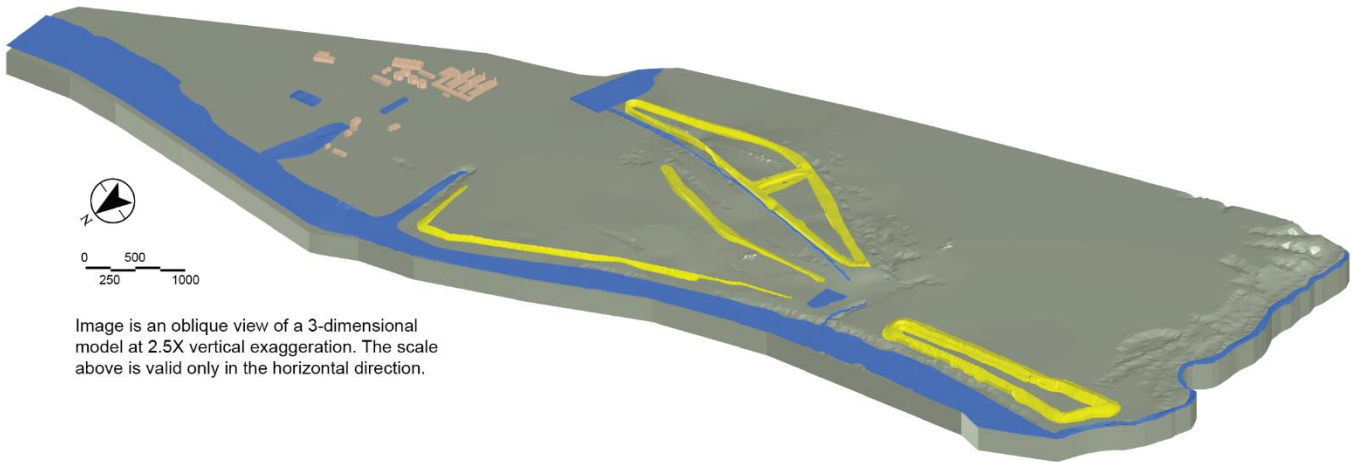
## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### JSF Plant Bedrock Surface

#### Legend

	Building Structure		Waterbody
	Clay Dike		Bedrock



Representative cross-sections, showing the underlying lithologic units and CCR material, are provided in Appendix D. Exhibit D-1 is a transect location map for the cross-sections. Exhibit D-2 depicts the profiles across Ash Disposal Area J and the Dry Fly Ash Stack. Exhibit D-3 depicts the profiles across the Bottom Ash Pond and Highway 70 Borrow Area. Hydrostratigraphic units are geological formations that have been defined to characterize the hydrogeology of the JSF Plant to understand where and how groundwater is flowing. Geological formations capable of yielding useable quantities of groundwater are called aquifers. Aquifers are targeted for development as water sources by property owners. The hydraulic characteristics of aquifers are used to classify them. If an aquifer's boundary forms the water table, then the aquifer is called an unconfined aquifer.

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

#### 5.1.3.3 Uppermost Aquifer and Groundwater Flow

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

Based on the geology and hydraulic conductivities measured in the vicinity of the CCR management units, the coarse-grained unconsolidated materials and upper bedrock are hydraulically connected and are defined as the uppermost

## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

aquifer, which is under unconfined conditions. Appendix H.1 provides additional details regarding the characterization of the uppermost aquifer.

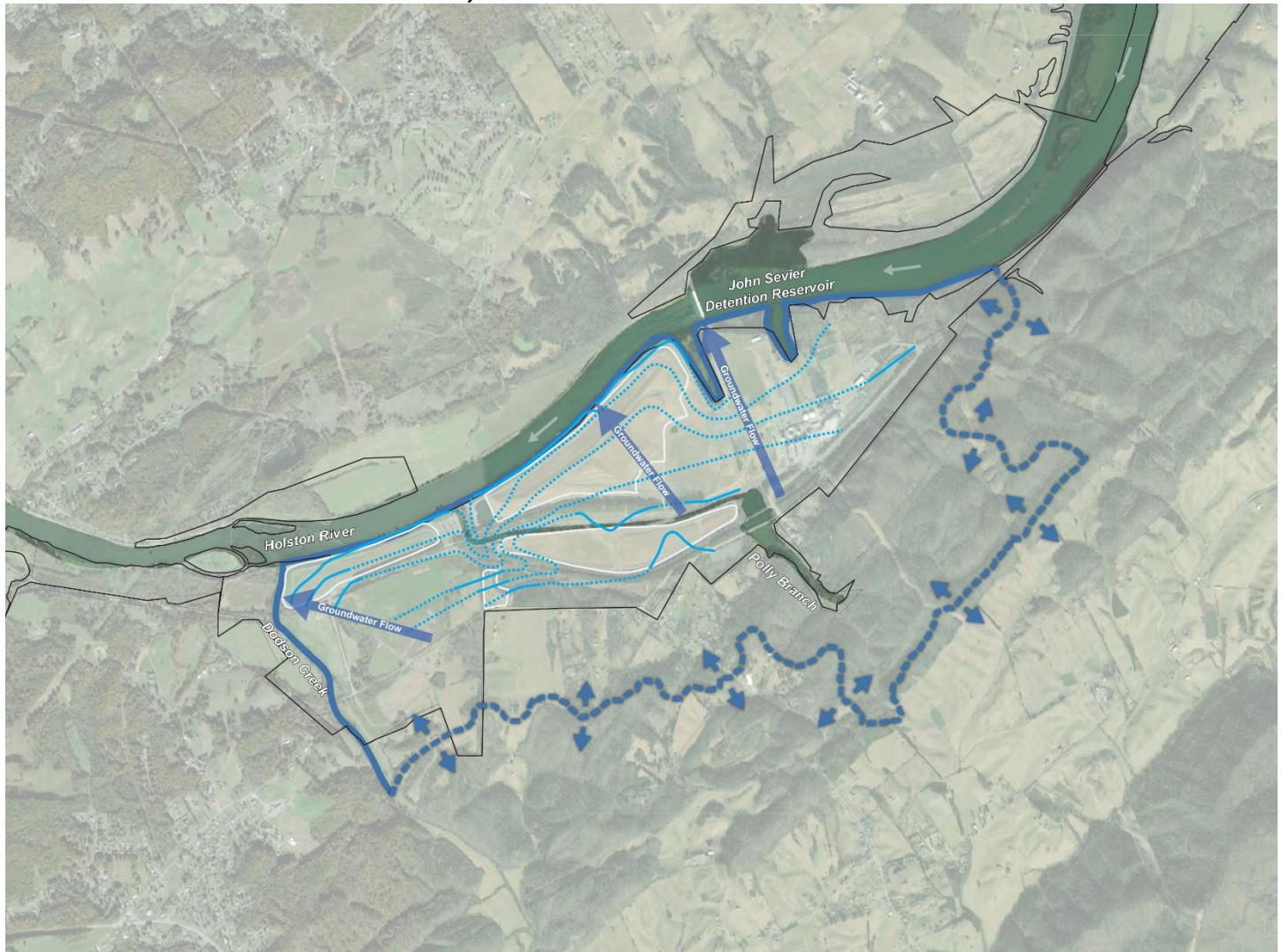
During the EI, groundwater levels were measured within the uppermost aquifer prior to the six groundwater sampling events to evaluate the direction and rate of groundwater flow in the uppermost aquifer. Surface water elevations were measured at the Holston River because the elevations of surface streams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

The available data indicated that groundwater generally flows to the north-northwest or northwest toward the Holston River or, near Dodson Creek, to the west toward Dodson Creek. Calculated groundwater flow rates ranged from approximately 2 feet/year in the unconsolidated materials to 4,500 feet/year in the upper bedrock where fracture zones that have higher permeability exist, 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). Exhibits 5-1 and 5-2 are representative groundwater contour maps. Physiographic features that affect groundwater flow in the vicinity of the JSF Plant include the Holston River to the north, Polly Branch between the CCR management units, Dodson Creek to the west, and ridges that form watershed boundaries to the south (see the figure below). Groundwater in the vicinity of the JSF Plant flows from the ridges south of the plant to the north toward the Holston River. This limits the potential for effects of CCR management to move to the south of the plant or to the north past the Holston River by the flow of groundwater. In the vicinity of the CCR management units, groundwater flow is bounded to the north by the Holston River and to the west by Dodson Creek. Groundwater flow directions, boundaries, and the groundwater divide are shown in the following figure. Additional discussion of the hydrogeology and groundwater flow is provided in Appendix H.1.

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
 John Sevier Fossil Plant

**Groundwater Flow Directions, Boundaries and Divides**



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

- CCR Unit Area (Approximate)
- TVA Property Boundary Approximate

Note: Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 5-2, Groundwater Elevation Contour Map Event #4 (February 3, 2020), for actual groundwater elevations and groundwater contours.

**5.1.3.4 Groundwater/Surface Stream/Pore Water Relationships**

TVA measured pore water levels within the temporary wells monthly for six months. In addition, the wells were gauged during bi-monthly groundwater sampling events. This information was combined with available information from other instruments to develop maps of the phreatic surfaces for each of the CCR management units at the time of gauging. The phreatic surface is the surface of pore water at which pressure is atmospheric and below which CCR material may be

## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

saturated with pore water. The use of the term “saturated” or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material. Saturated CCR material can have a range of moisture contents based on the characteristics of the material. In addition, some of the other instruments that measure pore water, groundwater, and surface stream levels have been automated to provide time-series data, which have been plotted to evaluate the relationships of the elevations of pore water, groundwater, and surface streams. Detailed discussion of these relationships is provided below and in Appendix H.1.

Within the Dry Fly Ash Stack and Bottom Ash Pond, there has been a downward trend in the pore water phreatic surface since the geosynthetic caps were installed. The downward trend in pore water levels suggests that the caps are performing as expected and have effectively eliminated infiltration into the CCR materials. During the EI, the pore water phreatic surfaces were near the bottoms of these units. Within Ash Disposal Area J during the EI, the pore water phreatic surface was present above the base of the CCR management unit and fluctuated up to approximately 10 feet. Within the Highway 70 Borrow Area during the EI, the pore water phreatic surface was present above the base of the CCR management unit and fluctuated up to approximately 8 feet. Groundwater water table surface elevations were measured or estimated to be below the elevations of the phreatic surfaces. Available information indicates that pore water levels are not causing a reversal of the groundwater flow direction along the upgradient edge of these CCR management units (sometimes referred to as mounding).

For the Dry Fly Ash Stack and Bottom Ash Pond, the groundwater level fluctuations for monitoring locations near the river, and generally installed within the coarser alluvial materials or upper bedrock, had fluctuation patterns that were similar to the river stage fluctuations. Other groundwater monitoring locations farther from the river either show muted fluctuations that correlated with river stage or potentially precipitation events. Groundwater level fluctuations for monitoring locations installing in fine-grained materials showed a muted response to river stage fluctuations, with occasional responses to precipitation events. The groundwater levels for monitoring locations installed beneath the CCR management unit showed gradual decreases in levels with no obvious fluctuations. The pore water hydrographs had no apparent correlation between river stage or precipitation and the pore water fluctuations. The pore water elevations generally declined over time.

For Ash Disposal Area J and the Highway 70 Borrow Area, the groundwater levels for monitoring locations near the river had fluctuation patterns that were similar to the river stage fluctuations. Other groundwater monitoring locations farther from the river either showed muted fluctuations that correlated with river stage or potentially precipitation events. Groundwater level fluctuations for monitoring locations installed beneath the CCR management units showed fluctuations that were correlated with the fluctuations of pore water within the CCR management units. The pore water level fluctuation patterns were different than the river stage fluctuations and appeared to correlate with some precipitation events but not others.

Each of the TDEC Order CCR management units was previously closed in accordance with applicable regulations in effect at the time of closure. The pore water levels reported herein may not represent steady-state conditions.

### 5.1.3.5 Groundwater Quality Evaluation

This section provides a discussion of the analytical results for groundwater samples collected from monitoring wells installed as part of the EI and previously installed wells monitored as part of the TDEC permitted landfill and CCR Rule groundwater monitoring programs. The groundwater quality evaluation is based on a statistical evaluation of constituents listed in Appendix I of TDEC Rule 0400-11-01-.04 (TDEC Appendix I) and Appendices III and IV of the CCR Rule. The



## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

analytical results were compared to GSLs approved by TDEC (see Table 1-1 and Appendix A.2). The statistical evaluation of groundwater analytical data is provided in Appendix E.3. Additional discussion of the results of the statistical evaluation is provided in Appendix H.1.

The dataset compiled for statistical analysis includes available analytical data for groundwater samples collected between May 2016 and August 2022, although the specific start date and frequency of sampling may vary between wells based on date of well installation and the applicable monitoring program. This time period was selected because it coincides with modifications that were made to the monitoring program at the JSF Plant in 2016.

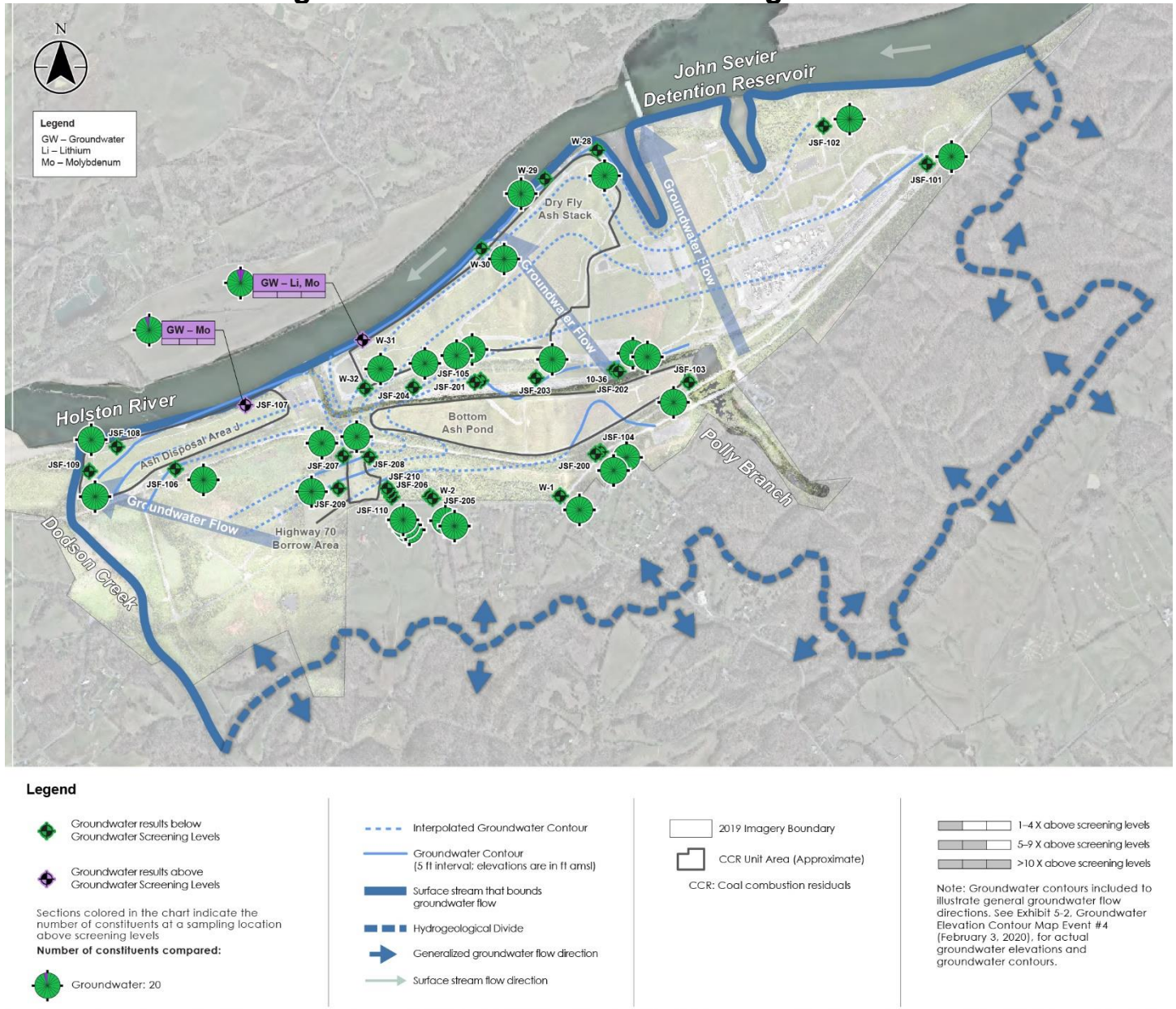
Downgradient of the CCR management units, two CCR Rule Appendix IV CCR constituents had statistically significant concentrations above a GSL in two wells, including lithium (W-31) and molybdenum (JSF-107 and W-31). No TDEC Appendix I constituents had statistically significant concentrations above a GSL. The groundwater impacts described above are limited to onsite areas downgradient along the perimeter of the CCR management units.

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

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

**Groundwater Findings Near the JSF Plant CCR Management Units**



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

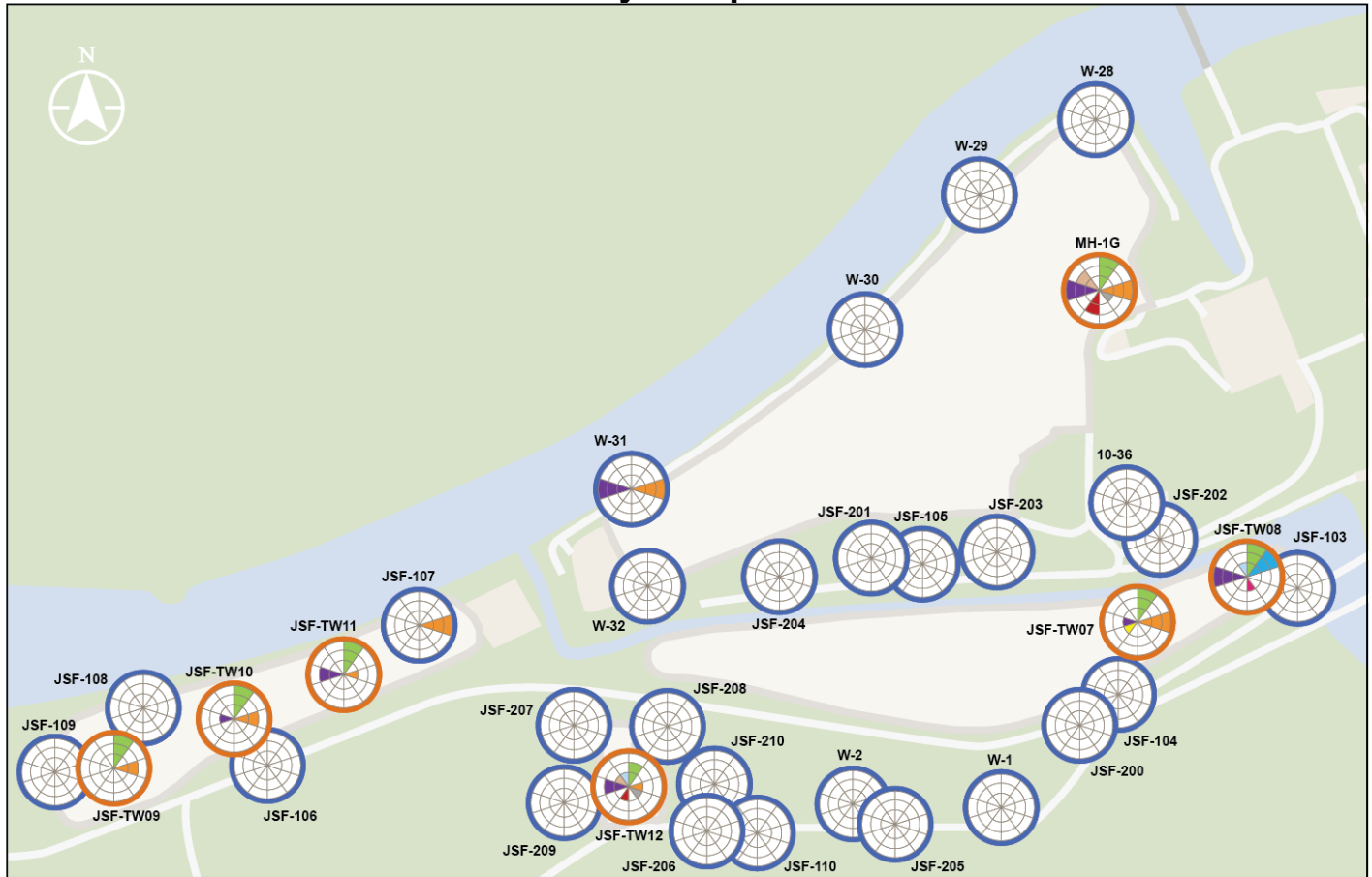
In addition, the quality of pore water was compared to groundwater quality. The following two figures illustrate the difference between pore water quality (symbol with orange outer ring) measured within the CCR management units and groundwater quality (symbol with blue outer ring) measured within the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

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
 John Sevier Fossil Plant

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

**Pore Water and Groundwater Quality Comparison**



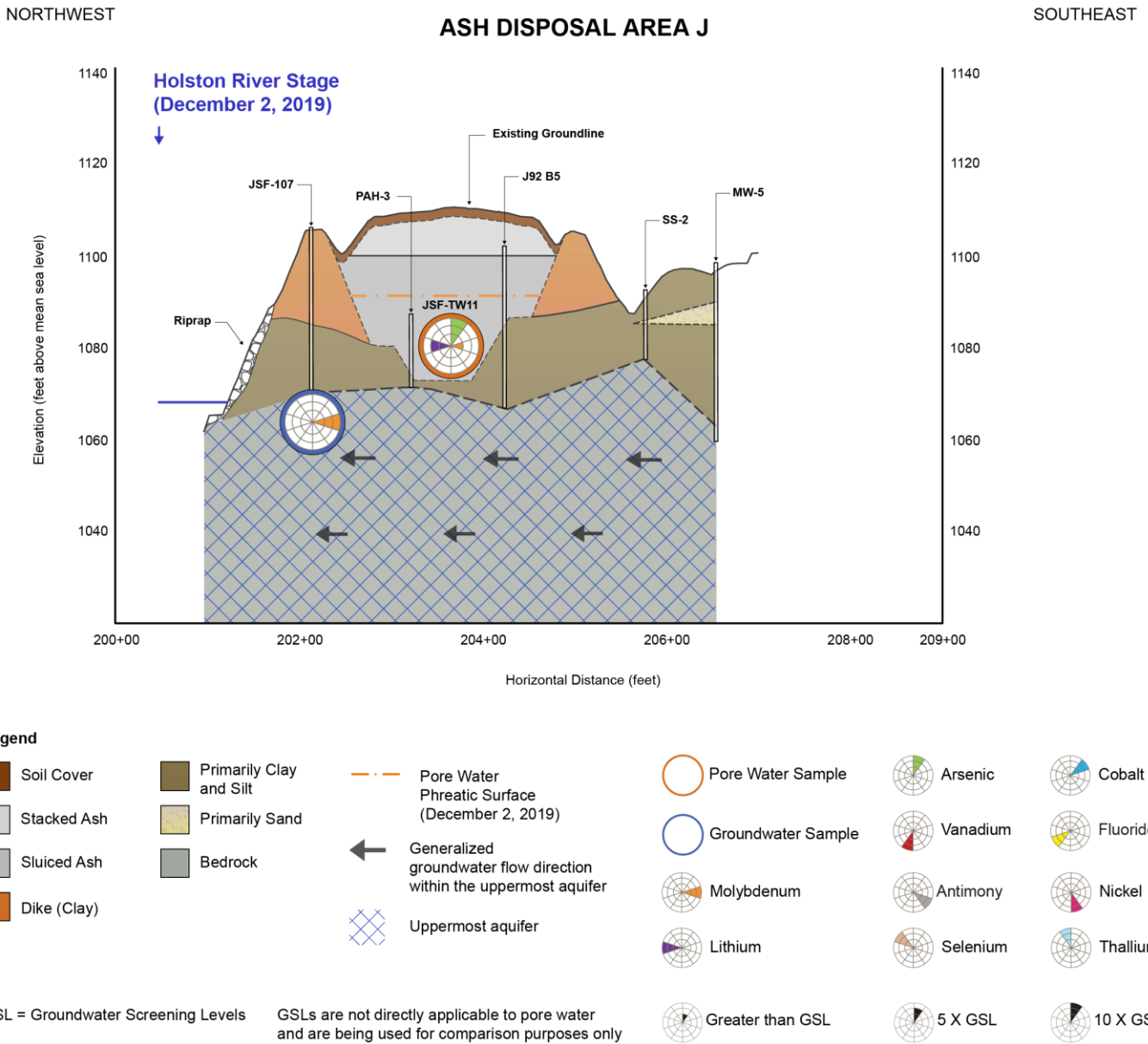
**Legend**

Pore Water Sample	Arsenic	Cobalt	Molybdenum	Antimony	Nickel
Groundwater Sample	Vanadium	Fluoride	Lithium	Selenium	Thallium
GSL = Groundwater Screening Levels GSLs are not directly applicable to pore water and are being used for comparison purposes only			Greater than GSL	5 X GSL	10 X GSL

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

**Cross Section View of Pore Water and Groundwater Comparison**



**5.2 Geochemical Evaluation of Groundwater Data**

Groundwater quality is affected by numerous geochemical processes during groundwater flow through geological materials. The distinct difference between the chemical characteristics of pore water within the CCR material, presented in Chapter 4, and the characteristics of groundwater quality downgradient of the CCR management units at the JSF Plant is difficult to explain without the aid of geochemistry. It is well documented in the literature that certain CCR constituents that are detected in pore water (typically at higher concentrations than groundwater) can be affected by geochemical processes that occur between constituents dissolved in groundwater and geological materials through which it flows. The effects of these geochemical processes, which often result in the attenuation of CCR constituents (i.e., reduced

## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

concentrations) can explain the observed differences between the characteristics of pore water and groundwater quality. The extent of the interactions between dissolved constituents in groundwater and geological materials ranges from limited interaction for constituents such as boron, chloride, and sulfate, to strong interactions for constituents such as arsenic and cobalt.

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

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

## 5.3 Water Use Survey

The objectives of the EIP water use survey are to identify and sample usable private water supply wells and surface water sources potentially being used for domestic purposes within 0.5-mile of the boundary of the JSF Plant, herein referred to as the Survey Area, as outlined in the EIP and shown in the figure below. For this study, TVA defined a usable water well to be one that will house a pump (even if a pump is not currently present) and does not contain an obstruction or defective construction that would prevent the insertion or operation of a pump. A detailed discussion of the water use survey is provided in Appendix H.9.

### 5.3.1 Desktop Survey

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

#### 5.3.1.1 Desktop Survey Results

Based on the results of the desktop survey, 39 parcels were identified that may contain potentially usable wells for domestic or business purposes. No springs were identified within the Survey Area.

#### 5.3.1.2 Usable Water Well and/or Spring Identification

In addition to conducting the desktop survey, the JSF *Water Use Survey SAP* outlines a process using results of investigative activities required as part of the EI to identify offsite areas where groundwater has the potential to be affected

## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

by the JSF Plant CCR management units. This process considered geologic and hydrogeological conditions (i.e., hydrogeological barriers [rivers/streams], topography, groundwater flow direction, and watershed boundaries).

Groundwater flow in the unconsolidated materials and upper bedrock at the JSF Plant CCR management units is bounded to the north by the Holston River and to the west by Dodson Creek as shown in the figure below. In addition, near the southern boundary of the JSF Plant, the groundwater flow direction was consistently from the southern boundary of the JSF Plant to the north toward the Holston River during an investigation conducted as part of the EI. Based on this finding, potable water wells located south and upgradient of the CCR management units would not be impacted by groundwater associated with the JSF Plant CCR management units. This is consistent with expected groundwater flow directions for the physiographic setting in which the JSF Plant is located. Groundwater movement toward surface streams is shown on the following figure.

Considering the geologic and hydrogeologic conditions present at and in the vicinity of the JSF Plant, two parcels where the JSF Plant is located have potential of being impacted by CCR management operations. The parcels within the area of interest are shown in the figure below. Other potential wells identified in the desktop survey were located outside the two parcels.

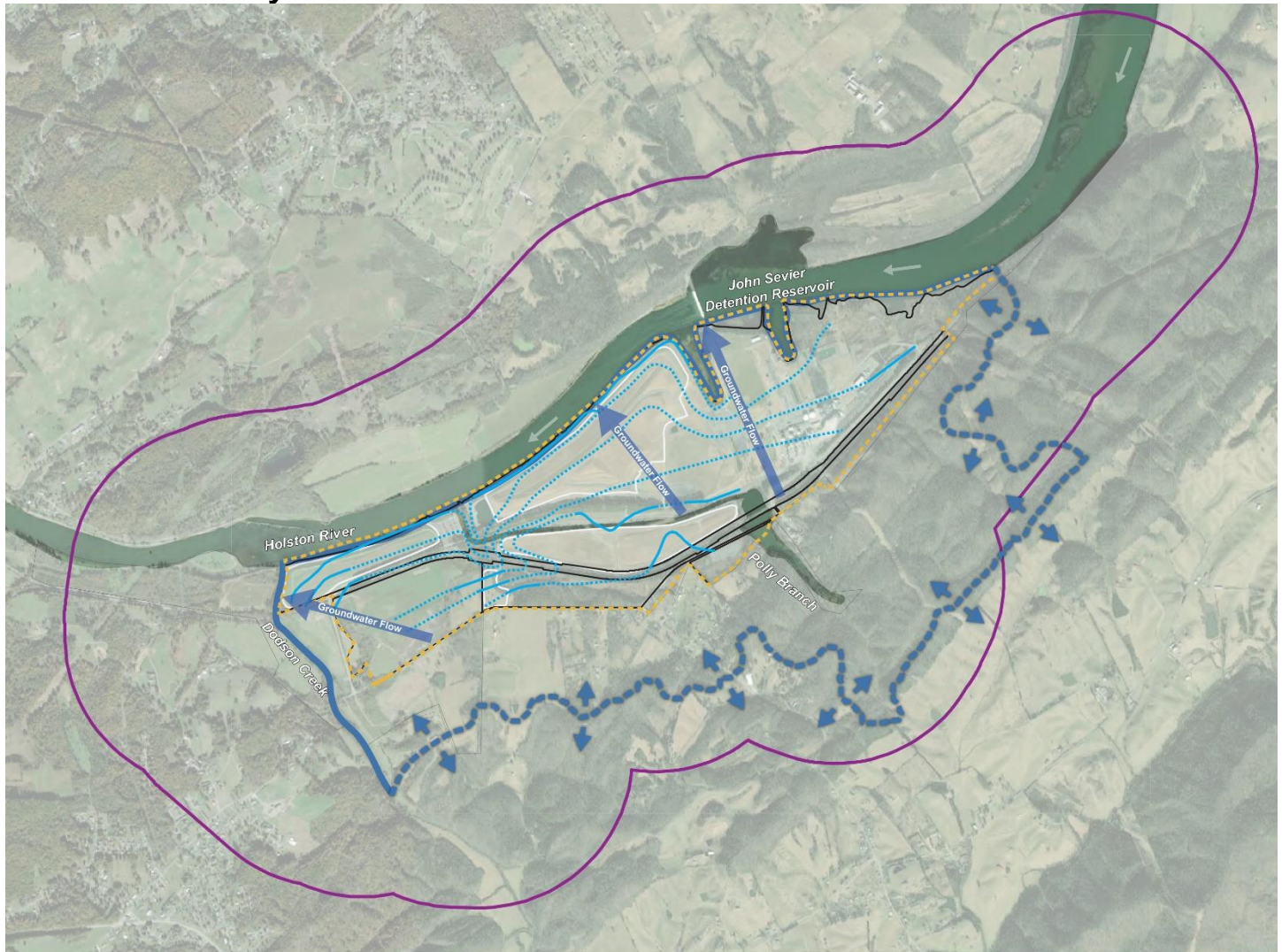
### 5.3.1.3 Parcel Owner Outreach

On May 10, 2023, a letter and stamped postcard containing basic inquiries into the presence of a well or spring was mailed to the parcel owners within the Area of Interest; both of which were TVA. On May 12, 2023, TVA's JSF Plant Manager returned completed postcards and reported that there were no known water supply wells or springs on either parcel. Based on the overall results of the water use survey, current and historical CCR management associated with the JSF Plant has not affected water supply wells or springs located in the vicinity of the JSF Plant.

**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
 John Sevier Fossil Plant

**Water Use Survey Area**



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

- CCR Unit Area (Approximate)
- WUS Survey Area
- Water Use Survey Area of Interest
- Parcel Identified for Water Use Survey

Note: Groundwater contours included to illustrate general groundwater flow directions. See Exhibit 5-2, Groundwater Elevation Contour Map Event #4 (February 3, 2020), for actual groundwater elevations and groundwater contours.

**5.4 Hydrogeological Investigation Summary**

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

## Hydrogeological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

- TVA evaluated analytical results for groundwater in support of the EAR based on data collected under three groundwater monitoring programs (some of which overlap), including the EI, CCR Rule, and TDEC permitted landfill monitoring programs. Monitoring well locations and CCR constituents that will require further evaluation in the CARA Plan are provided below.

<b>Summary of Findings Requiring Further Evaluation in the CARA Plan</b>	
<b>CCR Management Unit</b>	<b>Groundwater</b>
Ash Disposal Area J	Molybdenum (JSF-107)
Bottom Ash Pond	None
Dry Fly Ash Stack	Lithium (W-31) Molybdenum (W-31)
Highway 70 Borrow Area	None

- Pore water within the CCR material has specific chemical characteristics that are different from the characteristics of groundwater downgradient of the CCR management units. Certain CCR constituents that have been detected in pore water are affected by geochemical processes during transport by groundwater through geological materials. The effect of these geochemical processes, which can result in the attenuation of CCR constituents and reduced dissolved groundwater concentrations, can explain the observed differences between the characteristics of pore water and groundwater quality.
- The pore water levels reported herein may not represent steady-state conditions. The low permeability of the geosynthetic caps is expected to result in the continued decrease in pore water levels in the Dry Fly Ash Stack and the Bottom Ash Pond. The low permeability of the perimeter dikes limits lateral flow into or out of the CCR management units. The pore water levels within Ash Disposal Area J and the Highway 70 Borrow Area would be expected to decrease in elevation if stormwater drainage or cap modifications were to be implemented. The use of the term “saturated” or references to the moisture content of CCR material does not imply that the pore water is readily separable from the CCR material.
- The coarse-grained unconsolidated materials and upper bedrock are defined as the uppermost aquifer, which is considered to be under unconfined conditions. The horizontal groundwater flow direction within the uppermost aquifer is generally to the north-northwest or northwest toward the Holston River or, near Dodson Creek, to the west toward Dodson Creek. Groundwater flow in the unconsolidated materials and upper bedrock is bounded to the north by the Holston River and to the west by Dodson Creek.
- Near the southern boundary of the JSF Plant, the groundwater flow direction was consistently from the southern boundary of the JSF Plant to the north toward the Holston River. Based on this finding, potable water wells located south and upgradient of the CCR management units would not be impacted by groundwater associated with the JSF Plant CCR management units.
- Considering the geologic and hydrogeological conditions present at and in the vicinity of the JSF Plant, two parcels within the Survey Area were evaluated. No potable water wells or springs were identified on the two parcels; therefore, no groundwater samples were collected.



**Hydrogeological Investigations**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

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

## Summary of Historical Seep Information

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 6 Summary of Historical Seep Information

As described in the EIP, there were no known active seeps at the JSF Plant at the commencement of the EI due to repairs implemented as part of remedial activities conducted by TVA beginning in 1998. Therefore, a seep investigation was not considered necessary as part of TDEC Order EIP activities. However, in response to TDEC's EIP request, TVA developed a *JSF Plant Seep Summary Report* (Appendix I), which provided a summary of historical seep-related observations, remediation/mitigation efforts, and ongoing closure and post-closure monitoring activities for the four CCR management units at the JSF Plant. The summary report provided seep-related observations documented from 1979 to the date of the Summary Report for the Dry Fly Ash Stack, Ash Disposal Area J, Bottom Ash Pond, and Highway 70 Borrow Area. The summary report noted that no historical seeps or areas of concern have been observed near Ash Disposal Area J or at the Highway 70 Borrow Area, and since 1998, TVA has conducted corrective action efforts for historical seeps and areas of concern associated with the Dry Fly Ash Stack and Bottom Ash Pond. These remedial actions, combined with the non-flowing conditions observed during routine inspections over time, indicate there are still no active seeps present at the JSF Plant. Closure and post-closure monitoring for the presence of seepage conditions at the CCR management units continues to be performed and documented in accordance with the JSF Plant's NPDES permit Seep Action Plan (Geosyntec Consultants, Inc. 2020). Additional information on the seep-related activities at the JSF Plant is provided in Appendix I.

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 7 Surface Streams, Sediment and Ecological Investigations

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

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

## 7.1 Previous Studies and Assessments

### 7.1.1 Surface Stream Studies and Ongoing Monitoring Activities

As noted in Chapter 2.3, the JSF Plant was constructed on the southern bank of the Holston River within the inflow of the Holston River to the Cherokee Reservoir and is downstream of the John Sevier detention dam. TDEC's assessment and reporting on the quality of surface waters throughout this area characterizes water quality within the Cherokee Reservoir and the John Sevier Detention Reservoir as impacted and not supportive of intended water uses (TDEC 2020a and 2020b). Current and historically documented impairments to the reservoir system adjacent to the JSF Plant include mercury impacts from legacy issues associated with the Saltville Waste Disposal Ponds Superfund site in Smyth County, Virginia as detailed in Appendix J.3 and from atmospheric deposition (TDEC 2014, 2020a, and 2020b).

Surface stream monitoring conducted by TVA near the JSF Plant as part of NPDES permit renewals included evaluation of general water quality parameters, such as temperature, dissolved oxygen, conductivity, and pH; no specific surface stream water quality sampling to evaluate CCR constituents was performed prior to the EI. Details regarding these studies are provided in Appendix J.1.

### 7.1.2 Sediment and Benthic Invertebrate Studies

Historical sediment sampling for CCR constituents has not been conducted in the Holston River adjacent to the JSF Plant.

Between 1973 and 1981, TVA conducted biological assessments by periodically monitoring aquatic communities (including fish and benthic macroinvertebrates) to evaluate their status upstream, adjacent to, and downstream of the JSF Plant as detailed in Appendix J.3.

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

The data from 1973-1975, 1977, and 1978-1981 related to benthic invertebrate communities showed the following key findings (TVA 1979a and 1979b and 1984):

- While control site and experimental station benthic macroinvertebrate communities were different, and downstream communities appear to be more highly stressed, results did not directly correlate with JSF Plant thermal discharges, and it was not possible to separate JSF Plant thermal discharge effects from other ecological ambient variables.
- It was suspected that substantial reductions in gastropod productivity immediately downstream from the JSF Plant may have been due to the chlorinated discharge. Elevated chlorine concentrations may be expected to kill periphyton and prevent its growth, which would ultimately affect food availability for secondary production in the benthic community, particularly scrapers like gastropods.

Pre- and post-operational biological monitoring of the Holston River was performed in summer and autumn 2011 and 2012 as part of NPDES permit renewals to determine if limits established for the JSF and JCC Plants thermal discharges were protective of balanced indigenous populations of aquatic life. These studies found that upstream and downstream aquatic communities near the JSF and JCC Plants were ecologically similar to their respective control sites. As such, TDEC accepted TVA's conclusion that thermal effluent from the JSF Plant was not adversely affecting downstream biological communities, and that water quality was satisfactory for supporting aquatic life.

Mayfly collections during previous studies were limited to those collected as part of the overall benthic community Reservoir Benthic Index (RBI) sampling. Mayflies were not historically collected for bioaccumulation analysis of CCR constituents.

### 7.1.3 Fish Community and Fish Tissue Studies

As noted above, TVA has conducted biological assessments by periodically monitoring aquatic communities (fish and benthic invertebrates) to evaluate their status upstream, adjacent to, and downstream of the JSF Plant. Historical fish population assessments were completed between 1973 and 1981, 1986, 2003, and 2012-2013, as detailed in Appendix J.5. Additionally, sport fish surveys, fish impingement monitoring and entrainment studies were conducted from the 1980s through the present, with fish tissue samples collected from Cherokee Reservoir. Conclusions based on previous fish population assessments and tissue studies near the JSF Plant are as follows:

**Fish Population Monitoring.** The initial fish population monitoring studies in the 1970s showed that the Cherokee Reservoir fish assemblage was not balanced nor indigenous but found no significant adverse impact on fish assemblage associated with JSF Plant operations (TVA 1977). Between April 1980 and January 1981, sampling revealed a riverine fish assemblage downstream from the JSF Plant that was more diverse than earlier collections indicated. (TVA 1984)

Overall, the 2000s fish community sampling events and Reservoir Fish Assemblage Index (RFAI) results showed that:

- Fish community surveys conducted in 2003 in the Holston River (within Cherokee Reservoir) concluded that the Holston River met balanced indigenous population criteria at three downstream locations, and the RFAI scores at these locations were equal to or higher than the two locations further downstream in Cherokee Reservoir (TVA 2003).
- The 2011 and 2012 pre- and post-operational biological monitoring of the Holston River at the JSF and JCC Plants found that downstream aquatic communities were ecologically similar to their respective control sites,

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

supporting the conclusion that the JSF Plant thermal effluent was not adversely affecting downstream fish communities (TVA 2012b, 2013b, and 2013c).

Therefore, in the context of USEPA's interpretation of the regulatory definition of a balanced indigenous population, the findings demonstrated the presence and maintenance of a balanced indigenous fish population in the Holston River in the vicinity of the JSF Plant.

**Fish Impingement Monitoring.** The initial 1970s demonstration indicated that the John Sevier detention dam prevented at least two fish species (paddlefish and sauger) from swimming upstream to spawn. This, in combination with chronic pollution of the Holston River associated with upstream sources not related to the JSF Plant, results in a relatively low-value fishery (TVA 1977 and 2007) near the plant. The 1970s and 2000s impingement studies indicate that the relatively low impingement at the JSF Plant would not constitute a significant impact to fish populations in the John Sevier Detention Reservoir (TVA 1984 and 2007).

**Fish Entrainment Studies.** The 1970s and 2000s entrainment studies indicated no significant adverse environmental impact to the Cherokee or John Sevier Detention Reservoirs nor changes in the fish community due to JSF Plant operations (TVA 1977, 1984, and 2007).

**Fish Tissue Collection.** TVA maintains a program to examine contaminants in fish filets from TVA reservoirs and their major tributary streams on a rotational basis. As part of this program, screening-level fish tissue samples have been collected from Cherokee Reservoir from the 1980s through the present. TVA, in cooperation with TDEC, collects and analyzes filets from indicator fish species (primarily channel catfish and largemouth bass) to inform human health fish consumption advisories and identify reservoirs for further intensive study (TVA 1992). Except for mercury, fish tissue contaminant concentrations in Cherokee Reservoir were typically either below detectable levels or below TDEC fish consumption advisory levels. There is a documented source of mercury contamination to the Holston River upstream of the JSF Plant (USEPA 2017).

## 7.2 TDEC Order Investigation Activities

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

The EI field activities were performed in 2018 and 2019 in general accordance with the *Surface Stream SAP*, *Benthic SAP*, *Fish Tissue SAP* and the *QAPP*, including TVA- and TDEC-approved programmatic and project-specific changes made following approval of the EIP. Surface stream and sediment samples were collected from transects located upstream, adjacent, and/or downstream of the CCR management units in the Holston River and at representative locations within Polly Branch upstream of and adjacent to the CCR management units. Mayfly (*Hexagenia*) and fish tissue samples were collected at sampling locations and reaches located in similar areas as the surface stream and sediment transects within the Holston River (see below).

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### Ecological Investigation Sampling Transects and Reaches



In summary:

- A total of 120 surface stream samples were collected during EI activities (90 from transects located in the Holston River and 30 from transects and single points in Polly Branch). Technical evaluation of these sampling results is presented in the *Technical Evaluation of Surface Stream Data* (Appendix J.1), and investigation sampling information is provided in the *Surface Stream SAR* (Appendix J.2).
- A total of 31 shallow sediment samples and eight deeper sediment samples were collected during EI activities (18 shallow from transects located in the Holston River and 13 shallow and eight deeper from transects and single points in Polly Branch) (Exhibit 7-1). Technical evaluation of these sampling results is presented in *Technical Evaluation of Sediment and Benthic Invertebrate Data* (Appendix J.3), and investigation sampling information is provided in the *Benthic SAR* (Appendix J.4).
- A total of eight composite mayfly tissue samples were collected during EI activities from individual areas in the Holston River (Exhibit 7-2). Technical evaluation of these sampling results is presented in *Technical Evaluation of Sediment and Benthic Invertebrate* (Appendix J.3), and investigation sampling information is provided in the *Benthic SAR* (Appendix J.4).
- Six fish species consisting of bluegill, redear sunfish, largemouth bass, smallmouth bass, channel catfish, and shad were targeted for EI sampling in sampling reaches located in the Holston River (Exhibit 7-3). The fish were resected and composited to provide a total of 50 fish tissue samples comprised of muscle, liver, and ovary tissues

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

for the gamefish, and whole fish for the shad. Technical evaluation of these sampling results is presented in *Technical Evaluation of Fish Community and Fish Tissue Data* (Appendix J.5), and investigation sampling information is provided in the *Fish Tissue SAR* (Appendix J.6).

- A total of 11 composite benthic macroinvertebrate community samples were collected from transects located in the Holston River. The five samples collected along each transect were processed individually by the laboratory and individual sample taxa lists (and counts) were composited to generate a comprehensive taxa list for each sampled transect. Technical evaluation of these sampling results is presented in *Technical Evaluation of Sediment and Benthic Invertebrate* (Appendix J.3), and investigation sampling methods are provided in the *Benthic SAR* (Appendix J.4).

## 7.3 Results and Discussion

The following summarizes the results of the surface stream water, sediment, benthic macroinvertebrate community, mayfly tissue, and fish tissue investigations for the JSF Plant CCR management units. Sampling results for these media are presented in Exhibits 7-1 through 7-3.

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

Surface water screening levels for human health, which are based on use of surface water as a drinking water supply source, are applied only to surface stream results for the Holston River, as it may potentially influence a potable surface water source located downstream of the JSF Plant CCR management units (Section 2.3 and Appendix H.9). Ecological screening levels, based on published studies of CCR Parameters' health effects on ecological receptors, are applied to surface stream, sediment, mayfly tissue, and fish tissue results.

The ecological data evaluation approach utilized a two-step process. First, data analysis identified whether CCR Parameters were present at concentrations higher than the EAR Ecological Screening Values (ESVs) (Tables 1-2 and 1-3 and Appendix A.2) in surface stream water and sediment samples. Second, when CCR Parameters were detected above surface water and sediment ESVs, fish and mayfly tissue concentrations for those constituents were compared to TDEC-approved Critical Body Residue (CBR) values. Due to their potential for bioaccumulation effects, mercury and selenium were evaluated in fish and mayfly tissue samples even if these constituents were not detected above ESVs in surface stream water and sediment samples. ESVs include chronic and acute values for CCR Parameters and % ash analyzed by PLM. As described in the Benthic SAP, a 20% ash result was used to trigger additional Phase 2 sampling.

### 7.3.1 Holston River

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

### Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

None of the PLM results for sediment samples from the Holston River were above 8% ash, well below the 20% ash threshold that would trigger Phase 2 supplemental sampling. Most CCR Parameter concentrations in sediment samples collected from the Holston River were below acute and chronic ESVs. Copper, zinc and mercury were the only constituents at or above chronic ESVs (Exhibit 7.1). Copper and zinc were detected in sediment above (1.1 times, copper) or equal to (zinc) the chronic ESV at one of six locations (HR09-LB) downstream of the CCR management units. Mercury was detected in sediment above the chronic ESV at five locations (four of six locations downstream of the CCR management units and one adjacent location). Mercury results are related to a documented source of mercury contamination upstream of the JSF Plant (USEPA 2017), as detailed in Appendix J.3.

Selenium concentrations in mayfly tissue samples, and mercury, copper, selenium, and zinc concentrations in fish tissue samples were detected above CBR values but showed very little variability in results upstream, adjacent, and downstream of the JSF Plant CCR management units. These data result from a sampling design formulated to minimize overlapping fish home ranges and to include different feeding guilds. The similar results for all reaches, in combination with results from historical fish community assessments and both historical and EI benthic community data indicate that mayfly and fish tissue concentrations greater than CBR values, regardless of the source, are not impacting the fish or benthic communities in this area. Additionally, the detected mayfly and fish tissue concentrations displayed no spatial patterns relative to the CCR management units and, as described above, were not detected in surface stream water or sediment, except for copper and zinc in one sediment sample. Finally, as discussed previously, a documented source of mercury contamination is present upstream of the JSF Plant.

Based on the above evaluation, copper and zinc in Holston River sediments will be further evaluated in the CARA Plan.



**Surface Streams, Sediment and Ecological Investigations**

Environmental Assessment Report – Rev. 1  
 John Sevier Fossil Plant

**Holston River Sediment and Surface Stream Sampling Locations**



**Legend**

<ul style="list-style-type: none"> <li> Sediment / Surface water sample results below chronic Ecological Screening Values (ESVs)</li> <li> Sediment / Surface water sample results above chronic Ecological Screening Values (ESVs)</li> </ul>	<p>Sections colored in the chart indicate the number of constituents at a sampling location above screening levels</p> <p><b>Number of constituents compared:</b></p> <ul style="list-style-type: none"> <li> Holston River Sediment: 18</li> <li> Holston River Surface Stream Water: 26</li> </ul>	<ul style="list-style-type: none"> <li> 2019 Imagery Boundary</li> <li> CCR Unit Area (Approximate)</li> <li>CCR: Coal combustion residuals</li> </ul>	<ul style="list-style-type: none"> <li> 1-4 X above screening levels</li> <li> 5-9 X above screening levels</li> <li> &gt;10 X above screening levels</li> </ul>
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**7.3.2 Polly Branch**

CCR Parameter concentrations in surface stream samples from Polly Branch were below acute and chronic ESVs.

None of the PLM results for sediment samples from Polly Branch were above 7% ash, well below the 20% ash threshold that would have triggered Phase 2 supplemental sampling. Most CCR Parameter concentrations in sediment samples collected from the Polly Branch were below acute and chronic ESVs. Arsenic and beryllium were detected in two sediment samples and nickel was detected in one sample above chronic ESVs adjacent to the CCR management units. Of these, beryllium and nickel results were both less than 1.3 times the screening level, with arsenic results up to about two times the screening level. These constituents were not detected in sediment above ESVs downstream in Polly Branch or the Holston River nor were they detected above ESVs in surface stream water in either water body.

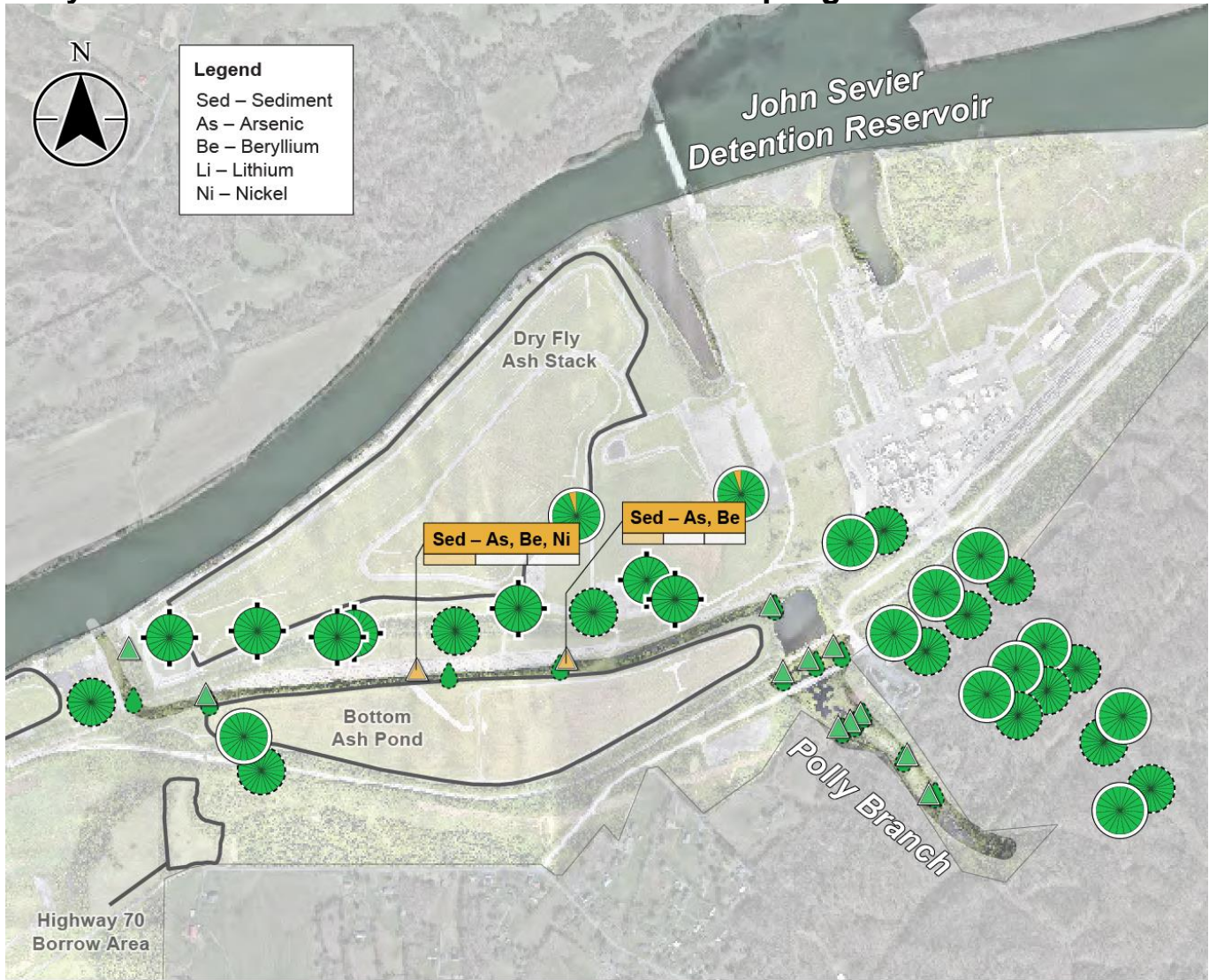
Fish tissue and mayfly tissue sampling was not performed in Polly Branch, nor required in the EI SAPs, because physical habitat limitations in this waterbody prevent sustained mayfly and sport fish communities (e.g. lack of appropriate substrate, appreciable depth of organic materials, lack of depth and volume of water).

Based on the above evaluation, arsenic, beryllium, and nickel in Polly Branch sediments will be further evaluated in the CARA Plan.

Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Polly Branch Sediment and Surface Stream Sampling Locations



Legend

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

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

- Polly Branch Sediment: 19
- Polly Branch Surface Stream Water: 24

- 2019 Imagery Boundary
- CCR Unit Area (Approximate)
- CCR: Coal combustion residuals

- 1-4 X above screening levels
- 5-9 X above screening levels
- >10 X above screening levels

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 7.3.3 Benthic Macroinvertebrate Community Analysis

Benthic macroinvertebrate community sampling was conducted in the Holston River. Ponar dredge sampling was performed at locations upstream, adjacent to, and downstream of the JSF Plant CCR management units in the Holston River. The benthic community sample data were composited by transect to capture a comprehensive cross section of the existing benthic community in each representative stream segment. Community metrics were then used as indicators of biological integrity and surface stream water and sediment quality, including a RBI Total Score and supplemental metrics as described below.

Generally, the benthic macroinvertebrate community metrics were corroborative and demonstrated spatially consistent relationships among indicators. The RBI results for the Holston River, representative of overall biological integrity, generally showed similar total scores throughout the study area (Appendix J.3). Of these similar results, the best scores were observed adjacent to the JSF Plant. Although downstream locations scored slightly lower than adjacent locations, their total scores were consistent with upstream control locations. The 2019 RBI results are similar to 2011 and 2012 data which also showed that a majority of the average downstream total scores were higher than upstream control locations, and do not reflect potential impacts associated with the JSF CCR management units.

In addition to the inclusive multi-metric RBI results, supplemental metrics including Total Taxa Richness and the Hilsenhoff Biotic Index (HBI) were calculated and are presented in Appendix J.3, where the results are discussed in greater detail. Total Taxa Richness is a count of the number of different types of organisms (typically as genera or next lowest practicable identification level) observed within the benthic community samples collected from each transect. Like the RBI results, the Total Taxa Richness evaluation showed that the richest (most diverse) communities are adjacent to the JSF Plant, and downstream community richness is roughly equivalent to unimpacted upstream controls. The HBI is a metric that reflects environmental stress tolerance for the community as a whole. The HBI evaluation indicates that although benthic communities were slightly more stress-tolerant adjacent to the JSF Plant, downstream transects supported either more sensitive or equivalently sensitive communities compared to unimpacted upstream controls. Results for both Total Taxa Richness and the HBI corroborate the findings of the RBI evaluation described above.

In summary, benthic communities within adjacent and downstream areas generally appear to be at least as healthy, rich, and sensitive as in unimpacted control locations upstream of the JSF Plant CCR management units. The benthic community data do not reflect any impacts from the CCR management units.

## 7.4 Surface Streams, Sediment, and Ecological Investigation Summary

The evaluation of EI surface stream, sediment, benthic macroinvertebrate community, mayfly tissue, and fish tissue sampling results indicate minimal, if any, potential impacts to water quality and aquatic life in the Holston River and Polly Branch as summarized below.

- Surface stream water quality in the Holston River and Polly Branch is within ranges protective of human health and aquatic life. Sampling results were below chronic ESVs (Table 1-2) and indicate no potential water quality impacts from the CCR management units.
- Sediment quality is generally within ranges protective of aquatic life in the Holston River and Polly Branch. Sampling results for % ash were below the ash screening level, and most CCR Parameter concentrations were below chronic ESVs (Table 1-3) except for limited occurrences. Within the Holston River, copper and zinc were identified at or slightly above chronic ESVs at one of six downstream sediment sampling locations. Within Polly

## Surface Streams, Sediment and Ecological Investigations

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Branch, arsenic, beryllium, and nickel were detected at up to two locations above chronic ESVs adjacent to the CCR management units (Exhibit 7-1).

- Sediment quality results for mercury in the Holston River were above chronic ESVs (Table 1-3) at five locations (four of six locations downstream of the CCR management units and one adjacent location) (Exhibit 7-1). These results are related to a documented source of mercury upstream of the JSF Plant and are not a result of operations of the CCR management units.
- The adjacent and downstream mayfly and fish tissue sampling results for the Holston River were similar to upstream control locations and the detected mayfly and fish tissue concentrations displayed no spatial patterns relative to the CCR management units. These data result from a sampling design formulated to minimize overlapping fish home ranges and to include different feeding guilds. The similar results for all reaches, in combination with results from historical fish community assessments and both historical and EI benthic community data indicate that mayfly and fish tissue concentrations greater than CBR values, regardless of the source, are not impacting the fish or benthic communities in this area.
- The adjacent and downstream benthic communities appear to be similarly healthy, rich, and sensitive as upstream control locations, and collectively, the benthic community data reflect no potential impacts from the CCR management units.

Overall, the EI sample results in conjunction with historical benthic community and fish population data demonstrate healthy and consistent ecological communities within the investigation area and indicate that the JSF Plant CCR management units have minimal, if any, potential impacts to sediment and surface stream water quality in the Holston River and Polly Branch, and ecological communities in the Holston River.

Based on the EI findings, sampling results above ESVs will be further evaluated within the context of the overall EI results in the CARA Plan, including specific evaluations of copper and zinc sediment concentrations in the Holston River, and arsenic, beryllium, and nickel sediment concentrations in Polly Branch.

## TDEC Order Investigation Summary and Conceptual Site Models

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 8 TDEC Order Investigation Summary and Conceptual Site Models

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

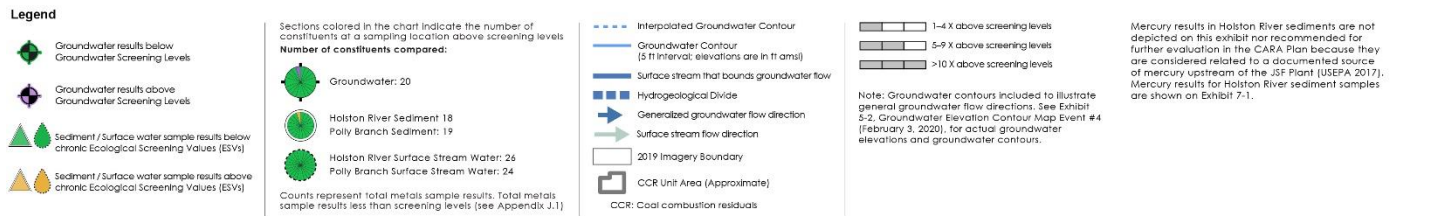
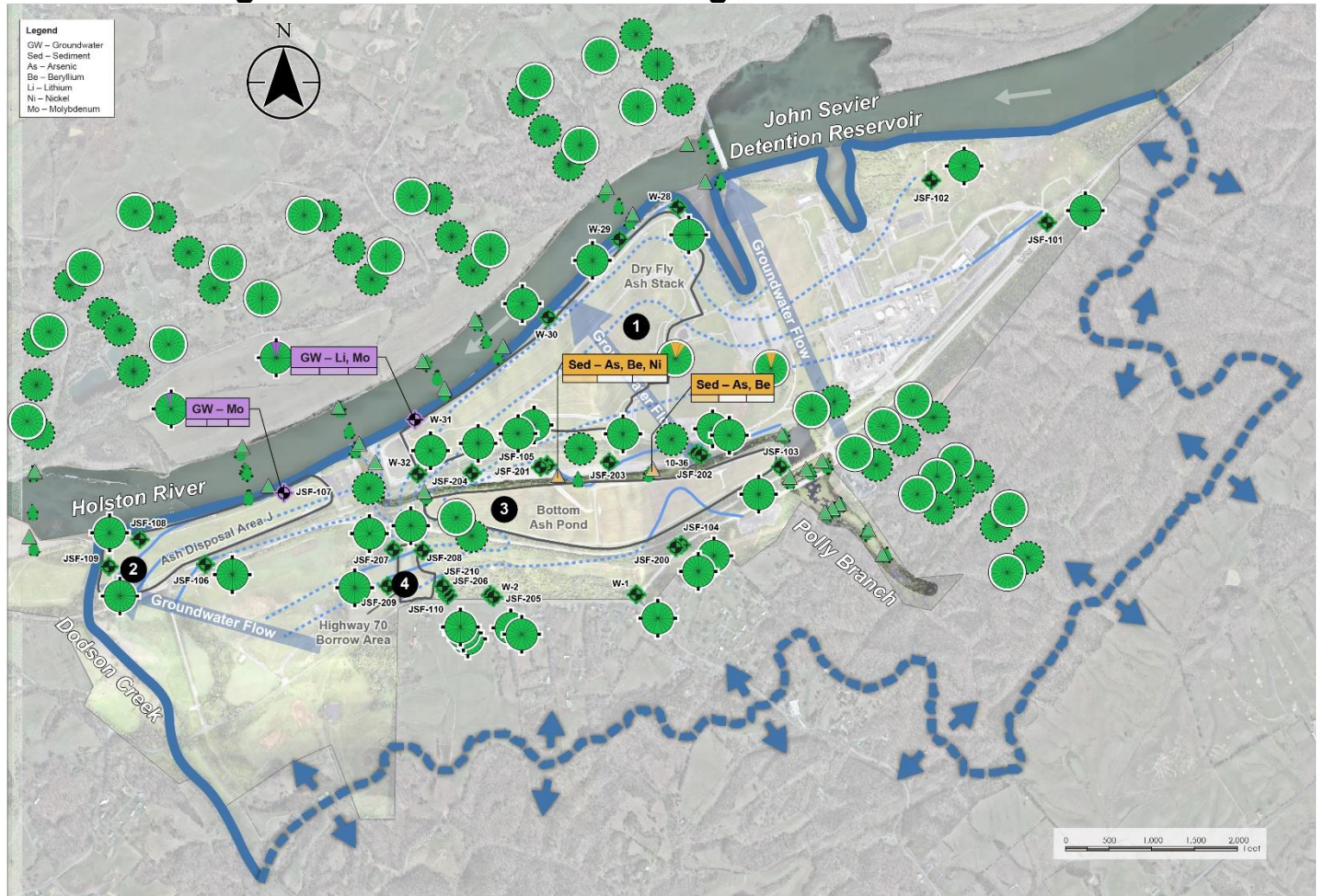
Analytical results were compared to TDEC-approved EAR screening levels to identify areas that require further evaluation. Most screening levels are not regulatory standards and are conservatively based on published health studies. Concentrations above the screening level do not necessarily mean that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

TDEC Order Investigation Summary and Conceptual Site Models

Environmental Assessment Report – Rev. 1  
 John Sevier Fossil Plant

Several EI findings are common among the CCR management units and are discussed in Chapter 8.1. Specific EI findings and CSMs for each CCR management unit are described in Chapters 8.2 through 8.5 and presented in Exhibits 8-1 through 8-4. These exhibits depict findings discussed in this EAR on a representative cross-section of subsurface conditions for each unit. Results of the EI are presented for the overall investigation area on Exhibit 8-5 and near the CCR management units as shown on the figure below and on Exhibit 8-6.

Overall Findings Near JSF Plant CCR Management Units



## TDEC Order Investigation Summary and Conceptual Site Models

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 8.1 Common Findings

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

**Structural Stability and Integrity:** The global slope stability and the veneer slope stability for each of the four CCR management units meets the established factor of safety criteria for the static and seismic load cases. The four CCR management units have adequate structural integrity, and there is no evidence of voids/cavities in bedrock that could lead to loss of structural support and potential release of overlying CCR material.

**Hydrogeology:** The coarse-grained unconsolidated materials and upper bedrock have been defined as the uppermost aquifer, which is considered to be under unconfined conditions and is monitored downgradient of the CCR management units.

The horizontal groundwater flow direction within the uppermost aquifer is generally to the north-northwest or northwest toward the Holston River or, near Dodson Creek, to the west toward Dodson Creek. Groundwater flow in the unconsolidated materials and upper bedrock is bounded to the north by the Holston River and to the west by Dodson Creek.

Near the southern boundary of the JSF Plant, the groundwater flow direction was consistently from the southern boundary of the JSF Plant to the north toward the Holston River. Based on this finding, potable water wells located south and upgradient of the CCR management units would not be impacted by groundwater associated with the JSF Plant CCR management units.

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

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

**Sediment:** Most CCR Parameter concentrations in sediment samples collected from the Holston River and Polly Branch were below chronic ESVs, except for limited occurrences. Within the Holston River, copper and zinc were identified at or slightly above chronic ESVs at one of six downstream sediment sampling locations, and mercury was above the chronic ESV at five sediment sampling locations (four of six locations downstream of the CCR management units and one adjacent location). Mercury results are related to a documented source of mercury upstream of the JSF Plant and not related to operations of the CCR management units.

**Bioaccumulation:** Mayfly and fish tissue results are similar, upstream, adjacent, and downstream of the CCR management units in the Holston River and the detected mayfly and fish tissue concentrations displayed no spatial patterns relative to the CCR management units. Although selenium (mayfly and fish tissue) and mercury, copper and zinc (fish tissue) were above chronic ESVs, these CCR Parameters have not been detected above GSLs in groundwater samples presented in the EAR. This, along with the absence or limited occurrence of these parameters at concentrations

## TDEC Order Investigation Summary and Conceptual Site Models

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

at or slightly above ESVs in surface water and sediment indicate that potential bioaccumulation effects within these populations are not related to the CCR management units.

**Benthic Communities:** The adjacent and downstream benthic communities in the Holston River appear to be similarly healthy, rich, and sensitive as upstream control locations, and collectively, the benthic community data suggest no potential impacts from the CCR management units.

**Seeps:** There are currently no known active seeps present at the JSF Plant based on ongoing monitoring. Monitoring continues to be performed in accordance with the JSF Plant NPDES permit Seep Action Plan.

## 8.2 Dry Fly Ash Stack

A summary of EI evaluation findings and a CSM for the Dry Fly Ash Stack is provided on Exhibit 8-1 in cross-sectional view and on Exhibit 8-6 in plan view. These exhibits also illustrate surrounding units and surface streams for the Dry Fly Ash Stack.

CCR materials in this unit are stacked fly ash above sluiced fly ash and bottom ash, with an estimated total volume of approximately 8.4 million cubic yards.

Within the Dry Fly Ash Stack, there has been a downward trend in the pore water phreatic surface since the geosynthetic cap was installed. The downward trend in pore water levels suggests that the cap is performing as expected and has effectively eliminated infiltration into the CCR materials. During the EI, the pore water phreatic surfaces were near the bottom of this unit. Inferred groundwater elevations were estimated to be below the elevation of the phreatic surface. Available information indicates that pore water levels were not causing a reversal of the groundwater flow direction along the upgradient edge of this CCR management unit (sometimes referred to as mounding).

Most CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater were below GSLs. The primary constituents of interest in groundwater for the Dry Fly Ash Stack are lithium and molybdenum at well W-31. No TDEC Appendix I constituents had a statistically significant concentration above a GSL. Concentrations of lithium and molybdenum in sediment and surface water were below the ESVs in samples collected from the Holston River, which serves as a boundary for groundwater flow.

CCR Parameter concentrations in sediment samples collected from the Holston River adjacent to the CCR management unit were below chronic ESVs, except for one mercury result which is related to a documented source of mercury upstream of the JSF Plant. Within the northern portion of Polly Branch, west of this CCR management unit, sediment results were below chronic ESVs. Ash was not detected in sediment samples from the Holston River and Polly Branch above 8%, well below the 20% ash threshold that would trigger Phase 2 supplemental sampling.

The results of the EI and other ongoing ecological monitoring programs indicate that operations at this CCR management unit have not impacted adjacent sediment and surface stream water quality, benthic macroinvertebrate communities, or mayfly and fish tissues and populations in the Holston River or sediment and surface stream water quality in the northern portion of Polly Branch.

In summary, potential impacts associated with the Dry Fly Ash Stack CCR management unit based on EI sampling results are limited to lithium and molybdenum in onsite groundwater at one monitoring well. These constituents will be further evaluated and addressed in the CARA Plan to determine if corrective actions are needed.



## TDEC Order Investigation Summary and Conceptual Site Models

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 8.3 Ash Disposal Area J

A summary of EI evaluation findings and a CSM for Ash Disposal Area J is provided on Exhibit 8-2 in cross-sectional view and on Exhibit 8-6 in plan view. These exhibits also illustrate surrounding units and surface streams for the Ash Disposal Area J.

CCR materials in this unit are stacked fly ash (placed as part of contouring the facility to final grade, prior to capping) and bottom ash above sluiced fly ash, with an estimated total volume of approximately 760,000 cubic yards.

Within Ash Disposal Area J during the EI, the pore water phreatic surface was present above the base of the CCR management unit. Inferred groundwater elevations were estimated to be a few feet below the phreatic surface elevation. The higher phreatic surface within this unit also indicates that the low permeability of the perimeter dikes and foundation soils are impeding lateral and vertical flow of pore water. The continued presence of pore water within the unit is interpreted to be caused by precipitation infiltrating into the CCR material. Available information is inconclusive regarding whether pore water levels are affecting the direction of groundwater flow along the upgradient boundary of this CCR management unit, but groundwater elevations are generally consistent with what would be expected based on observed groundwater flow patterns across the JSF Plant.

Most CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater are below the GSLs. The primary constituent of interest in groundwater for Ash Disposal Area J is molybdenum in well JSF-107. No TDEC Appendix I constituents had a statistically significant concentration above a GSL. Concentrations of molybdenum were below the ESV in sediment and surface water samples in the Holston River, which serves as a boundary for groundwater flow.

CCR Parameter concentrations in sediment samples collected from the Holston River and the northern portion of Polly Branch adjacent to this CCR management unit were below chronic ESVs. Ash was not detected in sediment samples from the Holston River and Poly Branch above 8%, well below the 20% ash threshold that would trigger Phase 2 supplemental sampling.

The results of the EI and other ongoing ecological monitoring programs indicate that operations at this CCR management unit have not impacted adjacent sediment and surface stream water quality, benthic macroinvertebrate communities, or mayfly and fish tissues and populations in the Holston River or sediment and surface stream water quality in the northern portion of Polly Branch.

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

### 8.4 Bottom Ash Pond

A summary of EI evaluation findings and a CSM for the Bottom Ash Pond is provided on Exhibit 8-3 in cross-sectional view, and on Exhibit 8-6 in plan view. These exhibits also illustrate surrounding units and surface streams for the Bottom Ash Pond.

CCR material is not present in the western portion of the unit as it was excavated and stacked (as part of closure) in the eastern portion of the unit in 2016. CCR material in the eastern portion of the unit are sluiced and stacked ash, with an estimated total volume of approximately 660,000 cubic yards.

## TDEC Order Investigation Summary and Conceptual Site Models

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

Within the Bottom Ash Pond, there has been a downward trend in the pore water phreatic surface since the geosynthetic cap was installed. The downward trend in pore water levels suggests that the cap is performing as expected and has effectively eliminated infiltration into the CCR materials. During the EI, the pore water phreatic surface was near the bottom of this unit. Inferred groundwater elevations were estimated to be below the elevation of the phreatic surface. Available information indicates that pore water levels were not causing a reversal of the groundwater flow direction along the upgradient edge of this CCR management unit.

TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater are below GSLs at the Bottom Ash Pond.

Within Polly Branch, arsenic, beryllium, and nickel were detected at up to two sediment sample locations above chronic ESVs adjacent to the CCR management unit; concentrations of these constituents are below chronic ESVs downstream. These constituents were not detected above the GSL in groundwater samples from wells at the Bottom Ash Pond and were not above ESVs in surface stream water samples collected from Polly Branch. Ash was not detected in sediment samples in Polly Branch above 7%, which is well below the 20% ash threshold trigger level for Phase 2 sampling.

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

In summary, potential impacts associated with the Bottom Ash Pond CCR management unit based on EI sampling results are limited to arsenic, beryllium, and nickel in sediments of Polly Branch. These constituents will be further evaluated and addressed in the CARA Plan to determine if corrective actions are needed.

## 8.5 Highway 70 Borrow Area

A summary of EI findings and a CSM for the Highway 70 Borrow Area is provided on Exhibit 8-4 in cross-sectional view and on Exhibit 8-6 in plan view. These exhibits also illustrate surrounding units and surface streams for the Highway 70 Borrow Area.

CCR material in this unit are material that were previously removed from the Bottom Ash Pond, with an estimated total volume of approximately 90,000 cubic yards.

Within the Highway 70 Borrow Area during the EI, the pore water phreatic surface was present above the base of the CCR management unit. Inferred groundwater elevations were estimated to be a few feet below the phreatic surface elevation. During some groundwater sampling events, upgradient groundwater elevations were higher than pore water elevations. During other groundwater sampling events, groundwater elevations were lower than pore water elevations. These elevation differences indicate that if a reversal of the groundwater flow direction is ever present, then it is transient.

TDEC Appendix I and CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater were below GSLs at the Highway 70 Borrow Area.

CCR Parameter concentrations in sediment samples collected from Polly Branch and the Holston River downstream of the Highway 70 Borrow Area were below chronic ESVs, except for two mercury results in the Holston River which are related to a documented source of mercury upstream of the JSF Plant. Ash was not detected in sediment samples from

**TDEC Order Investigation Summary and Conceptual Site Models**

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

the Holston River and Poly Branch above 8%, well below the 20% ash threshold that would trigger Phase 2 supplemental sampling.

In summary, there are no potential impacts associated with the Highway 70 Borrow Area.

## Conclusions and Next Steps

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

# Chapter 9 Conclusions and Next Steps

## 9.1 Conclusions

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

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

In summary, more than 99% of the compared environmental sample results from over 600 samples were below screening levels. Most screening levels are not regulatory standards and are conservatively based on published health studies. The EI data indicate impacts to limited onsite groundwater areas and that the CCR management units have had minimal, if any, potential impacts to sediment and surface stream water quality in the Holston River and Polly Branch, and ecological communities in the Holston River. The following are overall assessment findings for the investigation based on data as presented in this EAR:

- Surface stream water quality is within ranges protective of human health and aquatic life in the Holston River and Polly Branch.
- Sediment quality is generally within ranges protective of aquatic life in the Holston River and Polly Branch adjacent to and downstream of the CCR management units. Mercury results in Holston River sediments are considered related to a documented source of mercury upstream of the JSF Plant and are not a result of operations of the CCR management units. Additional evaluation of potential risks associated with sediment at one location in the Holston River and two locations in Polly Branch are warranted in the CARA Plan to determine if corrective actions are needed.
- The EI data indicate that fish and benthic communities are healthy in the Holston River adjacent to and downstream of the CCR management units (sport fish and benthic communities are not sufficiently present in Polly Branch for sampling).
- The CCR management units have adequate structural stability, and slopes are stable under current static and seismic loading conditions.

## Conclusions and Next Steps

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

- There were no known active seeps onsite during the EI.
- Most CCR Rule Appendix IV CCR constituent concentrations in onsite groundwater were below TDEC-approved GSLs, and groundwater impacts are limited to onsite areas downgradient along the perimeter of the CCR management units. No TDEC Appendix I constituents had a statistically significant concentration above a GSL. However, additional assessments will be included in the CARA Plan to evaluate the need for corrective action for targeted onsite groundwater remediation at locations where statistically significant concentrations of CCR constituents above GSLs existed.
- Drainage improvements or potential corrective actions are expected to reduce concentrations of CCR constituents to below GSLs in groundwater at downgradient monitoring locations.
- Groundwater flow in the unconsolidated materials and upper bedrock is bounded to the north by the Holston River and to the west by Dodson Creek. Near the southern boundary of the JSF Plant, the groundwater flow direction was consistently from the southern boundary of the JSF Plant to the north toward the Holston River. Based on this finding, potable water wells located south and upgradient of the CCR management units would not be impacted by groundwater associated with the JSF Plant CCR management units.
- Based on the overall results of the water use survey, current and historical CCR management associated with the JSF Plant have not affected water supply wells or springs located in the vicinity of the JSF Plant.

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

Summary of Findings Requiring Further Evaluation in the CARA Plan			
CCR Management Unit	Stability	Groundwater	Surface Stream, Sediment, Ecology
Ash Disposal Area J	None	Molybdenum (Well JSF-107)	None
Bottom Ash Pond		None	Arsenic and beryllium (two samples), and nickel (one sample) in sediment within Polly Branch
Dry Fly Ash Stack		Lithium, molybdenum (Well W-31)	None
Highway 70 Borrow Area		None	None
Downstream of CCR Management Units	Not applicable		Copper and zinc in sediment within the Holston River (one sample)

## Conclusions and Next Steps

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

### 9.2 Next Steps

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

## References

Environmental Assessment Report – Rev. 1  
John Sevier Fossil Plant

## Chapter 10 References

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